Bachelor Programme in Economy and Society

Department of Economic History

Transitioning Towards Net-Zero Emissions While Staying Competitive - Is BASF Capable Of Doing So?

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The chemical industry stands as a critical player in the global effort to combat climate change and achieve environmental sustainability. As the world is getting closer to crucial temperature thresholds, the need for decarbonisation becomes increasingly urgent. Thus, this paper focuses on BASF as the biggest chemical company in Germany but also globally and the German chemical industry in general, which holds a prominent position in the nation's economy, to explore how it can transition towards net-zero emissions while remaining competitive. By analysing industry data and conducting qualitative interviews with sustainability managers from BASF, this study aims to assess current progress, identify challenges, and propose viable strategies for a sustainable future. Through collaboration and innovation, the German chemical sector can play a leading role in realising climate goals while maintaining its economic strength. Findings indicate that regulations and frameworks set out by the European Commission need to be further developed in order for companies such as BASF to continuously become more sustainable.

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List of Abbreviations

AI	Artificial Intelligence
BASF	Badische Anilin- und Sodafabrik
CCS	Carbon Capture and Storage
CDR	Carbon Dioxide Removal
Cefic	European Association for the Chemical Industry
COP	Conference of the Parties
CSS	Chemicals Strategy for Sustainability
ETP	European Technology Platform
EU	European Union
EU ETS	European Union Emissions Trading System
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-Governmental Organisation
KPIs	Key Performance Indicators
OECD	Organisation for Economic Co-operation and Development
R & D	Research and Development
R & I	Research & Innovation
SDGs	Sustainable Development Goals
SME	Small and Medium-Sized Enterprise
SSbD	Sustainable by-Design
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America

1. Introduction

The global focus on sustainability is rapidly increasing, driven by the alarming escalation of wildfires, rising sea levels, and extreme weather events fueled by climate change. These challenges underscore the urgent need to reduce greenhouse gas (GHG) emissions and ensure responsible management of natural resources.

Several countries have made significant strides in reducing their GHG emissions. Germany, for instance, decreased its GHG emissions by 39% since 1990 and aims to achieve carbon neutrality by 2045. However, this goal poses a considerable challenge for industries like the chemical sector, which are vital to the economy but face difficulties in transitioning to sustainable practices.

The recent conflict in Ukraine has exposed vulnerabilities stemming from Europe's reliance on Russian energy imports, resulting in soaring energy prices. This has prompted companies such as BASF, heavily reliant on energy for production, to seek alternative solutions to remain competitive and meet emission reduction targets. Germany stands to benefit from embracing new technologies and fostering the development of value chains, such as the green hydrogen sector, which holds promise for sustainable growth.

The impact of climate change is becoming increasingly evident in Germany, with a notable rise in the number of days exceeding 30°C since 1951. A severe drought in 2022 caused the Rhine's water levels to plummet, disrupting crucial shipping routes and exacerbating supply chain bottlenecks, hindering post-pandemic industrial recovery. Regions like the South, Southwest, and East of Germany, where major industrial players like BASF are situated, are expected to see the highest frequency of climate extremes, posing significant challenges to biodiversity, agriculture, and water management (Krill et al., 2023).

The chemical industry plays a crucial role in mitigating climate change and maintaining environmental sustainability, making the shift to net-zero emissions an imperative effort. In the Paris Agreement, members of the United Nations Framework Convention on Climate Change

(UNFCCC) pledged to keep the increase in global temperatures well below 2 degrees Celsius over pre-industrial levels, with a 1.5 degree Celsius target in mind. Even the 2-degree Celsius goal could be surpassed by 2050, though, if global GHG emissions are not substantially lowered. The global mean temperature near the surface between 2012 and 2021 could possibly already have been 1.11–1.14 degrees Celsius higher than it was prior to industrialisation, according to recent data, making it the warmest decade on record. During the same period, land temperatures increased much more quickly across Europe, rising by 1.94 to 1.99 degrees Celsius (European Environment Agency, 2023).

According to predictions, the yearly mean temperature near the surface between 2023 and 2027 may exceed the 1850–1900 average by 1.1–1.8 degrees Celsius (World Meteorological Organization, 2023). At some point between 2030 and 2052, the planet may cross the 1.5 degrees Celsius threshold, according to the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5 degrees Celsius warming (IPCC, 2018). This timeframe was reduced to the early 2030s in a 2021 prediction made with a different approach, highlighting the pressing need to attain the peak of global GHG emissions before 2025. Thus, in order to ultimately protect the Earth for future generations, achieving net-zero emissions and making a positive impact on the environment would require collaborative and innovative efforts across all sectors, but specifically the chemical sector, considering its high energy consumption.

