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INTRODUCTION

With the Brundtland Report published in 1987, the notion of sustainable development was formally recognized and largely accepted in international relations. Presently, the principle of sustainable development is widely accepted globally. The biggest obstacle to realizing sustainable development is the issue of climate change. Addressing climate change is crucial for attaining sustainable development objectives and is a driving force for progress. Climate change is perceived as the most pressing environmental concern, attracting increasing public awareness and concern. As people become more conscious of the potentially disastrous impacts of climate change, there is an increasing sense of urgency and attention to this issue. (Richard Kinley, 2006)

The definition of the climate change is a phenomenon that incorporates changes in temperatures and weather patterns over time, according to United Nations. While some of these changes can attribute to natural factors, such as solar variability, human activities have become the dominant source of climate change ever since the 1800s. The emission of greenhouse gases (GHGs) from industrial processes, transportation, and deforestation acts as a blanket covered the Earth, trapping the heat from the sun and causing a rise in global temperatures. As a concerning issue for the entire world, the global temperature is projected to rise by 2.8°C by the end of this century. The emissions that contribute to climate change are generated in every part of the world and affect every person on the planet. The effects of climate change can cause far-reaching impacts on our health, food security, housing, safety, and employment. This highlights the urgent need to take action to mitigate its effects and transition to a more sustainable future. (*What Is Climate Change?*, no date)

Attaining carbon neutrality has emerged as a crucial global consensus for advancing sustainable development and mitigating the severe consequences of climate change. Over 120 nations set targets to reach this objective by a particular deadline. Achieving a country's carbon neutrality goal requires all societal sectors' collective efforts. As major contributors to carbon emissions, companies should contribute significantly to decrease emissions and foster environmental sustainability. Therefore, it is essential to understand how companies respond to the call for carbon neutrality and climate sustainability in this context. (Wu, Tian and Guo, 2022)

Our paper begins by introducing the concept of carbon neutrality and analyzing each country's goal for carbon neutrality and its current progress toward that goal. In Chapter 1, we also explore the role of government and technological action in achieving the goal of net zero emissions.

Chapter 2 is about companies' reactions as significant carbon emitters to the call for environmental sustainability and carbon neutrality. Our analysis starts by exploring the general motivations and pathways for a company to pursue its goal of carbon neutrality. Then, it thoroughly examines the drivers and obstacles to the transition to carbon neutrality. Finally, we propose a comprehensive and practical framework for transforming to a more environmentally sustainable and carbon neutral business model.

Chapter 3 focuses on exploring the transformation of the food and beverage industry towards greater environmental sustainability and carbon neutrality. We start by introducing the industry's current state and selecting 311 companies as our research sample. Then we perform a cluster analysis to identify different types of food and beverage companies in terms of comprehensiveness and tendency of a climate-friendly transformation. Finally, we further analyze the characteristics of identified clusters and give suggestions for improvement accordingly.

Chapter 1 What is carbon neutrality

Introduction

Sustainability is the ability to retain and preserve resources and the environment for future generations by ensuring the present needs are met without hindering their capacity to meet their needs in the future. It is a holistic concept encompassing social, economic, and environmental aspects. The range of sustainability is overly broad that it usually involves using the resources responsibly, protecting natural ecosystems and biodiversity, and promoting social well-being. (Purvis, Mao and Robinson, 2019)

There are three fundamental pillars of sustainability: economic, social, and environmental. Economic sustainability refers to the ability to maintain and improve economic growth and development, while social sustainability indicates the capability to meet the needs of all people, as the same time, promote social well-being. And last, the Environmental sustainability pillar, as the name implies, refers to the ability to use resources in a manner that preserves the environment for future generations. (Purvis, Mao and Robinson, 2019)

These three pillars are closely related and influence each other, so the practice of pursuing sustainability needs to balance these three pillars. For example, a company pursues the growth of the economy at the price of the environment is not truly sustainable, as it is not considering the long-term impact of its actions. Similarly, a company that prioritizes environmental protection at the expense of social well-being is not truly sustainable. (Hansmann, Mieg and Frischknecht, 2012)

Achieving sustainability requires a long-term perspective and a system-thinking approach to understand the interconnections and trade-offs between different aspects. It is not a one-time goal but a continuous improvement process, where authorities, organizations, and individuals constantly look for ways to reduce their environmental impact and promote social and economic well-being. (Kates, 2011)

Our topic today is carbon neutrality, one of the most important topics when considering environmental sustainability. As we discussed above, environmental sustainability is a subset of the broad topic of sustainability that focuses explicitly on protecting and preserving the environment. The main aspects of environmental sustainability can include reducing the use of non-renewable resources, protecting biodiversity, preventing pollution, and mitigating the climate change's effects. Moreover, climate change among them is considered to be the most challenging obstacle in environmental sustainability development. Greenhouse gas emissions as the primary cause and driver of global climate change, need to be mitigated and managed to avoid exacerbating climate change. Therefore, Carbon neutrality has become a global consensus in addressing the impact of climate change.

This chapter introduces the concept of carbon neutrality and its origin. Followed by an

assessment of major countries and regions' carbon neutral goal and their progress. Finally, we introduce the government's role and the technical approach in pursuing its national carbon neutrality goal.

1. 1 Carbon neutrality, the concept and history

Carbon neutrality indicates to the achievement of net zero carbon dioxide emissions through balancing the amount of CO₂ emitted and removed to prevent it from growing in the atmosphere and causing global warming (Chen, 2021).

It is worth noting that 'net zero carbon' implies that any acts that result in emissions would be followed by additional actions that firmly offset emissions. The objective of carbon neutrality is to reduce carbon emissions caused by humans to a level where the natural world can absorb itself. Thus, the planet becomes an equilibrium rather than reaching absolute zero. On the contrary is 'zero carbon,' which is an unrealistic concept for it means no carbon emissions at all (*Yale Experts Explain Carbon Neutrality*, 2020).

In 1997, Future Forest first introduced the economic concept of carbon neutrality. From the standpoint of energy technology, it focuses on achieving carbon neutrality through purchasing certified carbon credits to offset carbon emissions caused by transportation, daily living, and personal conduct (Kong and Wang, 2022). The core of achieving carbon neutrality is that every role from each level of society takes accountability for their emissions, whether direct or indirect, and is responsible for reducing them. Industries and companies can take action to reduce their emissions and make carbon offsets investments, which means reducing emissions in one place and making compensation in another. While for individuals, we can contribute to carbon neutrality by reducing the energy we use, supporting carbon neutral products, changing the way of traveling, etc. (*Yale Experts Explain Carbon Neutrality*, 2020). According to the British Standards Institution, a product or service is considered carbon neutral at the product level if its production does not contribute a net increase of GHG emissions into the atmosphere (Kong and Wang, 2022).

Now carbon neutrality is a worldwide consensus. In 2015, 196 parties adopted the Paris Agreement. According to this agreement, the goal is to restrict global warming temperature to 1.5 degrees Celsius, compared with pre-industrial levels. The Agreement does not define a carbon neutral or climate neutral target. However, Article 4 suggests balancing human-caused GHG emissions by sources with removals by sinks in the second half of the twenty-first century, which is the equivalent of net zero emissions. To achieve this goal, the world should try to reach the peak of greenhouse gas emissions worldwide by mid-century (*Paris Agreement* 2015). The Paris Agreement (Article 4, paragraph 2) further encourages each party shall create, communicate, and sustain a set of Nationally Determined Contributions (NDCs) every five years that reflect its intended objectives. The NDCs reflect each government's efforts to reduce emissions and prepare for climate change's effects. To achieve the objectives of such commitments, Parties must adopt domestic mitigation measures. (*Nationally Determined Contribution*, no date).

In 2019, UN Secretary-General Guterres made a statement at the United Nations Climate Action Summit, stating that 65 countries and the European Union have fully promised to achieve the goal of carbon neutrality by 2050. (Deng, Xie and Teng, 2021)

By the end of 2022, more than 120 countries have declared to make a joint effort toward the globe carbon neutrality and announced their carbon related target. (Wu, Tian and Guo, 2022) Carbon is frequently employed as a proxy for GHG when nations proposing neutral or net-zero emission targets, as the main part of current human-caused greenhouse gas emissions (GHG) are mostly CO₂. Deng, Xie and Teng (2021) further argue that there are, in general, four main

types of concepts when countries propose their carbon neutrality related targets: carbon neutrality, climate neutrality, net-zero emissions and net-zero carbon emissions. The Special Report on Global Warming of 1.5°C of the Intergovernmental Panel on Climate Change (IPCC) provides clear definitions of these concepts.

According to IPCC's report, carbon neutrality is equal to net-zero carbon emissions, which refers to the balance between CO₂ emissions emitted by human activities and global anthropogenic CO₂ absorption in a certain period of time. Net-zero emissions refer to the GHG emission instead of only CO₂ and are defined from an emissions perspective. (*Special report on global warming of 1.5°C*, 2018) Attaining carbon neutrality necessitates balancing the GHG emissions released into the atmosphere and the sinks that absorb them. Net-zero GHG emissions are not equal to net-zero climate impact. Finally, climate neutrality implies net zero impact on the climate system and does not necessarily require net zero GHG emissions, which is different from net zero emissions. (Deng, Xie and Teng, 2021)

While greenhouse gas emissions are the main contributor to climate change caused by human activities, they are not the only element. There are some other human actions, including urbanization, deforestation, and land use change can also affect the climate. In practice, even though the IPCC establishes a clear distinction between net-zero emissions and climate neutrality in terms of both impacts and emissions, practically all nations equate the two in their official documents. For instance, the EU has declared net zero emissions and climate neutrality as a long-term targets and considers them synonymously. (Deng, Xie and Teng, 2021)

1.2 National carbon progress

After knowing the concepts of carbon neutrality related targets, we will have a clear view of the global status of achieving carbon neutrality. Several main countries' and regions' statements on their neutralization-related objectives and NDCs are listed below. Information and numbers are from Kong and Wang (2022); Deng, Xie and Teng (2021); Wu, Tian and Guo (2022) and NDC Registry in UNFCCC.

- China

In 2020, China reported its NDC goals stating that it will reach its peak carbon dioxide emissions before 2030 and aim to achieve the goal of net zero by 2060. Reduce by approximately 65 percent its carbon dioxide emissions per unit of GDP from 2005 levels by 2030. It also reports the current progress as until 2021, China's carbon emission intensity has reduced by 3.8% compared with 2020 and a cumulative decrease of 50.8% compared with 2005. (*Progress on the Implementation of China's Nationally Determined Contributions*, 2022)

- Japan

Japan has set an idealistic target aligning with its long-term objective of achieving carbon neutrality emissions by 2050: a reduction in GHG emissions of 46% from the level of fiscal year 2013 to the fiscal year 2030. In addition, Japan will keep making its heroic efforts to achieve the ambitious target of reducing the GHG emissions by 50%. (*Japan's Nationally Determined Contribution*, 2021) The environment ministry shows that the GHG emission figure for 2020–21 represents a decrease of 18.4% from 2013 levels. This marks the lowest level since

Japan started collecting data on greenhouse gas emissions in 1990-91. (Al Jazeera, 2022)

- The United States

The United States NDC registry in 2021 indicates a net-zero emissions target by 2050. To do so, the United States has declared an objective of reducing net GHG emissions by 50-52% compared with 2005 levels across the entire economy by 2030. In 2020, U.S. emissions were 22.2% below 2005. However, the number rose to 17.4% in 2021. (*The United States of America Nationally Determined Contribution*, 2021)

- The European Union

The European Union (EU) announced in Brussels a new climate change policy called A European Green Deal in 2019, which claimed to reach net zero GHG emissions by 2050 and decouple resource consumption and economic growth in Europe. This objective was also incorporated into the draft European Climate Law. In order to move Europe toward a more environmentally and climatically friendly path, the EU committed to lowering its 's overall carbon emissions by 40% by 2030, 60% by 2040, and 80% by 2050. 78% of the cities have set a carbon emission reduction goal, and 25% want to achieve carbon neutrality. (Wu, Tian and Guo, 2022)

According to the European environment agency, the EU has achieved its 2020 reduction goal of 20% and done even better. It is reported that the actual EU GHG emissions in 2020 were 32% lower than in 1990, surpassing the EU's climate goal by 12 percentage points. This overshoot was greatly influenced by the sharp decrease in emissions that was seen in 2020 as a result of the COVID-19 epidemic. (*Total greenhouse gas emission trends and projections in Europe*, 2022)

- The United Kingdom

The United Kingdom's updated NDC in 2022 states that the country's framework for reducing greenhouse gas emissions and better address climate risks was legally established through the Climate Change Act of 2008. The initial intent of the Act was that by 2050, the UK reduce its emissions by no less than 80% under the 1990 baseline level. This aim was updated on June 27, 2019, pledging the UK to a legally valid goal of net zero emissions by 2050, calculated across the entire economy. The UK's updated NDC in 2022 confirms that its target remains a commitment to lower domestic GHG emissions by at least 68% by 2030 in comparison to 1990 levels, which is in line with the temperature goal of the Paris Agreement and its 2050 carbon neutrality targets. The business, energy and industrial strategy department reported in national statistics that by the end of 2020, net territorial GHG emissions in the UK were estimated to have 405.5 million tons of carbon dioxide equivalent, which would be a 9.5% decline from the 2019 figure of 447.9 million tons and a 49.7% reduction from 1990. (*2020 UK Greenhouse Gas Emissions, Final Figures*, 2022)

Figure 1.1 is the diagram we made from the target set by each region and their reported achievement so far. From the five countries and regions shown above, we noticed that despite all government efforts to reach the goal, Japan (40%) and The US (43%) are not halfway through their target. The EU has made the best performance so far for achieving and exceeding its 2020 goal and has already met 80% of its 2030 target. UK and China are also making excellent progress in approaching their 2030 goals. With the achievement of the UK (73%) and

China (78%), they are well on track to reach their respective emissions reduction targets by 2030.

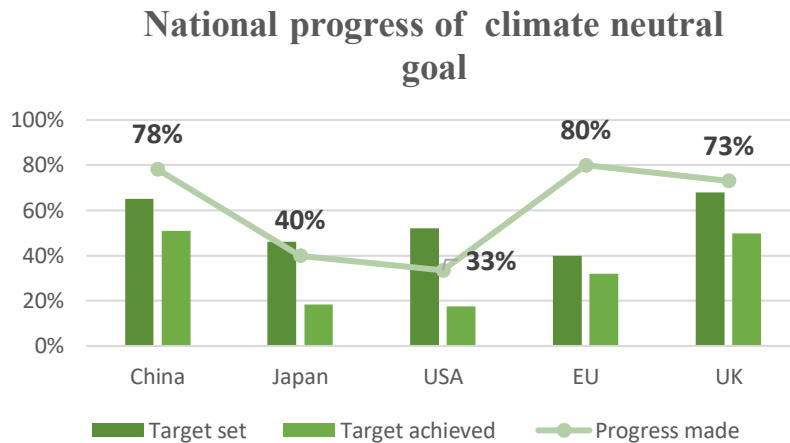


Figure 1.1 Integrated National progress of climate neutral goal

Combing the research of Deng, Xie and Teng(2021), we can tell that among all countries or regions that have formally proposed a neutralization commitment, the UK and six EU member states (including Sweden, Denmark, France, Germany, Hungary, and Spain) have made neutralization commitments in the form of legislation. Which is the most legally binding form of targeting and generally occurs in countries or regions with better climate change response institutions and climate legislation. Combing with the results of each region's progress we mentioned above, we can see legislation is the form that has contributed most to the achievement of the targets. The rest countries tend to clarify their emission reduction targets by submitting agreements and policy pledges.

1.3 The role of government

The role of government in achieving global climate neutrality goals is crucial as they have the power to establish policies, regulations, and targets that can accelerate the transition towards a low-carbon economy. As discussed above, governments engage in this area by establishing emissions reduction targets. The government's actions after declaring the national carbon neutrality goal are what we will discuss in this sector. Firstly, the government investment made in research and innovation of green energy technologies and infrastructure and providing support in the low-carbon economy transition is an important way of controlling its GHG emissions. Also, government policy on financial incentives like tax breaks or subsidies and regulations and enforcement can drive the progress of its carbon neutrality goal. In addition, government plays an essential role in international cooperation to coordinate global actions that reduce emissions and prepare for the impacts of climate change. Lastly, policies encouraging businesses and individuals to minimize their carbon footprint is a powerful instrument in pursuing the carbon neutrality goal. In numerous government publications on carbon neutrality from different nations, the most frequently addressed economic instruments are the emissions trading scheme (ETS) and carbon taxes. (Zhang, Luo and Wan, 2021)

ETS is a cost-effective and market-based instrument to reduce GHG emissions.

The share of global GHG emissions covered by an ETS refers to the proportion of total GHG emissions that are regulated by an emissions trading system. This means that the emissions of these specific sectors or regions are capped, and companies or organizations operating in those sectors or regions are required to hold emissions allowances equal to their emissions. The cap on emissions and the trading of allowances create a financial incentive for companies to cut their emissions to sell their excess allowances.

In April 2022, World Bank published a survey on the share of global GHG emissions covered by an ETS from 2005 to 2022, as shown below. The result shows that around 17.7% of total greenhouse gas emissions worldwide were regulated by an Emissions Trading System (ETS). From 2005 to 2020, the proportion of emissions overseen by an ETS rose from approximately 5% to 8%. Moreover, a significant boost appears in 2021 with the implementation of China's national ETS.

