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**Green Alliances and ESG
performances of multinational
corporations**

Relatrice:

Chiara Ravetti

Candidata:

Pasquini Matilde

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Abstract

In today's globalized and interconnected world, the business community must take a proactive stand on sustainability challenges. Historically, companies were primarily focused with making profits, creating jobs, and providing goods and services. However, this traditional approach is becoming increasingly insufficient to meet the complex and interconnected concerns that characterize our current era, such as climate change, resource depletion, social inequality, and global health crises. These challenges are not just societal concerns; they also have a direct influence on the commercial landscape. As businesses increase their reach in a globalized economy, their environmental and social consequences become more pronounced, heightening the expectation that they actively engage in solutions to global concerns rather than contributing to them. The solution investigated in this research is the formation of sustainability alliances, which is based on the concept of United Nations Sustainable Development Goal 17, which stresses partnerships for sustainable development. Methodologically, the present research used a panel dataset focusing on the Electrical and Electronic Equipment (EEE) sector, including data collected from the Thomson Reuters SDC Platinum Database, Refinitiv's ESG database, and the Bureau Van Dijk Orbis database. Following rigorous adjustments, the sample currently includes 1.411 enterprises involved in 1.178 sustainable partnerships. Key findings show that two-partner alliances are becoming more common in sustainability projects, with a higher incidence in Europe, the Far East, and Central Asia. The research additionally demonstrates that sustainability alliances have increased significantly over time, with younger firms being inclined to form these collaborations. This is presumably due to the fact that younger firms are more likely to include sustainability-oriented business models, driven by agility and a competitive advantage that prioritizes sustainable practices. These findings highlight the rising importance of strategic alliances in promoting corporate sustainability; nonetheless, academic research on this issue is limited, leaving important parts of the field remaining unexplored. More study is thus required to increase understanding in this area and help the ongoing growth of sustainability-focused corporate practices.

1. Introduction

This study intends to explain, within the framework of sustainability-driven strategic partnerships, the main variables that give a significant competitive advantage to enterprises in the Electrical and Electronic Equipment (EEE) sector.

Strategic partnerships, formerly considered to be just a commercial practice, will become critical for firms in the future years, as organizations are quickly understanding that establishing shared value is vital for cooperatively addressing the dangers associated with climate change. Thus, the purpose of this thesis is to answer the following research question: «How do strategic alliances in the EEE sector contribute to environmental sustainability, and what factors influence their formation and geographical distribution?»

To answer this question, the first section of the study explores the concepts of sustainability and sustainable partnerships using current literature. After setting the historical framework for the growth of sustainable practices in business contexts, the research focuses on the critical role that these topics play inside enterprises in mitigating the negative consequences of climate change. The major legislation and standards that today play a critical role, notably in Europe, are then provided to help readers comprehend the subsequent investigation. The study next examines the distinction between net-zero goals and carbon neutrality, followed by a discussion of the increasingly widespread voluntary sustainability criteria in corporate environments.

After discussing the many various types of alliances made by businesses, the focus moves to sustainability alliances and its fundamental attributes. These include their applicability in developing-country markets, the relationship between sustainability and innovation, and an outline of the primary reasons for which corporations develop alliances.

The methodology employed in this study involved using a panel dataset focused on the EEE sector, including data from the Thomson Reuters SDC Platinum Database, Refinitiv's ESG database, and the Bureau Van Dijk Orbis database. The final sample includes 1.411 enterprises engaging in 1.178 sustainable partnerships, all of which are privately held and were established between 2002 and 2022.

The findings chapter examines the dynamics of these alliances based on factors such as industry, participant composition, geographical distribution, and business age, offering vital insights into the nature and drivers of these collaborations.

To sum up, this study emphasizes the significant role that strategic partnerships play in advancing global sustainability, with implications for industries, regions, and company strategies. It suggests that while economic and regulatory environments shape the distribution of partnerships, the increasing focus on environmental goals highlights the essential role of alliances in achieving global sustainability objectives.

2. Background and literature

In the contemporary era, it is imperative for the business community to adopt a more proactive role in addressing sustainability-related issues. In order to comprehend the rationale behind this assertion, it is first necessary to acknowledge the evolving landscape within which companies operate. In decades past, the primary role of business was perceived through a narrow lens, defined by the generation of profit, the creation of employment opportunities, and the provision of goods and services. However, this traditional view is no longer applicable in the present century because the challenges currently facing humanity are far more complex and interconnected. Climate change, resource depletion, social inequality and global health crises are not merely societal issues; they are also business issues. As companies expand and become integrated into a globalised economy, their impact on the world intensifies. Consequently, the corporate world is increasingly expected to contribute to the solution of these global problems, rather than exacerbating them. It is in this context that sustainability is playing a crucial role.

2.1 Literature review

The literature review for the present research focuses on the significance of studying strategic partnerships and their features, digging into how they are established, why corporations join alliances, and what effects they achieve. The phenomenon has gained international prominence because of the 17th United Nations Sustainable Development Goal, making it a highly relevant issue that requires scientific attention and progress.

The goal of the literature review was to identify, synthesize, and highlight contributions that emphasize the relevance of the issue, as well as to incorporate them for this research development and on support to the findings of this study.

For the purpose of my research, I used the Scopus platform and input the key terms most linked to the issue of partnerships, cross-referencing some of them such as «alliance», «ESG», «environment», «sustainability», «SDG17», «circular economy», «green», «company location», «company age», «performance», «strategy», «partnership», and so on.

Although the literature on sustainability has a wealth of unique thoughts and views, shifting the focus to partnerships reduces the number and quality of publications. The most

commonly discussed issues are single examples of alliances between two corporations, rather than a large and spread panel of enterprises, as ought to be the case in this thesis. Additionally, it is common to come across articles that focus on a specific characteristic of a particular set of firms, such as age or territorial presence, and investigate the implications regarding sustainability and/or corporate social responsibility.

Although the number of studies dealing directly with the topic of green alliances has increased over the last decade, this topic is still considered under-explored with some gaps, which is why the following paper aims to enrich knowledge on the subject.

2.2 Pursuing ESG Performances

2.2.1 The history of sustainability-related businesses

The history of sustainability can be seen to have its roots in the 1972 United Nations Conference on the Human Environment in Stockholm. This marked a turning point in global environmental policy, with the acknowledgement of the necessity for shared principles to guide the preservation and enhancement of the environment. The conference addressed a number of new key themes, including: the responsibility of humanity to safeguard the environment for future generations, as the misuse of science and technology has the potential to cause irreversible harm; the interconnectivity between development and the environment, as issues pertaining to both are prevalent in underdeveloped nations and industrialised countries alike; a global cooperation requiring international collaboration, shared responsibility, and support for developing countries in managing their environmental challenges; and environmental rights and policies, so that to every individual can be afforded the right to an environment that is conducive to their dignity and well-being. Furthermore, it is for the first time that governments were advised to align their development policies with environmental protection and the Principles for Action. The latter comprises 26 principles, which address a range of issues including sustainable resource use, pollution prevention, environmental education, science and technology integration, and international cooperation (United Nations, 1972).

In the same year the Club of Rome, a new born organisation founded by Dr. Aurelio Peccei, an Italian industrial manager, economist, and visionary, published the report *Limits to Growth*, which had been prepared over a two-year period by a team of scientists,

educators, economists, humanists, and industrialists coming from the famous Massachusetts Institute of Technology. The report received significant attention following the Stockholm Conference and the oil crisis that emerged in the early 1970s. The introduction of that document starts with the following words:

I do not wish to seem overdramatic, but I can only conclude from the information that is available to me as Secretary-General, that the Members of the United Nations have perhaps ten years left in which to subordinate their ancient quarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse the population explosion, and to supply the required momentum to development efforts. If such a global partnership is not forged within the next decade, then I very much fear that the problems I have mentioned will have reached such staggering proportions that they will be beyond our capacity to control.

In this quotation, which is attributed to U Thant, a burmese diplomat and the third secretary-general of the United Nations from 1961 to 1971, the report *Limits to Growth* established for the first time a direct correlation between sustainability issues and the necessity for immediate action. In order to gain a deeper understanding of the long-term consequences of exponential population growth, economic expansion and finite resource use, the report sought to model and analyse these factors. The findings indicated that if the trends in population growth, resource consumption, and pollution will persist without intervention, the world may reach the limits of growth within a century, eventually resulting in a sudden and uncontrollable decline in both population and industrial capacity due to resource shortages and environmental degradation. It is important to recognise that *Limits to Growth* emphasised the necessity for long-term planning and resource management in order to avoid ecological collapse and this is why has since become a foundational text in discussions on sustainability and environmental policy (Meadows et al., 1972).

Another milestone document in the history of sustainability is *Our Common Future*, also known as the Brundtland Report or Brundtland Commission Report, which was published by the United Nations in 1987. The document's name is a tribute to Gro Harlem Brundtland, a former Norwegian prime minister and chairman of the World Commission on

Environment and Development (WCED), a sub-organisation of the United Nations that was created in 1983 with the aim to unite countries in the achievement of sustainable development. The content of the United Nations (UN) Brundtland Report on sustainability grew out of the need to reconcile human development (both present and future) with the carrying capacity of nature; indeed, it was in this document that was defined the concept of Sustainable Development as «the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs».

A further significant concept that emerged during that period was that of Corporate Social Responsibility (CSR). It was defined in the Green Paper COM 366/2001 of the European Union as: «a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis». Corporate social responsibility has three main elements that characterise it: the voluntary nature, as the behaviour undertaken does not arise from an obligation to respond to the law; cooperation with stakeholders; and finally the Triple Bottom Line approach (also known as TBL or 3BL), based on:

- The enhancement of human capital, in the sense of correct application of contracts, attendance of training courses, attention to respect for equal opportunities, concern for the health and safety of workers and the working environment, and so on;
- Economic and social sustainability, achieved, for example, by implementing anti-corruption practices, adopting codes of ethics, drawing up a social report, insisting on good relations with suppliers, orienting customers or being transparent to everyone, especially stakeholders;
- Environmental sustainability, which consists of efficiency, energy saving, conscious, careful and measured use of raw materials and environmental resources, reduction in the use of packaging and waste, and finally, more generally, respect for the environment.

The European Union defined that CSR is the process by which companies should manage their relationships with a variety of stakeholders who can have a real influence on their licence to operate, so that corporate social responsibility should be treated as an investment, not a cost, much like quality management: in the long-term perspective, this will allow companies to pursue a more inclusive financial, commercial and social approach (European Commission, 2001).

It was evident at that juncture that all of these concepts, such as the environment, people, commerce, governance, growth, and so forth, were inextricably linked: there was no longer any room for discussing one of them without including the others, and all were interrelated and influencing each other. It is within this context that the concept of ESG gained prominence. The etymology of the acronym ESG (Environment, Social and Governance) can be traced back to the publication of the report *Who Cares Wins* in 2004. This document was produced by the United Nations Global Compact in collaboration with Switzerland, and it received grant funding from four other European countries: Italy, Luxembourg, the Netherlands, and Norway (United Nations et al., 2004). The objective of the report was to demonstrate the potential benefits of incorporating ESG considerations into long-term investment strategies, namely enhanced long-term investment performance and a more harmonious alignment between financial markets and sustainable development. To this end, it proffered pragmatic recommendations for asset managers, analysts, and financial institutions on the incorporation of ESG strategies into their financial appraisals, proposing that the integration of such strategies could assist in the identification of risks and opportunities that may be obscured by traditional financial analysis. Consequently, this paved the way for the broader acceptance of ESG criteria in investment strategies (United Nations et al., 2004).

In the years since, there have been many regulatory initiatives in terms of sustainability and ESG topics, but surely the most famous is the 2030 Agenda for Sustainable Development, which was drafted by the UN General Assembly and published on 25 September 2015. It not only represents the virtuous system to which we must strive globally, but also represents the framework within which the theme of «business for good» is developed, i.e. an enterprise that in itself generates the conditions for the creation of economic, human, social and environmental value. It is a very important action programme that includes also the famous SDGs, or Sustainable Development Goals (Figure 1: Logos of

the seventeen Sustainable Development Goals): 17 goals and 169 sub-goals concerning all spheres of human life and the planet and to be achieved by all countries in the world by 2030, from which the name derives.

An early attempt to create goals that could be shared globally and that could represent a target for all had been the Millennium Development Goals (MDGs), which were published in 2000 and were meant to provide guidance until 2015. They included eight themes of focus and, unlike the SDGs, proposed sustainability as one of the points on which to improve, not the basic concept from which to start. This clearly shows how, in the passage of just fifteen years, sustainability issues have taken on a pivotal role in driving the world towards a viable blueprint for future generations.



Figure 1: Logos of the seventeen Sustainable Development Goals <https://sdgs.un.org/goals>

2.2.2 The role of business and the urgency of covering sustainability topics

It was commonly assumed until the mid-1980s that the objectives of those pursuing sustainability and those seeking industrial development were fundamentally incompatible. In particular, it was assumed that these two were mutually exclusive and that industrial development could not gain further value through green practices, leading to a strong detachment of companies from the world of sustainability. Over time, these differences have become less pronounced, and now a days it is evident that the competitive advantages of companies that are interested in sustainability and operate in this field can gain significant competitive advantages.

Today's world is driven by two major issues that encourage businesses to be interested in sustainability and to take business actions that support sustainability: the first is the dire situation the world is in, which is now known to have a major consequence due to climate change, which is ultimately caused by human behavior and the misuse of resources, among other things (García-Navarro et al., 2024); the second is the need to adjust to market factors that allow the company to have a good positioning and keep its stakeholders engaged.

A more detailed analysis of the situation reveals a pressing need for action to mitigate the planet's increasingly adverse impacts. Climate change is a global crisis that requires coordinated action by governments, businesses and individuals to mitigate its impact and move towards a more sustainable future. It refers to long-term variations in temperature and weather patterns, which are caused mainly by human activities, particularly the burning of fossil fuels such as coal, oil and gas. This process releases greenhouse gases (GHGs) such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) into the atmosphere. Normally, the Earth's surface absorbs sunlight and subsequently radiates heat back into space. However, greenhouse gases absorb and subsequently radiate back some of this heat, preventing it from escaping and thus warming the planet. The heat trapped by the sun causes a phenomenon known as the greenhouse effect, which results in a gradual warming of the Earth's surface. In addition to the utilisation of fossil fuels, which represent the primary source of CO₂ emissions, there are a number of other contributing factors to this phenomenon, and one of the main ones is deforestation. Trees play a crucial role in the absorption of carbon dioxide from the atmosphere through the process of photosynthesis, which occurs in the soil and in their biomass, ultimately constituted by

trunks, branches, leaves and so on. This contributes to the improvement of climatic conditions, however the progressive shift towards urbanisation of landscapes has resulted in the uprooting of trees, which has significantly reduced the planet's capacity to remove carbon from the atmosphere. Furthermore, trees play a role in regulating local temperatures through the provision of shade, contribute to the water cycle through transpiration and help prevent soil erosion. Following the depletion of fossil fuels and the degradation of natural habitats, the third and final main cause of climate change is agriculture: it is a significant source of greenhouse gases, particularly methane from livestock digestion and rice paddies, and nitrous oxide from the use of synthetic fertilisers. Intensive agricultural practices have also an adverse impact on soil quality, reducing its capacity to sequester carbon, and moreover it is also important not to forget the use of fossil fuels in machinery, irrigation and the transport of agricultural products throughout their entire life cycle. Lastly, the overuse of water, soil degradation and the excessive utilisation of chemicals contribute to climate change, as they impact natural ecosystems and the global carbon cycle.

The consequences of climate change are manifold and encompass a range of interrelated effects. Chief among these is global warming, which has already resulted in an increase of approximately 1.1°C in the Earth's average temperature compared to pre-industrial levels. In order to mitigate further damage, the international community has set targets through the 2015 Paris Agreement, a major international climate change treaty born during the COP21 (Conference of the Parties), of which there will be a discussion further below. The primary target of the Paris Agreement is to restrict global warming to a level below 2°C in comparison to preindustrial levels, with the objective of limiting the temperature increase to 1.5°C. This limit is widely acknowledged to be crucial to avoid the most severe consequences of climate change, nevertheless, the current policies and actions are considered not sufficient, and experts have cautioned that in the absence of a marked acceleration of climate efforts, the 1.5°C target may be surpassed as early as 2030, resulting in a further intensification of the environmental and socio-economic challenges that the world is currently grappling with. A direct consequence of the above is the progressive intensity and frequency with which major weather events, such as melting ice caps and rising sea levels, are occurring. In fact, the rate at which glaciers are melting is accelerated, contributing eventually to rising sea levels. This threatens cities and coastal ecosystems,

leading to increased flooding, loss of land and, in the most severe cases, population displacement. Also hurricanes, droughts, floods and heat waves are now a days more frequent than before, and the ultimate consequence of this is a strong damage of ecosystems, agriculture, infrastructure and human health (García-Navarro et al., 2024).

Even the oceans are not exempt from climate change, because as the oceans absorb more CO₂, their chemistry changes, leading to ocean acidification, which affects marine life, particularly organisms with calcium carbonate shells or skeletons such as corals, molluscs and some plankton species. The consequences for such species are disastrous, and there is a strong risk of a major loss of biodiversity, especially as it disrupts food chains and, ultimately, the species that cannot adapt quickly enough are doomed to extinction.