In 2022, industry and fossil fuels contributed 37.15 billion metric tonnes ($GtCO_2$) of carbon dioxide emissions into the atmosphere. Global CO2 emissions have climbed by about 60% since 1990 (see figure 1). China is the country that contributes the most to global GHG emissions, followed by the United States of America (USA). Although China was not previously the largest emitter in the world, in recent decades, its emissions have skyrocketed due to fast economic growth and modernisation. China's CO2 emissions have surged by around 400% since 1990. In contrast, CO2 emissions in the USA have decreased by 2.6%. Even so, the USA continues to be the world's largest carbon polluter (Statista, 2023).

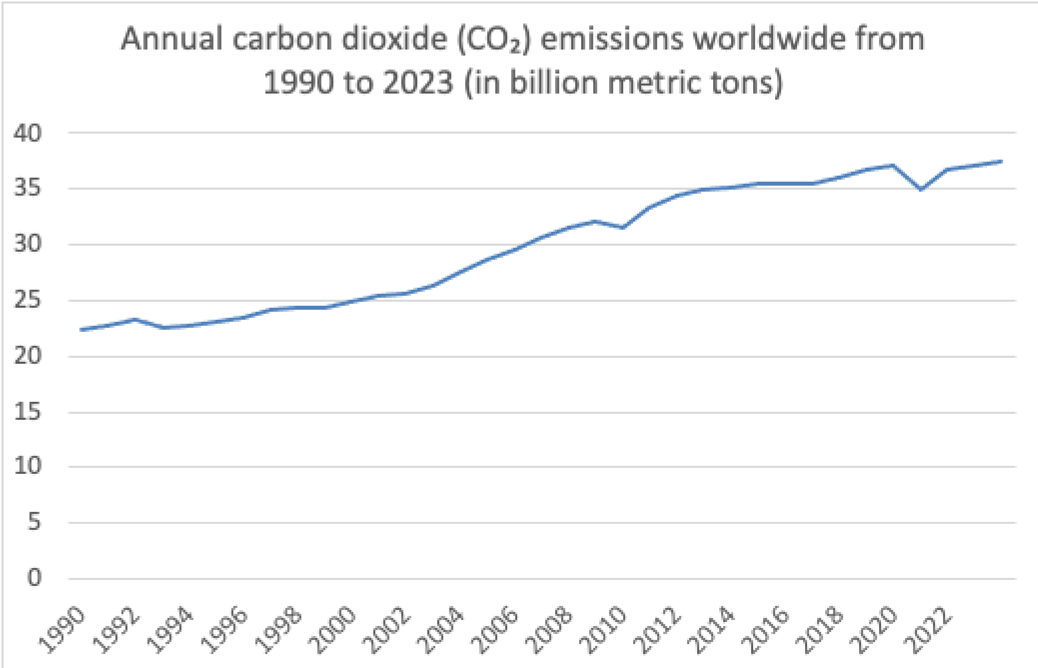

Figure 1: Annual carbon dioxide (CO_2) emissions worldwide (in billion metric tons) from 1990 to 2023 (Statista, 2023)

In the case of Germany, chemicals and pharmaceuticals, after automotive and machinery and equipment, make up the third largest industry with a 2021 turnover of €227.1 billion and 2,228 companies as of 2021 (Cefic, n.d.). All sectors of the German chemical industry—basic inorganics, petrochemicals, polymers, agrochemicals, specialities, cosmetics, and pharmaceuticals—are strong. It is also widely distributed nationwide, with some areas concentrating more on specialisations or medicines and others more on basic chemicals. Most people may be unfamiliar with these chemicals but they are crucial for the production of everyday products such as cosmetics, cleaning products, car parts, pharmaceuticals, etc.

Up until 2021, energy consumption in the chemical sector in Germany has been fluctuating but has been on the rise in the later years, as can be seen from Figure 2. However, the Russo-Ukrainian war and the subsequent energy crisis made 2022 an especially challenging year for the German chemical industry with its enormous dependency of Russian oil and gas. Germany's industry is currently facing significant challenges due to significantly higher costs of energy and rising prices for inputs and raw materials. As a result, production and energy consumption decreased again leading expenses to increase more rapidly than sales prices (Cefic, n.d.).