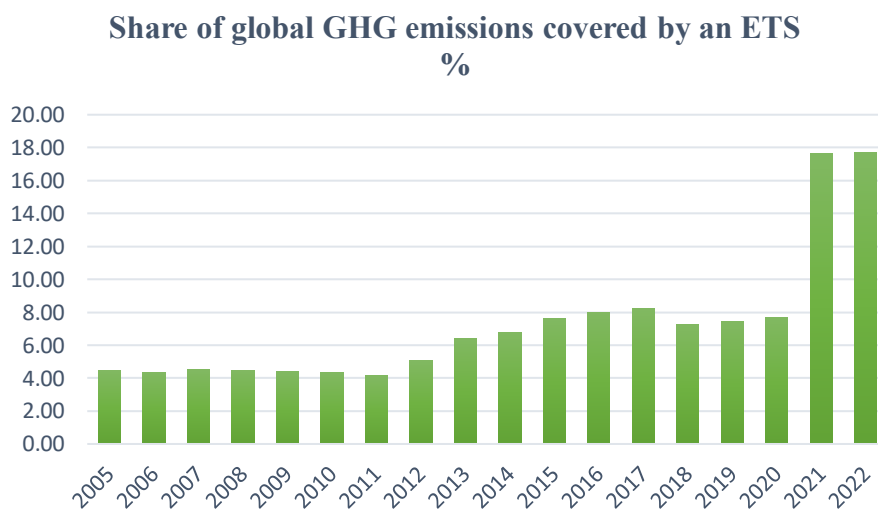


Figure 1.2 Share of global GHG emissions covered by an ETS 2005-2022, source from Statistics

Governments are increasingly encouraging enterprises and other entities to reduce emissions by establishing a limit and giving licenses for one ton of GHG emissions. Permits must be obtained from the government or traded from the carbon market for every unit of GHG emitted by the entities. If firms do not have enough permits, they must cut pollution or buy more, with one permit equaling one ton of CO₂. (Lam, 2022) As a result, the regulated businesses' energy usage is reduced by 22.8% under ETS. And CO₂ ETS operates more effectively in regions with strong environmental regulation and marketization. (Hu *et al.*, 2020)

The firms under an ETS face the challenge of simultaneously managing shifting carbon prices, the number of permits, and the balance between permit trading and permit-consuming production. (Wei *et al.*, 2023) ETS is not always a challenge for companies, it can also be an opportunity, Albertini(2013) indicates that companies that sell allowances and offsets on the European carbon market improve their financial position without taking into account their carbon impact. A trading carbon credit can generate capital, and such transactions offer managers the benefit of producing capital for enterprises that may not otherwise be obtainable. Another study from Marin, Marino and Pellegrin (2018) indicates that under EU ETS, firms' economic performance is not affected negatively. In response to the EU ETS, businesses have improved labor productivity while also passing costs to their customers. Jia (2023) demonstrates that while the consequences of ETS are short-term unfavorable for downstream

businesses, they are long-term good.

Another primary carbon pricing instrument the government use is a carbon tax. A carbon tax is a fixed price on carbon emissions. It is typically charged per ton for the carbon emission caused by coal, oil, and natural gas being burnt. Carbon taxes are intended to reduce dependency on dirty energy and reduce carbon emissions. However, taxes also raise the cost of these fuels, which means that with a carbon tax in effect, consumers and companies would have to spend more on their monthly utility bills. This would in turn increase the cost-competitiveness of renewable energy options. (*What is a carbon tax?*, 2020)

Compared with ETS, a consistent carbon tax price avoids uncertainty and encourages businesses to alter their activities and practices. And carbon taxes have been implemented in more nations or regions than ETS. (Zhou *et al.*, 2021) The research from Wang *et al.*(2022) argues that taxation is not the ultimate solution. In the short term, it is a helpful method for lowering and controlling GHG emissions. However, in the long run, carbon taxes might harm competitiveness for the increased production costs, potentially boosting FDI outflow. Zhang, Luo and Wan (2021) proposes that unilateral carbon tariffs that impose carbon taxes on imported high-carbon industries could become disguised green trade barriers, further affecting global economic development prospects.

1.4 The role of technical actions

From the technically feasible level, The research of Kong and Wang (2022) summarized four practical approaches to contribute to global carbon neutrality, which are carbon substitution, reduction, sequestration, and recycling.

Carbon substitution means replacing energy sources that may cause GHG emissions with green and clean energy sources. To replace thermal power using wind, hydropower, and photoelectric is a good example.

Carbon reduction mainly entails energy savings and improved energy efficiency, and practices vary in different industries. For example, in the transportation sector, utilizing more effective power techniques and lightweight materials reduces CO₂ emissions directly at the source.

Carbon sequestration is the process of first collecting CO₂ emissions from big thermal power plants, heavy industry, and chemical industry, then transferring it to a suitable location and employing technical ways to remove it from the atmosphere for an extended period of time. The primary method for storing carbon is through geological storage, and the storage locations could be defunct coal mines, oil and gas reserves, and other suitable locations.

Carbon recycling uses artificial and natural systems, such as carbon sinks in forests and other natural systems. Artificial carbon conversion is the process of turning CO₂ into valuable chemicals or fuels by using chemical or biological means. Forest carbon sink means plants capture CO₂ from the air and fix it in the plants and soil. This lowers the amount of CO₂ in the air and makes gray carbon, which can be used repeatedly.

Kong and Wang (2022) produced a prediction based on technological maturity or economic efficiency with traditional fossil fuels. Between 2030 and 2050, the reduction rate of CO₂ emissions is expected to be relatively modest due to the lack of financial incentives for clean

energy and limited use of carbon sequestration technology, as well as its underdeveloped state. When it comes to 2030–2050, the cost of clean energy will have a competitive advantage against fossil energy, clean energy projects will be implemented, and CO₂ emissions will reduce dramatically due to related technology evolving and maturing. By 2050, carbon sequestration will contribute the most (47%) to carbon neutrality. Carbon reduction, carbon sequestration, and recycling followed, contributing 21%, 15%, and 17%, respectively.

Chapter 2 How do companies react to climate friendly and carbon neutrality?

Introduction

Chapter 1 has described carbon neutrality as a global consensus requiring a joint effort and collaboration among all parties. Most regions worldwide have claimed their carbon neutrality related goal, with some regions making steady progress and others needing more emissions reductions to meet their targets. More academic research focuses on the macro level, discussing carbon neutral initiatives and related national policies and technologies in various regions of the world, as discussed in the first chapter. However, there are few studies on carbon neutrality at the company level, which we will discuss in the following chapters.

Achieving the global carbon neutrality goal needs effort from every role within each level of society. Businesses are widely recognized as major carbon emitters. Firms' low carbon management and climate-friendly orientation determine whether a region can successfully transfer to a low-carbon economic model and fulfill its promise of being carbon neutral. (Zhang and Liu, 2020)

Zhang *et al.* (2022) also emphasize the importance of the company's commitment to carbon neutrality. They consider businesses to play a critical and essential role in the global decarbonization effort. And discovered that many of the most influential corporations have begun to plan toward achieving net-zero in operations and their supply chains. The Climate Pledge has been accepted by 201 leading firms from 26 industries and 21 countries as of September 2021. These corporations are dedicated to achieving net-zero carbon emissions in their global operations and reaching the Paris Agreement ten years ahead of schedule. Albitar *et al.* (2022) also underline the importance of responsible business, where technical innovation within enterprises can lead to green solutions and contribute to carbon neutrality. They proved that environmental innovation in enterprises reduces carbon emissions, particularly in firms with more excellent environmental governance.

Companies have shifted to a more climate-friendly development strategy out of corporate social responsibility (CSR) in the current social environment. And carbon neutrality is one of the most notable commitments made by companies under its climate friendly strategy. In other words, a carbon-neutral promise remarkably demonstrates a company's eco-friendly tendency. A responsible company introduces this concept into its business model and implements it to fulfill its long-term carbon neutrality and eco-friendly commitment.

This chapter explores how companies respond to the call for climate-friendly and carbon-neutral operations. Companies may have a variety of motivations for committing to carbon neutrality and face significant challenges in making this transition. By examining the drivers and barriers of this transformation, we present a seven-step framework at the end of this chapter to provide a comprehensive and practical guide for companies seeking to undertake an eco-

friendly and sustainable business model transformation.

2.1 Motivations and the path to carbon neutrality

After understanding the importance of companies pursuing carbon neutrality, de Sousa Jabbour *et al.* (2019) summarized four major theories when discussing barriers and motivators for one company's carbon reduction processes, including resource-based view (RBV) and the stakeholders, institutional, and ecological modernization theory. Following their research, we will discuss this motivation and barriers to a firm's carbon reduction discussion later in this chapter. Among these four theories, stakeholder theory is mostly mentioned and applied.

Boiral, Henri and Talbot (2012) stated that compared with economic motivations, companies' carbon management commitment is driven mainly by environmental and social concerns and pressure from stakeholders. Böttcher and Müller (2015) also indicated that stakeholder pressure strongly impacts the deployment of low-carbon operational techniques, especially in manufacturing industries. Zhang *et al.* (2022) use stakeholder and institutional theories to explain how these two theories drive one company's carbon related decisions. Similarly, Albitar *et al.* (2022) use a resource-based view to prove that carbon-neutral companies have a more competitive advantage and that stakeholders will play an increasingly significant role in driving firms toward this goal. Chithambo *et al.* (2020) discovered that stakeholder pressure like regulatory, imitative, and shareholder pressure effectively enhanced the disclosure of GHG information. And thus, positively affect companies' carbon reduction result.

As for the path for one company to achieve its carbon neutrality goal, several papers have different emphases. The goal can be achieved from different approaches, including green technology innovation, improvement in production and supply chain, and optimizing internal corporate operations.

Zameer *et al.* (2021) suggest that the way for companies to achieve carbon neutrality, green process innovation is one crucial role. They proved that green process innovation would significantly enhance one company's environmental performance, thus contributing to the long-term carbon neutrality goal of the region. And finally, they suggested that enterprises in the country should enhance their green process innovation and environmental orientation to meet carbon neutrality standards and environmental restrictions.

Wanke *et al.* (2021) indicate that the employment of low-carbon operations management strategies has been perceived in a number of ways by businesses. In general, businesses are more interested in investing in low-carbon logistics. However, low-carbon manufacturing techniques and products are typically neglected in this setting.

Bauer, Hansen and Nilsson (2022) propose five prototype pathways for carbon reduction for manufacturing and heavy industry. Which are diversification of bio-feedstock use and circular material flows, production and end-use optimization, carbon capture and storage (CCS), and Carbon capture and utilization (CCU).

Melville, Saldanha and Rush (2017) approach this topic from a completely different angle. They discovered that the systems used within the organization could affect its environmental performance. Due to accuracy and completeness, firms using specialized systems and software networks have better performance in carbon reduction than firms using spreadsheets. Second, management incentives are also positively correlated with emission reduction targets. In their conclusion, building a more efficient internal organization system and implementing management incentives are also important ways for companies to achieve carbon neutrality goals. However, for most companies, reducing carbon emissions alone is not enough to achieve

carbon neutrality. To offset their excess emissions and become carbon neutral, companies that surpass their limits could acquire carbon credits under the emissions trading scheme. (Velvizhi *et al.*, 2023) The detail of the path for companies to become carbon-neutral will be discussed later.

2.2 Climate friendly and corporate performance

There is not as much academic research on how corporate carbon neutrality commitments affect corporate performance. Therefore, we look for related research on carbon reduction and other corporate climate friendly related efforts over the year, to see how these efforts affect corporate performance. Most studies suggest that corporate climate-friendly strategies can boost corporate performance in certain instances, while a few studies indicate the opposite or do not observe a direct effect.

In Böttcher and Müller's (2013) study of German automotive suppliers, no indication of a direct link between low-carbon operations and economic performance was discovered. Contrary to their conclusion, Boiral, Henri and Talbot (2012) demonstrate that corporate GHG emission reduction commitment positively improves financial performance. Despite observing a substantial economic gain from carbon reduction commitments, the authors of the study showed that economic reasons have no positive effect on company GHG emission reduction commitments. Their finding shows that environmental and social concerns and pressure from numerous stakeholders are the primary drivers of this commitment.

Chakrabarty and Wang (2013) also found a positive effect on corporate climate-friendly efforts in their study of multinational corporations. They found out efforts by multinational corporations (MNC) on climate-friendly commitments help in getting product leadership and improve sales efficiency. In addition, they discovered that the effect of these efforts on return on equity was favorable but not statistically significant. In other words, the climate friendly initiatives may not considerably boost MNCs' return on equity, but they do not cause financial loss either. In general, they suggest climate-friendly efforts can directly benefit multinational corporations by bringing them a competitive advantage if the market signals and organizational learning can be effectively harnessed.

Lewandowski (2017) has the same conclusion regarding sales efficiency. However, he also notes that carbon reduction measures negatively affect the company's stock performance. He found that emission reduction measures can effectively improve sales efficiency. His findings also indicate that, for businesses with significant carbon reduction outcomes, the financial return from the reduction approach exceeds its cost, indicating that it is worthwhile. The result is adverse for businesses with poor carbon performance. It is also important to note that companies' climate-friendly improvements do not improve their stock market performance. Better carbon performance, on the other hand, is neither favored nor even punished by investors. van Emous, Krušinskas and Westerman (2021) made an empirical analysis of more than 9,000 companies. They confirmed that reducing carbon emissions does not harm a company's performance but increases its short-term profitability, as evidenced by an increase in ROA, ROE, and ROS. Like Lewandowski, they also demonstrate that companies with superior ESG scores and emissions reduction performance are more likely to see their ROA increase due to emissions reductions. But contrary to the Lewandowski's study, they indicate the reduction of emissions

does not significantly affect the company's stock market performance or liquidity.

Li *et al.* (2021) observed the positive effects of environmentally friendly strategies among Chinese manufacturers. Specifically, innovation in low-carbon technologies can significantly boost the performance of a business. They believe this innovative behavior is not costly because they can receive government subsidies and tax deductions. The advantages of this type of innovation are evident; it effectively enhances the company's green core competitive advantage, thereby enhancing corporate performance.

Deng *et al.* (2022) also demonstrated the positive effects of carbon-neutral measures but with strict government regulation and environmental inspections. They believe strict government regulations can help mitigate the principal-agent problem within corporations and reduce agency expenses. Consequently, encourage green innovation and improve corporate profitability by decreasing agency expenses.

In conclusion, corporate climate-friendly measures, such as emission reduction measures and low-carbon innovations, can improve sales efficiency and short-term corporate profitability, but different industries and regions influence these effects. Typically climate-friendly actions incur additional expenses. However, these actions will not harm the company's overall performance considering increased profits, government subsidies, and tax breaks. However, managers must consider the impact of the push for environmentally friendly measures on the stock market, as some investors may react negatively.

2.3 What are the drivers for companies involving in climate friendly and carbon neutrality transformation?

CSR and Triple Bottom Line

Business activities impact the economy, society and the environment, and more specifically, it affects people's lives. (Azapagic, 2003) While business growth drives economic growth, this economic growth may not bring about the same increased social welfare and happiness for most people. The reason is that the serious environmental problems behind this growth cannot be properly resolved. More specifically, economic growth increases production and consumption while depleting natural resources, creating pollution and waste in the process. This leads to the inevitable negative social and environmental impacts of economic growth without intervention. Therefore, it is essential for companies that boost economic development to acknowledge these effects and turn them into the accountability they should assume to function in a more environmentally responsible manner. This responsibility is called Corporate social responsibility. (Majerník, Naščáková, *et al.*, 2021)

Corporate social responsibility (CSR) entails a company's awareness of the effects of its actions on all aspects of the world, including society, the economy and the environment. Out of this sense of responsibility, the company undertakes these social responsibilities. And this company action is usually considered a voluntary corporate act. It is defined as “voluntary integration of social and environmental aspects into day-to-day business operations and interactions with corporate stakeholders (individuals, groups)” in the Green Paper published by the European Union in 2001.

Under European legislation, CSR is clearly explained in the standard EN ISO 26000:2010 Guidance on Social Responsibility. According to this particular standard, EN ISO 26000:2010,

the concept of corporate social responsibility (CSR) is defined as the duty of a company for the influence of its actions and activities on both society and the environment, as well as concurrently ethical and fair behavior that promotes sustainable development, along with the well-being and health of society. (Majerník, Naščáková, *et al.*, 2021)

In corporate governance, however, short-termism surpasses sustainability, particularly environmental sustainability. This prevents companies from being proactive and taking responsibility for climate change. Mainstream corporations prioritize the short-term financial interests of shareholders over responsibility for the environment on which we all rely, as dictated by the shareholder primacy theory. Only if the majority of shareholders believe that an environmentally friendly sustainable strategy can create shareholder value will a company consider pursuing a climate-friendly strategy. As a result, while CSR was initially defined as a voluntary act, the EU implemented mandatory non-financial reporting obligations in 2014. CSR is no longer considered a purely voluntary matter for companies. Large corporations must report on their environmental, social, and human rights policies and implement due diligence procedures to better fulfill their corporate social responsibilities. (Hösli and Weber, 2022)

CSR requires businesses to abandon short-termism and exploitative strategies in their strategy formulation to achieve long-term sustainable development. This requires enterprises to measure their development and success not only based on short-term economic returns but consider long-term sustainability. From the perspective of sustainability, companies are not only concerned with the monetary bottom line but also taking into account the ecological, economic, and social impacts of the business and public life, also known as the triple bottom line. (Glauner, 2016)

CSR drives companies to incorporate socio-environmental and economic considerations into their values, decision-making and strategic direction more transparently and responsibly. (Dathe *et al.*, 2022) Although this push is not entirely voluntary. With the public and society paying more attention to environmental issues, enterprises will face more negative consequences if they fail to fulfill their corporate social responsibilities, particularly environmental responsibilities. In other words, a corporation with good CSR could increase its financial performance and this could in turn drives corporate to develop a more climate friendly strategy.

Stakeholder pressure

Multiple environmental and sustainability studies have employed stakeholder theory. (Zhang *et al.*, 2022) As discussed in the previous chapters, stakeholder theory is one of the most used theories to explain the motivation or the driver for one company's carbon neutrality climate friendly strategy. Stakeholder theory is a descriptive, normative, and instrumental theory. It is the result of communicating the obligations of people who create value through trade to those groups and individuals whose benefits are affected by those actions. Each of these affected parties is a stakeholder under this theory. Stakeholder theory explains first how each stakeholder is affected by managers' decisions and company actions, then how these stakeholder groups' interests should be aligned, and finally how to maximize each stakeholder's value in optimizing operations. (Sacconi, 2011)

The term "stakeholder" refers to a group of individuals or organizations that are affected by corporate and voluntarily accept the benefits from corporate. Therefore, the scope of stakeholders is not only within the organization but also refers to individuals or organizations outside the company. This includes employees, shareholders, customers, financiers, local

communities, and other derivative or potentially affected parties. Stakeholders expect that organizations will carry out their operations with responsibility for the effects those operations have and will make an effort to improve the stakeholders' well-being. (Phillips, 2003)

The organization will, in turn, benefit from the outcomes of the efforts made by the organization to improve the welfare of its stakeholders. Sacconi (2011) believes that optimization based on stakeholder theory will result in organizations conducting business with suppliers who wish to improve, have engaged employees, and be good community members, all of which are likely to align with the company's long-term and possibly short-term goals. Management under stakeholder theory is considered to be an excellent way to maximize earnings.