Finally, a last serious consequence of climate change falls on the human population, which suffers in terms of health and livelihood: directly through heat waves, because the body is put under strain, and indirectly by worsening air quality, reducing food security and increasing water scarcity. In vulnerable regions that depend on agriculture and natural resources, the threat is even greater, because there are less instruments to provide consistent and material help.

From the perspective of companies, the initial effort they can make to mitigate climate change is to monitor and improve their energy efficiency. This is because energy plays a key role in the production of greenhouse gases (Figure 2: Global greenhouse gas emissions by sector) and is therefore the starting point from which to seek solutions to the problem. It is important to underline that every year the globe emits around 50 billion tons of greenhouse gasses, which are quantified in carbon dioxide equivalents (CO₂eq) (Ritchie, 2020). To establish how to reduce emissions most efficiently and which emissions can or cannot be reduced using present technology, one must first identify where GHG emissions originate. The overall picture is that nearly three-quarters of emissions originate from energy usage, over one-fifth from agricultural and land use, and the remaining 8% from industry and garbage. This implies that there is no one, clear method to addressing climate change and that focusing just on power, transportation, food, or deforestation is insufficient; however, there are several steps that businesses may take to reduce these issues. The first is the use of renewable energy, which means switching from fossil fuels to renewable energy sources such as solar, wind, and hydropower with the goal of lowering greenhouse gas emissions; energy efficiency is also a solution, and when handled properly,

it may result in a large reduction in energy use. Another technology that can help with this is Carbon Capture and Storage (CCS), nonetheless this will be covered in further detail later.

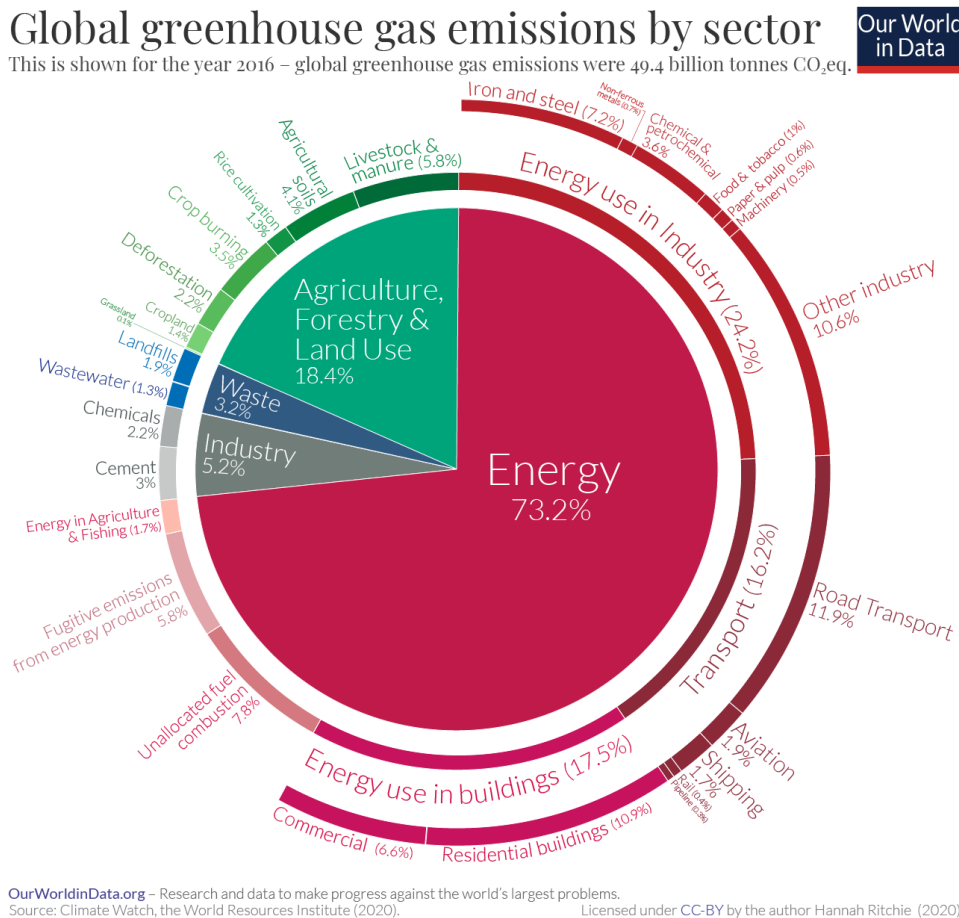


Figure 2: Global greenhouse emissions by sector <https://ourworldindata.org/ghg-emissions-by-sector>

As mentioned earlier, it is not only the external issues related to climate change and the concerns arising from it that drive companies to engage in sustainability; in fact, there is a whole other branch of initiatives, which as a common factor have the intention of generating a benefit for the company itself, with an internal and closer point of view to the company. There are many factors that drive companies to engage from a sustainable point of view; the main ones are:

- The international Standards and Guidelines on the subject, which according to UNEP, the United Nations Environment Programme, have numbered more than 1.100 since 1980, call for an increasingly strong integration of

environmental and social sustainability within the company perimeter, sometimes allowing the company to receive concessions in return;

- The need to always offer innovative products to the market in order to remain competitive over time: sustainability often entices companies to look for innovative solutions that exploit cutting-edge technologies and/or materials or even waste (Zhao, 2024), which can be either from the same production process or from completely different industries. The concept of giving a new life to something that was considered as waste can also be later resold in marketing terms;
- The need and/or desire to distinguish and strengthen one's own brand in terms of corporate culture and reputation, increasing credibility towards the consumer: in this context, the tool of marketing is joined by that of psychology, so much so that today we speak of the «emotional branding» phenomenon, i.e. the ability to create, through a communication channel, empathy between the brand and the customer;
- The need to strategically distinguish from competitors in terms of reputation: having a good reputation in terms of sustainability plays a key role on the shelf because today's green-conscious customers are becoming more and more numerous. In this context, however, a mention must be made about greenwashing, which consists of the promotion of a product and/or service by valorising it from an ethical and environmental point of view, without real and reliable feedback. Greenwashing is exploited by companies that want to improve their positioning not by engaging in a process of change but by misleading potential customers, who will erroneously perceive the company as better than its competitors. Greenwashing frequently stems from a need to save money, as it is more cost-effective to offer the market a fictitious promotion of one's own product and/or service than to implement measures that truly reduce environmental impacts and are guided by sustainable development logics. Although greenwashing allows a consistent economic return in the short term, the risk for the company that uses it over a long period of time is that of incurring errors, often dictated by the superficiality of communication, which will be

recognised by society, and which will condemn it, damaging its reputation and positioning, and causing it to lose credibility and transparency with stakeholders;

- Competitive factors in the market: in each business market, customers make purchase decisions based on certain attributes, and these can be classified as order qualifiers or order winners. The former are necessary attributes that a product must possess for it to enter into competition; the latter, order winners, are instead the winning attributes that lead to customers buying a product. Compared to the order factors, sustainability has proven to be an order Winner: in both the Business to Business (BTB) and Business to Consumer (BTC) markets, there is an increasingly strong tendency on the part of customers to choose, performance being equal, the company that is more transparent, ethical, aware and attentive to the environment that surrounds it, be it tangible, intangible assets, and/or people.

It is now evident that urgency involves more than simply external demands; it is also about foresight, because the propensity toward sustainability subjects is critical for organizations seeking to lead and influence the future. Those who delay tasks will fall behind, struggling to adapt to tougher rules, shifting market demands, and rising costs of environmental and social concerns.

2.2.3 ESG-compliant companies

By combining conventional economic analysis with non-financial elements that have the potential to significantly impact a company's long-term risk profile and return prospects, environmental, social, and governance investment has emerged as a key paradigm in portfolio management. From a financial perspective, ESG integration is a sophisticated risk management conduct that targets systemic risks that are frequently missed by traditional metrics, rather than just being a values-driven initiative.

In the construction of investment portfolios, the use of ESG data is becoming increasingly prevalent in factor-based investing strategies, with the objective of enhancing risk-adjusted returns. Morgan Stanley Capital International (MSCI), a global provider of financial research specialising in stock market indices, risk analytics, and data for institutional investors, is

particularly renowned for its ESG ratings. These were developed with the objective of assisting investors in evaluating companies based on environmental, social, and governance criteria, thereby facilitating the integration of sustainability factors into their investment decision-making processes (Dong et al., 2024). Investors utilise ESG ratings and scores to evaluate a company's vulnerability to idiosyncratic risks, such as regulatory penalties for high carbon emissions or operational disruptions resulting from poor labour practices. Such scores are incorporated into alpha generation models, particularly in the case of active strategies that aim to generate returns in excess of market benchmarks. The incorporation of ESG criteria can influence a fund's beta exposure by systematically favouring sectors with lower environmental and social risks, which may exhibit less volatility in response to global sustainability trends. To illustrate, funds may adopt a strategy of overweighting renewable energy companies or technology firms with robust governance structures, while simultaneously underweighting sectors such as fossil fuels or tobacco, which are frequently correlated with adverse ESG impacts and tail risks. Furthermore, ESG factors are of significant importance in discounted cash flow models, in which analysts make adjustments to their assumptions regarding the cost of capital (WACC) based on a company's ESG profile. Companies with poor ESG scores may be subject to higher borrowing costs or equity risk premiums as a consequence of anticipated liabilities or reputational damage, directly affecting their enterprise value and intrinsic valuation (Ruan, 2024). Conversely, firms that demonstrate robust ESG practices may benefit from lower capital costs, driven by increased demand from institutional investors seeking sustainable assets.

The integration of ESG considerations also affects asset allocation. An increasing number of institutional investors, including pension funds and sovereign wealth funds, are employing negative screening or best-in-class strategies to align their portfolios with ESG principles, causing a reshape of the market liquidity and price discovery mechanisms. Furthermore, regulatory developments such as the European Union's Sustainable Finance Disclosure Regulation (SFDR) oblige asset managers to reveal the extent of ESG integration, thereby influencing capital flows.

From the perspective of fiduciary duty, ESG factors are now considered to be material to long-term financial performance. The failure to consider ESG risks may be regarded as a

contravention of the principle of maximising shareholder value, given that it entails the neglect of a company's full risk profile.

The advent of the global pandemic caused by the Covid-19 virus has served to further accelerate the momentum of ESG investing. The crisis served to illustrate the interconnectivity of global challenges, from health and social inequalities to environmental vulnerabilities (Fatica et al., 2024). Consequently, a significant number of investors undertook a reassessment of their portfolios, demonstrating a growing preference for companies that exhibited resilience and responsibility during the pandemic. This shift has resulted in a notable increase in the availability of sustainable investment products, including ESG-focused mutual funds and exchange-traded funds (ETFs), which has made it more straightforward for individual investors to align their financial objectives with their personal values.

However, the growth of ESG investing is not without its challenges. The issue of greenwashing has led to concerns being raised about the integrity of ESG claims, and investors must navigate a landscape where the quality and availability of data can vary significantly, which presents a challenge in assessing a company's true ESG performance. As the market matures, there is an increasing demand for the implementation of standardised metrics and the clarification of definitions in order to guarantee the credibility and efficacy of ESG investing.

2.2.4 Regulations and Standards

Over the decades, the need for regulations and standards regarding sustainability issues slowly emerged, and as the years passed and technologies changed, these standards quickly became obsolete and had to be updated. For this reason, this topic has become more and more the focus of attention and has over time collected an extremely large multitude of regulations and standards.

Most of the regulations that have been created over the years are based on two principles: the precautionary principle and the polluter pays principle. The precautionary principle, also referred to as the precautionary approach, can be defined as a form of prudence that should be exercised in the context of uncertainty. This concept is based on two principal justifications: the first rationale is that it should be linked to the need of decision-makers,

for example within a company, to anticipate and prevent harms and problems before they occur. Consequently, the opposite reasoning also holds true, namely that an activity should only be proposed if it is proven that it will not, or is very unlikely to, result in significant harm. The second reason is that it should be considered in conjunction with the concept of risk and its proportionality, as well as the requisite responses to that concept, which must take into account the factors of feasibility and cost. This principle first emerged during the 1970s and has since been formally incorporated into a number of international environmental treaties, particularly those of the European Union. A comprehensive analysis of this topic reveals however that the precautionary principle is a matter of significant contention. While some organisations and scientists view it as unscientific and an impediment to progress, others consider it a crucial tool for safeguarding human health and the environment.

A second fundamental principle that underlies numerous regulations is the polluter-pays principle. This principle was first articulated in the European Parliament and Council Directive 2004/35/CE of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage. In this European document, the following words can be found, which may be used to define the polluter pays principle:

The fundamental principle of this Directive should therefore be that an operator whose activity has caused the environmental damage or the imminent threat of such damage is to be held financially liable, in order to induce operators to adopt measures and develop practices to minimise the risks of environmental damage so that their exposure to financial liabilities is reduced.

In essence, this principle underscores the notion that the party responsible for the pollution, rather than the consumer, bears the financial burden of the associated costs: from an economic standpoint, this implies the internalisation of environmental negative externalities. Consequently, the cost of pollution is shifted from the general public to the polluters, who must then incorporate this additional expense into the price of their goods, ultimately resulting in a rise in consumer prices. Nevertheless, given that consumers typically aspire to procure inexpensive products and services, there is a significant

motivation for polluters to refrain from marketing items and services that could potentially be detrimental to the environment and human well-being (European Union, 2021).

Here follows, in chronological order, the most recent regulations of the European perimeter, i.e. with the European Union as the regulator, which has made a decisive contribution to steering companies towards a more sustainable future.

In December 2015 the first EU Circular Economy Action Plan was published, and it marked a major step in the transition of the European economy from a linear model based on the traditional life stages of a product, such as production, use and disposal, to a circular economy, in which resources are aligned with the logic of cradle-to-grave, where they are reused, recycled and kept in circulation, essentially recognising a value until the end of the product's life. The plan proposed legislative measures to promote sustainability throughout the life cycle of products, from production and consumption to waste management and resource recovery. Some areas, such as plastics, food waste, raw materials and construction and demolition waste, were identified as key to achieving ambitious targets for recycling and reducing landfill. Some of the other key themes of this Regulation were: boosting global competitiveness, promoting sustainable economic growth and creating new jobs, with a total of 54 actions in the outline. Attention was also paid to product design, which played a crucial role, as it shouldn't only be associated with an aesthetic reason for living, but should have higher goals, such as allowing easier repair, reuse and recycling, increasing resource efficiency, reducing environmental impact and stimulating economic growth (European Union, 2015).

The first EU Circular Economy Action Plan was fully completed with its 54 actions by the end of 2019, but some of them were improved even after that year. Meanwhile, 2018 saw the publication of the EU Circular Economy Framework, which aimed to accelerate Europe's transition to a circular economy with concrete measures and a more strategic approach: it introduced updated targets for recycling and recovery of different materials, aiming for a 65% recycling rate of municipal waste by 2035 and limiting landfilling to a maximum of 10%. Once again, plastics played a key role, with proposed initiatives including the European Strategy for Plastics, which aims to increase recycling rates and reduce single-use plastics. Another important field was the recycling of critical raw materials essential for high-tech industries, with the intention of reducing the EU's dependence on external suppliers. The framework also targeted the bio-economy, including food and agricultural waste, and in

this context also reinforced the responsibility of producers and their role as promoters of a sustainable transition. This regulation also strengthened the role of innovation and digitalisation in driving the circular economy, with continued financial support through EU research and innovation programmes such as Horizon 2020, the European Union's largest research and innovation funding programme, which ran from 2014 to 2020 with a budget of around €80 billion and was intended to promote scientific excellence, industrial leadership and address societal challenges by funding research projects across a wide range of disciplines. Its successor for the period 2021-2027 is Horizon Europe, which has an even stronger focus on sustainability and innovation.

As we move forward, it is possible to find the EU Roadmap: A Clean Planet for All, published in November 2018, which is particularly important because it was the first time the European Union's long-term vision for a climate-neutral economy by 2050 was declared. This strategic plan, which supported the development of the European Green Deal to align Europe with the goals of the Paris Agreement, focused on reducing greenhouse gas emissions and proposed methods to reduce them by at least 45% by 2030 and at least 60% by 2050, while improving energy efficiency, investing in renewable energy and promoting technological innovation. In this document, of particular relevance, it is included a reformed EU Emissions Trading System (ETS), which will be described below.

Let's take a closer look at the EU Green Deal, which was born out of the Von der Leyen Commission in December 2019 and has since become the European Union's flagship strategy for achieving climate neutrality by 2050. The Green Deal encompasses a wide range of policy initiatives in key sectors such as energy, agriculture, transport, industry and biodiversity, and sets a legally binding target to reduce net greenhouse gas emissions, moving from the EU Roadmap's 45% by 2030 to a new target of 55%, with the overarching goal of making Europe the world's first carbon-neutral continent. The key elements of the document include a massive shift towards renewable energy, a major effort to improve energy efficiency, a Circular Economy Action Plan to reduce waste and promote recycling, and a progressive empowerment of consumers in the green transition with the aim of guaranteeing them a deeper knowledge of the sustainability of products combined with better protection against the risk of greenwashing; indeed, the Green Deal emphasises the importance of a transition based on the Just Transition Mechanism, meaning that no region or citizen is left behind in the shift towards a sustainable economy. It also introduced the

European Climate Law, which for the first time enshrined the 2050 climate neutrality target in law. On the financial side, the European Green Deal Investment Plan aims to mobilise €1 trillion in sustainable investment over the next decade.