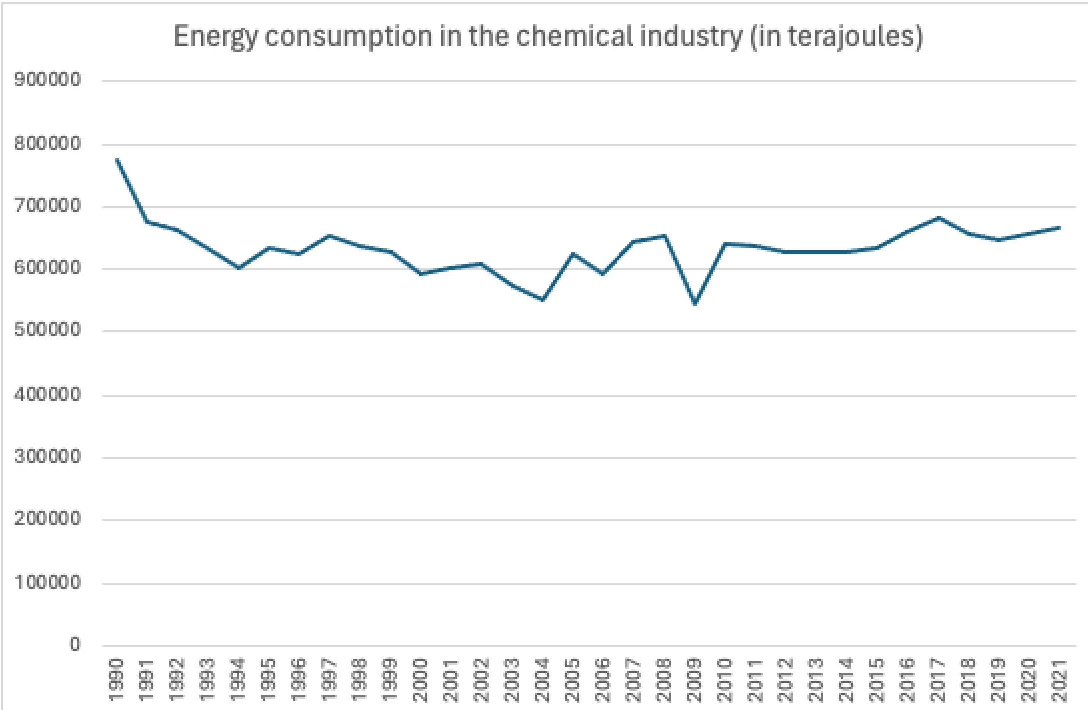

Figure 2: Energy consumption (in terajoules) in the German chemical industry from 1990 to 2021 (Verband der Chemischen Industrie, 2024)

1.1 Research Question

When an economy or business reaches net-zero emissions, it indicates that it either produces no GHG emissions at all or balances its emissions in some other way, such as by planting trees or using technologies that absorb carbon before it is released into the atmosphere. Over 120 countries worldwide have committed to reaching net-zero emissions by 2050, including Germany (Government of Canada, 2024).

The purpose of this thesis is to examine the impact that the chemical sector faces from the pursuit of GHG neutrality. In particular, the study looks at how BASF, one of the largest chemical firms globally, intends to meet its climate targets. The study looks into the experiences of a chemical firm and evaluates the new rules implemented as a result of the net zero emissions objective. The study discusses the potential and difficulties that climate neutrality brings to the chemical industry, as well as the ways in which it may affect laws and regulations. This study essentially examines how the regulatory environment controlling the chemical industry is affected by climate legislation, as well as the adaptation techniques that a corporation uses to deal with these changes.

The research question to be answered in this study is the following:

Main Research Question:

How can BASF transform towards net-zero CO2 emissions while staying competitive?

An extensive analysis of this ambitious goal and all of its constituent parts will be carried out in order to properly analyse the question. The European Transition Pathway for the Chemical Industry, a European Union (EU) strategy document will be introduced to understand the background of the new regulatory changes that were introduced during the 'Green Deal' which have a particularly high impact for companies, specifically for companies within the chemical sector. To understand how chemical companies are supporting this framework set out by the European Commission at the beginning of 2023, this thesis will analyse the case study of BASF.