Because corporations cause external consequences inside the ecosystems in which they operate. According to the stakeholder theory, consequently, they need to manage the expectations of those parties who are directly affected by their decisions and activities. This is due to such stakeholders having a tendency to exert pressure on corporations. (de Sousa Jabbour *et al.*, 2019) According to Böttcher and Müller (2015), authorities, financial institutions, investors, insurance, customers, the public media, the general public, non-governmental organizations, suppliers, business groups, and competitors are the main parties of stakeholders when discuss about climate change and carbon reductions. The demand from these stakeholders provokes a sense of immediacy and pressure for businesses to go beyond improving carbon transparency and embrace more climate friendly initiatives, including carbon reduction and carbon neutrality. (Zhang *et al.*, 2022)

This stakeholder pressure can include the pressure exerted by the government in the form of regulation, the request made by institutional investors, or the expectations of society. For instance, the government established a cap on carbon emissions; institutional investors require the disclosure of carbon emissions, including those related to products and processes, as well as a transparent strategy for addressing carbon emissions; and the general public is becoming more worried about climate change and is pressing businesses to take action. (Böttcher and Müller, 2015) To deal with these pressures from stakeholders, corporates utilize carbon mitigation strategies to confront risks and opportunities generated from climate change, particularly when the pressure is perceived to have a significant degree of influence on the corporation. (Zhang *et al.*, 2022)

To conclude, stakeholders are conscious of the impact that business operations have on the surrounding environment, and they have expectations that companies should meet with their satisfaction by enhancing the environmental performance of their operations. And as a result of this pressure, companies have been motivated to develop carbon-neutral strategies and implement climate-friendly policies to satisfy stakeholders' interests.

Institutional Pressure

Institutional Pressure comes from institutional stakeholders, and the theoretical approach to explain how this pressure drives corporate action is institutional theory. According to institutional theory, the mere fact that a corporation is part of a larger organizational structure that exists outside the corporation itself has the potential to cause it to be subject to various forms of social pressure. These pressures are called institutional pressure. This pressure may result in alterations to management and production processes in order to justify their activities, conform to the legislation, or mimic the competition. (de Sousa Jabbour *et al.*, 2019)

Stakeholders who exert institutional pressure on companies in the environmental field can include governments, regulators, industry associations, consumers and competitors, etc.

(Delmas and Toffel, 2004). Based on these different sources of pressure, institutional pressures can be categorized into three types: coercive pressure, mimetic pressure, and normative pressure. (Latif *et al.*, 2020)

External stakeholders, for example, government authorities and a major client, impose coercive pressure on a business. This pressure forces companies to conform to various rigid environmental requirements and guidelines. In regions with more comprehensive environmental laws, for instance, environmental regulators exert pressure on companies within their jurisdictions, requiring them to comply with environmental protection laws and formulate effective emission reduction strategies. Under such pressure, large upstream companies within the supply chain will exert the same pressure on downstream suppliers and may urge suppliers through mandatory terms. Therefore, under coercive pressure, companies will have to adopt strategies to reduce carbon emissions. And being more proactive in the face of such coercive pressures can give companies a chance to gain a competitive advantage, for they may proactively seek out new business prospects. For example, if a company is sharply aware of the growing concern of all parties in society for the concept of carbon neutrality and recognizes the commitment to carbon neutrality as a means of enhancing the company's social reputation, the company will be in a position to improve its social reputation. Companies in the pioneer are more likely to attract new environmentally conscious consumers and be the first to enter new markets. (Zhang *et al.*, 2022)

Normative pressures also come from outside the firm, such as professional associations, academic institutions, the media and other social actors. It represents values widely accepted by society and regulates what a company should do to be considered normal. For example, at present, it is considered normal for companies to show concern and active support for environmental protection. On the contrary, if the company ignores the general call for environmental protection, does not make a climate-friendly statement, does not respond to consumers' opinions, and still carries out the original corporate behavior without climate-friendly transformation, these behaviors may be detrimental to the company's reputation and lead to competitiveness weakens. Therefore, normative pressure can prompt companies to devote serious response to fields related to environmental protection and formulate carbon-neutral strategies to control public sentiment and in response to social expectations. Generally, normative pressure drives the company to do what is considered correct in the current social environment instead of going against it. (Zhang *et al.*, 2022)

In competition, it is essential for companies to observe and respond to the actions of their rivals. A prompt and accurate response will provide the company with a greater competitive advantage, resulting in improved performance. When companies observe the actions of industry competitors, they can choose to imitate in order to prevent the pioneer from gaining further competitive advantages. In the context of intensifying social discussions on the environment and carbon neutrality, companies are increasingly concerned that the industry's slow response to new initiatives will allow competitors to enter new markets. When facing emerging sustainability uncertainty, a company may join the sustainability path by imitating the behavior of its peers if it finds that many of its peers are making similar transformations. For downstream companies of the supply chain, if an industry is in the process of carbon neutral transformation, downstream companies may be forced to join the effort of climate friendliness and carbon neutrality. Because the company's clients compare its carbon performance to that of its competitors, and it wishes to maintain a competitive position in the supply chain. Similarly, for those first movers who have already made the carbon neutral commitments, imitation from their

peers has prompted them to make more creative and substantive climate-friendly measures to maintain their competitive advantage. (Zhang *et al.*, 2022)

Economic benefit

The economic benefit is not considered the primary driver of one company's carbon neutrality decision. As we have discussed in the previous sector about how carbon neutrality affects corporate performance, various research has proved that normally carbon neutrality can bring long-term economic benefits. But meanwhile, it can be costly and will be a burden in the short term for one company first enter into the carbon neutrality area. But the economic benefit can be a driving factor for a company's carbon neutrality policy if the company evaluates the carbon neutrality strategy and finds that such a strategy is profitable.

The economic benefit of climate friendly action comes from a different source. Firstly, carbon reduction and sustainable development in the production stage can improve resource utilization efficiency and decrease carbon reduction. This could be beneficial for optimizing process and thus in turn result in cost reduction. For instance, one commonly used strategy for the company to improve energy efficiency is to seek new clean energy to replace fossil energy. When alternative energy sources are accessible and at an affordable price, it is considered to be a feasible strategy. At the same time, technological innovation and productivity improvement that may be brought about in the process of improving energy efficiency are also among the motivating factors. (Boiral, Henri and Talbot, 2012)

Secondly, the economic benefit can be generated from satisfying customer environmental expectations. Some customers view the presence of a climate-friendly or carbon-neutral certification on a product as one of the most crucial elements in selecting which brand to purchase. By making climate-friendly commitments and gaining carbon-neutral certification, companies gain a solid business reputation and achieve positive consumer perceptions and goodwill. More importantly, if one company takes action as a pioneer, it would have the possibility to gain a head start on new consumer segments and foster loyalty. This would greatly improve the competitive advantage and stand out in the fierce competition.

The authority of some countries and regions will also provide certain economic incentives in this process. Typically, authorities use subsidies and tax breaks to motivate companies and make them less worried about cost. Other potential economic benefits may include companies trading excess carbon emission permits for income after meeting their own emission reduction targets. Alternatively, if the company's target consumer group is willing to pay more for climate friendliness, this will also bring additional profits. (Becker, Bouzdine-Chameeva and Jaegler, 2020)

In general, companies can improve their competitiveness, develop new products, and expand into new consumer markets if they make commitments to lessen their environmental impact and work toward achieving carbon neutrality. Jointly, in this process, some nations and regions offer companies financial incentives like tax breaks and subsidies to encourage them to operate more environmentally and lighten the load of the costs associated with becoming carbon neutral. Carbon neutral strategies are economically attractive for companies in the long-term when the economic benefits of environmental practices can compensate, to some extent, for the initial investment.

2.4 The barriers and obstacles

After understanding the driver and motivation for corporate carbon neutral operation, it is also important to determine what could be the barriers and obstacles in this context. A corporation is not able to develop a suitable and feasible climate friendly strategy without having a clear knowledge and understanding of the obstacles it would confront in advance. And having a comprehensive level of understanding can also help a corporation make the right decision to take certain actions in practice. Obstacles may appear before the decision-making or during the strategy implementation process. Followed by commonly used classification of business barriers (de Sousa Jabbour *et al.*, 2019; Bataille, C. 2020; *Collection of possible decarbonization barriers*, 2021), we will identify the barriers for the company to develop a carbon neutrality strategy and implement climate friendly practices from the following four aspects: economy barrier, regulatory or societal barrier, governance barrier, and technical barrier.

Economy barrier

Although we identify economic benefits as non-primary motivation in 2.2, the economy barrier, however, can be influential when a corporation assesses its carbon neutrality strategy. A report published on the European Steel Technology Platform makes a rank on 20 barriers that stakeholders are concerned with most when considering climate friendly actions. Among the top 20 barriers, top 5 are all economy-related barriers, including increased expenditure, lack of funding and unknown profitability. (*Collection of possible decarbonization barriers*, 2021) The concern of major financial barriers like increased operating expenses and capital expenditure is understandable. Increased operating expense, for instance, can be generated from seeking substitute green energy and raw materials, environmental management training, the fees related to carbon performance disclosure and auditing, the cost of carbon capture and utilization/storage (CCUS), the price of buying carbon credit and possibly the R&D cost if it requires carbon reduction innovation. And the green upgrade of machines, vehicles, and green buildings can inevitably increase capital expenditures. As a result, shareholders' concerns about the additional expense of adopting this plan and the unpredictability of future profitability have a negative impact on the company's initial discussion and formulation of a carbon neutral strategy. And the lack of additional financing will hinder the deployment of environmentally friendly practices. The unknown market condition causes uncertainty of future profitability and raises financial risk.

Regulatory or societal barrier

External framework conditions, rules, policies, and societal acceptability may provide challenges to the carbon reduction progress or the deployment of decarbonization technology, and these challenges are referred to as regulatory or socio-ecological barriers. (*Collection of possible decarbonization barriers*, 2021)

Companies may confront a lack of policy guidance and sector-specific restrictions in regions with lower environmental standards. In addition, businesses may be cautious about implementing carbon-neutral practices due to the ambiguity around the carbon neutrality certification. And differences between domestic and international environmental policy increase the risk for a multinational corporation to involve in carbon neutral progress. Moreover, one of its most essential techniques for power generation and industrial facilities in the carbon neutrality process is carbon capture and storage (CCS). However, this can be hindered by certain

regulatory issues if the company decides to implement it. To begin the CCS process, CO₂ is extracted from the gas stream, then compressed, transported, and eventually stored at a suitable location with an appropriate facility. CO₂ extraction and transportation do not have a technical barrier, but finding an acceptable storage location can be problematic. The facility and location of CO₂ storage is not random. It needs to be identified enough capacity for CO₂ injection and minimize the leakage risk of the stored gas. Although authorities encourage companies with high GHG emissions to actively involve in the CCS process, the concerns for potential leakage risk and the serious consequences of leakage lead to unfavorable attitudes for local authorities of storing CO₂ in their jurisdictions. In Europe, Austria, Croatia, Estonia, Latvia and Slovenia current legislative restrictions do not allow CO₂ storage in their region. Similarly, Societal concerns about the possible environmental risk of CCS practices reduce public acceptance to this progress and raise the societal barrier. (*Collection of possible decarbonization barriers*, 2021)

Governance barrier

The degree to which the board of directors acknowledges the relevance of low-carbon initiatives has a great impact on the strategic deployment of the organization. The ability of the management team to sustainable management and the availability of qualified staff determines whether one company can carry out its climate neutral strategy successfully. Ensuring the strategy's successful and effective implementation requires a dedicated sustainable management team and providing employees with sustainable environmental training. It is important to have an eligible sustainable management team to develop a realistic goal and an appropriate plan that are suitable to the company's condition, possible to accomplish and not conflict with the current operation. In addition, companies are required to have adequate risk management capabilities to accomplish the transformation of more environmentally friendly practices without disrupting current operations.

Technical barrier

The technical barrier exists in developing green technology innovation and in practice. The company faces the difficulty of inventing its own innovative carbon reduction technology due to a lack of data and access or the complexity of the technology blocking the innovation process. One company can also face the restriction in the use of related carbon reduction technology for the limitation of intellectual property right and the technical blockade from peers. Moreover, integrating new technologies into existing operations can be problematic. It can be challenging for companies to improve process efficiency while also coordinating the supply chain of new materials and making realistic plans to incorporate new equipment into the current factory production line. (de Sousa Jabbour *et al.*, 2019; *Collection of possible decarbonization barriers*, 2021)

2.5 The climate friendly business model transformation – A seven-steps framework on the transformation to climate friendly and carbon neutrality

As we discussed above, firms are increasingly concentrating on operating in a more environmentally sustainable and climate-friendly way, considering the current market

environment and various pressures and motivations. Next, we will discuss how to put the concept of environmentally sustainable development into practice. Followed by (Sommer, 2012; Szekely and Dossa, 2017; Johnson, 2018). In order to provide a systematic approach to this topic, we will apply the framework of business model transformation to have a comprehensive knowledge of how one company realizes its climate friendly and carbon neutrality idea. An organization may not be able to effectively contribute to climate friendliness or fully realize the development potential brought about by environmental sustainability and carbon neutrality if it only takes one or two environmental measures rather than a comprehensive and systematic transformation. (Sommer, 2012)

What is business model?

To start with the discussion on business model transformation framework, we need to firstly understand what business model is. A business model is a blueprint that demonstrates a company's value proposition. It describes how a company “creates, delivers, and captures value”. (Osterwalder, Pigneur and Clark, 2010) For the origins of business model, (DaSilva and Trkman, 2014) did a clear review, they specify in 1957, a paper studying the building of business games for the purpose of explaining the complexities of constructing business models first used the word "business model" in an academic context.

Until the 1990s, however, the phrase business model was not commonly used in scholarly publications. The real rise of this concept came after 1990s, with the expansion of electronics and communication technology, the rise of Internet enterprises, and the emergence of e-commerce, the word "business model" quickly became the topic of widespread discussion. This tendency occurs not only in academic publications but also in other fields, including finance, management, and marketing. During this period, the stock prices of technology-related companies soared, and the old, real economy era seemed to be being replaced by the new economy. The valuations of some Internet companies during this period soared disproportionately to their earnings. An example is the merger of AOL and Time Warner in 2000. As an Internet service provider, AOL's profits are only a quarter of Time Warner's, and its valuation is amazingly twice that of Time Warner. The reason for this phenomenon is that investors have strong confidence that these companies will achieve amazing growth and profits in the future through the innovative and disruptive business models demonstrated by these Internet companies. Despite the fact that the company's current profitability and financial status are not ideal, investors have strong confidence that these companies will achieve these outcomes. (Sommer, 2012) Two representative examples are Pets.com and Kozmo.com. These two companies have attracted a lot of investment at a time when their finances are not doing well. Pets attracted \$300 million in less than two years, while Kozmo raised \$280 million in two and a half years before the bankruptcy. (DaSilva and Trkman, 2014)

It was not just these two companies. During this period, millions of investments were poured into flawed business models. Often the core of the flawed business models is untested, mere speculations about future conditions. Such a business model will inevitably expose companies to greater risks and uncertain outcomes. For example, Pets.com raised \$300 million. It misjudged its customers' sensitivity to price. After spending a huge amount of money on marketing, pets.com did gain huge brand awareness, and the public became aware of this company that sells pet supplies online. However, only a small number of pet owners are willing to order online. Among them, the very price-sensitive users prefer to buy the same price or even cheaper in the local store instead of ordering online and waiting for days for delivery. As a result,

the share price of pets.com dropped from 11 USD per share to only 0.19 USD per share in a few months, and it went bankrupt. (DaSilva and Trkman, 2014)

The creation and widespread application of the concept of a business model contributed to the boom and bust of the Internet in the 1990s. On the one hand, a business model is an effective tool for demonstrating how a company can change an entire market by introducing an entirely new business model. On the other hand, the ambiguous interpretation and incorrect application of the concept, along with the incredible hype effect of the period, led to many failures. This history offers vital insights for applying sustainable business concepts that are as appealing as today's Internet notion. The proper deployment of business models increases the sustainability and competitiveness of businesses. Discovering the actual white space in sustainable development, seizing development chances, and avoiding traps are feasible for corporations through the correct formation and innovation of their business model. (Sommer, 2012)

In 2010, Osterwalder, Pigneur and Clark (2010) proposed a framework for companies to consider and describe their business model blueprint easily. They integrate this framework into a common language and use nine building blocks covering the offer, consumers, infrastructure, and financial feasibility to describe the business model comprehensively and comprehensively. Furthermore, as shown in Figure 2.1, they designed a canvas to demonstrate these blocks that are now wildly used and accepted by academics and businesses. In the process of identifying these nine blocks, the organization makes a clear view of first identifying its target customers and deciding what and how to offer its products or service to those customers. And then, it defines what kind of relationship to establish with the customer and how to maintain it. After that, assess the revenue generated through the previous steps and identify the key resources used, key activities performed, and key partnerships acquired during this progress. At last, assess the cost associated with these activities. Following this systematic approach of demonstrating one corporate business model prevent the failure caused by ambiguity and unclear vision of the future operation.

Business Model Canvas

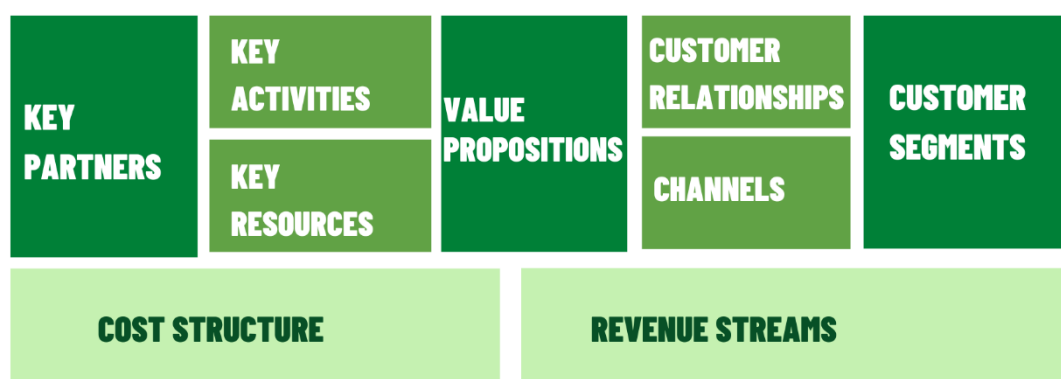


Figure 2.1 business model canvas based on Osterwalder, Pigneur and Clark (2010)

A company's business model is not permanent. In order to face the dynamic market and business environment, companies should make prompt adaptations and transformation to maintain a competitive position. Back in 1990, the most popular trend was the concept of the internet, as we discussed above, and now the most concerning concept is sustainability.