Let's now move on to the post-Covid regulations, which of course include funds and recovery measures to try to mitigate the tragic consequences of the pandemic era the world has been through.

In July 2020, in the middle of the first wave of Covid-19, the European Council approved the Next Generation EU (NGEU), also known as the Recovery Plan or the Recovery Fund; it is an ambitious financial instrument designed to help European countries recover from the economic impact of the COVID-19 pandemic, with the aim of building a more resilient, sustainable and digital economy. The Recovery Plan is based on a budget of €750 billion and aims to stimulate economic recovery while aligning investments with the EU's long-term goals: around 37% of the funds are dedicated to climate change-related projects, underlining the importance of this issue, and 20% are aimed at improving Europe's digital capabilities. The NGEU is structured through recovery plans, which are country-specific, and on top of these there are various mechanisms, one of which is the Recovery and Resilience Facility (RRF), which provides grants and loans to member states, although they can only access the funds if they meet specific milestones and targets related to green and digital transitions.

Moving on, as a central part of the European Green Deal, there's the new Circular Economy Action Plan (CEAP), adopted in 2020 and based on the first EU Circular Economy Action Plan. Like its predecessor, it focuses on driving the EU's transition to a circular economy in order to further reduce environmental impacts, increase resource efficiency and promote sustainable economic growth, in particular for the electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and food, water and nutrients sectors. The plan also strengthens the right to repair by designing products with features that make them more durable over time, easier to repair and/or recycle, thus promoting an extension of their life cycle. The CEAP was considered a landmark document regarding the direction the European Union wanted to take in the coming years, in particular it resulted in a series of actions to be implemented with a specific timeframe and a list of sectors for each goal to be achieved; for example, it proposed the EU Strategy for Textiles, a standard dedicated to the clothing and textile industry, through which the EU introduced the Extended

Producer Responsibility (EPR) for textiles, which will be enforced on its member states by 1 January 2025 and will make fashion brands and retailers fully responsible for the entire life cycle of textiles.

In line with the European Green Deal, a close look needs to be taken at the Fit for 55 package, a set of policy proposals launched by the European Commission in July 2021 with the objective of making a concrete effort to propose solutions to reduce the EU's greenhouse gas emissions by at least 55% by 2030. The package includes a variety of reforms in different sectors, such as energy, transport, industry and agriculture, and proposes updated solutions and legislation, such as ETS and CBAM, which will be discussed below.

Finally, let's take a look at the Corporate Sustainability Reporting Directive (CSRD), which was born with the intention of creating a regulatory framework to be adopted by European companies to improve and standardise the way companies report on their ESG practices, ultimately improving the quality of the data collected and thus increasing the transparency and comparability of sustainability disclosures across EU companies. The Directive extends its scope to include all large and small and medium-sized listed companies in its sphere of influence, covering more than 50,000 companies in total. According to the CSRD, by 2026 all companies that comply with the standards will be required to report detailed information on the environmental impact of their activities, their social responsibility practices and how they manage governance risks. This process will have to be carried out through a set of tools called ESRS, namely the European Sustainability Reporting Standards, which are divided into different themes aimed at covering the entire company structure and data disclosure (Figure 3: The ten thematic standards of the ESRS). As can be seen in the figure, the topics are divided into three categories: the environment, which includes 5 ESRS; the social, which includes 4 ESRS; and governance, which is represented by only 1 ESRS. The CSRD also obliges companies to have third party assurance and to align with EU sustainability standards, which leads to more stringent assurance requirements and obliges the company to report financial and non-financial data consistently, as the ESRS not only ask for numbers but also for qualitative information. From an investor and stakeholder perspective, the Directive supports the EU's broader sustainability goals by making it easier to assess companies' long-term performance and ESG risks.

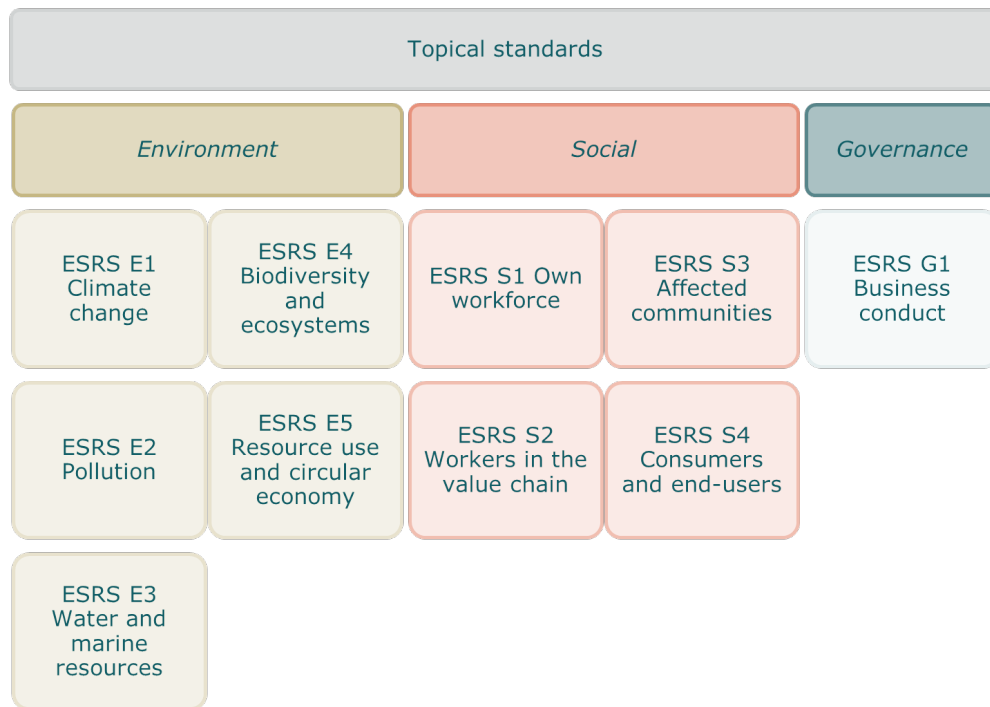


Figure 3: The ten thematic Standards of ESRS <https://www.cssf.lu/en/esrs-main-requirements/>

2.2.5 Net-zero versus Carbon Neutrality

In order to have a thorough understanding of net-zero and carbon neutrality, it is essential to take a step back and talk about scope 1, 2 and 3. These concepts are at the heart of the Greenhouse Gas Protocol Initiative, a partnership of companies, non-governmental organisations (NGOs) and governments launched in 1998 by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) (World Resources Institute et al., 2010). The partnership was established to provide support and assistance in the development and implementation of an internationally accepted GHG accounting system and guidelines, and its most famous methodology is the GHG Protocol Corporate Accounting and Reporting Standard, published in 2004. The idea arose from the increasing need for companies to quantify their emissions and provide a material vision for how they operate.

In this wave, emissions were divided into three main categories in order to calculate and manage them separately, as the division is intentional to allow for better management of the associated GHG emissions. As shown in the figure below (Figure 4: Overview of scope and emissions across the value chain), emissions were divided into Scope 1, Scope 2 and Scope 3.

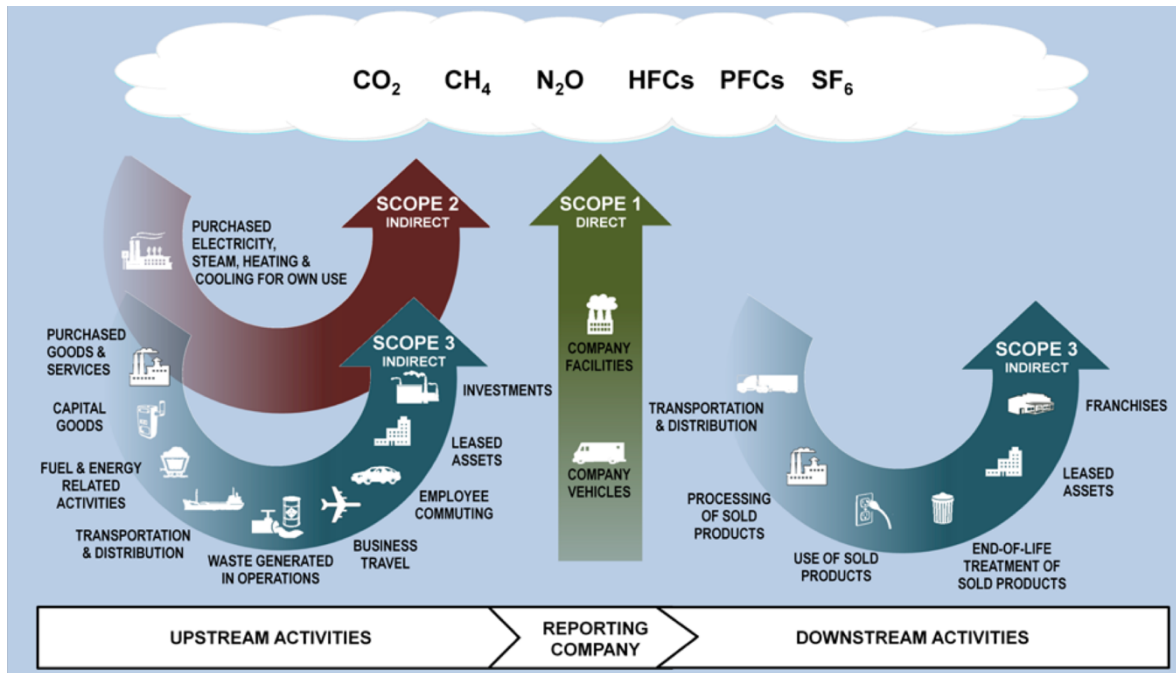


Figure 4: Overview of scope and emissions across the value chain

<https://ghgprotocol.org/sites/default/files/ghgp/ghg-protocol-scope-3-standard-executive-summary1.pdf>

Analysed separately, Scope 1 emissions are direct GHG emissions from sources owned or controlled by a company, such as emissions from fuel combustion in company vehicles or manufacturing processes. By their nature, Scope 1 emissions are the easiest to measure as they are directly linked to the company's operations. Scope 2 emissions, on the other hand, are indirect GHG emissions resulting from the consumption of purchased electricity, steam, heat or cooling, and although these emissions occur at the energy producer's facilities, they are attributed to the company that consumes the energy. Scope 1 and 2 are easier to measure than Scope 3 emissions, because the latter encompasses all other indirect emissions that occur along a company's value chain, including both upstream and downstream chains, so it can include emissions from very different business concepts such as business travel, purchased goods, waste disposal and the use of products sold. Scope 3 is associated with the concept of «emissions outside the company's gate» and is arguably the largest and most difficult for companies to be determined (Greenhouse Gas Protocol, 2001).

As already mentioned, the European Union introduced the famous issues of emission reduction targets from 2015 onwards, which today, following the Green Deal and the Fit

for 55 package, are set at 55% of emission reduction by 2030 and the final target is to achieve climate neutrality by 2050. It is important to note that the 2030 target only covers Scope 1 and 2 emissions, so the regulation does not extend to the entire value chain of the companies, but efforts are underway to encourage companies to take action on Scope 3 emissions as well; instead, climate neutrality by 2050 refers to the entire value chain of the companies, thus including Scope 3 in the calculations.

The core element of this part of the analysis is the differentiation between net-zero and carbon neutrality targets, as mentioned above. These two concepts need to be carefully distinguished as they have inherent differences that make them completely separate in scope and approach. Carbon neutrality focuses on the balance of a company's CO₂ emissions, in particular between what a company pollutes and the effort to neutralise this effect, and to achieve this goal it's implemented the offsetting with carbon credits. The essential difference with Net-zero is that in this case there is not necessarily a requirement for large reductions in emissions; Instead Net-zero, which by nature has a broader objective as it sets targets for reducing all greenhouse gases, including methane and nitrous oxide, not just CO₂, requires significant emission reductions across the entire value chain, leaving only the unavoidable emissions to be offset. In other words, the goal of net-zero is to achieve a long-term balance between greenhouse gas emissions produced and those removed from the atmosphere, making it a more ambitious and comprehensive approach. To help meet these targets, there are two key regulatory schemes that companies need to manage carefully: the EU Emissions Trading Scheme (ETS) and the Carbon Border Adjustment Mechanism (CBAM).

Since 2005, the EU Emissions Trading Scheme has been one of the world's largest carbon markets and a tool used by EU companies to control and reduce greenhouse gas emissions. Companies also refer to it as a cap and trade system, and the way it works is very simple: each year the system sets a price on carbon credits and, based on the GHG emissions of each company in the system, the allowances are redistributed, meaning that for each company a cap is set, that is, a maximum amount of emissions allowed based on many factors including the type of company and its size. Consequently, firms that are able to stay below that level of emissions are allowed to sell the unused credits for money to companies that are above, or are expected to exceed, their own cap. The incentive to trade allowances is that there are fines for companies that emit more than their allowances, so it is more

profitable for them to buy allowances from other companies rather than pay a fine, while the advantage for cleaner businesses is that they can earn money by polluting less. An interesting point is that the cap is also degressive, meaning that it will decrease by about 2.2% each year, effectively forcing companies to pollute less and less over time.

The second law enforced for carbon neutrality is the Carbon Border Adjustment Mechanism (CBAM). It was born to safeguard the ETS and eliminate the risk of leakage, which could encourage companies to relocate their emissions to countries where the cap-and-trade system is not applied. The CBAM is a border tax adjustment whereby goods imported from non-ETS countries that emit very high levels of greenhouse gases are subject to a high entry fee, with the aim of preventing companies within the EU's borders from encouraging this behaviour.

2.2.6 Voluntary Sustainability Standards

In today's world, when businesses are increasingly expected to operate in ways that respect human rights, workers' rights, the environment, and the society as a whole, there is a need to communicate environmental and social gains to stakeholders. To do this, firms may utilize a variety of beneficial tools to execute sustainability plans, of which the most common is Voluntary Sustainability Standards (VSS): they help businesses and their stakeholders to measure, monitor, communicate, and assess the social and environmental consequences of their operations, and are considered as transnational governance tools used to promote sustainable development in global value chains, often pushed by non-governmental organizations (NGOs) or commercial enterprises (Marx, A. et al, 2024). Since the 1990s, the quantity and percentage of VSS has increased significantly, in particular, Figure 5: Evolution of the number of VSS depicts the evolution of the number of these standards during the past eight decades. The two lines in Figure 5 portray the standards from the perspective of the Ecolabel Index, which will be explored shortly, and the ITC Standards Map, an online platform developed by the International Trade Centre (ITC), an intergovernmental agency of the United Nations and the World Trade Organization (WTO). The evolution and dissemination of standards encompasses the range of VSS now in use, including VSS spanning different sectors, several ones within the same sector, and many forms of VSS, such as strict versus less stringent, public versus private, etc. Factors driving

the considerable VSS expansion between 1990 and 2020 include an increase of consumer demand for ethical and sustainable products, government and NGOs assistance, and the usage of transnational authority structures on sustainability problems. (Marx, A. et al, 2024).

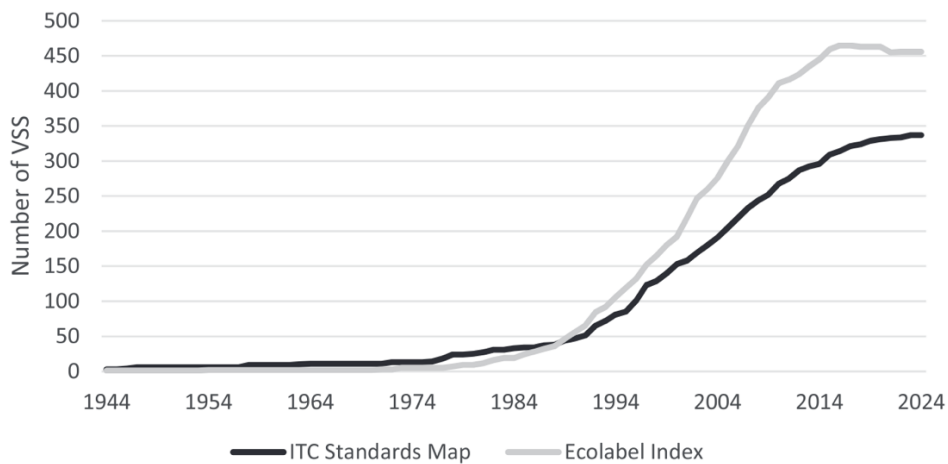


Figure 5: Evolution of the number of VSS <https://onlinelibrary.wiley.com/doi/10.1111/1758-5899.13401>

VSS are often classified into two categories: those at the product level and those at the organization level. At the product level, they may be classified as:

- ISO type I, which are based on multi-criteria considerations and supervised by independent granted third parties, usually national authorities, who rigorously adhere to the ISO 14024 standard. This category includes for example the Ecolabel, which is a certification for products and services having a low environmental effect throughout their life cycle, from manufacturing to disposal, ensuring environmental sustainability and safety.
- ISO type II, which originate as self-declarations of companies on single-criteria factors and which follow ISO 14021 standards. One of the most famous examples is the Forest Stewardship Council (FSC) label, which is a certification for wood and paper products, demonstrating that they come from responsibly managed forests, meeting strict environmental, social and economic standards.
- ISO type III, which are based on Life Cycle Assessment (LCA), a now widely used method that allows the calculation of a product's environmental impact at every stage of its life; the related ISO standards range from 14040 to

14044. The most famous example of LCA-based certification is the EPD, or Environmental Product Declaration, which provides transparent information on the environmental impact of a product. Moreover, it also compares the environmental impact of similar products, promoting more sustainable choices for both consumers and companies.