The chemical sector is a significant contributor to GHG emissions and resource consumption. Therefore, BASF, as a major player, is committed to the transformation towards sustainable production and practices and to supporting the European Transition Pathway for the Chemical Industry. The company has set high standards on the path to climate neutrality and is working hard to reach net zero CO2 emissions globally by 2050. Furthermore, its goal is to cut its global GHG emissions by 25% by 2030 in comparison to 2018 levels. BASF also intends to accomplish this goal even with deliberate expansion and the establishment of a sizable facility in Southern China. By the end of this decade, CO2 emissions from the current business should have been reduced by half, excluding the effects of the anticipated growth. They also aim to lower their emissions by 2030 in relation to the products and services they buy from their suppliers. Thus, the company can be reasonably regarded as a representative player within the industry because it is both the largest chemical company in Germany and the largest in the world, as of 2021, (GlobalData, 2021).

1.2 Research Aim

This research offers a thorough examination of the Transition Pathway for the Chemical Industry in its entirety as well as the regulatory implications for the EU, particularly Germany's, chemical industry. It looks at how a business in this sector has dealt with the recent legislative changes in an effort to provide insight into the challenges and opportunities brought about by the net-zero transition. The research's conclusions will, in general, have a big impact on how chemical corporations and legislators manage this regulatory framework's complexity.

Moreover, it aims to investigate the multifaceted challenges and opportunities facing BASF in its endeavour to achieve net-zero CO2 emissions while ensuring its sustained competitiveness in the global market. Through a comprehensive analysis of internal and external factors, including technological innovations, regulatory frameworks, market dynamics, and stakeholder engagement, the research seeks to develop actionable strategies and recommendations for BASF to navigate the transition towards carbon neutrality effectively. By addressing the intricate balance between environmental sustainability and economic viability, the study aims to contribute to the discourse on corporate sustainability initiatives and provide insights applicable to both BASF and other industry players striving for similar transformations.

However, it is essential to acknowledge the potential limitations of this research, which include the following: the EU Chemical Industry Transition Pathway is a framework which is relatively new, and as such, it may undergo minor modifications in the months or years ahead; also, this study is limited to a single firm, whose experiences and challenges may not be compared to other firms in the same industry. The legislative publications that were available were employed in this analysis, which was carried out in the spring of 2024. However, additional articles may appear later, which could affect some of the analysis' conclusions. Furthermore, despite the preferred company, BASF, a chemical company that is thought to be representative of this industry due to its size, share of the market in comparison to competitors, use of renewable energy, and sustainability agenda, its experiences with this framework and its implementation may be limited. Businesses in related as well as unrelated economic sectors may have varied implementation experiences and unique needs related to their economic activity.

1.3 Thesis Structure

This thesis consists of the following main sections: introduction, literature review, theoretical framework, methodology, analysis and discussion/conclusions.

By stressing sustainability in the EU and outlining the European Transition Pathway for the Chemical Industry as a framework for advancing sustainable development, the introduction motivates the research topic. The reason behind selecting the chemical industry is supported, and the research goal is outlined, providing the foundation for the primary research inquiry. The literature review gives a general overview of the chemical industry's CO2 net-zero emission aim, including its history, particular objectives, and components. It presents the German chemical industry's net-zero CO2 emissions target, explores its implications, and outlines its several sub-goals. It also describes the importance of the chemical industry in the EU, since most products involve chemicals in one form or another. The policy implementation theory is introduced in the theoretical framework part, along with its significance for comprehending the actual execution of the Regulation. Interviews with BASF employees who are subject matter experts are used to describe the qualitative case study methodology used in the thesis. The analysis part digs into the case of German chemical giant BASF and examines the ramifications of the net-zero emissions objective inside this industry. It focuses on examining the (sustainability) reports of BASF, pinpointing and evaluating the main obstacles to reaching the net-zero emissions target: time limits, interpretation problems, and the categorisation of transitional economic activity. The results of the investigation are then seen through the lens of policy implementation theory. Ultimately, recommendations for upcoming enhancements to the European Transition Pathway are derived from the analysis results. Furthermore, the research's consequences for businesses, legislators, and stakeholders are examined. The limits of the study are acknowledged, and recommendations for more avenues of investigation are provided.