Until today, society and the general public are greatly concerned about environmental

sustainability. This trend toward a sustainable and green economy has impacted business significantly, and investors and corporations made responses actively. From this perspective, carbon-neutral and climate-friendly business strategies strengthen a company's social reputation and competitiveness. (Sommer, 2012) In other words, transforming into a climate-friendly and carbon neutral business model is an excellent way for companies to respond to the call for environmental sustainability. When companies address environmental issues, a single initiative may not lead to better, convincing environmental performance. It is necessary for businesses to transition into a sustainable business model in order to make real contributions to climate sustainability when traditional strategy and framework can no longer take a company to climate neutrality. This transformation is not an immediate achievement but rather a framework implemented progressively and systematically in response to dynamic challenges and opportunities. The ultimate output will be the formation of a feasible and sustainable business model that minimizes environmental damage and maximizes environmental well-being. (Szekely and Dossa, 2017)

2.6 How to transform into a climate neutral business model?

Our framework of discussing the climate friendly and carbon neutral business model in figure 2.2 is followed by the book of Szekely and Dossa (2017). This new business model framework is an adjustment of Osterwalder's business model, as we showed above in sustainable areas. Furthermore, we will introduce each step in detail below. This seven-step framework can instruct corporate businesses model transformation or assess one corporate

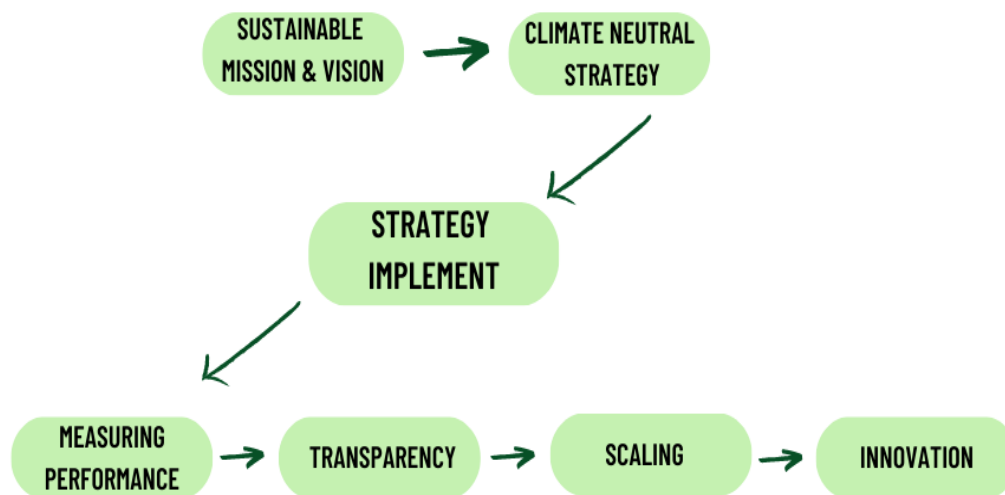


Figure 2.2 Climate neutral business model framework based on Szekely and Dossa (2017) transformation process

- Step 1 Sustainable mission and vision

Vision

Although the words vision and mission often appear together, they represent two different concepts. Vision is the ideal forecast of the future development of the enterprise.

Vision is a goal state that describes what the company will develop into in the ideal state and what kind of goals it is likely to achieve over the following ten years, 20 years, or even longer time span. Typically, the company vision is put forward by the founder, and the founder of the company with vision may often lead the company towards a long-term stable and successful development. (Constantin BRĂȚIANU, 2018)

A company's vision is normally very concise, usually one or two sentences. And vision can be very ideal compared to real-life constraints. For example, LinkedIn's vision is "Create economic opportunity for every member of the global workforce."

Also, the company's vision is not fixed at all times. It can be proposed at the very beginning of the organization establishment and adapting along with the huge shift in environment, organization culture, technology, and market. For example, Microsoft's original vision is "put a computer on every desk and in every home", and it was changed to "Empower every person and every organization on the planet to achieve more."

Or when the old vision has been successfully achieved, the company would propose a new vision to lead the development continuously. A vision statement enlightens the development of the company by influencing and guide within the organization and gaining a competitive advantage. Vision is also considered to be a primary way of showing corporate ethical value by adding the social responsibility one company would take into its vision. (Bowen, 2018)

The traditional strategic management approach aims to the optimization of financial performance and shareholder value through the analysis of internal and external factors, such as industry competition, market trends, and resource allocation. This approach primarily considers the economic bottom line and aims to increase efficiency and profitability. However, today's companies have begun to focus more on social strategy activities and social responsibilities. These considerations are increasingly factored into mission statements, which now frequently incorporate social and environmental considerations. Current mission and vision statements contain green and sustainability as a primary emphasis, reflecting the growing importance of environmental concerns in the global business landscape. (Latif *et al.*, 2020)

Companies are recognizing that their actions have a direct impact on the society and environment, and they are increasingly taking steps to reduce their negative influence and increase their positive impact. This shift in focus is driven by a growing awareness of the urgent need to address climate change and other environmental challenges, as well as by changes in consumer and investor expectations. As a result, companies are increasingly showing their environmental and social considerations through their mission and vision statements. (Yozgat and Karataş, 2011)

To express commitment to the environment and assume responsibility, companies can modify their vision by incorporating environmental objectives into their core vision (see Table 2.1, leading companies that claim to have a sustainable vision and mission) or by creating a new vision for environmental sustainability.

In recent years, companies made commitments to achieving net zero carbon emissions as part of their environmental sustainability vision. This is becoming a popular strategy among companies looking to reduce their environmental impact and align with the global effort to combat climate change. For example, Xcel Energy Company states the vision as delivering 100% carbon-free electricity by 2050. Berkshire Hathaway Company hopes to achieve net zero emissions by 2050, which is affordable for their customers.

By setting a goal to reach net zero carbon, companies are taking a proactive approach to address their carbon footprint and work towards a more sustainable future. An illustration of this is Amazon's introduction of the "Shipment Zero" vision in 2019, which aims to achieve net zero carbon emissions for all their shipments, with half of all deliveries reaching this goal by 2030. Followed by this vision, Amazon has a proven track record of committing to sustainability through various programs like Frustration-Free packaging, a ship in its container, investments in renewable energy and circular economy, and daily initiatives by teams across the company.

They claim to have more than two hundred scientists, designers and engineers, who are exclusively focused on creating new options to use their scale for benefiting their consumers and the environment.

Mission

A vision statement indicates what one company wants to accomplish ultimately. While mission statement shows how they achieve their goals, and the phrase often starts with “To”. For example, Unilever make a mission statement as “to meet everyday needs for nutrition, hygiene and personal care with brands that help people look good, feel good and get more out of life.”

A mission is the pursuit of a unique objective that matches an organization's comparative competitive advantage, values, and offerings. The ideal mission statement is broad enough to motivate the pursuit of many corporate goals and objectives while still being particular enough to focus and prioritize activities and resources. In contrast to vision statements, mission statements typically consist of multiple phrases and try to address the question, "what is the goal of the organization?" They aid management in structuring the hierarchy of everyday and long-term priorities a firm faces. (Bowen, 2018)

The mission statement is also explained as a statement that defines the purpose and values of an organization. It outlines the company's goals, objectives, and strategies and serves as a guide for decision-making and resource allocation. A mission statement should be clear, concise, and easy to read and should be communicated to all stakeholders, including employees, customers, investors, and other stakeholders. (Williams, 2008) Similar to the vision statement we mentioned above, the mission statement regarding the environmentally sustainable area can be either adapted to one company’s original core mission or proposed as a new environmental mission. An environmental mission statement is a specific type of mission statement that focuses on the company's commitment to environmental sustainability. This type of statement is becoming increasingly important as companies recognize the impact of their operations on the environment and are taking steps to reduce their negative impact and increase their positive impact. The environmental mission statement outlines a company's commitment to reduce its environmental footprint, promote sustainable practices, and support the transformation towards a low-carbon economy.

The importance of an environmental mission statement is that it communicates the company's commitment to environmental sustainability to all stakeholders. It helps to align the company's goals and objectives with global efforts to deal with climate change and other environmental challenges. Additionally, it can be a powerful tool for building trust and loyalty among customers, investors, and employees, who are increasingly conscious of environmental issues.(Majerník, Malindžáková, *et al.*, 2021)

An environmental mission statement should be specific and measurable and set clear targets and goals for reducing the company's environmental impact. It should also be communicated to all stakeholders and should be integrated into the company's operations and decision-making processes.

To achieve an environmental mission statement, companies can take several steps, such as conducting an environmental audit to identify areas where they can reduce their impact, implementing sustainable practices in their operations, and setting targets and goals for reducing their environmental footprint. Companies should also involve all stakeholders when developing and implementing their environmental mission statement. This includes employees, customers, investors, and other stakeholders, who can provide valuable input and feedback on

the statement and help ensure that it aligns with the general goals and objectives of the firm. (Zhou, 2020)

In addition, Companies should communicate their environmental mission statement to all stakeholders, including employees, customers, investors, and other stakeholders, and make sure that it is integrated into the company's operations and decision-making processes. This can be done by involving employees in implementing sustainable practices, providing customers with information about the company's environmental performance, and reporting on the company's environmental performance to investors and other stakeholders. Finally, Companies should regularly review and update their environmental mission statement to ensure that it remains relevant and consistent with the company's goals and objectives and to reflect the changes in the environment and society. This will help ensure that the company continues to progress toward its environmental sustainability goals.

In conclusion, proposing an environmental mission and vision statement is the foundation of transforming a business model to be more environmentally sustainable. A clear and concise environmental mission statement communicates a corporate commitment to minimize its environmental impact and promote sustainable practices. A vision statement sets out a company's goals and objectives for the future and serves as a guide for decision-making and resource allocation. By involving all stakeholders in formulating and implementing the environmental mission and vision statement, companies can ensure that they are aligned with the company's overall goals and objectives and with global efforts to combat climate change. (Miao, 2021)The Table below shows examples of the company’s environmentally sustainable vision and mission statement.

COMPANY	VISION	MISSION
IKEA	Create a better everyday life for the many people	To improve the daily lives of as many people as possible by providing an extensive selection of well-designed, functional home furnishings at an affordable price for as many people as possible.
UNILEVER	Be the global leader in sustainable business.	To address daily needs for nutrition, hygiene, and personal care with goods that enable people look good, feel good, and enjoy life more.
GENERAL ELECTRIC	Become the world's most innovative, customer-centric and profitable growth company.	To create a new class of products, services, and software that will make energy greener and more efficient, healthcare more tailored and productive, and industries more robust and interconnected.
NESTLE	Become the world’s leading nutrition, health, and wellness company	To give consumers with the tastiest, most nutrient-dense options across a wide variety of food and beverage from morning to night.

Table 2.1 leading companies that claim to have a sustainable vision and mission

- Step 2 Environment sustainable and Climate neutral strategy

A company strategy is closely related to its vision and mission statement. As we discussed above, a mission is a statement that defines the purpose and values of an organization, outlining the

company's goals, objectives, and strategies. And a vision sets out a company's ideal goals and objectives for the future and serves as a guide for decision-making and resource allocation. A business strategy is the overall plan of an organization to achieve its goals and objectives, which should be aligned with its vision and mission. (Rothaermel, 2015)

In developing a business strategy, companies should start by defining their target market, identifying their unique value proposition, and determining the key resources and capabilities required to deliver and capture value. The company's target market and unique value proposition will shape its business model, while its key resources and capabilities will shape its business strategy. For example, suppose a company's mission is to reduce its environmental impact and promote sustainable practices. In that case, its business strategy may involve investing in renewable energy, implementing sustainable practices in its operations, and setting targets for reducing its carbon footprint. Its business model might involve developing eco-friendly products and services and marketing them to environmentally conscious consumers. (Johnson, 2018) In addition, Companies should also consider the feasibility of the strategy. The strategy should be practical and on the basis that future implementation will not harm the current operation and stakeholders.

The increasing pressure from stakeholders, including customers, investors, employees, and regulators, led to an increasing number of companies developing environmental sustainability strategies, as we discussed before. By incorporating environmental considerations into their business strategy and business model, companies can better align with these expectations and position themselves as leaders in sustainable business practices.

Furthermore, implementing a business strategy that is aligned with environmental sustainability may bring financial benefits to the company. Such as, reducing energy and resource consumption can lead to cost savings, and developing sustainable products and services can open up new markets and revenue streams. Additionally, by building a reputation as a socially and environmentally responsible company, companies can attract and retain consumers, employees, and investors who are progressively seeking to do business with corporations that share the same values. We detect and make a group of four types of strategy in terms of corporate climate action after considering several articles: green product, green logistics and supply chain, green organization and carbon neutral strategy. (Weinhofer and Hoffmann, 2010; Lee, 2012; Damert and Baumgartner, 2018b; Kim, 2022).

Green product strategy

This strategy aims to design, develop, produce, and market environmentally friendly and sustainable products. Green product strategy can include using sustainable materials, reducing energy consumption during production, and designing products for recyclability or biodegradability. The expected impact of implementing this strategy is to help companies to increase their revenue by appealing to environmentally conscious consumers and creating new market opportunities.

Green logistics and supply chain strategy

It refers to the set of actions and initiatives that companies implement to lessen the influence on the environmental of their logistics and supply chain operations. This includes both the transportation of goods and supply chain management. A green logistics and supply chain strategy aims to minimize the negative environmental effect of all activities associated with the movement of goods, including sourcing, transportation, warehousing, and distribution.

Green organizational strategy

Green organizational strategy refers to the series of activities and initiatives companies implement to reduce the negative environmental impact and enhance their environmental performance within their organizational structure and operations. This strategy is intended to align the company's organizational structure, processes, and culture with its environmental sustainability goals and objectives. (Schaltegger and Tukker, 2008)

Carbon neutral strategy

What makes this strategy different from other strategies we introduced above is that it aims to reduce corporate carbon footprint and ultimately achieve net zero. Based on the research of Kim (2022), three generally applied strategic approaches in pursuing carbon neutrality are carbon compensation, carbon independence, and carbon reduction.

Carbon compensation is a way to offset or balance out greenhouse gas emissions by investing in projects or activities that remove or avoid the same amount of carbon from the atmosphere. This can involve reforestation, carbon capture and storage, and renewable energy initiatives. Organizations and individuals often use carbon compensation as a way to achieve carbon neutrality or climate neutrality by balancing out their emissions with the carbon removed or avoided by the offset project. (Kim, 2022)

Carbon reduction refers to the process of reducing the number of carbon emissions that an organization or individual produces. This may involve boosting energy efficiency and converting to renewable energy sources, among other measures. It is aimed at lowering the overall carbon footprint of an organization or individual. (Kim, 2022)

Carbon independence, also known as energy independence, refers to the state of not being dependent on fossil fuels for energy needs. It is typically achieved by increasing the use of renewable energy sources like solar, wind, and hydropower. Carbon independence can be achieved by an organization or individual or by a country or region. (Kim, 2022)

- Step 3 Strategy implementation

The implementation of climate neutral strategy should be a comprehensive process and start from goal setting. Clear, measurable, and attainable goals that connect with the corporate mission and vision and overall business strategy make a good start in implementing strategy. After making clear of the goal, it is time to develop a plan of action to achieve its goals. This should include specific actions and milestones, as well as a timeline for achieving them. The plan can also include a monitoring and reporting system to track progress and measure success. While the plan is in action, it is better to continue monitoring by tracking key performance indicators and reporting their progress to stakeholders, including employees, customers, and shareholders. And finally, adjustments to the action plan can be made to improve its effectiveness. (Rothaermel, 2015) After understanding the strategy implementation process, we would like to introduce the possible initiatives for one company to perform in each type of environmental strategy we have discussed in step 3 in detail. The following mentioned initiatives are detected from the ESG rating system in the Eikon database and are originally from the company's annual report publications.

Initiatives on green product strategy

Environmental Product Design	Includes designing products with a smaller environmental footprint, considering the whole life cycle of the product.
Sustainable Sourcing	selecting suppliers and materials based on their environmental performance and sourcing from sustainable and responsible suppliers
Green Manufacturing	Reduce energy consumption and waste in manufacturing processes
Eco-labeling or certifications	Obtaining certifications such as climate neutral certification by authoritative organizations that demonstrate a product's environmental performance.
Green Marketing	Promoting products as environmentally friendly and sustainable to appeal to environmentally conscious consumers.

Initiatives on green organizational strategy

Environmental management	Set up the dedicated environmental management team and provide environmental training
Employee engagement	Includes training and educating employees on environmental issues and encouraging them to participate in sustainability initiatives
Green procurement	Includes implementing policies and procedures for purchasing environmentally friendly products and services.
Internal resource efficiency	Implement measures to reduce energy and resource consumption within the organization.
Green building and facilities management	Design and maintain buildings and facilities in an environmentally friendly manner, such as using energy-efficient lighting and heating systems and implementing recycling programs.

Initiatives on green logistics and supply chain strategy

Transportation optimization:	Measures such as reducing the number of transportation trips, consolidating loads, and using more fuel-efficient vehicles.
Sustainable packaging	Use sustainable packaging materials, such as recycled or biodegradable materials, and design packaging that is easy to recycle or compost.
Green warehousing	Similar to green buildings, use energy-efficient lighting, heating and cooling systems, energy-efficient equipment, and recycling programs in warehouses.
Reverse logistics	To collect and recycle or reuse materials from returned products.
Supply chain management	Chose environmental and responsible suppliers. Keep monitoring the supply chain partner's environmental performance and terminate the partnership if they fail to meet the sustainable demand.

Initiatives on carbon neutral strategy

Internal carbon pricing	companies set a price for carbon emissions within their own operations to help guide business decisions and investment choices in a more sustainable direction
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Emissions Trading	Obtain carbon permits from ETS or invest in carbon offsetting projects.
Energy efficiency	Use less energy to perform the same task, so to reduce costs and greenhouse gas emissions.
Carbon offsetting	Invest in projects to reduce or remove an equivalent amount of carbon from the atmosphere that compensate for one's own GHG emissions
Carbon capture and storage	Use carbon capture, utilization, and storage (CCUS) technology to capture carbon dioxide from industrial processes and power plants before it is released into the atmosphere and then store it in a safe and secure way.