At the organisational level, instead, they have the focus on:

- Management, in particular «quality management»: there are a number of ISO that provide support and guidance for companies about this topic. Among them, one example is 14001:2015, which establishes the requirements for an environmental management system and enables companies to identify, manage and reduce the environmental impacts of their activities; another example is ISO 50001, which provides the reference for energy management systems, helping companies to improve energy efficiency, reduce costs, lower greenhouse gas emissions and support the transition to a more sustainable use of energy resources.
- Reporting, where the most famous standard is the Global Reporting Initiative (GRI): it corresponds to a set of guidelines for sustainability reporting and is used globally to measure and communicate the ESG performance of organisations. The sustainability reporting initiative, which is now done annually by most of the companies worldwide, especially the larger ones and the ones on the stock exchange market, is a document that should be placed on the same level as an annual financial report, as it helps companies to improve transparency and accountability towards their stakeholders. Europe has taken a very clear direction in this regard through the introduction of the above-mentioned CSRD and the EU Taxonomy, which aims to guide investments towards projects and sectors that contribute to the EU's environmental goals, such as climate change mitigation and resource conservation.

It should be noted, however, that not all VSS have equal credibility, and especially where a certification is obtained by only a few companies, or where the issuer is suspect, one may have stumbled upon a case of greenwashing.

Finally, because of its international spread and the reputational prestige it brings, mention must also be made of the B Corp certificate and the concept of benefit companies. These are companies that, in addition to profit objectives, officially pursue common benefit purposes, such as a positive impact on society and the environment. The legal form of the benefit corporation, recognised in various countries, including, as of 2016, Italy, incorporates social and environmental commitments into the corporate mission. This concept must not be overlapped with that of B Corp, which instead is a certification issued by the non-profit organisation B Lab to the companies that meet strict standards of social and environmental performance, transparency and accountability. Although not a legal form, B Corp certification recognises companies committed to sustainability and positive impact through a rating ranging from 0 to 100 on all ESG aspects of the firms, and only issues the B Corp certificate when the score exceeds 80 points.

2.3 Sustainability alliances

Nowadays, moving a company forward also means being able and having to rely on the strengths of others. Corporate partnerships allow, when needed, to fill a gap in the business model or to provide an additional service to one's customers beyond what is already available (Zanetti, 2024). In order to achieve higher-level goals, therefore, the practice of partnership can be very useful for companies, so we will now analyse what a corporate partnership is, what advantages such a collaboration offers and how sustainability can be influenced by the practice of alliances. However, first it is necessary to analyse the situation that those in business are forced to face on a daily basis: in today's globalised world and in the context of hyper-competitiveness that companies are forced to deal with, many of them are still reluctant to embark on the path of partnerships for fear of losing the reins of projects and running into a serious problem, namely that of contractually tying themselves to partners who, while on paper aiming to create synergies, in reality only intend to access the local market by acquiring skills that would otherwise not be possible. The heart of the matter lies, in fact, in the creation of successful strategies that should ultimately lead to a competitive advantage. This can only be maintained as part of a proactive process for continuous improvement, since a competitive advantage, as yet, has no long-term effect precisely because of the aforementioned hyper-competitiveness. This is where the concept of the alliance comes into play, which is therefore aimed at companies gaining a strong competitive edge in a market that is becoming more and more complex and tightening.

2.3.1 What is an alliance

Strategic alliances can be called by various names, which have slight shades between them: joint ventures, partnerships, networks, collaborations and so on. What all these terms have in common is the collaborative relationship on a voluntary nature that is established between two or more companies, with the aim of obtaining one or more mutual benefits, such as the exchange or sharing of information and/or the development of products, technologies and services in collaboration.

There are, however, a number of distinctions that can be made between the various terms; in fact, the aforementioned joint ventures, partnerships and so on differ in their legal nature and, as a result, the way in which the partners behave towards each other changes

radically. In Joint Ventures, for example, the degree of collaboration, coordination and communication of information is definitely at a higher level, in fact it is the only case in which there is the formation of an entirely new company, in which the founding companies own equal percentages of shares and in which the board of directors includes the management positions of the companies themselves: it is evident that this is something extremely more significant than a simple agreement marked by a contract. When there is no joint venture case, one speaks of equity or non-equity alliances. The first case occurs when two or more companies involved in the partnership have different percentages of ownership of the firm they have created by combining their resources and capabilities, while the second case occurs when the two businesses collaborate while maintaining separate legal entities; such alliances are purely contractual in nature and lead to two or more companies combining their resources and knowledge while remaining independent; an example of a non-equity alliance may be a licensing, supply or distribution agreement. As far as the objectives of an alliance are concerned, it must be emphasised that they vary depending on the sector, the specific case and the companies involved. It is therefore clear how difficult it is to deal with this topic as each case is unique; nevertheless, alliances can be divided into four models that differ in the degree of competitiveness and objectives to be achieved through collaboration (Yoshino et al., 1995).

The first model is that of procompetitive alliances, which represent the classic case of vertical integration, i.e. when companies in the same value chain ally themselves to integrate complementary processes and technologies leading to the same finished product. This is the case of the supplier-customer alliance, where the degree of competitiveness is extremely low and the strategic objective is to preserve the companies' core competences. The second model is represented by non-competitive alliances, usually formed by companies in the same sector that do not, however, represent direct competition, because they may for example operate with the same products in different markets. In these cases, the partners are likely to invest a great deal of energy and resources in the creation of the alliance, so that even in this second case, it can be said that the level of competitiveness remains rather low and that the most common goal that the companies intend to achieve is to gain access to information that their respective partners possess.

The third model is that of competitive alliances, in which companies in the same competing sector decide to collaborate in order to gain a strategic advantage from the competitor

while trying to protect their own competencies. In these cases, there are several critical issues, the first of which is that one of the partners shares knowledge that is of little relevance to the others, for fear of revealing something that might actually benefit the competitor. It is therefore one of the cases in which alliances fail with the highest incidence. The fourth and last alliance model is the precompetitive one: in this particular case, the alliance involves an agreement between partners from different sectors who decide to join forces in order to gain access to competences and skills that allow them to carry out projects that they would otherwise not be able to; in these cases, most alliances are generated for research purposes (Yoshino et al., 1995).

Note that every company bases its operations on the resources it has at its disposal, and dependence on them represents a crucial point in the formation of partnerships, especially in periods of uncertainty or in highly fluctuating and ambiguous sectors, where having the resources of partners also represents a source of stability. Another strong incentive for the creation of partnerships is the possibility of acquiring new skills and knowledge: the sharing of these, by means of alliances, allows companies to increase their knowledge and ultimately increase their skills, thus gaining a competitive advantage. It should be noted that this happens more easily when there is proximity between the companies in terms of purpose and values, so it is likely that the more common elements the partners possess, the more the transfer of skills and competencies will be facilitated and will stand out even more.

Another driving force in the formation of partnerships are market trends. A couple of examples of this are the advent of the internet age in the early 2000s, and as we will see later, the ever-increasing focus on the topic of sustainability. In these examples, which represent a form of pressure for companies, which are obliged to chase market changes in order to keep up with the times and their current position, the alliance with partners engaged on key issues is a strong signal to competitors that a firm wants to remain active and at the same time allows the acquisition of new and extremely competitive skills. It should be noted that, in this case, remaining in one's own sector and not taking an interest in new developments represents a heavy risk and a missed opportunity that could have serious consequences in the future, especially if competitors form parallel alliances with players engaged in new areas of interest.

Then there is the topic of foreign markets, which are not always easy for companies to access and, above all, require large investments. In this case, if the company is unable to penetrate the external market on its own, the formation of partnerships makes it possible to access new realities without using the same amount of resources as would be necessary in the opposite case, i.e. where the company does not enter into partnerships.

Finally, one of the strongest motives for companies to enter into alliances is simply to make strategic choices in the market. There are companies that do this to gain an advantage over their competitors, some to develop competencies, some to share the risks associated with innovative activities, some use partnerships to speed up production times of new products, others want to bar competitors from entering certain markets, and so on.

As we have just seen, the reasons that drive companies to form alliances are manifold, however, partnerships are not without risk, on the contrary, they add further interstices to those that the company is already forced to face; for example, the relationship with the partner may be difficult, management systems may not allow for an adequate and consistent material and information flow, resources may prove incompatible or an incompatibility may emerge in the grounding of projects. Therefore, finding the right corporate partners turns out to be a crucial step for the successful performance of an alliance. Therefore, it is necessary for companies approaching partnerships to make a careful and thorough assessment, basing the selection of ideal partners on a number of well-defined assumptions.

First of all, some preliminary work is necessary: in order to choose the ideal partners, the company must have a clear and delimited idea of what it needs in order to grow and improve, e.g. it could be help in the area of technology or software, rather than capital or assets such as machinery and so on. Being aware of one's own needs is a key step in finding the ideal partner. Moreover, since the other partner should also receive added value from the collaboration, it is necessary, again at this preliminary stage, to ask oneself what one is able to offer one's collaborator as added value, both in terms of skills or resources and opportunities (Zanetti, 2024).

At this point, the company enters into one of the most delicate phases of the alliance creation process, that is, the phase in which one asks oneself whether it is convenient to join the partnership, what advantages it entails, what risks might arise and so forth. To do this, a very useful tool can be the SWOT Analysis (Figure 6: SWOT Analysis Matrix), which

originated in the marketing sector but which can be used in a very transversal manner to evaluate the possible consequences of corporate choices, including a possible new strategic alliance. The SWOT Analysis, which is divided into Strengths, Weaknesses, Opportunities and Threats, represents the four fundamental points of view from which to observe each strategic decision. In Figure 6, the black line delineates above what are internal strengths and weaknesses within the company, and below that what could be influenced from outside. To give an example, a company strength could be a brand name or a patent, something that represents an advantage and that possible partner companies would like to take possession of; a weakness could be the lack of economic resources to develop a project; an opportunity could be to create a stable and lasting link with a partner in the same value chain; finally, a risk could be that of giving away information to partners without receiving improvements in return.

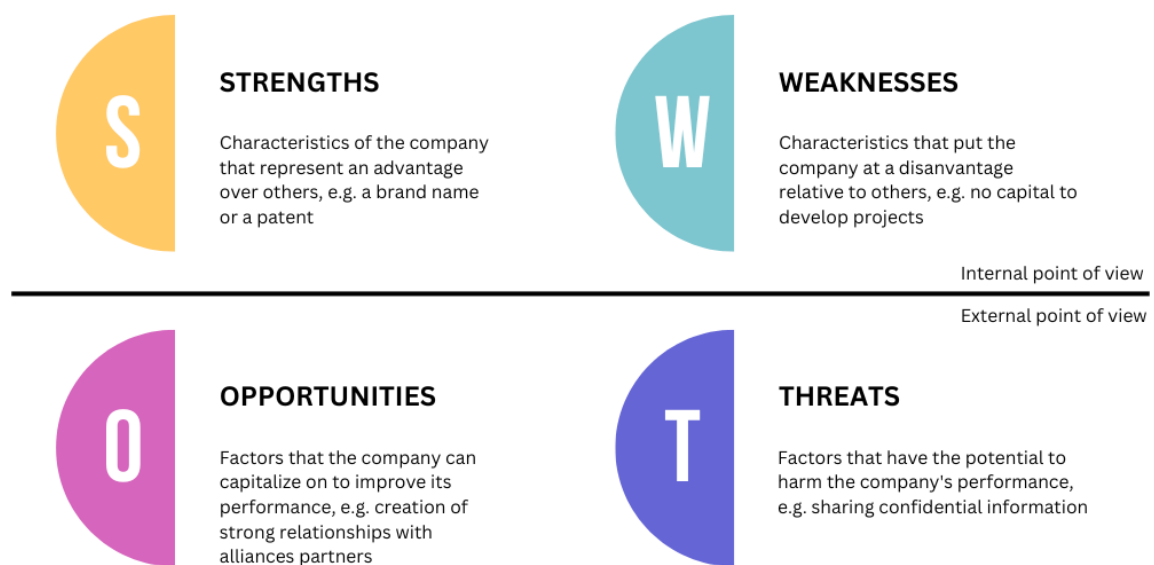


Figure 6: SWOT Analysis Matrix (Author's elaboration)

Once this has been done, if it is the case that an alliance is worthwhile, the actual phase of searching for the ideal partner begins, which must start with those potentially interested in entering into a partnership agreement: the choice, obviously, must fall on a player capable of satisfying the requirements set previously, minimising threats and enhancing hypothetical opportunities; in other words, the strengths and weaknesses of the partners must balance each other in order to be successful.

The next step is doubtless that of negotiation. It can take months or even years and this is closely related to the degree of closeness between the partners in terms of values, ethics, interests, and mentality; moreover, the more collaborative the parties are, the clearer and shorter the process will be. If the negotiation is successful, an actual contract is drawn up so that both parties are clear about what each party expects from the other. Agreements have the purpose of maturing common projects and obtaining financial returns to be shared, and can differ from each other in the degree of formalisation, duration, function and structure. This step is the basis for effective communication, which is a prerequisite for a thriving partnership: keeping the relationship and communication alive between the parties, so that prompt action can be taken in the event of problems that could compromise the partnership, is an absolute necessity (Zanetti, 2024). The negotiation and signing of the contract represents a turning point in the relationship between the actors who, unless in specific cases, until that moment have no constraints or obligations with respect to the other companies in the negotiation. Moreover, the contract represents an extremely delicate moment because it actually stipulates who has the greater bargaining power within the partnership, which may be unbalanced towards one partner rather than another. In the cases of unbalanced alliances, there tend to be two types of partners: a small company that survives thanks to a peculiarity that makes it unique but does not have many finances, and a large and well-structured company that has the funds to develop projects but does not have access to the peculiarity that the small company does. This is especially the case for start-ups, where innovative ideas require funds and resources in order to be implemented; however, it is common for them not to have the resources to develop their ideas and so they go looking for help from outside.

If the steps of searching for the ideal partner, negotiation and contract are carried out correctly, the result is a solid partnership, which is usually intended to be perpetuated over time. It is based on an essential concept, namely that of a win-win situation, whereby both parties benefit from maintaining an alliance with the other actor. This brings innumerable advantages for the partners, among which is a greater chance of achieving the desired objectives.

2.3.2 SDG 17 and sustainability partnerships

The number of partnerships has increased over time, as has their global significance, to the point where it has become essential to structure and prioritize them within a dedicated Sustainable Development Goal: Goal 17, named «Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development». Sustainability and partnerships have long been linked, and the 2015 SDGs stressed this connection even further. SDG 17 has many goals that are particularly important to this analysis:

- Target 17.5, named «Invest in least developed countries»;
- Target 17.6, named «Knowledge sharing and cooperation for access to science, technology and innovation»;
- Target 17.7, named «Promote sustainability technologies to developing countries»;
- Target 17.8, named «Strengthen the science, technology and innovation capacity for least developed countries»;
- Target 17.9, named «Enhance SDG capacity in developing countries»;
- Target 17.C, named «Remove trade barriers for least developed countries»;
- Target 17.G, named «Enhance the global partnership for sustainable development».

The desire to establish partnerships to increase sustainability efforts derives from an in-depth knowledge of the benefits they may provide in this area. As previously noted, it is now obvious how climate change affects all living things and the earth, and this research has also focused on the specific implications for companies. Physical damages, increased insurance costs, more R&D spending for building robust products and services that can resist global shifts, and rising production costs as a result of supply chain disruptions are all examples, and in this setting sustainable partnerships play an important role in minimizing risks and maximizing opportunities. One of these involves reducing CO₂ equivalent emission, because as previously stated, most corporate emissions belong to Scope 3, which occurs upstream and downstream in the value chain. The consequence is that by collaborating with players in both directions, businesses may enhance performance and mitigate climate risks, since by setting specific targets to reduce a company's effect requires supply chains to play an important part in reaching net-zero goals, given the majority of the

impact resides in acquired goods and services. Companies increasingly recognize sustainability as a substantial economic opportunity; those making early, bold commitments with concrete actions to support them are likely to reap financial rewards while benefiting both the environment and society. The basic concept we're discussing is sustainable procurement, and its policy must be considered vital to achieving change inside an organization: sharing this policy internally and externally signals the company's commitment to achieving its sustainability goals, in fact trading partners must align with the company's objectives and demonstrate progress in key areas of sustainability, including environmental responsibility, labor and human rights and ethical and sustainable practices. Note that integrating sustainability guidelines into the procurement process holds both the company and its partners accountable.

Moreover, when a financially dominant partner embraces sustainability, it inevitably guides smaller partners, such as suppliers, in that direction. This can be achieved through various tools, including the supplier code of conduct and the supplier award process, both of which emphasize sustainability goals. Sustainability can also act as a barrier to entry when selecting ideal partners; for example, minimum requirements, such as a minimum sustainable procurement performance score, can be mandated for potential partners.