2. Literature Review

The chemical industry plays a crucial role in the global economy by producing a large number of employment and contributing significantly to GDP. This industry has the potential to grow significantly and is expected to reach 2.5 times the current level by 2050 if emissions reduction is given priority. It might also be extremely important in helping other sectors make the switch to net-zero emissions, since many other industries rely on it both directly as well as indirectly. The chemical sector may achieve extraordinary growth and efficiently regulate its GHG emissions (Scope 1-3) in compliance with the Paris Climate Agreement, according to the Center for Global Commons at the University of Tokyo & Systemiq (2022). The European Commission (2023a) has put forward a transition path designed especially for the chemical industry to achieve these positive outcomes, called the 'Transition Pathway for the Chemical Industry'.

In order to address the research issue and conclude the thesis, a number of essential works of literature will be used as secondary data. These consist of studies about the relationship between transforming towards net-zero emissions in the chemical industry and remaining competitive. To explore this correlation, a literature search was conducted in Google Scholar, ScienceDirect and Jstor for the following keywords: 'net zero emissions', 'chemical industry', and 'Germany'. The period under consideration ranged from 2020 until 2024. According to Google Scholar results, about 17,300 articles on this topic have been published within this period. In comparison, searches on ScienceDirect and Jstor yielded a total result of 5,369 and 160 articles, respectively. These search results firmly demonstrate that during the past four years, collaboration between the chemical sector and the scientific community has been fostered by the pressing need to solve the issues posed by global climate change. It can be challenging to determine whether an article is trying to find a way to cut emissions or if the term "net zero" is just being used as a buzzword, but it is safe to say that both academia and industry are deeply aware of the need for such solutions. However, according to Kloo, Nilsson and Palm (2024) as of yet, the European chemical sector lacks a coherent and cohesive vision for achieving net-zero emissions. These primarily concentrate on supply-side solutions, such as the use of 'Carbon Capture and Storage' (CCS), converting to biomass, capturing CO2, or recycled plastics as fuel, as well as altering energy sources. Thus, the authors claim that less research has been done on ways to lower demand, like material substitution and efficiency or avoiding specific usage. Similarly, Canal Vieira, Longo and Mura (2021) claim that in order to achieve net-zero CO2 emissions by 2050, more policies that help installations that have not yet begun their decarbonisation pathway and are specifically aimed at super-polluters would be needed. On the contrary, Saygin and Gielen (2021) highlight the significance of renewable energy-based solutions, which, as opposed to earlier projections, account for more than half of the potential for total emissions reduction.

Mengis et al. (2022) predict that by 2050 Germany will achieve net-zero CO2 emissions mainly by avoiding CO2 emissions completely by employing the three strategies of emissions avoidance, reduction, and removal. In addition, using innovations such as ‘carbon dioxide removal’ (CDR) will have helped them achieve their goal of reaching net-zero CO2 emissions by 2050.

2.1 The Transition Pathway for Chemical Industry

2.1.1 Background of EU Climate Neutrality

Through the 2015 Paris Climate Agreement, the international community committed to keeping global warming in the 21st century to far below two degrees, preferably to no more than 1.5 degrees (United Nations, 2015). In order to accomplish this, the world's CO2 emissions must be cut by 80–95% by 2050, which will lead to a thorough decarbonisation of the economy. The European Green Deal and the EU Action Plan on Financing Sustainable Growth represent the EU's aggressive pursuit of these climate goals (Fetting, 2020; European Commission, 2018). By 2030, GHG emissions must have decreased by at least 55% from 1990 levels if Europe is to become climate-neutral by 2050 (Fetting, 2020). Redirecting investments towards sustainable projects and activities is essential to achieving the EU's 2030 energy and climate targets, as well as the European Green Deal proposal (European Commission, 2018).

But what does the word "sustainable" actually mean? Prior to the Transition Pathway for the Chemical Industry’s adoption, there was no widely recognised definition supported by a definite and quantifiable set of standards. As a result, it is now evident that a common language and a precise definition of "sustainable" are required. For this purpose, the Transition Pathway was developed as a guideline to among other things define ‘sustainable competitiveness’.

One of the several transition pathways that the European Commission has suggested is the one for the European chemical industry. BASF, via Cefic (its European trade association) has been working with the European Commisison on the Transition Pathway for the Chemical Industry since Spring 2022, in order to find a more coherent and coordinated way through the many requirements of the European Green Deal and the Chemical Strategy for Sustainability (CSS) in particular. The method of co-development yields a set of subjects and directives that each of the participating parties must carry out. Although it was released in January 2023, it wasn't until later that year that it came into effect (European Commission, 2023).