Table 2.2 The initiatives of each type of strategy

When making and implementing environmental strategies, companies should realize this process is not a one-time effort. It needs to be fully examined in advance to determine what initiatives one would take and make an appropriate action plan to perform step by step. This requires companies to fully understand potential barriers and challenges that may arise in implementing an environmentally sustainable strategy. These may include a lack of understanding and awareness, resistance to change, lack of resources, or lack of proper infrastructure. To overcome these barriers, companies should provide training and education to employees, involve all stakeholders in the process, and allocate the necessary resources to ensure the success of the strategy.

In conclusion, implementing an environmentally sustainable strategy is a critical step for companies to transform their business model and contribute to reducing their environmental impact and promoting sustainable practices. It requires clear goals, a comprehensive plan of action, commitment, and dedication from all levels of the organization, and the participation and engagement of all stakeholders. It also requires a continuous effort to monitor and improve the strategy and to overcome any barriers or challenges that may arise. By implementing an environmentally sustainable strategy, companies can create a competitive advantage, align with global efforts to combat climate change, and bring significant business benefits.

- Step 4 measure performance: introduce a commonly used framework for determining one company's climate performance.

Measuring the environmental sustainability performance after implementing strategies and initiatives is a crucial step in assessing the effectiveness of the company's efforts and identifying areas for improvement during the business model transformation.

By measuring environmental performance, companies can track their progress toward achieving their sustainability goals and identify areas where they are making progress or needing improvement. This allows companies to adjust their strategies as needed and to ensure that they are on track to meet their goals. Secondly, it helps to identify areas for improvement where they are not performing as well as they could be. So, they may concentrate their efforts where they will have the greatest impact on lowering their environmental footprint. Many countries and regions have laws and regulations requiring companies to measure and report their environmental performance. With a standard measurement process in place, companies can ensure that they meet these requirements and avoid penalties or fines. Also, measuring and reporting is a method for enhancing a company's reputation and increase engagement with stakeholders. Companies that demonstrate a commitment to environmental sustainability and

show progress toward achieving their goals are often viewed more favorably by customers, employees, and investors.(Putri, Budianto and Esa, 2020)

In addition, the measurement process provides companies with data on their environmental impact and achievement. This in turn allows them to make better-informed decisions, for example, the decision on where to invest resources, how to prioritize initiatives, or how to identify opportunities for improvement.

There are several methods and tools that companies can apply to measure their environmental sustainability performance, including:

Environmental performance indicators (EPIs): These are specific, measurable, and verifiable metrics that are used to track a company's environmental performance over time. Examples of EPIs include energy consumption, water consumption, and waste generation. These indicators can be used for corporations to track their progress and measure their performance over time. (Kumar, Giridhar and Sadarangani, 2019)

Environmental management systems: A Framework that companies can use to manage and improve their environmental performance. These systems typically include a set of processes and procedures for identifying, measuring, and monitoring environmental impacts and setting goals and targets for improvement. Companies can use these systems to track their performance and identify areas for improvement. (Ikram *et al.*, 2019)

External rating and certification for climate related initiatives are a way for companies to showcase their commitment to sustainability and demonstrate their progress in reducing their carbon footprint. These ratings and certifications are typically provided by third-party organizations and are based on a company's performance in energy efficiency, renewable energy, and greenhouse gas emissions. Some authoritative certifications include The Carbon Trust Standard, the LEED certification, The Global Reporting Initiative (GRI) Standards, Forest Stewardship Council (FSC), and Marine Stewardship Council (MSC), which allows corporations to show their environmental performance to stakeholders. (Ehlers and Packer, 2017; Ozcan, 2017)

Life Cycle Assessment (LCA) is a process for evaluating a product's or service's environmental impact throughout its whole life cycle, starting from raw material sourcing to disposal or recycling. (*Life Cycle Assessment | EcoAct*) This allows for a comprehensive and accurate assessment of a product's environmental impact and can identify areas for improvement.(Roy *et al.*, 2009)

In conclusion, having an applicable measurement process in place is essential to the process of environmental sustainability strategy and further promotes the successful transformation of business models. It allows companies to track progress, identify areas for improvement, ensure compliance with regulations, improve reputation, increase stakeholder engagement, make better-informed decisions, and identify cost savings. Furthermore, regular measurement and reporting of environmental performance also allow companies to communicate their environmental efforts to stakeholders and to demonstrate their commitment to sustainability.

- Step 5 Transparency

Many companies are now publishing sustainability reports that provide information on their environmental, social, and economic performance. These reports typically include information on the company's environmental performance indicators, as well as information on its sustainability goals and initiatives. Companies can use these reports to communicate their

performance to stakeholders and to track their progress over time. (Herzig and Schaltegger, 2006)

Unlike mandatory financial reports, environmental reports like carbon disclosure are commonly voluntary. This raises the problem of “Greenwashing” problem. Greenwashing involves making incorrect or misleading statements about the positive impact a product or service has on the environment. This can involve misrepresenting a product's environmental benefits, making unproven claims, or employing confusing or deceptive wording. Greenwashing can be a major problem in the area of corporate climate neutral activities and performance, as companies may make claims about their environmental performance that are not backed up by actual data or that are misleading. (Guo *et al.*, 2020)

Some companies choose to join some climate-neutral programs such as CDP disclosure and the UN's Climate neutral now event and propose their carbon-neutral goals to improve their corporate image rather than directly reducing actual carbon emissions through real actions. In their report, they do not provide enough information about their environmental performance to allow for accurate assessment. This lack of transparency makes it hard for stakeholders to evaluate the environmental performance of a company and to make informed decisions about whether to support or invest in a company. Moreover, some companies involved in greenwashing by making misleading or deceptive announcement about their environmental achievement or by using ambiguous or misleading language. This can include overexaggerating the one product's environmental benefits, making unverified claims, or employing confusing or deceptive wording. This can lead to confusion and mistrust among stakeholders and can make it difficult for companies that are genuinely committed to environmental sustainability to differentiate themselves from those that are not. (Guo *et al.*, 2020)

Therefore, transparency is critical to addressing the greenwashing problem, as it allows stakeholders to assess the environmental performance of a company and to make informed decisions about whether to support or invest in a company. To deal with the greenwashing problem, it is essential for companies to be transparent about their environmental performance and to provide accurate and verifiable information about their environmental performance. Companies can do this by publishing sustainability reports that provide information on their environmental performance and by providing detailed information on their website. Additionally, The use of external certification schemes, such as the Carbon Trust Standard, can provide independent verification of corporate environmental performance. With the effort of increasing transparency and accuracy, companies build trust with stakeholders, differentiate themselves from competitors and contribute to the development of sustainable business practices.

- Step 6 Scaling:

Scaling means extending the company's positive environmental impact without damaging operations. It can be achieved by different approaches, either within the organization or by looking for external partnership

Maintaining environmental performance while expanding operations is challenging for companies. Because these two development processes have certain conflicts, that is, the mission of environmentally sustainable development and profitability. This is different and more challenging than traditional organizations, which pursue growth to achieve greater economies of scale and scope and lead to higher profitability. And the efforts made by companies that choose to be environmentally oriented and sustainable to expand their environmental influence

may result in negative effect on the company's profitability in the short term. (Szekely and Dossa, 2017) However, there are also bright sides to extending corporate environmental sustainability impact. It strengthens the competitive advantage in the marketplace, further improves corporate reputation and enhances a sustainable brand image, and thus allowing companies to maintain the leadership in environmentally sustainable competition. Consumers and investors are increasingly looking for companies with stronger environmental performance, and companies that demonstrate promising environmental development can gain a competitive advantage over those that do not.

The next question is how to perform scaling if one company made up the decision to expand. To illustrate better, we will raise some examples of the ways to extend the impact of environmental activities.

Firstly, the implementation of a carbon offset program. Carbon offsetting allows companies to offset their carbon emissions by investing in projects that reduce or eliminate GHG emissions elsewhere. These investments can include clean energy projects, reforestation, and energy efficiency projects. Companies can efficiently erase their carbon footprint and become carbon neutral by offsetting their emissions. We introduce carbon offsetting as a way to expend the positive environmental impact because it can be relatively easy for companies to implement, compared to other carbon-neutral strategies that may require significant changes to business operations or investments in new technology. Carbon offsetting allows companies to continue with their current operations while also taking steps to reduce their overall carbon footprint. Additionally, carbon offsetting can be less stressful for companies as it does not require them to make significant changes to their operations. However, it is essential to stress that carbon offsetting is not a substitute for lowering emissions at the source. It is still crucial for companies to continually implement other sustainable strategies and practices that directly reduce emissions from their operations. Additionally, it is important to ensure that offset projects are verified and certified by a reputable third-party organization, so to ensure that they truly result in genuine carbon reductions.

The circular economy is another innovative way to scale up environmentally friendly impact. A circular economy is an alternative to the traditional linear economy. (Brauch *et al.*, 2016) Its goal is to prolong the use of resources as much as possible and to recover and renew products and materials at the end of their life cycle. (*The Circular Economy and Storage: How They're Connected | Stow It - Extra space in your Neighborhood*) By implementing a circular economy strategy, companies can minimize the negative environmental impact to the utmost extent.

We have introduced the initiative of engaging employees together to contribute to the environmental goal in discussing organizational environment strategy. And further enhancing and extending this strategy by engaging and educating their employees, customers, and communities can contribute to expanding the outcome impact. By educating and engaging these groups, companies can raise awareness of environmental issues and encourage them to take action to reduce their environmental impact. This can help extend the impact of a company's climate activities beyond its operations and into the broader community.

Last but not least, collaboration and partnerships can help companies to achieve a greater impact than they could alone and can also help to build trust and credibility with stakeholders. Companies can partner with other companies, organizations, and governments to share knowledge, resources, and best practices and to work together to achieve common environmental sustainability goals.

- Step 7 innovation

Business model innovation is crucial in the process of sustainable transformation. Companies can adopt a more secure approach by using models that have already proven successful in the market or take a more pioneering approach by proposing innovative models. The latter, however, comes with a higher level of risk and uncertainty, as there is limited practical data on the feasibility and outcomes of such models. It's important for companies to conduct thorough research and exercise caution when introducing new and untested business models.

In the past, excessive innovation without proper research and restraint had negative consequences for companies. However, when executed properly, business model innovation can also bring competitiveness for companies. Being the first to introduce a new market segment or doing something that has never been done before can give a company a first-mover advantage and provide a competitive edge over others.

The success of business model innovation is not solely determined by timing and being the first to market. It also relies on the ability to expand and reach a larger customer base. This means that for a business model to be considered successful, companies must be able to identify opportunities, enter the market at the right time, and continue to grow and dominate the market. (Markides and Sosa, 2013)

In the real world, companies normally don't change the way they do business entirely but engage innovation in various operations to maintain the balance between stability and innovative transformations. Below, we provide examples of how companies make innovative moves.

Green product innovation

Patagonia, a company known for its clothing and outdoor gear, introduced an innovative line of clothing made from recycled plastic bottles. This change in their production process not only reduces the environmental impact of traditional clothing manufacturing but also addresses the issue of plastic waste. By introducing this line of eco-friendly products, Patagonia has helped to shift the market towards more sustainable practices and inspired other companies to adopt similar environmentally conscious methods. (*Recycled Polyester - Patagonia*, no date) Similarly, a flooring company named Interface developed new carpets made from recycled plastic bottles, reducing the environmental impact of traditional carpet production.

Green process innovation

Green process innovation aims to minimize the use of resources and energy while maximizing efficiency through the utilization of recycled materials, implementation of recycling and environmental technologies, and utilization of technologies such as pollution control equipment. (Xie, Huo and Zou, 2019) The consumer goods giant Unilever claimed to waste by instituting a "zero waste to landfill" policy at all its production locations by redesigning its production process. (*Unilever announces new global zero waste to landfill achievement*, 2016) Ikea as the biggest furniture manufacturer and retailer has invested in renewable energy sources to power its production process and distribution facilities and use recycled materials, thereby decreasing its carbon footprint and cutting its energy expenses. (Magyar, 2018)

Green supply chain innovation

Nestlé has made innovative advancements in its cocoa supply chain to minimize its impact on the environment and enhance the livelihoods of farmers. The company has introduced an

income accelerator program for cocoa farmers and offered them leadership training to enhance the sustainability. Also formed long-term partnerships with cooperatives to implement shade management on cocoa farms, thus improving the environmental sustainability of the supply chain. (*Sustainable cocoa*, no date)

Amazon has developed a program dubbed "Shipment Zero" that seeks to make all Amazon shipping carbon-neutral, with 50 percent of all shipments carbon-neutral by the year 2030. Their innovation is the creation of a program to lower the carbon footprint of their shipping operations, thereby mitigating the environmental impact of e-commerce. (Dave Clark, 2019)

Chapter 3 Explore the Eco-friendly and carbon neutral transformation in the Food and Beverage industry

Introduction

Chapter 3 focuses on examining the transformation of the food and beverage industry towards greater environmental sustainability and carbon neutrality. The whole analysis contains three parts. We start with an overview introduction of this industry's environmental and climate-related current states and select 311 companies as our study sample. After that, we investigate the climate visions and missions of these selected companies by analyzing the extent of their commitment to zero-carbon goals, evaluate their transparency in environmental disclosure, and assess their environmental performance through the Refinitiv environmental performance scores.

The second and third parts of this chapter are all about the corporate Eco-friendly and carbon neutrality strategy, for it is one of the most important sectors in our seven-step business model transformation. We collect and analyze the data from the Eikon database that reflect selected corporate character and their strategies in facing the pressure of climate change. And we apply cluster analysis as our major research method, focusing on identifying the comprehensiveness and tendency of climate friendly strategy implementation in the food and beverage industry and detecting potential areas for improvement. Finally, we further explore the character of different types of companies that can give improvement and transformation suggestions accordingly.

3.1 Research design

There is a variety of research methods applied in the area of corporate strategy, as stated by Weinhofer and Hoffmann (2010) and Damert and Baumgartner (2018b). In order to analyze the types and characteristics of corporate eco-friendly and carbon neutrality strategies in the food and beverage industry, we organized our research into three parts.

- Part 1 is aimed at getting a basic understanding of the climate actions of the food and beverage industry and the characteristics of the selected sample companies. It will contain a descriptive statistical analysis of the selected company's characteristics and corporate environmental strategy. Firstly, we introduce the industry and the companies selected as the sample set for the following analysis and the reason for our selection. Then, we make a basic descriptive analysis of the characters of our sample set to primarily understand the situation of food and beverage companies in terms of environmental and climate engagement.
- Part 2 is a cluster analysis of the corporate environmental strategy. We identified 20 corporate environmental initiatives that potentially contributed to climate neutrality from the Eikon database and categorized them into five groups of strategies. We used the scores for each of the five strategy categories for the sample companies as variables and performed the cluster analysis. The process of cluster analysis starts with a hierarchical clustering method to determine what is the appropriate number of clusters by using Ward method. The decision is made based on the Elbow method. After determining the number of clusters, we performed the K means cluster method to assign the selected companies into clusters.
- Part 3 strives for a deeper understanding of the characteristics of each cluster. Further information is collected, such as the board size and employee count, as well as financial indicators like revenue, ROA, and ROE to assess the company's financial performance. We also include the region of the headquarters and emission scores in this section. Then we used analysis of variance (ANOVA) to determine if there are significant differences among these indicators across the clusters. And to further investigate these differences, we employed a post-hoc multiple comparison method. In particular, after completing the variance analysis, we conducted the Turkey test to analyze the characteristics of the indicators that show significant differences and determine the differences across the clusters. (Weinhofer and Hoffmann, 2010; Lee, 2012; Damert and Baumgartner, 2018b)

3.2 Research method

Descriptive statistical analysis

Followed by our research design, we applied the descriptive analysis in the first part of the research. Descriptive analysis is a method used to summarize and describe the characteristics of a given dataset. It involves using statistical measures and visualizations to identify patterns and trends in the data, such as the mean, median, and standard deviation. Descriptive analysis can be used to understand the distribution of the data, identify outliers, and describe the overall

shape of the data. It is often used as a starting point for further analysis and is useful for gaining an initial understanding of the data before conducting more complex analyses.

Cluster analysis

In the book of Joseph F. *et al.*, (2014), cluster analysis is introduced as a standard method for analyzing the distinctions and similarities of new goods and for identifying groups based on corporate strategies or strategic orientations. Weinhofer and Hoffmann (2010) applied cluster analysis to detect differences in corporate climate mitigation strategy. Damert and Baumgartner (2018a) and Lee (2012) used a similar approach in analyzing corporate environmental strategy. Cluster analysis is a commonly used technique for grouping similar objects or individuals in a population. This method allows for the identification of clusters, where objects within the same cluster have more similarities than those in different clusters. This approach is often used in situations where researchers aim to identify homogeneous groups, such as firms or behaviors, and is essential for strategy options like segmentation and target marketing. The goal is to create clusters with a high level of homogeneity within and heterogeneity between clusters. (Joseph F. *et al.*, 2014)

In our research, we chose cluster analysis instead of factor analysis because the group of the variables is already done in the first part, based on the knowledge we know and Classification methods commonly used in this field.

There are two clustering algorithms, hierarchical and nonhierarchical methods. And we chose to use the combination of both clustering algorithms.

Firstly, to detect the appropriate number of clusters in our data set, we use a hierarchical clustering technique. In a hierarchical procedure, the clustering algorithm defines the similarity between multiple-member clusters during the clustering process. (Joseph F. *et al.*, 2014) In our analysis, we use agglomerative hierarchical clustering, which is more commonly used (Weinhofer and Hoffmann, 2010) and is more efficient for large data sets. We use a method called Ward linkage, which minimizes the variance of the distances between the merged clusters. Due to our large data set, the presentation of the dendrogram is not very intuitive. Therefore, we visualize the result and use the Elbow method to assist us in choosing the appropriate number of clusters. (Joseph F. *et al.*, 2014)

Once the appropriate number of clusters is determined, we use the k-means clustering method, a nonhierarchical clustering algorithm to assign each object to a cluster. K-means algorithms divide a dataset into a specified number of clusters and then repeatedly adjust the assignment of observations to those clusters to minimize the distance between observations within the same cluster while maximizing the distance between different clusters. This process continues until a certain numerical criterion is achieved. (Joseph F. *et al.*, 2014)

Post-hoc multiple comparison method

Firstly, the statistical method known as analysis of variance (ANOVA) is used to answer the question, "Do the group means differ significantly?" by testing the null hypothesis that samples from at least two groups come from populations with equivalent means. Multivariate analysis of variance measures up group differences across three or more independent variables, whereas analysis of variance only looks at one dependent measure.