The aforementioned supplier code of conduct is a set of responsible business standards that a company establishes and expects its trading partners to uphold, ensuring that they provide safe working conditions, which is especially important if a company sources from countries where environmental and labor laws are weaker or poorly enforced. Implementing a code of conduct yields numerous benefits: it communicates a company's values to external stakeholders like suppliers and consultants, clarifies expectations around ethical business conduct, and provides trading partners with clear standards and behaviors required when working with the company. Furthermore, it enables the company to express its core values while managing potential risks along the value chain, and eventually it promotes financial and social transparency, creating accountability and encouraging full disclosure on matters such as human rights, health and safety, and environmental impact. Ultimately, procurement plays a central role in supporting sustainability partnerships for several reasons; for example, given that procurement is a cyclical process, each new contract or partnership reinforces sustainability impact; moreover, procurement allows companies to accelerate positive environmental and social outcomes by actively

incorporating sustainability as a core consideration in every business deal and partner engagement.

2.3.3 Innovation for sustainability

Significant advances in sustainability sometimes require organizations to move beyond their current technical paradigms, since incremental changes to existing technology and manufacturing methods are insufficient. However, achieving significant advances in sustainable innovation is difficult, and moving to a new technology paradigm necessitates fresh findings in science, engineering developments, and material innovations. Digitalization is commonly used as a catalyst to address these sustainability concerns.

Innovation, which is an iterative process involving unique combinations of components and processes, emphasizes the value of externally supplied information. Collaborative innovation and technology transfer are required for breakthrough advances, with science playing an important role, particularly in environmental partnerships aiming at replacing obsolete technologies. During this process, firms must establish innovative combinations of external and internal resources. This synergy is acknowledged as a potential engine of innovation, while the advantages are not automatic (Simms, C. et al., 2024).

Low and medium-sized technology enterprises, such as those in the process industries, are particularly at odds since they account for a considerable amount of overall greenhouse gas emissions, making it difficult for them to adapt to new technical regimes. Integrating new technology into current manufacturing systems is difficult so, in order to address these issues, these companies usually seek partnership with high-tech enterprises. The connections between high-tech and low and medium-technology industries are a key driver of growth and change, because, while supply chain collaborations are common, alliances beyond a firm's existing supply chain with partners who have unique and complementary scientific and technological knowledge are essential. Alliances between low-technology firms and their high-technology partners are of particular importance in addressing the unfolding environmental crises, even if it is usual for problems to arise from these kinds of alliances. This happens because of the underlying divergence in the nature of knowledge and in learning approaches, where low and medium technology firms' knowledge is closer

to that of learning by doing model, while high-technology firms address for a bigger level of innovation (Simms, C. et al. 2024).

2.3.4 Sustainability in developing countries

The pursuit of sustainability goals is a collaborative effort involving researchers, policymakers, and other stakeholders, and is viewed as critical to improving human life quality while protecting the environment. At the conclusion of the 2021 G7 Summit, a significant commitment was made to help poor countries by increasing, improving, and speeding up funds to aid in their transition to sustainability (G7 Summit, 2021). Researchers in science and technology studies have been increasingly interested in finding policies that might foster this transition (D'Adamo I. et al., 2021).

Global partnerships for sustainable development focus on important sectors such as finance, technology, commerce, and data. However, there have been mixed results in terms of mobilising financial resources for development and increasing internet access. Notably, poor countries confront a significant \$4 trillion yearly financial shortage to meet the SDGs, which is exacerbated by challenges like as high levels of foreign debt and inadequate internet access in low-income countries. This emphasizes the vital need for ongoing engagement, cooperation, and assistance against the backdrop of weakening international cooperation and escalating geopolitical tensions (United Nations, 2024).

Furthermore, the number of countries advocating external foreign direct investment (FDI) in developing countries, particularly those that are least developed, remained low. By 2023, at least 50 nations, 19 of which were emerging or developing economies, had some type of investment promotion mechanism for external FDI. Of them, only 23 countries have launched systems especially focused at emerging and least developed countries (United Nations, 2024).

Tight economic conditions in 2023 resulted in a 26% decrease in foreign project funding, which is crucial for infrastructure developments in industries like as power and renewable energy. As a result, investments in SDG-related industries fell by more than 10%. According to the World Investment Report, there would be less internationally supported projects in agrifood systems, water, and sanitation in 2023 than in 2015, when the SDGs were first announced. On top of that, although funding for SDG-related investments in global capital

markets continue to increase, the rate has slowed, and sustainable bonds grew just little in 2023, while inflows to sustainable investment funds fell by 60%.

Policymakers should also examine the negative consequences of sustainability reporting regulations for businesses outside of main markets. Small and medium-sized firms (SMEs) in developing countries may struggle to fulfill increased transparency requirements, thus limiting their market access and involvement in global supply chains (World Investment Report, 2024).

2.3.5 Benefits of collaborations and controversies

As previously said, joining into strategic alliances provides several benefits to firms that choose to partner with other organizations. The primary benefits are discussed here, followed by a consideration of the major obstacles involved with such coalitions. It is important to note that the examples offered are only a small sample of the many elements that might contribute to the establishment and dissolution of relationships. As a result, this research should not be seen as complete; each firm, sector, and instance is unique, introducing new elements into the dynamics of strategic relationships.

One of the most significant benefits of business partnerships is that organizations may obtain access to new resources and skills that would otherwise be unavailable; in this way, companies can profit from one other's knowledge and assets by collaborating on a shared project. These resources can be either real, such as advanced machinery or specialized technology, or intangible, such as expertise or brand recognition. In each scenario, the objective is to gain new skills that may be used to a variety of situations, even beyond the initial collaboration, so increasing flexibility and overall competitiveness.

Furthermore, partnerships enable businesses to pursue expansion goals by easing entrance into new markets or sectors that would otherwise be unreachable. This growth is especially beneficial for businesses trying to expand into foreign or emerging areas, since it provides them with an established presence and local knowledge through their partner. For businesses entering new sectors, especially in sustainability-focused areas, partnerships can lead to a meaningful increase in market share. This subject is closely related to ESG concerns since firms that offer green products and demonstrate ethical business practices are more likely to attract environmentally concerned consumers, resulting in a bigger

market share across diverse demographics. This development adds to a virtuous cycle: as a company's client base expands, so does its ability to increase customer satisfaction by satisfying the growing need for ethical business practices; ultimately, this improves both brand reputation and consumer loyalty.

Reputation management, therefore, becomes a crucial consideration in partnerships. For a successful alliance, transparency is essential, especially when partnering with prominent organizations known for their credibility and strong reputation. Transparent collaborations build trust, which is a key asset in a market where businesses are increasingly held accountable for their activities. Consumers, for example, like collaborations with charitable groups because they demonstrate an ethical commitment. However, with heightened transparency comes greater exposure; companies can no longer hide their mistakes. Any unethical action inside a partnership can hurt not just the relationship but also a company's reputation, generating a poor image that may impede future collaborations.

Another significant advantage of partnerships is the ability to become market leaders by rethinking and upgrading products and services in order to keep a competitive edge. Partnerships enable businesses to assess their present materials, processes, and product offerings, allowing them to determine which aspects to keep, replace with more efficient alternatives, or remove entirely. This method can result in unique solutions that provide businesses a competitive advantage, allowing them to differentiate their services in a crowded market.

Strategic relationships also provide considerable cost savings and risk reduction opportunities since collaboration with other enterprises can help businesses avoid unexpected expenditures and handle risks more efficiently. In fact, partners can better foresee and manage issues thanks to shared resources and competencies, which spreads the financial burden and reduces the effect of any losses. Furthermore, there are financial benefits associated with sustainability-focused alliances: as organizations incorporate sustainable practices into their operations, they become more appealing to investors and financial institutions, particularly those interested in ESG projects. Investors, stockholders, and banks are more likely to support firms that demonstrate a commitment to sustainability, and eventually this not only lowers borrowing costs but also creates more favorable circumstances for growth.

Alliances provide extra benefits to small and medium-sized organizations and firms in developing nations, such as alignment with internationally recognized sustainability frameworks. Partnering with other organizations enables these enterprises to standardize labor and business processes in accordance with global norms, so increasing their reputation in the global marketplace. Demonstrating best practices in sustainability enables SMEs and enterprises in emerging economies to extend their network, acquire resources, and obtain access to innovative technology, all of which may help them grow enormously. Furthermore, adhering to global standards decreases the chance of facing penalties for noncompliance with local or international legislation, adding an extra layer of risk management.

Despite these advantages, it is critical to recognize that entering into a partnership does not ensure a positive outcome for all parties involved. Challenges and unanticipated challenges may develop, especially if the partnership agreement is ambiguous or lacks clear boundaries. Uncertain contract conditions might lead to misunderstandings and disagreements, which could threaten the relationship. Furthermore, certain obstacles arise from the social and cultural components of collaborations, particularly when working with partners from diverse backgrounds.

From a social standpoint, corporations often face three major problems when picking partners: language barriers, social context, and cultural norms.

Language barriers are prevalent in multinational collaborations, especially when participants communicate in languages that are not their native tongue. This might lead to misinterpretations of crucial concepts or industry-specific terms, for example terms such as «materiality assessment», «GHG emissions», or «CO2 emissions» may be difficult to appropriately interpret, resulting in misunderstanding. Furthermore, partners in non-English-speaking countries may not have access to international sustainability norms or terminologies in their own language, which might impede comprehension. In other words, while the contract may appear straightforward on paper, conflicting interpretations might undermine the partnership's efficacy.

Regarding social context, another challenge lies in understanding and respecting the social norms of each partner's environment. For example, while child labor is officially forbidden in industrialized countries, it may remain a cultural standard or an economic necessity in some nations that are developing. In these locations, family contributions, even those of

younger generations, may be critical for survival, and from the point of view of the partnerships, such disparities might cause frictions, particularly if they collide with high international norms. While these collaborations should not be discouraged, they may need more supervision to guarantee conformity with agreed-upon standards while respecting cultural circumstances.

Finally, in distributed partnerships, social and cultural norms governing labor rights and worker treatment might differ dramatically; for instance, in certain developing nations with high unemployment, low salaries, or significant economic inequality, the relevance of workers' rights may differ from international standards. This divergence can cause conflict in collaborations, especially if one side expects high standards while the other operates under a different paradigm.

3. Methodology

The primary objective of this analysis is to investigate the age and geographic location of alliances, with a particular emphasis on their impact on sustainability outcomes. To effectively examine these dynamics, it is essential to utilize a comprehensive dataset that encompasses a diverse set of alliances specifically focused on companies with well-established portfolios in environmental collaborations. This section provides an accurate explanation of the sample selection process and the empirical methodology that has been used.

3.1 The panel dataset

The starting point of this study is the creation of a panel dataset, which includes environmental alliances that involve key partners operating within high-tech industries, as these sectors play a cardinal role in advancing decarbonization efforts and promoting circular economy outcomes. To delineate the sample for this study, a deliberate decision was made to focus on environmental alliances in which at least one participant belongs to the Electrical and Electronic Equipment (EEE) sector. This sector was chosen due to its central importance in both the opportunities it presents and the challenges it poses concerning environmental sustainability, in fact the EEE industry is recognized as a critical area of study, as outlined from the European Commission in many of its regulations. The sample construction involved collecting detailed information on all participants within the selected alliances, including those firms that do not fall directly within the EEE sector, and the decision to use this category of companies as the foundation for identifying a relevant set of alliances has its roots in three core considerations.

Firstly, EEE companies are considered to be key promoter of the broader sustainable transition since their contributions are particularly significant in areas such as digitalization and electrification, both of which are fundamental to enhancing energy efficiency, reducing carbon footprints, and supporting the development of smart, sustainable infrastructures. EEE companies are in fact at the front line of technological innovations that drive the efficiency of energy use across various sectors, including automotive, industrial, and residential applications; consequently, these innovations are essential for meeting global sustainability targets and are therefore a focal point for this research.

Secondly, the EEE sector is characterized by a substantial environmental footprint, which is the result of resource-intensive production processes and the generation of significant quantities of electronic waste (Cicerelli & Ravetti, 2023). This environmental impact is aggravated by the rapid obsolescence of electronic devices, leading to an accumulation of waste that poses one of the most serious challenges for waste management systems worldwide. In this context, the pressure on EEE companies from regulatory bodies is raising, with increasing demands for these firms to integrate comprehensive environmental impact assessments into their strategic planning processes. Regulatory institutions, particularly within the European Union, have been instrumental in pushing EEE companies towards the adoption of net-zero strategies and more sustainable business practices (Wijethilake et al., 2017).

Thirdly, it is important to note that EEE companies are turning to strategic alliances as a means of leveraging collective efforts towards sustainability goals (Wassmer et al., 2014). These alliances often involve collaboration with firms from a variety of high-tech sectors, including automotive, energy, and appliances, all of which are themselves highly relevant to the themes of decarbonization and circularity; therefore, by engaging in such alliances, EEE companies are not only addressing their own environmental impacts but are also influencing the sustainability practices of other sectors within the supply chain. This interconnection between the EEE sector and other high-tech industries further justifies the focus on EEE companies as the starting point for the sample definition.

Given these three reasons, it is easy to understand why the EEE industry serves as an appropriate and relevant foundation for the definition of the sample used in this analysis.

3.2 Data collection

To conduct a comprehensive analysis of the environmental alliances formed by EEE companies, data were meticulously collected from three distinct and trustworthy databases: Thomson Reuters SDC Platinum Database, Refinitiv's ESG database and Bureau Van Dijk Orbis database. Each of these provided crucial information that, when combined, allowed for a robust and multifaceted examination of the alliances and their environmental impact.

The first one, namely Thomson Reuters SDC Platinum Database, was utilized to identify and select all environmental alliances that EEE companies entered from 2002 to 2022, thus over a range lasting 22 years (Stadtler & Lin, 2017). A choice was made to exclude alliances formed after 2022 from the analysis due to the difficulties encountered in obtaining reliable and consistent data on more recent alliances, as their quality and availability is often lacking: by limiting the analysis to alliances established up until 2022, it is ensured that the data used are of high quality and reliability. In order to analyse exclusively environmentally related alliances, the research on SDC Platinum Database was based on keywords within the Deal Synopsis section of each alliance such as «emission reduction», «carbon neutrality», «renewable energy» and other terms explicitly linked to environmental topics. Secondly, to complement the alliance data, corporate environmental performance metrics were collected from the Refinitiv ESG Database. As its name suggests, this database is widely recognized for its extensive coverage of ESG indicators, providing detailed insights into the sustainability performance of individual companies.

The third database used is Bureau Van Dijk Orbis Database, from which were obtained, for each alliance member, some specific financial data such as income statements, and other key metrics.

3.3 Corrections and Bias

It is crucial to highlight that this analysis considers the entire alliance portfolio created by the companies within the specified timeframe, incorporating both ongoing alliances and those that were terminated or became inactive during the study period. (Wassmer et al., 2014). This approach underlines the dynamic nature of strategic alliances, where partnerships may evolve, dissolve, or achieve their objectives over time. By including inactive alliances, the analysis considers the full spectrum of strategic collaborations that companies engage in, offering a more comprehensive view of their alliance behavior and its potential long-term impact on environmental sustainability.

After the general decisions were made and the final data sheet was reviewed, it became apparent that further corrections were needed, and the subsequent corrections required are as follows.

Firstly, an assessment of the companies themselves was conducted, and it was clearly identified that the analysis needed to include companies that are no longer operational due to dissolution.

Moreover, the analysis split young versus old firms, since the study encountered a significant number of mature companies alongside some new corporations. This lack of age distribution balance necessitated the adoption of a threshold to effectively distinguish companies; specifically, the ones that were founded before the year 2000 were categorized as «old», while those established from the year 2000 onwards were classified as «young». This delineation, while somewhat arbitrary, was carefully chosen after considering various age thresholds. The decision reflects a balance between maintaining a sufficient sample size of young firms and ensuring the threshold remains relevant for capturing the characteristics of new market entrants. A lower age threshold would have excessively reduced the number of young firms, compromising the robustness of the analysis. Conversely, setting a much higher threshold would not plausibly reflect the attributes of genuinely young firms, as it would start to include companies that have already established themselves in the market for a considerable time, thus blurring the distinction between young and old firms (Hottenrott H., 2016).

Given that firms can operate across a vast range of business areas, the analysis required a high level of granularity to accurately represent the diversity within each company's operations; as a result, the study refined its focus from an initial list of parent companies to include 1.411 subsidiaries. This detailed approach was crucial for capturing the differences between various divisions or subsidiaries that operate under the umbrella of a larger corporation. For instance, Alpha Corp (for privacy reasons, the full names of the companies have been anonymized) and some of its subsidiaries, such as Alpha Chem Ltd, Alpha Electronics Inc and Alpha Display Co Ltd, were treated as distinct entities within the analysis. Alpha Corp engages in a broad spectrum of sectors including electronics, chemicals, telecommunications, biotechnology, renewable energy, healthcare, finance, home and personal care, and real estate development; in contrast, for instance, Alpha Chem is an independent company with its own governance, financials, and board, although Alpha Corp holds a significant stake. Additionally, Alpha Chem has its own subsidiaries, including Alpha Energy Solution, which was established in 2020 with the objective of focusing on the production of electric vehicle batteries and energy storage solutions. Alpha

Corp holds shares in other affiliates, but each maintains legal independence in order to more effectively manage their respective business areas and attract specific investors. By considering Alpha Corp and its subsidiaries as separate entities, the analysis could more accurately capture the distinct strategic priorities and operational focuses of different parts of the same parent company, particularly when these subsidiaries operate in vastly different market segments.