Its goal is to assist European industry in making the transition to digital and green technologies, i.e. it gives industry a compass and helps to keep track of its ultimate goal: to achieve the double twin transition, meaning to become digital, circular, CO2 neutral and to produce more sustainable chemicals while remaining competitive and resilient. The document presents the important subjects and activities in the form of a three-part roadmap: the regulatory roadmap, the action-oriented roadmap, and the technology roadmap (European Chemical Transport Association, n.d). By listing all the legislative proposals and initiatives on one chart with a timetable in the regulatory roadmap, the Transition Pathway for the Chemical Industry gives industry clarity, also by differentiating short, medium (2030) and long term (2050) measures. Eight "building blocks" make up this system (Cefic, n.d.):

- Sustainable competitiveness
    - This building block looks at the new issues facing the business, such as heightened global competitiveness and growing feedstock and energy costs. These tendencies affect chemicals, but they also have an effect on value chains and the economy as a whole in the EU. The EU has pledged to establish a business environment that enables the industry to develop sustainable solutions in Europe and beyond through the Chemicals Strategy for Sustainability (CSS). This takes into account international frameworks that support cogent policies and actions in addition to enforcing uniform regulations and levelling the playing field with additional EU players.
- Investments and funding
    - The chemical industry's shift to a circular economy depends on research and innovation (R & I). Investing in unique solutions requires overcoming a few major obstacles. Investors, businesses, and issuers can obtain clear and trustworthy information on environmental sustainability through the EU taxonomy and Safe and Sustainable by-Design (SSbD) framework. This building block requires investment schedules that account for the industry's lengthy

investment cycles as well as the requirement for pilot and demonstration plants, along with an action plan to facilitate the conversion or replacement of current assets with more sustainable alternatives.

- R & I, techniques and technological solutions
    - The proper solutions could avert 38% of predicted emissions from current equipment in energy-intensive industries if they can make it onto market in time for the upcoming 25-year refurbishment cycle, which begins around 2030 (IEA, 2021). This is a once-in-a-generation chance to change the course of history. A well-supported R&I policy agenda must be used to develop and scale up new processes and technological solutions for the EU chemical sector. The policy agenda ought to be directed by the ideas of co-creation, diffusion, updating, transformation, and directionality. Nonetheless, different approaches are required to deal with the various R&I phases.
- Regulation and public governance (legislation)
    - A successful transition is mostly made possible by regulation. Securing and attracting investment in Europe will require improving the predictability and consistency of laws.
- Access to energy and feedstock
    - The difficulty of both direct and indirect emissions must be addressed if the EU is to achieve its goal of being climate-neutral by 2050. The chemical industry will need to switch from using primarily fossil fuel-based feedstock to alternatives like green hydrogen, renewable energy, waste, biomass, and collected CO_2 in order to meet the climate goals. Massive volumes of low-carbon electricity will be needed for the sector's direct and indirect electrification. In the meantime, rival industries will fight for the same resource, and if it becomes scarce, prices run the danger of not being competitive and sustainable. Thus, the shift must be supported by a well-defined strategy for using renewable energy sources as well as easy access to feedstock and raw materials.
- Infrastructure
    - For the chemical sector to have access to renewable energy sources and circular resources, it is imperative that the required infrastructure be deployed. In addition,

this will enhance integration within industrial clusters and promote industrial symbiosis by facilitating the transportation, storage, and capture of CO2 from emitting facilities. Conversely, lengthy regulatory processes at the Member State level and a lack of infrastructure surrounding some industrial locations may impede this development.

- Skills
    - Small and medium-sized enterprises (SMEs) in the chemical sector run the risk of losing workers after completing vocational training due to their restricted ability to upskill and reskill their personnel. Workers in the industry, particularly those in SMEs, can benefit from chances to map current and developing skills through partnerships and programmes like the EU Pact for Skills. In order to speed the development of safe and sustainable chemicals and materials as well as integrate digital technologies like artificial intelligence (AI), blockchain, and robotics into industrial processes and product design, the chemical sector will also need to establish a sizable talent pool with the necessary capabilities.
- Social dimension
    - People must come first in the shift to a circular economy, and those who will confront the biggest obstacles must be supported. The EU Digital Strategy and the European Green Deal are intended to assist affected industries, workers, households, and consumers. Given its reputation for high-calibre employment and a highly qualified labour force, the chemical sector needs to put worker safety, regional unity, and advancing gender equality and diversity as top priorities. The industry's dedication to worker health is demonstrated via the Responsible Care initiative. There may be employment changes and a reallocation of assets and labour throughout the transition, therefore there needs to be enough planning ahead of time and socially responsible restructuring.