After a primary statistical analysis (ANOVA) has identified a statistically significant difference between groups or treatments, the post-hoc multiple comparison method is used to further evaluate the data. Post-hoc analysis is used to identify which specific groups or treatments are

significantly different from each other.

Additionally, we use SPSS 27 software to complete the mentioned analysis. And the meaning of the name of all indicators is in Appendix at the end of this paper.

3.3 Part 1 The characteristics of the selected food and beverage companies

In this section, we present a description of the selected sample companies. This will include the location of headquarter, indicators related to CSR report and environmental performance. The data for this analysis will be extracted from the Eikon database and presented in tables and graphs to facilitate comprehension and interpretation. In addition, we will provide a quick summary of the outcomes, emphasizing any significant findings or trends that occurred during the analysis. This section will offer a foundation for the upcoming cluster analysis.

3.3.1 The Food product and beverage industry

The considerable environmental impact of the food and beverage industry was a factor in selecting this business for this study. Most climate change initiatives have primarily focused on reducing emissions from sources such as electricity production, transportation, and industry, but relatively less attention has been given to the impact of food production on the environment. However, it is important to note that food production is responsible for a significant portion of greenhouse gas emissions, roughly 25%. While this may be less than emissions from the energy sector, it is still a significant contributor that should be addressed. (*Emissions from food alone could use up all of our budget for 1.5°C or 2°C – but we have a range of opportunities to avoid this*, 2021) Research suggests that if current trends continue, emissions from food production alone will surpass the 1.5-degree target set by the Paris Agreement by the middle of the century. (Clark *et al.*, 2020) Therefore, it is essential to resolve the climate impact of the food and beverage industry and explore the industry climate friendly transformation.

Food and beverage production, processing, packaging, and transportation have a substantial influence on the environment, including GHG emissions, deforestation, and water and air pollution. The focus of this chapter is to detect how food and beverage companies engaging environmental and climate changing topics and explore the extent of company's climate friendly strategies and actions.

Food and beverage companies should increasingly get involved in climate friendly topics based on shareholders theory, as we discussed in chapter 2. Under the stakeholder theory, consumers, investors, and politicians are increasingly pressuring food and beverage industries to minimize their environmental impact and optimizing their sustainability policies. Consumers are increasingly conscious of the environmental impact of their food choices and are demanding more sustainable alternatives. Investors are becoming progressively interested in sustainable businesses and are willing to invest in companies that are reducing their environmental impact. And authorities and politicians are creating policies and incentives to encourage businesses to decrease their environmental effects, and some nations are implementing carbon pricing schemes to incentivize businesses to cut emissions. Therefore, the food and beverage industry is under pressure to reduce its environmental effect and enhance its sustainability policies.

Lastly, the food and beverage industry comprises numerous companies offering a representative

sample for the research. The diversity of enterprises in this industry in terms of size, goods, and geographical distribution provides an excellent opportunity to fully understand the industry and generalize the findings.

One of the most important resources to analyze a company's environmental behaviors is through its CSR report. As discussed in chapter 2, a CSR report provides openness regarding a company's sustainability and social impact initiatives, thereby increasing accountability and comprehension of the company's operations. In addition, they are used to measure a company's performance in key areas and monitor its development over time. In the food and beverage sector, in 2014, only 113 companies made CSR reports; this number steadily rose to 307 in 2021, as shown in Figure 3.1. This suggests that companies operating in the food and beverage industry are increasingly paying attention to the impact of CSR and becoming more responsible by improving transparency.



Figure 3.1 Number of companies made CSR report from 2014 to 2021

However, despite the observed growth of CSR reports, it's worth noting that the food and beverage industry has a relatively low proportion of companies reporting compared to other industries. For example, only 14% of companies in this industry reported their CSR activities in 2021. This is in contrast to the energy sector, which has a much higher CSR reporting rate of 32%. This demonstrates that there is room for improvement in the food and beverage industry in terms of transparency and accountability in terms of environmental and social impacts.

3.3.2 The sample selection

According to the description of the overview of ESG analysis in the Eikon database, Refinitiv delivers ESG data for over a thousand private companies and over thirteen thousand public companies. ESG specialists manually gather and assess the data using publicly accessible sources like corporate websites, yearly reports, and CSR documents. (*Financial Technology, Data, and Expertise, 2023*)

Since 2002, Refinitiv has provided comprehensive coverage of over 630 ESG data items. In addition, the provided statistics are standardized and comparable ESG data. Their data analysts collect company-reported data along with connections to the original source and then normalize the results to common units across all businesses. Each data point's detail links provide comprehensive transparency. (Guide of Eikon ESG data)

As of the end of 2021, 346 beverage companies and 1841 companies are involved in the food industry, filtered by GICS industry names of 'Beverage' and 'Food product.' Then, based on the fact that the Eikon ESG data used in this chapter is mostly extracted from the company's reports, and CSR reports are an important resource for analyzing a company's environmental behavior,

we added a filter to screen the companies that made a CSR report in 2021. Therefore, at the time of this research, the number of food and beverage companies that have their CSR report is 311. As a result, the ESG data from the Eikon database of these 311 companies will be the dataset used for this chapter.

3.3.3 The characteristics of the sample

Firstly, we collected data on the number of companies that set emission reduction goals and the percentage of the target reduction. Among 311 companies, 173 have set their emission reduction goals. When grouping these 173 companies by the region of their headquarters, we can see that Asia and Europe have the most companies with set targets, indicating that companies in these regions are particularly active and motivated to contribute to global carbon neutrality. This is consistent with our discussion in Chapter 1, where China and the EU are recognized as countries or regions that have made the most progress towards their carbon neutral targets. Africa and Oceania have the least number of food and beverage companies that have declared their reduction goals. While Oceania's companies have promised the largest carbon reduction at 58%, and American companies have set the lowest target at 32.8%. The most commonly set target year to achieve the goal among all regions is 2030 (91) and followed by 2025 (45), which is consistent with most countries' climate neutral promises.

	Africa	Americas	Asia	Europe	Oceania
No. of companies claim to have Emission Reduction Target	3	36	63	61	10
Ave. Emission Reduction Target %	32.3	32.8	41.0	47.3	58.3

Table 3.1 Company's emission reduction target

Next, since all the data used for this research was originally sourced from companies' CSR reports, we also collected data on 'GRI Report Guidelines', 'CSR Sustainability External Audit', and 'ESG reporting scope' to assess the quality of the companies' CSR reports.

The CSR Sustainability External Audit indicator reflects the robustness and transparency of the company's disclosure. It examines whether the company's CSR data has been considered in an external audit, or if the company has published an external audit statement for its environmental and social data in its annual report. The GRI report guideline indicator reflects a certain level of normativity, as it examines whether the report or data follows the framework or guidelines of the Global Reporting Initiative (GRI) principles. And finally, the ESG reporting scope reflects the comprehensiveness of the report, represented by the percentage of the company's operations that are reported on in terms of their environmental and social impact. Table 3.2 shows the descriptive statistics of the quality of the company's CSR report.

	GRI Report Guidelines Score	ESG Reporting Scope	External Audit Score
Valid	197	75	104
Missing	114	236	207
Mean	57.5	33.5	80.1

Median	69.5	9.0	84.3
Mode	8.7	5.0	95.5
Range	87.9	99.2	89.1

Table 3.2 Score of company CSR report

Although our sample represents 311 companies that have made CSR reports, only two-thirds of the sample followed the GRI report guidelines, and only one third of the reports were audited externally. The wide range of GRI scores and reporting scope indicates that the comprehensiveness and format of these reports vary greatly. The low mode of these two indicators, especially, suggests that a significant number of the sampled companies have poor performance in these aspects. The ESG reporting scope has the lowest scope mean and median, which suggests that comprehensiveness is a common issue among our sample. The mean and median of the GRI Report Guidelines Score are both over 50, which is a relatively good score, but there is still room for improvement in terms of the format. Finally, only one third of the reports were audited externally, but they obtained very good scores for both the mean, median, and mode, which likely indicates the certain robustness of the sample data.

Finally, we collected five-years data on the ESG scores, Environmental Pillar scores, and CO2 equivalent Emissions Totals for the selected companies to gain a primary understanding of the environmental performance of our sample. (Table 3.3)

		2017	2018	2019	2020	2021
Mean	ESG score	47.1	48.5	49.8	52.2	54.0
	Environmental Pillar Score	44.0	46.8	49.2	51.9	52.6
	CO2 Equivalent Emissions Total	948	899	799	747	779
Maximum	ESG score	91.8	92.0	89.4	90.7	91.1
	Environmental Pillar Score	96.0	97.9	96.5	97.5	98.0
	CO2 Equivalent Emissions Total	17471	17363	17100	16200	16000
sum	CO2 Equivalent Emissions Total	111912	132094	141481	150067	177565

Table 3.3 Five years ESG performance of the sample

From the Table, we first noticed that the average environmental pillar score of all years is lower than the overall average ESG score. This suggests that on average, the sampled food and beverage companies have relatively low performance and consideration for the environment compared to their performance and consideration in the social and governance pillars.

However, the conclusion is reversed for firms with the strongest environmental performance. The best environmental performing companies from 2017 to 2019 are Remy Cointreau and from 2020 to 2021 is Orkla ASA. According to our data, the companies with strong performance have consistently exhibited exceptional performance over the past five years, and their environmental performance is mostly better than their overall ESG performance. This may

suggest that once a company fully commits to an eco-friendly transformation and reaches the best performance, it becomes more natural for them to maintain this accomplishment in the future. At this stage, being eco-friendly is likely to become part of the company's culture and operations.

Below is a combined graph format for an easier understanding of the results (Figure 3.2). From this graph, we can easily see that the ESG score and the Environmental Pillar Score have steadily increased over the past five years. Over the period from 2017 to 2021, the average ESG score for the chosen food and beverage company rose by 15%, and the score for the Environmental Pillar specifically increased by 19%. As a result, the average CO2 emissions have been reduced by 18%. It is worth noting that the total emissions of these 311 companies have increased by 59% over the five years. This could be due to the increased transparency of corporate disclosures, as more and more companies are joining the global climate movement and reporting their emissions.

In 2017, only 118 companies disclosed their carbon emissions, but this number doubled over the next five years, and by 2021, carbon emissions data for 228 companies were available. This indicates that the overall climate performance of the sampled companies has effectively improved from 2017 to 2021.

However, it is worth noting that the sample is based on companies that voluntarily report their ESG performance. Companies with superior carbon performance are more likely to take the initiative to disclose their total carbon information (Weinhofer and Hoffmann, 2010; Chithambo *et al.*, 2020). As a result, this conclusion cannot represent the entire food and beverage industry. However, it does show that companies with better performance are consistently improving their environmental and carbon reduction performance.

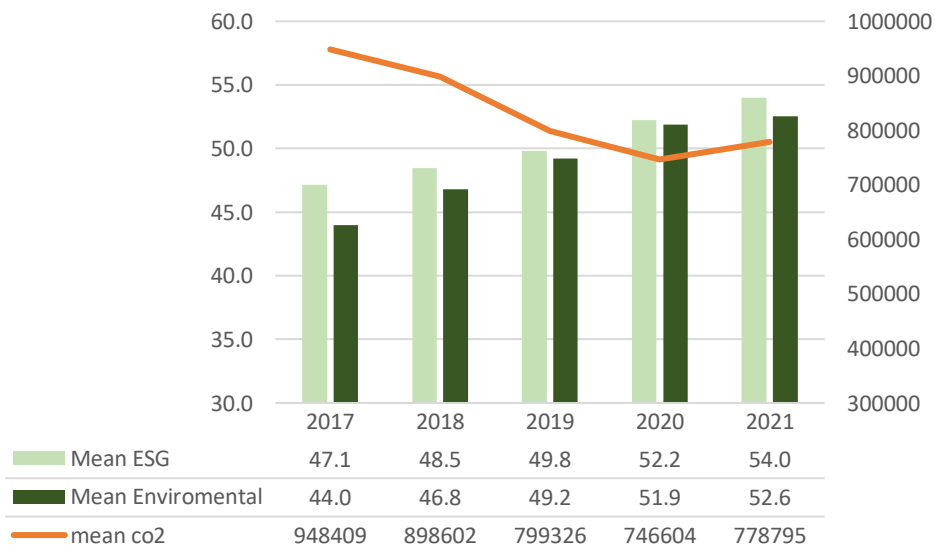


Figure 3.2 Average performance from 2017 to 2021

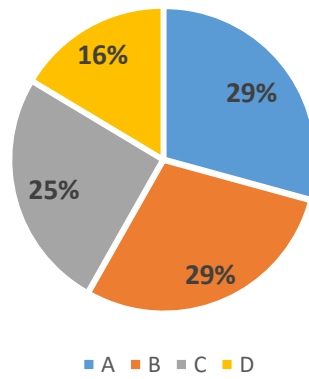


Figure 3.3 Emissions score grade

Figure 3.3 illustrates the percentage of emissions score grades of the sample companies in 2021. 58% of the companies received a good grade of A and B class, while only 16% of companies scored in D. This suggests that the sampled companies generally have good climate performance, but there is still room for improvement.

3.4 Part 2 Types of corporate eco-friendly strategy. A cluster analysis

3.4.1 Data

We gathered 20 indicators that are related to the corporate environmental and especially climate neutral behaviors from the Eikon database and grouped them into five different types of strategies that may result in a climate-friendly outcome. These strategies include product strategy, CSR governance strategy, organizational strategy, external strategy, and carbon neutral strategy, as illustrated in Table 3.4. Additional information and explanations on each indicator can be found in the appendix at the end of the paper.

Product	Environmental Products	Environmental Materials Sourcing	Product Impact Minimization	Sustainable Packaging
CSR governance	Climate Change Commercial Risks Opportunities	CSR committee	Sustainability Compensation Incentives	Executives compensation ESG performance
Organizational	Environment Management Team	Environment Management Training	Staff Transportation Impact Reduction	Green Buildings
External	Environmental Supply Chain Management	Environmental Supply Chain Monitoring	Env Supply Chain Partnership Termination	Environmental Partnerships

Carbon Neutrality	Goal setting	Emissions Trading	Internal carbon pricing	Energy Efficiency
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Table 3.3 Types of strategy

The product strategy category contains activities that a company report to have in product environmental transformation, from re-design the product and optimizing the production line to be more environmentally responsible, to using more sustainable materials and packages and other initiatives to minimize its product's negative environmental impact.

The next category indicates the environmental transformation at the governance level. Generally, governance refers to the connection between the owners and management of a firm, it reflects the structures and mechanisms used to make and implement decisions, monitor performance, and enforce responsibility. (Damert and Baumgartner, 2018a) Our CSR governance strategy category encompasses factors such as board awareness of climate change issues, linking senior executive compensation to CSR/sustainability targets, and providing financial incentives for improved environmental performance. Additionally, the governance strategy includes setting up a dedicated committee at the board level for monitoring and responsible for CSR decision-making.

The way a company approaches and manages its environmental impact can be influenced by the prevalent culture and values within the organization or among certain individuals or departments. Under the Organizational strategy category, we include measures that cultivate a pro-environment company culture, such as establishing a dedicated environmental management team and providing specialized training, promoting transportation emissions reduction, and using green offices. These measures reflect the organization's values and capabilities in shaping an environmentally friendly workplace. (Damert and Baumgartner, 2018a)

Internal efforts alone are not enough to achieve an organization's environmental vision and mission. Effective management of external factors is also crucial. The supply chain accounts for 18% of total GHG emissions related to food, highlighting the importance of considering its impact. (*Food production is responsible for one-quarter of the world's greenhouse gas emissions*, 2019) Therefore, we include supply chain management in our environmental transformation, starting from selecting supply chain partners on the basis of their environmental behavior, keep monitoring their environmental performance and terminating partnerships if environmental criteria are not met. External strategies encompass not just the supply chain but also other initiatives that are taken outside the organization to be more environmentally friendly. In this category, we include environmental partnerships, which are relationships with industrial organizations, specialized NGOs, government or supra-government organizations to address environmental issues. These partnerships are distinct from supply chain partnerships.

Lastly, is the strategy category that includes dedicated initiatives addressing climate change problems and pursuing carbon neutrality. Firstly it detects whether one company has set its goal to carbon reduction or carbon neutral. This action provides direction for the company's carbon neutral transformation and demonstrates the corporate concern and responsibility to its shareholders. The initiatives beyond goal setting can include taking part in emission trading and setting an internal carbon price to better support corporate carbon neutral transformation. In addition, having an overall policy to improve energy efficiency can contribute to the ultimate net zero goal.

Therefore, we end up having five strategy categories as we specified above, and each category contains four initiatives. The data downloaded from the Eikon database is in the format of 'True'

and 'False' of each of the 20 environmental and carbon zero initiatives. 'True' means the sample company mentioned this action in its CSR report and 'False' means there is no sign of evidence that this company involves this initiative in all forms. To calculate the final score of each strategy category, we converted 'True' to 1 point and 'False' to 0 points and added up the total score for the four initiatives in each category. As a result, the score for each strategy category ranges from a minimum of 0 to a maximum of 4. This score reflects the level of involvement a company has in that strategy category. For instance, a score of 0 means that the company did not engage in any strategic actions in that area, while a score of 4 indicates that the company fully engaged in all the mentioned strategic approaches. Next, we used the total score of the integrated strategy categories to conduct a cluster analysis. The sample size for the cluster analysis is 311 and the variables are the scores for each strategy category.

3.4.2 Descriptive Statistics

Frequency	Product	Governance	Organizational	External	Carbon neutral
0	53	27	60	77	15
1	80	54	81	42	114
2	87	130	122	57	154
3	38	62	44	76	22
4	53	38	4	59	6
Total	311	311	311	311	311

	Product	Governance	Organizational	External	Carbon neutral
No. Valid	311	311	311	311	311
Mean	1.86	2.10	1.52	1.99	1.65
Median	2.00	2.00	2.00	2.00	2.00
Mode	2	2	2	0	2
Std.	1.32	1.10	1.00	1.46	0.76

Table 3.4 Descriptive Statistics of the final score of each strategy category

The range of the score for all strategy categories is 0 to 4. While the average score falls between 1 to 2 points, and the means are all 2 points. The average score of all strategies is 1.82, meaning that over half of the environmental actions have not been mentioned in the corporate report in any form. This may suggest that the average level of environmental awareness and practice in the food and beverage industry has a huge potential for improvement.