Some other corrections were made regarding any alliances involving undisclosed firms, which were specifically removed from the dataset. As is common knowledge, in certain cases alliances involve partners who prefer to remain anonymous, a factor that can introduce considerable bias and hinder the accuracy of the analysis. To maintain the integrity of the study and avoid opacity in results, it was decided to exclude these alliances, ensuring that only those with fully disclosed participants were considered for a more reliable examination of the collaboration dynamics.

Additionally, intrafirm alliances, where different business areas or subsidiaries within the same company interact with each other, were also excluded from the analysis since the primary aim of this study was to explore the interactions between different, independent firms when they engage in collaborative efforts. In fact, although potentially impactful within a company, intrafirm alliances do not provide insights into the dynamics of inter-firm collaborations, so by removing them the analysis becomes more precisely focused on the relationships between distinct entities and avoid conflating internal corporate strategies with broader, inter-organizational collaborations.

Furthermore, alliances composed of only two partners where one is a private firm and the other is a public authority (such as a government, university, or any other different kind of public entity) were also removed from the dataset, since the study's specific objective was to investigate relationships exclusively between private companies. Public-private partnerships often involve different motivations, structures, and outcomes compared to purely private alliances, and including them could have introduced bias factors. The final dataset, after these refinements, offers a clear and focused view of the environmental alliances formed between private firms in the EEE sector. The final sample is therefore more representative of the interactions that occur inside alliances, allowing for a more accurate investigation of how these firms collaborate to achieve sustainability goals.

Included in the subsequent pages there are 12 examples drawn from the Alliances' Excel file that was specifically developed for this research. Figure 7: Example of Alliances data (1-6) and Figure 8: Example of Alliances data (7-12) illustrates the structure and key variables used in the analysis, providing a glimpse into how the data were organized. Note that what follows is only a small extract of the work done on alliances, in fact the total number of examined alliances is 1.178, and that the names of the firms have been anonymized.

Now let's analyse the data by presenting the information sought in each column. The column «Deal Synopsis» is a tool for quick reference, providing essential information at a glance to better understand what the goal of the strategic alliance and its boundaries is. This is further explained in the next column, «Aim», which as we can see indicates the topic of the purpose: in some cases it speaks of renewable energy, which in turn can be declined into solar (examples 2 and 11), wind energy (examples 1, 6 and 8), jet fuels (example 5), and many other types, while in other cases the purposes are among the most disparate, see example 9 on electric vehicles, example 10 on green hydrogen and examples 4 and 12 which are instead more focused on the topic of circular economy and environmental benefits.

This is followed by «Alliance Activity», «Alliance Major Industry» and «Alliance SIC Primary», which refers to the Standard Industrial Classification (SIC) code that designates the primary business activity of an organisation or industry.

Next comes the «Alliance Nation», which sometimes differs from the nations to which the companies that make up the alliance belong; for example, in example 6, the Alliance Nation is Mexico while the partners are a Chinese and a Spanish company.

Next there is «Participant Name» and «Parent Name», this is because it is important to distinguish between subsidiaries and groups. Example 1 corresponds to this scenario. In fact one of the two partners is Beta Transmission GmbH which however is a subsidiary of Beta Group SA.

Subsequently, the countries of the strategic partners, the cities of these companies, the «Alliance High Technology Code», which again represents groups of categories within which the alliances were delimited, and the date on which the alliances were announced were defined.

Deal Name	Deal Synopsis (Text)	Aim	Alliance Activity	Alliance Major Industry	Alliance SIC Primary	Alliance Nation	Participant Name	Parent Name	Number of Participants	Participant Nation	Participant City	Alliance High Technology (Code)	Date Announced
1 BETA TRANSMISSION GMBH/GAMMA SA-STRATEGIC ALLIANCE	Beta Transmission GmbH and Gamma SA formed a strategic alliance. The purpose was to cooperate with regard to the construction, installation and commissioning of the offshore substation (OSS) for Baltic Eagle wind farm being developed in German waters of the Baltic Sea.	Renewable energy	Industrial Maintenance Services; Construction Services	Repair Services	Roofing, siding, and sheet metal work	Germany	Gamma SA; Beta Transmission GmbH	Gamma SA; Beta Group SA	2	Spain; Germany	Bilbao; Berlin	Primary Business; not HI-Tech	18/05/21
2 DELTA/CLEANTECH SOLUTIONS LTD/EPSILON SDI CO LTD-STRATEGIC ALLIANCE	DELTA/Cleantech Solutions Ltd and EPSILON SDI Co Ltd planned to form a strategic alliance to manufacture lithium ion batteries in India and Africa. The companies will make batteries required for telecom, solar power, defence sectors and logistics sectors. DELTA aims to sell 110MWh of lithium ion batteries by the 2016 fiscal year.	Batteries for solar power	Manufacturing Services; Marketing Services	Electronic and Electrical Equipment	Electronic components	South Korea	DELTA Cleantech Solutions Pvt Ltd; EPSILON SDI Co Ltd	DELTA Cleantech Solutions Pvt; EPSILON SDI Co Ltd	2	India; South Korea	Gurugram; Yongin	Semiconductors; Other Electronics; Superconductors	28/11/13
3 ZETA BATTERY LLC/ETA INDUSTRIES LTD-STRATEGIC ALLIANCE	Zeta Battery LLC and ETA Industries Ltd planned to form a strategic alliance to license its GreenSeal technology to ETA Industries Ltd that will simplify lead battery manufacturing and significantly improve lead battery performance by increasing cycle life, lowering weight, reducing recharge time, improving reliability and is fully recyclable.	Batteries	Software Development Services; Licensing Services; Electric Utility Services	Electric, Gas, and Water Distribution	Electric services	United States	ETA Industries Ltd; Zeta Battery LLC	ETA Industries Ltd; Zeta Battery LLC	2	India; United States	Kolkata; Clare	Other Software (Inq. Games); Primary Business; not HI-Tech	02/01/18
4 THEIA ENERGY INC/IOTA ENERGY GROUP LLC/CAPPA MOTOR CORP-STRATEGIC ALLIANCE	Theta Energy Inc, Iota Energy Group LLC and Cappa Motor Corp formed a strategic alliance to enable to provide the customers with integrated, carbon-free energy supply that delivers long-term price stability and environmental benefits.	Carbon-free energy supply that delivers long-term price stability and environmental benefits.	Electric Utility Services	Electric, Gas, and Water Distribution	Electrical work	United States	Cappa Motor Corp; Iota Energy Group LLC; Theta Energy Inc	Iota Electric Power Co Inc; Cappa Motor Corp; Global Theta Infrastructure Mgmt	3	Japan; United States; United States	Cappa-Shi, Aichi; San Francisco; Chicago	Primary Business; not HI-Tech	06/02/20
5 LAMBDA SAS/MI AEROSPACE/NI LLC/ INTERNATIONAL CS/ENGINES/OMICRON AIRWAYS CORP-STRATEGIC ALLIANCE	Lambda SAS, a unit of Lambda NV, MI Aerospace Inc, a unit of MI International Inc, NI Inc, a unit of NI Capital Corp, International CSI Engines AG, and Omicron Airways Corp formed a strategic alliance to provide research and development services of jet fuel from renewable sources, such as algae and a hearty arid plant called Jatropa, with the aim of creating a jet fuel that would perform identically to traditional ones.	Renewable energy	Research & Development Services	Business Services	Commercial physical and biological research	United States	NI LLC; International CSI Engines AG; Lambda SAS; MI Aerospace Inc; Omicron Airways Corp	MI International Inc; NI Capital Corp; Lambda NV; Omicron Airways Corp; CSI Engines AG	5	United States; France; United States; United States	Jersey City; Glasstonbury; Blagnac; Phoenix; Long Island City	Research & Development Firm	15/05/08
6 PHIPOWER SL/RHO ENERGY TECHNOLOGY CO LTD-STRATEGIC ALLIANCE	Phi Power SL and Rho Energy Technology Co Ltd planned to form a strategic alliance. The purpose of the strategic alliance is to evaluate, develop, and operate utility-scale wind farm projects in Latin America, starting with a 90-megawatt project in the Peninsula of Yucatan, Mexico.	Renewable energy (wind)	Electric Utility Services	Electric, Gas, and Water Distribution	Electric services	Mexico	Rho Energy; Phi Power SL	Phi Corp; Rho Energy	2	China (Mainland); Spain	Shanghai; Madrid	Primary Business; not HI-Tech	13/07/18

Figure 7: Example of Alliances data (1-6) (Author's elaboration)

Deal Name	Deal Synopsis (Text)	Aim	Alliance Activity	Alliance Major Industry	Alliance SIC Primary	Alliance Nation	Participant Name	Parent Name	Number of Participants	Participant Nation	Participant City	Alliance High Technology (Code)	Date Announced
7 SIGMA SOLAR INC/TAU ENERGY LTD- STRATEGIC ALLIANCE	Sigma Solar Inc and Tau Energy Ltd formed a strategic alliance. The purpose was to offer enhanced technology solutions for developers and owners of battery storage assets to capture additional revenue from trading optimization, while improving grid stability and contributing to the global energy transition to a cleaner, smarter and more efficient power grid.	Battery energy storage	Electric Utility Services	Electric, Gas, and Water Distribution	Electric services	Canada	Sigma Solar Inc; Tau Energy Ltd	Sigma Solar Inc; Tau Energy Ltd	2	Canada; United Kingdom	Guelph; Oxford	Primary Business not HI-Tech	13/05/21
8 YPSILON INC/PI WIND SYSTEMS AS- STRATEGIC ALLIANCE	Ypsilon Inc and PI Wind Systems AS formed a strategic alliance to remanufacture wind turbine components.	Renewable energy and remanufacturing	Manufacturing Services	Machinery	General industrial machinery and equipment	Denmark	Ypsilon Inc; PI Wind Systems AS	Ypsilon Inc; PI Wind Systems AS	2	United States; Denmark	Peoria; Aarhus	Primary Business not HI-Tech	07/11/11
9 CHI AG/PSI MOTOR CO/OMEGA MOTOR CO LTD- STRATEGIC ALLIANCE	Chi AG, Psi Motor Co and Omega Motor Co Ltd formed a strategic alliance to develop cell electric vehicle system. The alliance will focus on the development of common fuel cell system that will speed up availability of zero-emission technology and reduce investment costs.	Electric Vehicle (EV)	Research & Development Services; Manufacturing Services	Electronic and Electrical Equipment	Semiconductors and related devices	Japan	Chi AG; Psi Motor Co; Omega Motor Co. Ltd	Chi AG; Psi Motor Co; Omega Motor Co. Ltd	3	Germany; United States; Japan	Stuttgart; Dearborn; Yokohama-Shi, Kanagawa	Other Electronics; Semiconductors	28/01/13
10 ALPHA ALPHA SA/ALPHA BETA ENERGY SA/ALPHA GAMMA QUINTERO SA- STRATEGIC ALLIANCE	Alpha Alpha SA, Alpha Beta Energy SA and Alpha Gamma Quintero SA formed a strategic alliance. The purpose was to develop an electrolysis plant in Quintero Bay to generate green hydrogen from water (H2O) and renewable electricity.	Green hydrogen	Electric Utility Services	Electric, Gas, and Water Distribution	Electric services	Spain	Alpha Gamma Quintero SA; Alpha Alpha SA; Alpha Beta Energy SA	Alpha Gamma Quintero SA; Alpha Alpha SA; Alpha Beta Energy SA	3	Chile; Spain; Spain	Quintero; Madrid; Alcobendas	Primary Business not HI-Tech	19/08/21
11 ALPHA DELTA SPA/ALPHA EPSILON CORP- STRATEGIC ALLIANCE	Alpha Delta Spa and Alpha Epsilon Corp formed a strategic alliance to manufacture solar panels in Italy. The partners were expected to build solar power-generating facilities with a solar power battery-manufacturing production plant.	Renewable energy	Manufacturing Services	Electronic and Electrical Equipment	Semiconductors and related devices	Italy	Alpha Delta Spa; Alpha Epsilon Corp	Alpha Delta Spa; Alpha Epsilon Corp	2	Italy; Japan	Rome; Osaka-Shi, Osaka	Semiconductors	16/05/08
12 ALPHA ZETA SPA/ALPHA ETA AB- STRATEGIC ALLIANCE	Alpha Zeta Spa and Alpha Eta AB formed a strategic alliance. The purpose of the strategic alliance is to research in strategic scientific and technological areas which have considerable potential impact for the Country, including the circular economy, alternative energy and environmental protection.	Technology for circular economy, alternative energy and environmental protection.	Environmental Services; Real Estate Investment Services	Petroleum Refineries; Software Publishers	Real estate investment trusts	Italy	Alpha Zeta Spa; Alpha Eta AB	Alpha Zeta Spa; Alpha Eta AB	2	Italy; Sweden	Rome; Kista	Primary Business not HI-Tech	19/07/18

Figure 8: Example of Alliances data (7-12) (Author's elaboration)

On the following page are some examples taken from the excel sheet about companies. The two sheets, the one we have just seen and the one we are about to observe, have been used in a complementary way in order to be able to analyse the interesting results that have come out of them.

Figure 9: Examples of Companies Data highlights the structure and key variables used in the analysis, providing an insight into how the data were organised. Again, it should be noted that what follows is only a small extract of the work done on firms, as the total number of companies examined is 1.411.

Let us analyse the data by introducing the information that is requested in each column. The first column shows the name of the company, while the second column shows the «Number of Alliances»: this is one of the most interesting key variables as a lot of reasoning will be done on it, which will be analysed in the results of the paper.

The next column is that relating to the number of workers in the company; this variable is one of the most difficult to calculate accurately and, above all, clashes with the limits of disclosure of small and/or new companies, for which it is more difficult to have objective and timely data. During the research, out of 1.411 subsidiaries, employee data was found for just under 900 of them, i.e. 59.45%. As can be seen for the rows relating to Delta Cleantech Solutions Pvt Ltd and International Csi Engines AG, for instance, when the employees data could not be obtained, the words not determined (n.d.) were entered.

The next two columns are those that give geographical indications on the companies, in particular they mention the country in which they are based and their geographical area of reference, which is not divided into the 5 continents but into 8 regions, since Oceania and Africa have been considered as continents in their entirety, while Europe has been divided into Western Europe and Eastern Europe, America has been divided into North America and South & Central America and the Asian continent has been split into Far east & Central asia and the Middle East. In Figure 10: Countries involved in the Alliances there is an overview of all the countries with participants in the strategic alliances and their geographical area of reference.

The next one is the «EU Membership» column, which has also been used in the results to determine whether there is a strong incidence of EU member countries forming alliances.

Company name	Number of alliances	#Workers (last available year)	Country Code	Geographical Area	EU membership	Year of Birth	Expiration Date	Born after 2015	Born after 2010	Born after 2005	Born after 2000
Beta Transmission GmbH	1	1.100	DE	Western Europe	1	2002	-	0	0	0	1
AlphaBeta Energy SA	2	1.700	ES	Western Europe	1	2001	-	0	0	0	1
Delta Cleantech Solutions Pvt Ltd	2	n.d.	IN	Far East and Central Asia	0	2003	-	0	0	0	1
Zeta Battery LLC	1	50	US	North America	0	2008	-	0	0	1	0
Theta Energy Partners	1	16.000	US	North America	0	1906	-	0	0	0	0
Lambda SAS	2	56.000	FR	Western Europe	1	1969	-	0	0	0	0
Sigma Solar Inc	9	22.200	CA	North America	0	2001	-	0	0	0	1
Ypsilon Inc	2	113.200	US	North America	0	1925	-	0	0	0	0
Iota Energy Group LLC	1	950	US	North America	0	2018	-	1	0	0	0
Chi AG	12	172.000	DE	Western Europe	1	1926	-	0	0	0	0
AlphaAlpha SA	2	1.400	ES	Western Europe	1	1972	-	0	0	0	0
AlphaEta AB	3	500	SE	Western Europe	1	1968	-	0	0	0	0
AlphaDelta SpA	10	61.000	IT	Western Europe	1	1962	-	0	0	0	0
AlphaZeta SpA	22	33.000	IT	Western Europe	1	1953	-	0	0	0	0
Rho Energy	1	1500	CN	Far East and Central Asia	0	2007	-	0	0	1	0
Eta Industries Ltd	3	5.000	IN	Far East and Central Asia	0	1947	-	0	0	0	0
Psi Motor Co	12	190.000	US	North America	0	1903	-	0	0	0	0
AlphaGamma Quintero SA	1	200	CL	South and Central America	0	2007	-	0	0	1	0
Tau Energy Ltd	1	90	GB	Western Europe	0	2017	-	1	0	0	0
Mi Aerospace Inc	1	40.000	US	North America	0	1936	-	0	0	0	0
International Csi Engines AG	1	n.d.	CH	Western Europe	0	1983	-	0	0	0	0
Gamma SA	19	40.000	ES	Western Europe	1	1992	-	0	0	0	0
Omicron Airways Corp	1	24.000	US	North America	0	1998	-	0	0	0	0
Omega Motor Co. Ltd	6	130.000	JP	Far East and Central Asia	0	1933	-	0	0	0	0
Epsilon SDI Co Ltd	6	10.000	KR	Far East and Central Asia	0	1970	-	0	0	0	0
AlphaEpsilon Corp	4	47.000	JP	Far East and Central Asia	0	1912	-	0	0	0	0
Cappa Motor Corp	15	380.000	JP	Far East and Central Asia	0	1937	-	0	0	0	0
Ni LLC	2	5.000	US	North America	0	1914	-	0	0	0	0
Pi Wind Systems A/S	15	25.000	DK	Western Europe	1	1945	-	0	0	0	0

Figure 9: Examples of Companies Data (Author's elaboration)

Africa	Eastern Europe	Far East and Central Asia	Middle East	North America	Oceania	South and Central America	Western Europe
• AO: Angola	• BG: Bulgaria	• BT: Bhutan	• AE: United Arab Emirates	• US: United States	• AU: Australia	• AR: Argentina	• AT: Austria
• DZ: Algeria	• BY: Belarus	• CN: China	• IL: Israel	• CA: Canada	• NZ: New Zealand	• BR: Brazil	• BE: Belgio
• EG: Egypt	• HR: Croatia	• HK: Hong Kong	• IR: Iran			• CL: Chile	• CH: Switzerland
• GH: Ghana	• LT: Lithuania	• ID: Indonesia	• OM: Oman			• CO: Colombia	• DE: Germany
• LR: Liberia	• PL: Poland	• IN: India	• QA: Qatar			• CW: Curaçao	• DK: Denmark
• NA: Namibia	• PT: Portugal	• JP: Japan	• SA: Saudi Arabia			• EC: Ecuador	• ES: Spain
• UG: Uganda	• RS: Serbia	• KR: South Korea				• KY: Cayman Islands	• FI: Finland
• ZA: South Africa	• RU: Russia	• KZ: Kazakhstan				• MX: Mexico	• FR: France
	• TR: Turkey	• LK: Sri Lanka				• SLV: El Salvador	• GB: United Kingdom
	• UA: Ukraine	• MM: Myanmar				• UY: Uruguay	• GR: Greece
		• MY: Malaysia				• VG: British Virgin Islands	• IE: Ireland
		• PH: Philippines					• IT: Italy
		• SG: Singapore					• LU: Luxembourg
		• TH: Thailand					• NL: Netherlands
		• TR: Turkey					• NO: Norway
		• TW: Taiwan					• PT: Portugal
		• VN: Vietnam					• SE: Sweden
							• TR: Turkey

Figure 10: Countries involved in the Alliances (Author's elaboration)

To conclude the explanation of Figure 10: Examples of Companies Data, the last six columns are dedicated to reasoning about the ages of the alliances, in particular, in addition to the «Year of Establishment», we wanted to analyse which companies are no longer active in the market today and which fall into the category of young companies that was defined earlier. The percentages of firms born between 2015 and 2022, between 2010 and 2014, between 2005 and 2009 and between 2000 and 2004 were then derived.