Stakeholders have identified a set of actions for each topic listed under the corresponding building block, along with a timeline for implementation that can be short-, medium-, or long-term. The short-term activities are denoted by the letter "S," the medium-term activities by the letter "M," and the long-term activities by the letter "L," which denotes activities that should begin and be finished by the year 2050.

2.1.2 The EU Green Deal

To better understand the context of the Transition Pathway for the Chemical Industry, it is essential to know how it fits within the broader Green Deal in the EU. The European Green Deal consists of a set of proposals to make the EU's climate, energy and taxation policies fit for reducing net GHG emissions by at least 55% by 2030, compared to 1990 levels, also known as the 'Fit for 55' legislation (European Commission, n.d). The Transition Pathway for the Chemical Industry, on the other hand, is the response to the European Green Deal from the chemical sector and can be seen as a framework established in collaboration with the European Commission, in order to reach this climate goal, as well as other goals.

2.1.3 Goals of the Green Deal

With the goal of becoming the world's first climate-neutral continent, Europe has made a number of promises to itself that serve as the foundation for this revolutionary shift. Among these pledges are the previously noted reduction of GHG emissions by at least 55% by 2030, as well as the elimination of net GHG emissions by 2050, the decoupling of economic growth from resource usage, and the guarantee that no person nor place is left behind in this transformation.

The European Green Deal as a whole includes the Green Deal Industrial Plan. The necessity to significantly accelerate technological advancement, production, installation, and manufacturing of net-zero products and energy supply in the upcoming ten years, as well as the value added of an EU-wide approach to jointly face this issue, serves as the foundation for the Plan. The worldwide rivalry for competent workers and raw supplies makes this more challenging. By concentrating on the areas in which Europe can have the most impact, the Plan seeks to resolve this contradiction. Through a combination of diversification and internal development and production, it also aims to reduce the possibility of substituting its reliance on Russian fossil fuels with other strategic dependencies that might obstruct its access to vital technologies and inputs for the green transition. By concentrating on the areas in which Europe can have the most impact, the Plan seeks to resolve this contradiction. Through a combination of diversification and internal development and production, it also aims to reduce the possibility of substituting its reliance on Russian fossil fuels with other strategic dependencies that might obstruct its access to vital technologies and inputs for the green transition. The Plan will support current initiatives to modernise industry under the EU Industrial Strategy and the European Green Deal. Energy-intensive industry modernisation and decarbonisation, as well as facilitating employment transitions and creating high-quality jobs through education and training, continue to be important priorities (European Commission, 2023b).

2.2 The EU Chemical Sector

Examining the chemical sector's historical relevance for Europe's economic expansion can help us better appreciate the sector's importance within the EU. Homburg et al. (1998) examine the connection between Europe's economic expansion and the chemical sector. The writers claim that Europe is the birthplace of the contemporary global chemical industry. The European chemical industry had a tremendous impact on economic development, the production and control of science and technology, as well as the transformation of living and working conditions, from the middle of the nineteenth century until the start of World War I.

Similarly, Behun et al. (2018) observed the impact that the manufacturing industry has on the economic cycle of EU countries and found that production and sales in the manufacturing sector behave as concurrent indicators in the majority of countries; shifts in any of these metrics virtually instantly translate into an increase or decrease in GDP. It has been demonstrated that labour market indicators are delayed cyclical indicators. The amount of hours spent in the industry, employee compensation, and employment are all significantly impacted by shifts in the nations' economic progress.

The EU is committed to changing its economy to be more sustainable, effective, and competitive, as evidenced by the adoption of the Transition Pathway for the Chemical Industry and the European Green Deal (European Commission, 2018). To do this, a number of economic reforms must be put into place, including decarbonising the energy system, establishing a circular economy, and stopping the loss of ecosystems and biodiversity. By establishing both long- and short-term goals and putting supportive policies in place, the EU has led the world in the deployment of renewable energy for more than 20 years, according to the International Renewable Energy Agency and the European Commission (2018). While the region's use of renewable energy increased significantly as a result, from 9% in 2005 to over 21% in 2021, the majority of energy still comes from the combustion of fossil fuels, which emits GHGs into the atmosphere and contributes to climate change (European Commission, 2018; European Environment Agency, 2023).