The frequency of each strategy score can be easily observed through the proportion stack bar Table (Figure 3.4). It clearly illustrates the proportion of scores for each strategy.

The product and external strategies have the highest standard deviation, indicating a significant variation in the performance of these strategies among companies. The average score for product and external strategies is 1.86 and 1.99, respectively, which are higher than the overall average score of all strategies (1.82). The high diversity of the food and beverage industry in terms of facility size, processes, and products (O'Shea *et al.*, 2022) may lead to a wide variation

in the industry's performance in product optimization and result in a high standard deviation(1.32).

The external strategy category has the most companies that achieved over 3 points (43%). While at the same time has the lowest mode of 0 points and the highest proportion of 0 points (24.8%), which shows that a quarter of companies do not manage their supply chain in an environmentally friendly way and never seek out any partnerships to support their environmental activities. This outcome might relate to our choice of the component of external strategy as 3 out of 4 are all supply chain management. Once one company decides to include its supply chain in the transformation process, it performs all three strategies, from selection to monitoring, and includes a termination clause.

On the other hand, the governance strategy has an average score of 2.1, the highest score among other categories and above the overall average score. Additionally, 32% of the companies scored above 3 points, according to Table 3.4. Furthermore, over 73% have reached over 2 points, indicating that most companies are above the average level of environmental governance. This result may suggest that the climate change issue may not be considered as a major problem in corporate governance.

The organizational and carbon neutrality strategies have the lowest number of companies reaching the maximum score. This means very few companies are completing the climate friendly transformation in these two aspects, with only 4 for organization and 6 companies for carbon neutrality. Most companies score 2 points (39%) and have the lowest average score for organizational strategy. The proportion of companies that can be identified as highly dedicated to carbon neutrality is the lowest. Only 9% of the sample scores over 3 in this area, with the majority only getting 2 points. Although the proportion of the companies not performing any carbon neutral practices is the lowest (4.8%), this may be because most companies (173) have set a carbon reduction goal, as discussed earlier. The results for the carbon neutrality strategy category may suggest that while over half of the companies (55.6%) have taken the first part of goal setting, actual action towards achieving these goals is limited. There is room for more engagement and action toward carbon neutrality among companies in the industry.

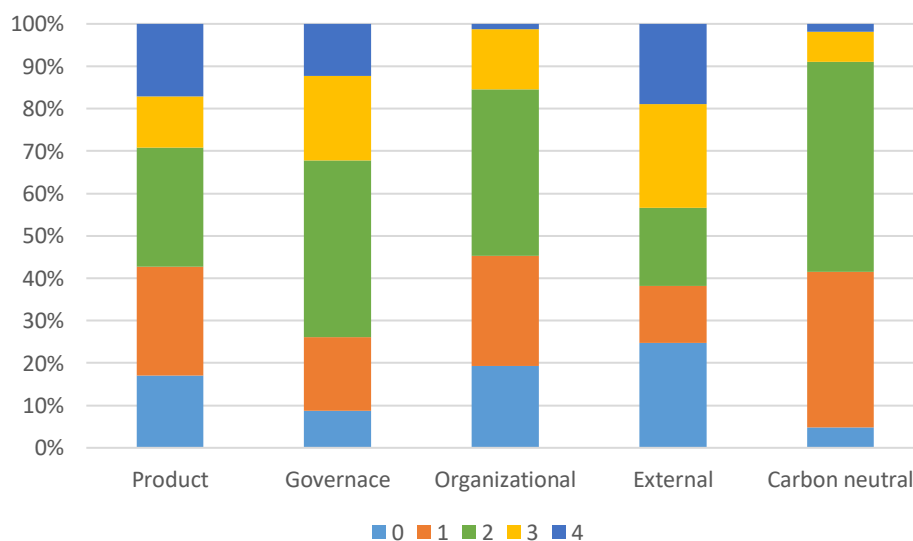


Figure 3.4 Proportion stack bar chart, % of score in each strategy

3.4.3 Hierarchical cluster analysis

To identify the appropriate number of clusters to perform in K means cluster, we first conduct a hierarchical cluster analysis by applying the Ward method in SPSS. The input variables are the scores of each strategy category: Product, Governance, Organizational, External and Carbon neutral strategy. The sample size is 311 and is too large to show with a dendrogram. Therefore, we put the result of the ward method in a line chart(Figure 3.5) and measured the appropriate number of the cluster through the Elbow method. (Weinhofer and Hoffmann, 2010; Lee, 2012; Damert and Baumgartner, 2018b)

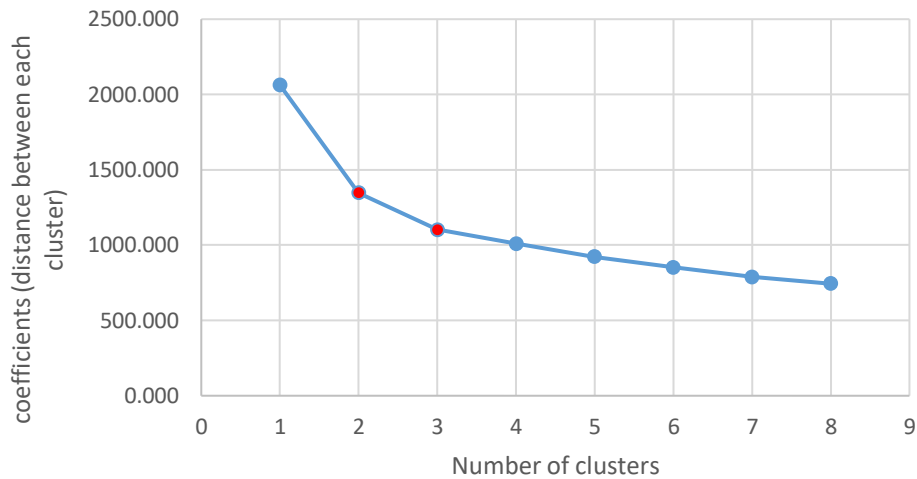


Figure 3.5 Elbow test results

Figure 3.5 shows part of the result of the Hierarchical cluster. 'Coefficients' in Hierarchical cluster result by the Ward method refers to the distance measure between the clusters. The elbow method is a technique used to determine the optimal number of clusters in a hierarchical clustering analysis. It is based on the observation that the decrease in the distance between clusters tends to slow down as the number of clusters increases. The elbow method looks for the point where the decreased distance between clusters starts to slow down, which is considered the optimal number of clusters. In this case, the most obvious turning point of the decrease in the distance appears when the sample is grouped into two clusters, but there is also a relatively significant drop in 3 clusters compared to a minor drop in 4 clusters. Combined with our actual research need, leading to the decision to use 3 clusters for the following K-means cluster analysis.

3.4.4 K-Means cluster analysis

We conduct a K-means analysis by setting the number of clusters as 3. The input variables are the same as the previous analysis, which are the points of Product, Governance, Organizational, External and Carbon neutral strategy. After 13 iterations, the final result of the clusters is shown below(Table 3.5 The final cluster)

	All-round leaders	Active followers	Shy laggard	Ave. score of each strategy of all Cluster	Sig.
Product	3.77	1.77	1.01	1.86	0.000*
Governance	2.54	2.49	1.41	1.46	0.000*
organizational	2.03	1.87	1.03	1.52	0.000*
external	3.22	3.04	0.66	1.99	0.000*
CN	2.13	1.86	1.26	1.65	0.000*
Cluster Ave.score	2.65	2.10	0.97		
Number of Case	82(26%)	113(36%)	116(37%)		

Table 3.5 The final cluster result

* represent the significance levels of 1% respectively

Table 3.5 shows the summary of the cluster centers, which are the average scores for each type of strategic action in the cluster and the number of samples in each cluster. Additionally, we have included the overall mean score for each strategy and the mean score for each cluster, as well as p-values to indicate the significance of the variables. It should be noted that the p-values for all five variables are less than 1%, indicating that there are significant differences among the categories identified through the cluster analysis.

Based on the data, we identified three clusters: All-round leaders, Shy laggards, and Active followers. All-round leaders have the highest average scores and scores higher than the overall average for each strategy category. Shy laggards have the lowest average scores and scores lower than the overall average, particularly in the External strategy category. Active followers have relatively good scores but lower than All-round leaders, and tend to lag behind in the Product strategy category.

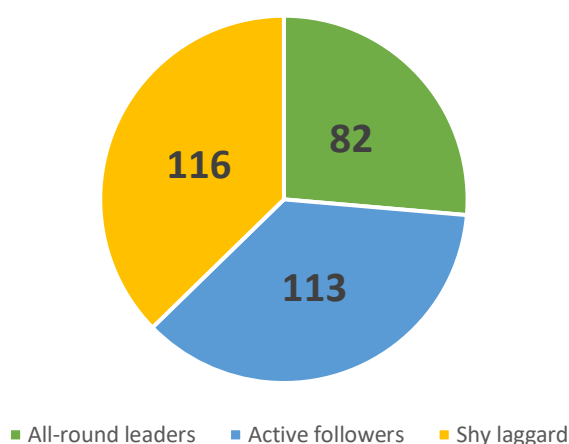


Figure 3.6 Number of companies in each cluster

Above is the distribution of companies across the three clusters (Figure 3.6). All-round leaders have the smallest number of companies, which is 82 and makeup 26% of the sample. The Active followers cluster has 113 companies, accounting for 36% of the sample. Lastly, the Shy laggards cluster has the largest number of companies but is rather close to the Active followers, with 116

companies, or 37% of the sample. It is worth noting that there appears to be a correlation between the number of companies in a cluster and their level of engagement in environmental strategies. The more comprehensive and complicated the strategy one cluster is engaged in, the fewer companies it contains.

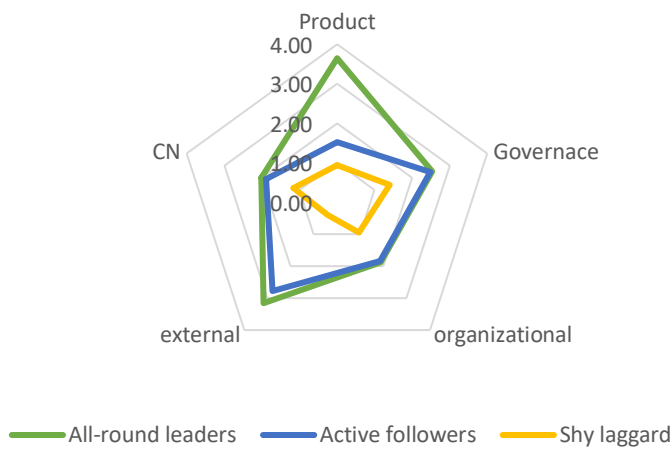


Figure 3.7 The radar chart of five types of strategies in each cluster

From the radar chart (Figure 3.7), we can easily detect the difference between the three clusters. Firstly, the three clusters can be used to identify the extent to the environmental strategy one company is involved by measuring the scale of the five variables. All-round leaders have the largest scale, indicating companies in this cluster develop the most comprehensive environmental strategy, while the shy laggard is the most limited. Secondly, we can identify the tendency of the choice of strategy on the basis of the different lengths of each strategy of a cluster.

- ***All-round leaders***

Companies in this cluster can be considered industry leaders in terms of environmental management for their dedication to the environment and climate change management. These companies have the highest average score in all five categories, and all of their scores are above the overall average score. They are considered to be the most advanced companies for the high range of implementation of all environmental strategies and reducing their climate impact. They are more proactive in product, governance and external strategies. Especially for product strategy, their product score is much higher than other two clusters. The name of this cluster is inspired by Weinhofer and Hoffmann (2010) and Damert and Baumgartner (2018).

- ***Active followers***

The Active Followers cluster consists of companies that show a moderate level of engagement in environmental strategies compared to the other two clusters. These companies have a score that is above the overall average score in most of the categories, but their performance still lags behind the All-round Leaders. These companies are more focused on governance and external strategies, but there is still room for improvement, particularly in their product transformation. They makeup approximately 36% of the entire sample and can be considered as companies that are making an effort to enhance their environmental performance but still have room for improvement.

- **Shy laggards**

The Shy Laggards cluster is comprised of companies with the lowest levels of implementation of all five categories of climate change management activities. These companies account for approximately 37% of the entire sample and are the least proactive firms in the industry. They show relatively low engagement in all five strategies, but particularly in the product and external strategy areas. When compared to other clusters that show a high level of implementation in external strategy, the Shy Laggards are particularly lagging behind in this area. Although they show some interest in governance and carbon neutral strategies, their overall level of implementation remains low in these areas as well.

3.5 Part 3 The characteristics of the clusters

3.5.1 The geographical dimension

We collected the regional information of the sample companies' headquarters and created a cross-tabulation to examine differences in the type of clusters by major country and region. (Weinhofer and Hoffmann, 2010; Damert and Baumgartner, 2018) Shown below is the proportion of each cluster in each region. (Figure 3.8)

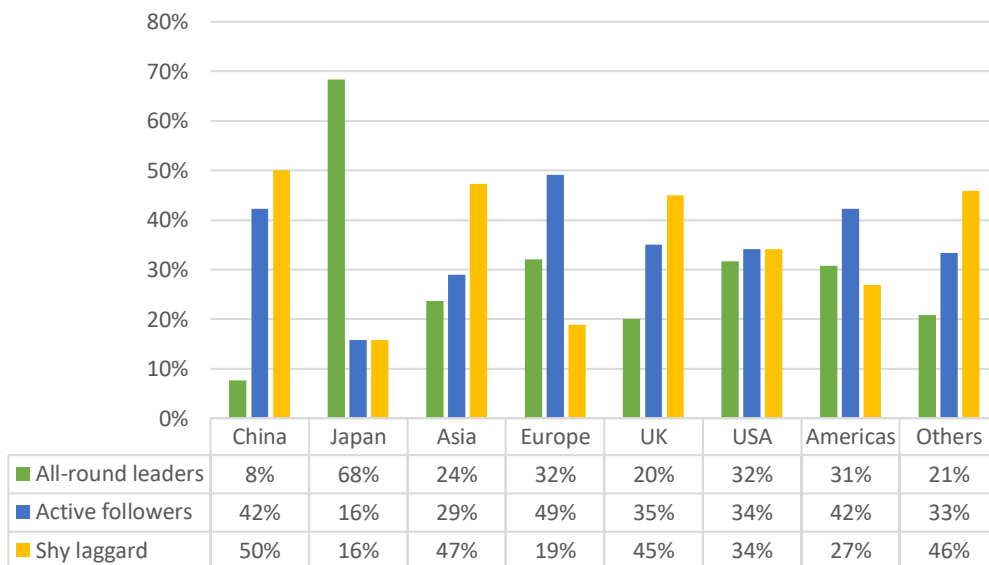


Figure 3.8 Proportion of each strategy type in each region

For most the regions like China, other Asia country, UK and other countries, the majority of food and beverage companies are Shy laggard that have relatively poor involvement in environmental and carbon topics. All-rounded leader, the most active and comprehensive player, takes a relatively small part of this industry. However, the Japan and Europe have completely different results.

Japan is the most unique. Japanese food and beverages companies, over all other country and regions, has the highest proportion (68%) of All-rounded leader. And only 16% of companies are shy laggards. The proportion of All-rounded leader in Japanese food and beverage industry is much higher than in other regions. This result indicates Japanese companies' proactive

approach to climate change management. In addition, the Japanese food and beverage industry has a reputation for the quality of products, which may contribute to the prevalence of All-rounded leaders. This high proportion of well-rounded leaders in Japan is unique among other regions and demonstrates the Japanese food and beverage industry's strong commitment to sustainability and environmental responsibility.

The European and American companies also have a good level of involvement. 81% of the European companies are considered to be All-rounded leaders and active followers and 66% of the USA. This may suggest that the food and beverage industry in these two regions has a relatively high level of environmental awareness and is making an effort to support the carbon neutral goal but may not explore their full potential, especially in taking a further product and external strategy.

China (50%) and the United Kingdom (45%) has a high proportion of shy laggard. And China also has the lowest percentage of All-rounded leaders. This shows the comparably low level of consideration and involvement of Chinses food and beverage industry in terms of environment friendly movement. However, in our previous discussions of the national carbon neutrality goal, China has reached 78% of its carbon neutrality goal and made the second high progress among the region we discussed. This may suggest that food industry is not the main focus of China's current carbon neutrality goal but could become more attributed in the future for its huge potential for carbon reduction.

3.5.2 The structural dimensions: a variance analysis

In this analysis, we include new variables to perform variance analysis: board size and number of employees to indicate the size of the company, the revenue to identify the market size of the company, ROA and ROE to reflect the company's key financial performance and emission score to show the company's carbon reduction performance.

The result of the variance analysis is shown below (Table 3.6). This table shows the results of mean \pm standard deviation, F test results, and significant P values. Then we analyze whether the P value of each analysis item is significant at 0.05 level. If $P < 0.05$, indicating a significant difference can be observed through clusters. Otherwise, the indicator cannot be considered with a huge difference through clusters.

In addition, if there is a noticeable disparity in the indicator among the clusters, perform post-hoc multiple comparisons to determine if there are significant differences between the groups that are grouped under the grouping variable.

		Mean	Std.	F	P
Board Size	All-round leaders	10.07	2.87	1.819	0.165
	Active followers	10.40	3.90		
	Shy laggard	9.29	3.84		
	Total	9.93	3.64		
Number of Employees	All-round leaders	41967.97	69989.40	9.798	0.000*
	Active followers	21719.75	32625.95		
	Shy laggard	8627.90	11019.51		
	Total	22954.04	44300.60		

Revenue(million)	All-round leaders	13432.37	19407.38	15.976	0.000*
	Active followers	5463.08	7381.52		
	Shy laggard	2268.00	3344.68		
	Total	6604.53	12153.97		
ROA	All-round leaders	5.9%	3.3%	0.429	0.652
	Active followers	7.3%	11.5%		
	Shy laggard	6.4%	9.3%		
	Total	6.6%	9.1%		
ROE	All-round leaders	16.9%	16.1%	2.215	0.112
	Active followers	19.1%	26.5%		
	Shy laggard	11.2%	24.2%		
	Total	15.8%	23.4%		
Emissions Score	All-round leaders	76.04	19.37	69.616	0.000*
	Active followers	65.98	19.34		
	Shy laggard	36.45	21.58		
	Total	58.88	25.93		

* p<0.01 The mean difference is significant at 0.01 level

Table 3.6 the variance analysis result

In this section, we detect three variables that show significant differences between clusters. The results of the empirical analysis indicate that there are significant distinctions between the companies among the clusters in terms of the average number of employees, average revenue, and average emission score. However, there were no significant differences detected in the average return on assets (ROA) and return on equity (ROE) and average board size across the clusters.