4. Results

4.1 Sector results of alliances

The merger of data from the three databases resulted in a rich and detailed sample consisting of 1.411 companies globally, engaged in a total of 1.178 environmental alliances. The resulting dataset provides global coverage, reflecting the widespread nature of environmental alliances in the EEE sector.

When it comes to major industry alliances (Figure 11: Alliances Major Industries), the category «Electric, Gas, and Water Distribution» is most common. This category is specifically associated with the idea of renewable energy and, as a result, the use of solutions that move the focus from traditional energy to the creation of green energy, such as wind turbines, solar panels, green hydrogen, low carbon steel, and any other solution that encourages energy efficiency and slows down climate change. The sector of «Wholesale Trade-Durable Goods» follows, and it refers to durable goods like electric cars and the vast universe of batteries. There are difficulties in lowering battery carbon emissions and enhancing its economic viability, including complexity in characterizing nonlinear behaviors like battery cycling aging and dynamic performance prediction under uncertainty. As a result, it is worthwhile for the partnerships to investigate ways to achieve carbon neutrality of batteries in a cost-effective manner. Keep in mind that the use of batteries itself is carbon-intensive, particularly in the processes of manufacturing, transportation, operation, and recycling (Song A. et al., 2024).

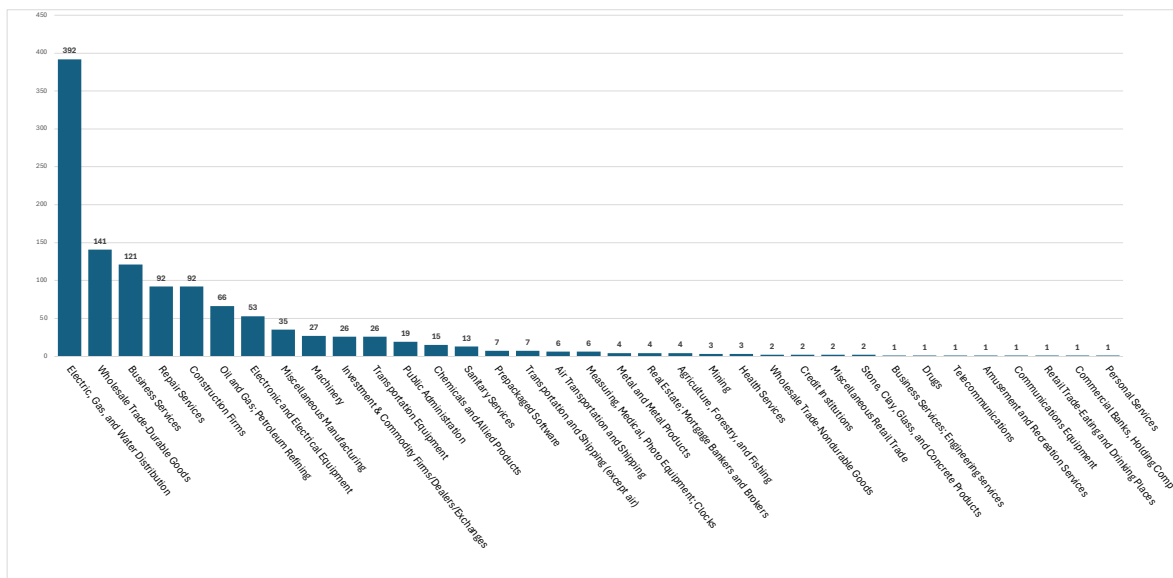


Figure 11: Alliances Major Industries (Author's elaboration)

4.2 Participants results of alliances

When the number of members in each alliance was examined, it was discovered that 87.69% of the businesses would rather work with just one strategic partner (Figure 12: Number of participants for each alliance). This can be explained by the very nature of partnerships: first, communication and coordination are made much easier when only two companies are involved. This is because there are fewer parties to satisfy or consult on every decision, which lowers the possibility of misunderstandings or conflicts of interest. Second, while coordinating the goals of three or more businesses can be challenging and necessitate concessions that could lessen the benefit of cooperation, it is simpler for two businesses to identify areas of agreement upon which to form a partnership. Third, there is the issue of mutual trust, which may be more challenging to maintain when numerous businesses are engaged. Fourth, businesses are less likely to view their partners as possible rivals in bilateral partnerships than in multi-company collaborations, where internal conflict may emerge for access to shared resources or market power. Lastly, the fewer partners one has, the faster decisions can be made, as direct confrontation between the parties is sufficient. With more partners, each choice is supported by discussions and approvals from all parties, which can help the decision-making process and make the partnership more flexible and responsive to the market.

It's interesting to observe that, with regard to the alliances with seven and eight partners, two of the three are run by businesses from the same nation (7 partners from Taiwan and 8 partners from China), whereas the third alliance is made up of nations that are very close to one another geographically (Norway, Finland, France, Sweden, Luxembourg, Ireland, and Germany). This is most likely due to the previously stated factors: proximity in geography most readily translates into similarity in values, regulations, and, incidentally, communication ease.

Number of participants for each Alliance	Number of Alliances	Percentage
2	1033	87,69
3	107	9,08
4	23	1,95
5	7	0,59
6	5	0,42
7	1	0,08
8	2	0,17
TOT	1178	100,00

Figure 12: Number of participants for each alliance (Author's elaboration)

4.3 Geographical results of alliances

Geographically, the nations where formal alliances are formed were analyzed and classified into eight regions: Oceania, Africa, Eastern Europe, the Middle East, South and Central America, North America, Far East and Central Asia, and Western Europe.

The findings (Figure 13: Geographical Regions of Alliances) demonstrate that the greatest number of partnerships are situated in Western Europe and Far East and Central Asia (32% each), followed by North America (25%). Interestingly, 90.23% of that 25% is made up of strategic partnerships taking place just in the United States, making it the densest nation in the analysis, with 231 alliances.

The results are exactly in line with global economic trends: most alliances take place where economies are most developed, such as Western Europe and North America, which are areas with advanced economies, established infrastructures, and mature markets, with a stable and predictable environment for companies, making investment in strategic partnerships safer and more appealing; the other area that is heavily engaged in alliances is that of countries with rapidly rising economies and strong technical and manufacturing capabilities, such as China, India, Japan, and South Korea. Furthermore, these countries are world-renowned as centers of technical innovation, making them ideal for forming alliances in the EEE industry, and they also have the most trained workforce and modern logistical facilities.

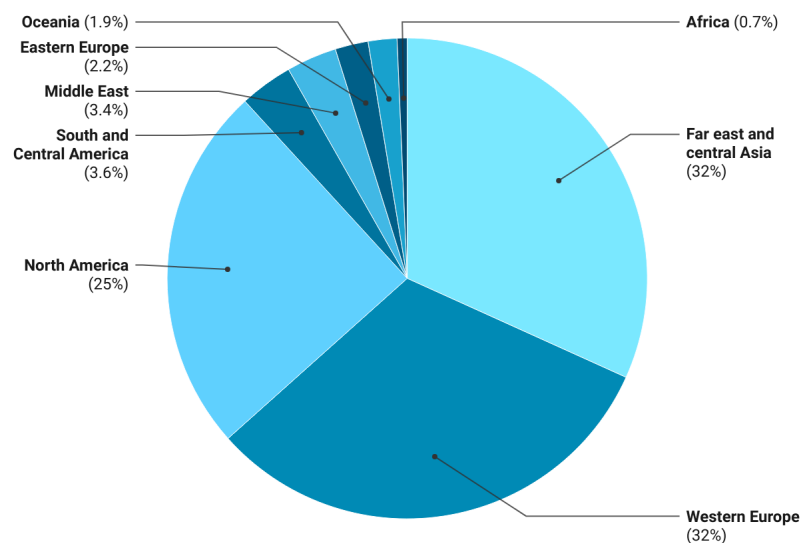


Chart: M. Pasquini - Created with Datawrapper

Figure 13: Geographical Regions of Alliances (Author's elaboration)

The following two figures, (Figure 14: Countries of Alliances) and (Figure 15: World Chart of the Distribution of Countries of Alliances), illustrate the distribution of strategic alliances across countries. Most of them are concentrated in the United States, where 231 environmental alliances are observed, more than doubling the following one, which is China with 96 alliances. Note that in Figure 15 the sixth column, the pink-coloured one, represents «Others», i.e. all the 23 alliances nations that have fewer than 7 alliances per country.

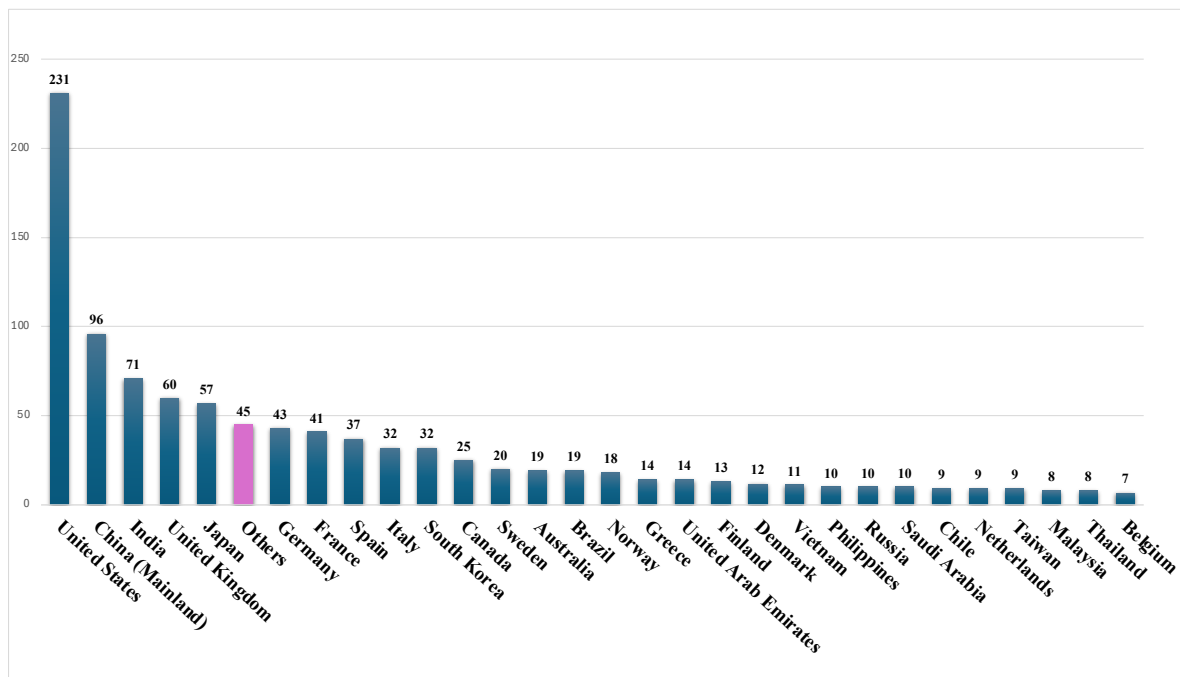
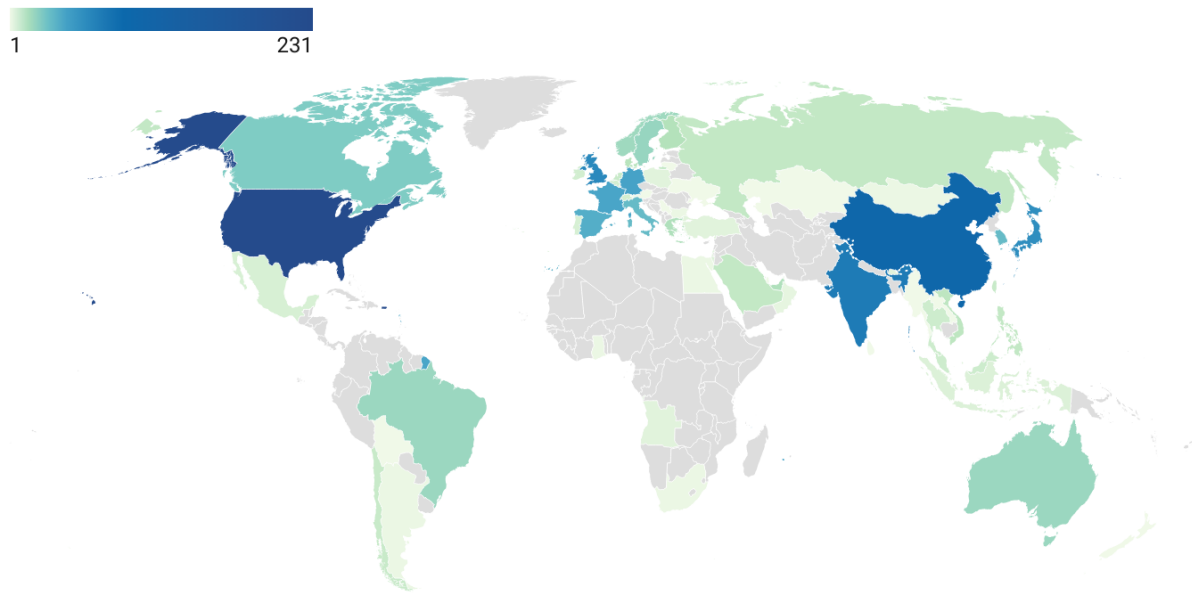


Figure 14: Countries of Alliances (Author's elaboration)

However, beyond the high concentration United States and China, environmental alliances are appearing all over the world, with 59 countries worldwide having more than one green alliance since 2002.

In Figure 9, the colors represent the density of alliances related to each country, and the more intense the color, the denser the nation, beginning with the milder shades of green associated with Bolivia, New Zealand, Qatar, Ukraine, and so on, and progressing to the midnight blue of the US. There are no alliances where the colour grey appears: confirming Figure 13, it is instantly clear that Africa is predominantly grey as with just 0.7% of partnerships taking place on that continent.



Map: Pasquini M. • Created with Datawrapper

Figure 15: World Chart of the Distribution of Countries of Alliances (Author's elaboration)

A visualisation on the world map allows for many important considerations, for instance it reveals the significant spatial heterogeneity of partnership uniformity between countries. The results show that the Global North is generally better at creating partnerships than the Global South, indicating a North-South division in SDG 17 uniformity (Qi, Y. et al., 2024). This might be due to a variety of circumstances, particularly in Africa and South and Central America, where several variables impact their exclusion from partnerships. First and foremost, economic and political instability, since nations with volatile economies or a history of economic crises, hyperinflation, or currency swings may provide a greater risk to firms seeking stability to preserve their investments. Furthermore, partnerships are typically long-term agreements, but frequent political changes, civil wars, and government instability discourage international companies from forming partnerships with countries in such areas, as political uncertainty makes it difficult to predict how economic policies and market conditions will evolve. Furthermore, from a geophysical standpoint, there are countries where it is much more difficult to consider forming an EEE partnership due to morphological constraints; for example, the Saharan zone has shortages in essential services such as reliable energy and connectivity, making partnerships difficult to manage. Finally, businesses in rich nations desire to protect themselves, and in many emerging countries, legislation, such as intellectual property laws, may be inadequate or poorly implemented, making it dangerous to share technology or ideas with local enterprises.