Therefore, we can have a conclusion that the extent and tendency of the environmental strategy can be significantly different through different sizes of companies. The shy laggard companies are the smallest, for all of their indicators are lower than average. In particular, for the number of employees and revenue, shy laggard company not even reach half of the average number. The result may indicate that smaller firms with a lower level of sales may not particularly interested in or are capable of performing environmental and carbon neutral transformation. And they may not include environmental issues as an important aspect of supply chain management.

The larger the average corporate size of the cluster, the more proactive the individual firm groups are in performing climate friendly transformation. This fits with the theory of stakeholder pressure we discussed earlier. Because large firms are subject to greater institutional pressure, as well as pressure from a customer perspective brought about by high visibility, they exhibit a greater range of actions. Second, large companies also tend to have more organizational resources and financial resources to implement climate change measures. (Damert and Baumgartner, 2018b)

The other variable that shows a significant difference is the emission score. The more strategic involvement and implementation a company has, the greater its sense of environmental responsibility, leading to positive feedback for its efforts.

3.5.3 Post-hoc multiple comparison method (Turkey HSD)

Knowing that there's a significant difference between clusters in terms of number of employees, revenue and emission score, we further conduct the post-hoc multiple comparisons to understand whether two clusters are significant with each other using these four variables. And the results are shown below (Table 3.7)

Dependent Variable	(I) Clusters	(J) Clusters	Mean Difference (I-J)	Std. Error	Sig.
Number of Employees	All-round leaders	Active followers	17829.53	5955.76	0.008*
	Active followers	Shy laggard	12389.77	5449.47	0.061
	Shy laggard	All-round leaders	-30219.30	5955.76	0.000*
Revenue	All-round leaders	Active followers	7201.74	1603.46	0.000*
	Active followers	Shy laggard	2889.26	1467.15	0.122
	Shy laggard	All-round leaders	-9223.37	1603.46	0.000*
Emissions Score	All-round leaders	Active followers	9.28	3.27	0.013*
	Active followers	Shy laggard	28.03	2.99	0.000*
	Shy laggard	All-round leaders	-37.31	3.27	0.000*

*. The mean difference is significant at the 0.05 level.

Table 3.7 the Turkey HSD result

The All-round leaders have the most number of employees that are significantly different from the other two clusters. While the size between active followers and shy laggard cannot be recognized as a huge difference at the 0.05 level.

All-round leaders have the most employees of over twice that of Active followers and almost 5 times those of shy laggards. This gives us the insight that All-round leaders are mostly the major and biggest companies operating in food and beverage industry. Suggesting they are the leaders of the industry and also in the environmental area. And these leading companies show more proactive responses to environmental issues.

While Active followers are likely to be the mid-sized firm in this industry, they are slightly lagging behind in dealing with environmental and emission issues with those of industry leaders, and their product environmental transformation is barely started. This may be due to the product transformation involving the transformation of the new design and new product line, which are too costly and financially too risky for the companies to bare at this stage. On the country to low interest in product optimization, they show more interest and make a great effort in other strategies. For example, they almost reach the same level as the leaders in governance and organizational transformation. This result shows that active followers are keeping up with the industry leaders' actions and showing the stakeholders their sense of responsibility for the climate change problem, while the production transformation could be the next move to follow. Shy laggards, however, are the smallest company in our sample. They are far behind the average level of climate friendly transformation in food and beverage industry. The potential reason can be that smaller organizations tend to lack the funds and human resources needed to commit to green supply chain management practices and are limited in their ability to acquire and implement environmental systems. (Younis and Sundarakani, 2019)

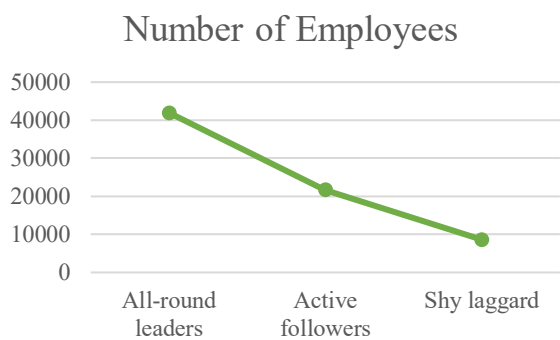


Figure 3.9 average number of employees of each cluster

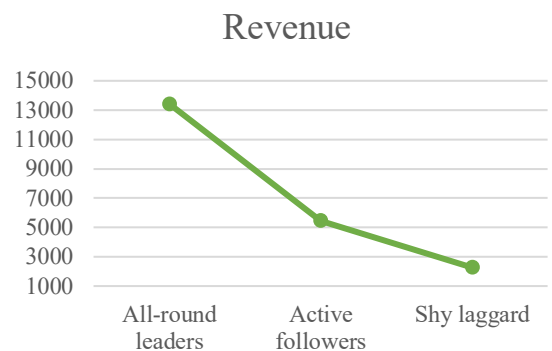


Figure 3.10 average revenue of each cluster

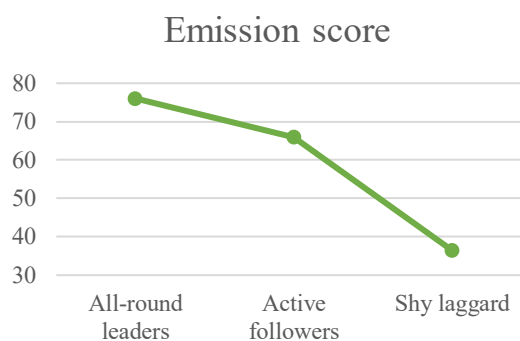


Figure 3.11 average emission score of each cluster

For the difference of revenue in each cluster (Figure 3.10), the result is rather interesting. Similar to the number of employees, only All-round leaders show a significant difference to the other clusters, while active followers and shy laggards cannot be identified with the same conclusion. And the average revenue of both active followers and shy laggards are far below the leaders. This suggests that All-round leaders are in a leading position and taking most of the market share. What's more, the gap between All-round leaders and active followers in terms of revenue is spotted as larger than the company's size. Which may suggest that followers are the companies in the expansion phase, the revenue at this stage is not so high but it has enough human and other resources that are ready for a more complicated transformation. They actively

take the same strategy as the industry leaders, and the next level of improvement could happen in product impact minimization.

The emission score (Figure 3.11), as a measure of the performance of the company's climate friendly transformation, shows a significant difference in all three clusters. This is sensible as the more strategy taken, the higher the score is. And the gap between All-round leaders and their followers is not as big as the gap with shy laggards. This may indicate that active participation in environmental action for followers has got the reward of reaching a score above the average level of the industry. And on the contrary, the shy laggards need to put more effort into the improvement of their climate impact.

3.6 Discussion

We identified three distinct clusters after analyzing the extent and tendencies of 311 food and beverage companies' implementation of their eco-friendly and carbon-neutral strategy. These three clusters display a range of unique characteristics.

Companies classified as All-round Leaders are at the forefront of the food and beverage industry, excelling not only in market share but also in environmental performance. The outstanding environmental performance of the top companies can be attributed to the resource-based theory, which suggests that larger companies have sufficient human resources and budgets necessary to invest in the transition of sustainable supply chain and the capability to implement environmental systems. And the leading company appears more in relatively highly developed regions, for environmental regulatory systems in these countries are more stringent and complete and have high green awareness among the society.

These companies engage actively in all five types of eco-friendly and carbon-neutral strategies, reflecting a strong environmental consciousness at the board level. The companies are well-aware of the risks and opportunities that come with environmental responsibility and incentivize their executives by linking their compensation to environmental performance. This emphasis on sustainability has become ingrained in the company culture, with green practices being embraced both internally and externally. The supply chain is managed through eco-friendly processes, and partnerships are sought to support and expand green operations. The All-round Leaders stand out by offering a vast selection of environmentally friendly products for consumers. These products are designed to minimize their impact on the environment, using eco-friendly materials and packaging and covering almost all aspects of the climate-friendly transformation.

However, there is still room for improvement for the All-round leaders. In order to achieve a higher level of environmental performance and reach their ultimate goal of being carbon neutral, it is necessary for them to further enhance their green transformation within the organization and adopt more carbon neutral practices.

The active followers in the food and beverage industry show that they are keeping pace with the industry leaders in terms of environmental awareness and responsibility. Despite being mid-sized companies, they are nearly on par with All-rounded leaders in terms of governance and organizational transformation. However, they lag behind in terms of product transformation, which could be a result of the high cost and financial risk involved in this process. Nevertheless,

the active followers' commitment to the environment can be seen in their efforts in other strategies. Their number of employees has reached the average level of the industry while the revenue falls relatively far behind. This suggests that they are likely to be in the expansion phase with enough resources ready for a more complicated transformation.

In conclusion, active followers in the food and beverage industry demonstrate a good level of involvement in environmental protection and have great potential in green product transformation in the future. These companies can be seen as a positive force for change in the industry, and their actions are likely to have a positive impact on the environment.

Shy Laggards are likely to be the smallest company in the sample and lag far behind in terms of their climate friendly transformation compared to other groups in the food and beverage industry. The lower average revenue and smaller size of these companies may indicate that they face a lower level of stakeholder pressure and are less motivated to make the systematic green transformation. They may have claimed a goal to achieve carbon zero but have limited ability to make significant changes to their business practices to reduce their carbon footprint.

Shy Laggards may need to increase their investment in green initiatives and allocate more resources towards reducing their carbon footprint if they have the desire to improve their environmental performance and contribute to the global carbon zero goal. The further transformation for shy laggards could start externally by enhancing the environmental performance of the supply chain to keep up with the average level within the food and beverage industry. Various other research also suggests that adopting eco-friendly practices in the supply chain can enhance product standards, reduce delivery times, and create chances to sell goods globally, even for small to medium-sized businesses. (Zhu, Sarkis and Lai, 2008; Younis and Sundarakani, 2019) Additionally, they may need to consider collaboration with other companies or organizations to share knowledge, resources, and expertise in this area.

Overall, it is important for Shy Laggards to acknowledge their role in addressing the climate change problem and take proactive steps to reduce their carbon footprint. By doing so, they can not only help mitigate their impact on the environment but also improve their reputation and competitiveness in the industry.

3.7 Conclusion

Building on the seven-step business model transformation framework outlined in Chapter 2, the key factors that contribute to the successful transition to a climate-friendly business model include a clear sustainability vision, high-level executive support and understanding of sustainable development, a company-wide culture of sustainability, collaboration in the supply chain, active communication with external sustainable partnership, a focus on continuous innovation, and the ability to balance profitability with sustainability goals. (Long, Looijen and Blok, 2018) In this chapter, we take the food and beverage industry as an example to explore the business transformation toward sustainability within the industry.

In conclusion, although the food and beverage industry has made efforts toward sustainability, there is still significant potential for growth and improvement. Our sample only represents 311 out of 2187 companies operating in this industry, meaning that over 85% of companies are not yet engaged in environmentally sustainable practices as they do not have any corporate social

responsibility reports.

Among the 311 companies that have reported their sustainable development, most companies have put forward a clear mission and vision of sustainable development as they pledge to achieve carbon neutrality by a certain time frame.

In general, companies with larger sizes tend to be more proactive in achieving their goal of carbon neutrality. The transformation process typically starts with changes in corporate governance through financial incentives to raise awareness among senior management about the significance of sustainable environmental practices. This awareness is then instilled throughout the organization, with a focus on integrating eco-friendly principles into the core values and training employees on sustainable practices. Secondly, the transformation extends to the external environment, particularly for larger companies with resources to transform their entire supply chain. A comprehensive and successful transformation in the supply chain can significantly enhance the overall environmental performance of the organization.

However, the food and beverage industry encompasses a wide range of facilities, processes, and products, and as a result, there is limited guidance from government or regulatory bodies on how to improve energy efficiency and optimize production processes. This can make it challenging for companies to adopt decarbonization technologies and make innovations in developing new, environmentally friendly products and processes. Compounding this challenge is the lack of information sharing among industry competitors, as they do not typically exchange information on sustainable product development or production process optimization. (O'Shea *et al.*, 2022) As a result, many companies are left to figure things out on their own, which can limit their ability to fully embrace sustainable practices. Our research shows that industry leaders report the most environmentally friendly products. However, many other companies have yet to initiate efforts or are not yet equipped to undertake ongoing sustainable product innovation.

While the transition process to a more environmentally-friendly business model can have positive effects on environmental performance and contribute to the global carbon neutrality goal, it is important to note that our research does not examine the financial impact of such a transformation. Further research is needed to understand the full impact of sustainable practices on the financial performance of companies within the food and beverage industry.

CONCLUSION

The global concern over the negative effects of climate change has prompted a growing focus on sustainable development to mitigate its impact. Many countries and regions have set carbon neutrality targets, but their progress toward these goals varies. Currently, the most commonly used policy tools by governments to achieve carbon neutrality are emissions trading systems and carbon taxes. The technical means of achieving carbon neutrality include the substitution of carbon-intensive products, reduction of carbon emissions, carbon sequestration, and carbon recycling.

The transition to a climate-friendly and carbon-neutral business model is crucial for mitigating the impacts of climate change and achieving global carbon neutrality. Companies undertake this transition for various reasons, such as stakeholder and institutional pressure, corporate social responsibility, and potential economic benefits. However, this transformation is not without challenges, such as the lack of economic and technical resources, as well as technological barriers to low-carbon solutions. The outcomes of this transformation and its impact on the company's economic performance are uncertain and remain a subject of debate. Nevertheless, a successful transition can significantly improve a company's environmental performance and contribute to the global goal of carbon neutrality.

Recognizing the crucial role that businesses play in achieving global carbon neutrality, it is important for companies to prioritize environmental and climate-friendly operations in order to meet societal expectations and contribute to the global goal. Achieving this requires a systematic and comprehensive transformation of their business model. To aid in this process, we propose a 7-step transformation framework, with a successful transformation starting by crafting a clear environmental mission statement and vision statement. This involves the commitment to reduce environmental impact and promote sustainability and outlines the company's goals for the future. Involving all stakeholders helps align these efforts with the company's goals and the global effort against climate change. The implementation of the strategy requires clear goals, a comprehensive plan of action, commitment and dedication from all levels of the organization, and the participation and engagement of all stakeholders. Regular measurement and reporting of environmental performance are necessary to track progress and communicate efforts to stakeholders. Transparency is critical to building trust with stakeholders and avoiding greenwashing. Finally, seeking for an external partnership to achieve greater impact and continues innovation to stand out and grow in the market.

Finally, we analyzed the sustainable transformation of business models in the food and beverage industry. Our results indicate that larger companies tend to implement these transformations more systematically and thoroughly, likely due to their abundant human and financial resources. These companies establish a clear mission for carbon-neutral development and implement diverse strategies to achieve this goal. They integrate the concept of climate friendliness into their core values, starting with the board of directors and senior management, and communicate it throughout the organization, affecting behavior from the top down. Climate friendliness and

sustainable development are integrated into the company's culture and reinforced through all activities and decision-making. By implementing a green supply chain management system, green product innovation, production line optimization, and specific carbon-neutral technologies, these companies have achieved higher environmental performance and competitive advantage, positioning themselves as leaders in sustainable development. Our advice for smaller companies looking to improve their environmental performance is to seek external partnerships to gain support and guidance in the transformation process. And strengthened climate-friendly management of supply chains may offer the solution to reach higher environmental performance and enhance their competitive advantage.

Our research presents a systematic framework for business model transformation in response to the global demand for carbon neutrality and applies this framework to the food and beverage industry. By evaluating the industry's transformation process, we determined its current status, developmental trends, and areas for improvement in the transition to sustainable business models. We also provide targeted recommendations for the future sustainability of the food and beverage industry.

The limitation of our study is that we cannot determine the effect of business model transformation on the financial performance of companies in the food and beverage industry. Future research can further examine the financial impact of business model transformation and provide a more comprehensive understanding of the relationship between sustainability and financial performance.

Appendix

The appendix lists 20 initiatives that have been identified and categorized into 5 categories, along with each initiative's definition in Eikon database.

Strategy category	Initiatives	Initiatives explanation
Product	Environmental products	The company reports on at least one environmentally friendly product or service that has a positive impact on the environment or is marketed and labeled as such.
	Environmental materials sourcing	The material used for product are environmental
	Product impact minimization	The company reports on recycling programs or product features that encourage responsible and environmentally friendly use
	Sustainable packaging	The company report includes details on environmentally sustainable packaging for the product.
Governance	Climate change commercial risks opportunities	The company recognizes that climate change can pose both commercial risks and opportunities and has taken action accordingly.
	Policy executives compensation ESG performance	The company has a compensation policy that is focused on performance beyond financial metrics.
	CSR committee	The company has a board level or senior management committee in charge of making decisions regarding their Corporate Social Responsibility strategy.
	Sustainability compensation incentives	The compensation of senior executives is tied to targets related to Corporate Social Responsibility, and Sustainability.
Organizational	Environment management team	The company has a dedicated environmental management team.
	Environment management training	The company provides training to its employees on environmental topics.
	Staff transportation impact reduction	Efforts to minimize the environmental impact of transportation used by its employees.
	Green buildings	The company has environmentally friendly or green offices or facilities.
External	Environmental supply chain management	The company employs environmental criteria in selecting its suppliers or sourcing partners.
	Environmental supply chain	The company conducts assessments of the environmental performance of its supply chain

	monitoring	partners.
	Env supply chain partnership termination	The company reports the process to terminate a partnership if partner's environmental criteria are not met.
	Environmental partnerships	The company reports on partnerships or initiatives with specialized NGOs, industry organizations, government or supra-government organizations, focused on addressing environmental concerns.
Carbon neutral	Goal setting	The company has established targets or objectives for reducing emissions.
	Emissions trading	The company reports on its participation in any ETS.
	Internal carbon pricing	The company have an internal carbon price
	Energy efficiency	The company has a policy promoting efficient use of energy and continuous improvement.

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