Companies are so careful of forming partnerships with companies in dangerous sectors in order to prevent imitations or losing a competitive edge.

Let's now have a look at Figure 16: Division of Alliances by Region and Number of Participants in Each Alliance: According to the graph, there are more alliances in Western Europe with two participants, while there are more in the Far East and Central Asia with three or more partners. This concept is mostly related to the business culture that distinguishes these two parts of the world; in Europe, particularly Western Europe, alliances between two companies may reflect a more traditional and conservative approach to business, where partnerships are based on well-established relationships and clear responsibilities, whereas in Far East and Central Asia, markets are often more diverse and complex, making it more advantageous for companies to form larger consortia, as collaborating with multiple partners allows them to share risks and resources while also accessing a broader range of expertise and distribution channels.

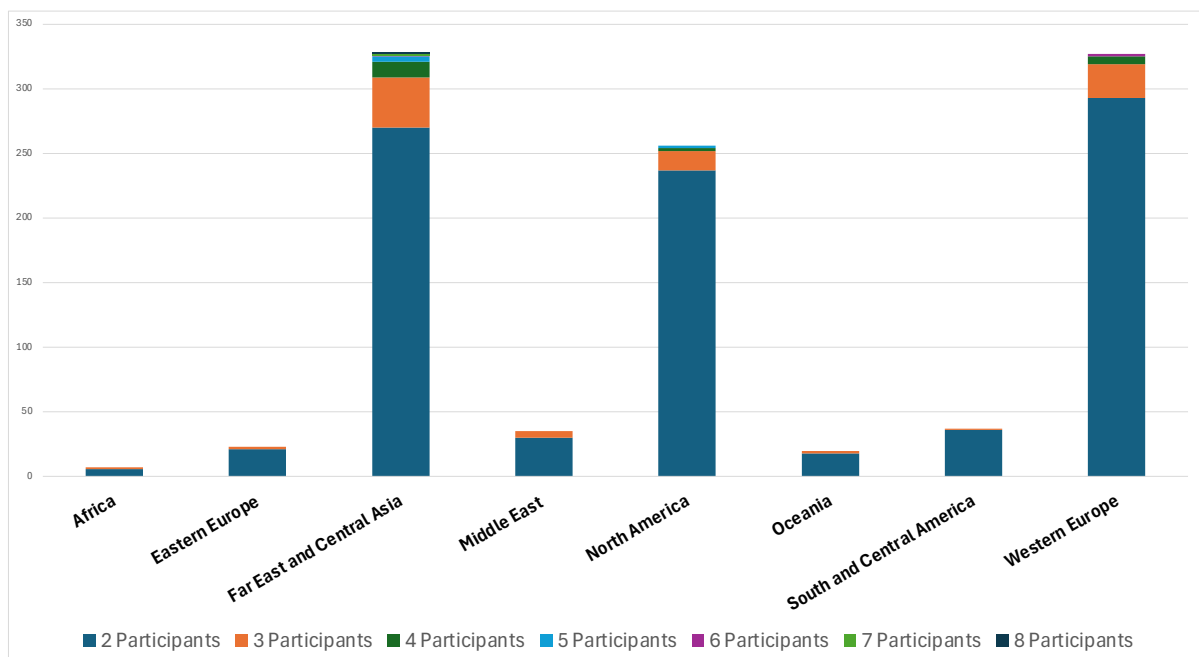
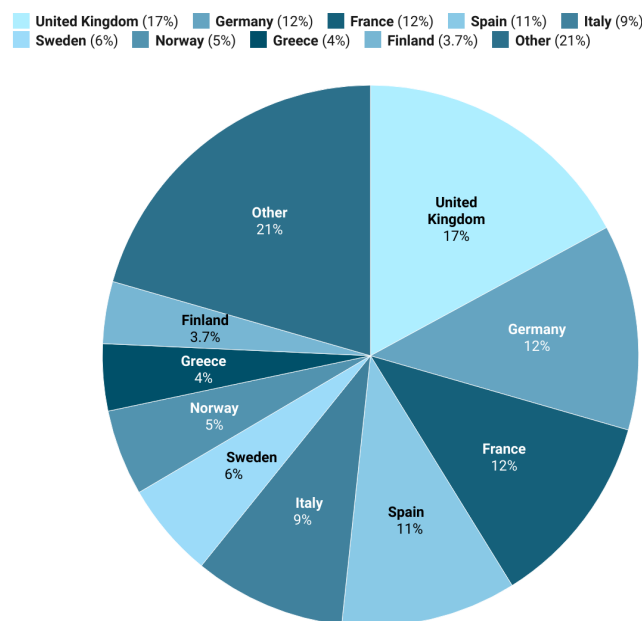


Figure 16: Division of Alliances for Region and Number of Participants for each Alliance (Author's elaboration)

Finally, let's look at the outcomes in Europe. Figure 17: European nations of the Alliances depicts the European nations that were most often discovered to be the foundation of the alliances. It should be mentioned that Russia, which is one of the 21% of «Others», was regarded inside European borders despite being a transcontinental country due to its

historical involvement in the continent's cultural and political life. Figure 17 reveals that the United Kingdom (17%) is the country most involved in strategic alliances, with 60 partnerships, followed by Germany (43, accounting for 12% of the pie chart). This is most likely due to the role of international hub that these two countries, particularly the United Kingdom, play: this nation has been a global economic and financial centre for decades, serving as a center for global corporations and investors, so it has attracted many companies interested in forming partnerships, particularly in the technology sector, such as EEE. It should be emphasized that, until Brexit in 2020, the UK was a member of the EU and therefore a part of the European market, making it particularly advantageous for corporations to develop strategic partnerships there, leveraging a preferential entry point to the EU market. Germany, on the other hand, has a significant industrial and technical presence in Europe and is a global leader in fields like as automotive, engineering, and renewable energy, all of which fall under the EEE sector.



Source: Pasquini M. • Created with Datawrapper

Figure 17: European Countries of the Alliances (Author's elaboration)

Finally, let's consider the European Union. Given that only four of the examined nations are not members (the United Kingdom, Norway, Switzerland, and Russia), it may be concluded that 27.14% of alliances inside European territory are not directly governed by the European Union, while the remaining 72.86% are.

4.4 Age results of alliances

Let's now look at the number of alliances formed during the period of interest of this analysis. In Figure 18: Number of alliances by year of establishment, we observe on the x-axis the range between 2002 and 2022, i.e. the twenty-year period that was taken as the dataset; on the y-axis, on the other hand, we observe the number of alliances established. Note that the reference year for each alliance is the year in which it is announced.

Figure 18 illustrates that the trend of alliances rose significantly until 2008, when it came to a standstill, most likely owing to the Great Recession, reaching its lowest peak in 2014, when only 15 partnerships were recorded. Following that year, the trend increased significantly until 2022, when this research concludes.

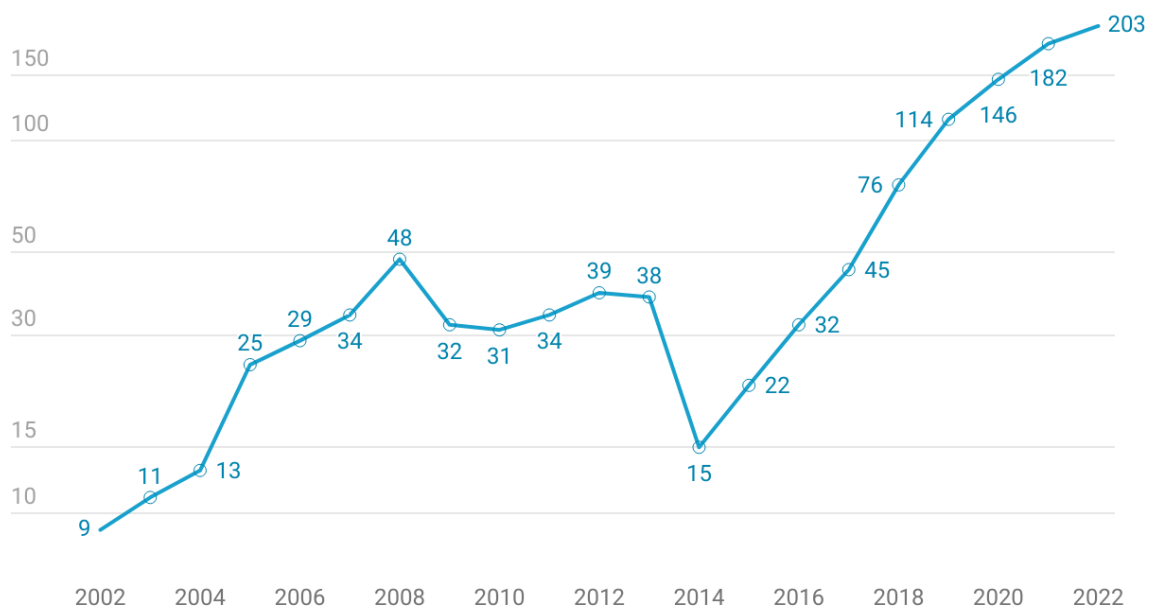


Chart: Pasquini M. • Created with Datawrapper

Figure 18: Number of alliances by year of establishment (Author's elaboration)

It is interesting to consider why the decline in strategic alliance development occurred in 2014. First and foremost, many countries were still dealing with the consequences of the crisis that had hit economies, particularly those in Europe, between 2010 and 2012, reducing the resources available for investments in sustainability initiatives, which were deemed less urgent than economic and financial priorities. Second, from mid-2014 onwards, the price of oil suffered a significant collapse: while oil was steadily above USD 100 per barrel in the first months of the year, it began a rapid descent from June onwards, bringing it down to around USD 50 per barrel by the end of 2014. This steep reduction,

which is also regarded as one of the most important during the previous decade, has had a huge influence on sustainability projects, particularly those using renewable energy. With falling oil prices, traditional energy sources have become more economically competitive, reducing the need for many businesses to engage in clean energy and sustainability programs. Finally, corporations were looking forward to the Paris Agreement, which was set to be signed in 2015. While waiting for a clearer legislative framework, firms were delaying new commitments to sustainable partnerships in anticipation of global accords, which ultimately led to the formation of SDG 17, which focuses on partnerships.

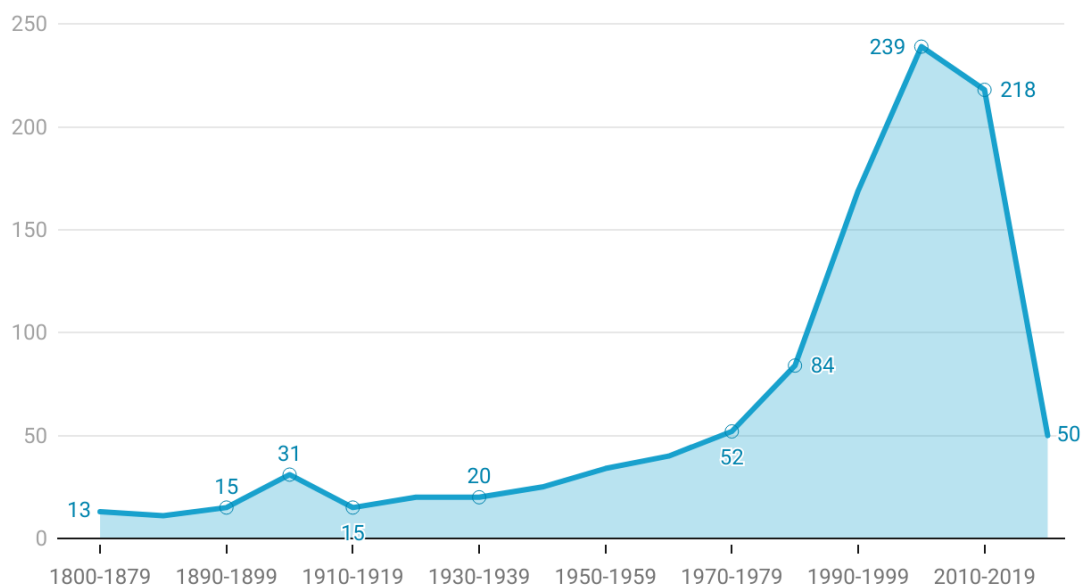
Another notable event was the year 2019, when the threshold of 100 yearly partnerships was surpassed. Soon after the Covid-19 pandemic struck, potentially jeopardizing these collaborations, however the growth curve did not stop, rather it continued to increase. This resilience may be linked to a variety of causes, including the fact that the pandemic biennium pushed many businesses to reconsider their business strategies, with a greater emphasis on partnerships with a sustainable effect. Aliances like this were increasingly viewed as a means of promoting long-term growth by utilizing renewable resources while mitigating environmental and social hazards. Moreover in 2020 attention to environmental and social well-being grew greatly, owing to increased public health knowledge and sensitivity to environmental concerns. Eventually the pandemic has boosted innovation and digitalization, allowing businesses to interact remotely: this transition enabled corporations to build sustainable alliances without the requirement for in-person meetings, allowing them to continue pushing programs despite health-related and, subsequently, geographical restrictions. Interestingly, four years later, corporations still choose such methods of detached corporate communication in the everyday business.

Note that the alliance numbers could be biased by the fact that the databases used for this research lack of updated and accurate records of alliances formed many years ago, since internet just became widely available in recent decades and it was still largely underused in the early 2000s, resulting in likely underreporting of many coalitions and so bringing subjectivity into the research. What is clear is that alliance development patterns are true, particularly in light of SDG 17 and the increasingly important role that partnerships play today: alliances are often regarded as one of the most important prospects for businesses, enabling access to highly inventive resources and higher-level technology through collaborative efforts.

4.5 Age results of the companies

Let's look at a fascinating finding about the ages of organizations participating in strategic alliances. In Figure 19: Year of Establishment of the Companies, the x-axis shows ranges denoting the years in which these businesses were created. These periods are separated by decade, with the exception of 1800-1879, which is longer to avoid a disproportionately small number of enterprises in that time. It is worth noting that the last entry does not represent a decade, but rather the period from 2020 to 2022, which marks the last years in which corporations may join coalitions created between 2002 and 2022.

The study results show that sustainable partnerships are primarily created by younger organizations, with a peak among companies started between 2000 and 2009, reaching 239 entities. This trend is most likely explained by the fact that firms created in recent decades are more likely to employ innovative and sustainability-focused business structures, allowing them to stay nimble and adaptable when selecting clean technology and low-emission manufacturing methods. Furthermore, newer firms utilize sustainability as a competitive advantage, distinguishing themselves from more established competitors. As new entrants to the market, they are often lower in size than organizations that have been in business for centuries, making them much more flexible and less bound by rigid traditional structures (Balasubramanian S. et al., 2021).



Source: Pasquini M. • Created with Datawrapper

Figure 19: Year of establishment of the Companies (Author's elaboration)

5. Conclusions

Summarizing the results of the analysis, the merging of data from the three databases provided a comprehensive dataset of 1.411 companies engaged in 1.178 environmental partnerships worldwide, providing a global coverage of sustainability partnerships within the Electrical and Electronic Equipment (EEE) sector, and this analysis focused on the dynamics of these alliances across characteristics such as sector, participant composition, geographical distribution, and company age, revealing key points about the nature and drivers of these types of collaborations.

The analysis shows that alliances are concentrated primarily in the Electric, Gas, and Water Distribution sector, strictly linked to renewable energy innovations, as well as in Wholesale Trade-Durable Goods, which focuses on innovative topics like electric vehicles and batteries. This distribution aligns with the EEE sector's pivotal role in promoting sustainable technologies that reduce carbon emissions. Moreover, it underlines the importance of overcoming technical and financial issues in these sectors to ensure a feasible transition toward sustainable energy.

An interesting finding is that most alliances involve only two partners, highlighting that companies prefer efficient and agile collaboration with fewer parties, facilitating quicker decision-making, enhanced trust, and reduced competition inside the alliance. In regions like the Far East and Central Asia, however, larger groups of three or more companies are more common, likely due to a business culture that favors diverse expertise and risk-sharing, being less structured with respect to the European business style.

Geographically, alliances are primarily concentrated in Western Europe and Far East and Central Asia, followed by North America. This distribution is perfectly consistent with global economic patterns, where developed economies and emerging industrial powerhouses drive environmental innovation. United States and China, which have the highest numbers of alliances, suggest that economic strengths and advanced infrastructure create a favorable ground for forming environmental partnerships; in contrast, regions such as Africa and parts of South and Central America see fewer partnerships, probably because of the economic instability, political volatility, and limited infrastructure of that countries, that pose challenges for long-term strategic alliances.

Finally, the data show that younger companies have become particularly active in forming sustainability partnerships in recent years. These firms often adopt flexible, innovative business models aiming to clean technologies and low-emission processes, differentiating themselves from traditional competitors. Moreover, their smaller size and adaptability make them well-suited for strategic collaborations focused on sustainability.

This study poses interesting questions which could be answered in several future research avenues. One potential area of investigation, as data become available, is the long-term impact of these alliances on company performance, both in terms of financial and environmental impact. Additionally, more granular regional studies could reveal how local policies, regulatory environments, and cultural factors influence the success and scope of environmental alliances. Eventually, future studies might also examine how alliances in emerging economies evolve under changing global sustainability regulations and market pressures, providing insights into strategies that foster successful partnerships across diverse economic landscapes.

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