When the EU's main economic sectors were ranked according to their GHG emissions, the manufacturing sector—which includes the chemical industry—accounted for 23% of the emissions, followed by the power and gas supply sectors, which accounted for 21% (Eurostat, 2022). This illustrates both the serious risk that the chemical sector can represent to the environment and the enormous influence that good shifts towards more environmentally friendly practices can have on the EU. Thus, achieving the EU's determined climate and energy targets—namely, raising the share of renewable energy sources in the total energy mix and conserving energy through efficiency upgrades—could greatly lower GHG emissions and their effects. In a similar way, the EU has depended significantly on imported energy. Russia's invasion of Ukraine brought to light the EU's reliance on imports of fossil fuels and their price volatility, which led to a rapid rise in energy prices and energy insecurity (European Environment Agency, 2023). The need for a rapid energy transition has grown due to the enormous amount of GHG emissions and the ongoing energy crises. Energy conservation and a quick shift to more dependable and reasonably priced renewable energy sources are essential to addressing these issues.

3. Theoretical Framework

3.1 Policy Implementation Theory

A new law, policy, or framework, like the EU Transition Pathway for the Chemical Industry, will only be successful if it is executed appropriately, regardless of its intended purpose. Due to the fact that policies might not be carried out exactly as planned, it is crucial to ensure their implementation and understand how they function (Mthethwa, 2012; Seraw & Lu, 2020).

A number of goals and actions are set out in policies. Policies are often modified and interpreted during implementation as they face the real challenges of execution (OECD, 2000). However, due to a variety of circumstances, some of which are without the policymakers' control, its implementation is frequently unpredictable and liable to change over time (Mthethwa, 2012; OECD, 2000). Policy implementation is thought to be one of the most difficult phases of public policy development, with a gap between what is intended to be implemented and what is actually done, according to Seraw and Lu (2020). Scholars and policymakers frequently overlook the implementation of policies due to their complexity, political sensitivity, and several obstacles that impede the process (Seraw & Lu, 2020).

In the end, a policy's success or failure is determined by a number of variables, such as crucial capacity, political backing, adequate funding, stakeholder analysis, strategic implementation planning, and efficient organisational and accountability systems (Cerna, 2013; Seraw & Lu, 2020). Political factors can include factors such as weak political support and lengthy approval processes. Conversely, inadequate management structures and low policy viability are traits of analytical competence and operational capacity, respectively (Seraw & Lu, 2020).

In essence, according to Seraw and Lu (2020), the success or failure of a policy hinges on a variety of factors. These factors, such as policy objectives, resources, implementing agency characteristics, and external economic, social, and political influences, collectively determine whether a policy achieves its intended outcomes. Cerna (2013) expands on this, emphasising the complexity of policy implementation and the need to consider multiple approaches to understand it fully.

This thesis applies the concept of policy implementation to analyse how the chemical sector is navigating its goal of achieving net-zero CO_2 emissions. By focusing on BASF, a prominent player in the industry known for its size and significant investment in renewable energy, the study aims to uncover any disparities between regulatory requirements and actual implementation practices within the company.

4. Methodology and Data

4.1 Research Design

The investigation of more intricate and subtle phenomena that are difficult to quantify—such as the experience and difficulties faced by a chemical company in adjusting to regulatory changes brought about by the Transition Pathway for the Chemical Industry—can be facilitated by the use of a qualitative case study approach, which presents a promising in-depth method for studying this topic (Creswell, 2013).

The purpose of the study was to contribute to the existing theoretical framework within policy implementation theory. However, one must note that the study's conclusions only apply to this specific organisational context and do not deduce any generalisations to other chemical companies aiming to reach net-zero CO2 emissions (Yin, 1989). The thesis design incorporates a case study of a German chemical company using semi-structured interviews. A case-study approach was chosen to explore a specific situation while being mindful that it might not apply to other contexts.

4.2 Research method

In order to present the given relationship between the theory and the phenomena within this paper, a deductive approach has been used. A deductive approach has its beginning in an established theory or in generalisation and seeks to determine if the theory applies to specific instances (Hyde, 2000). The theory is perceived as guiding the research within a deductive approach, and is generally subscribed to a quantitative research approach, due to that it commonly tests theories (Bryman and Bell, 2011). Furthermore, the deductive approach is useful and appropriate within qualitative research as it investigates beyond the existing theories (Hyde, 2000; Azungah, 2018). The approach therefore suits this research, as a deductive approach collects data from an existing theory with the aim of finding new insights (Azungah, 2018). The deductive approach drives the process of gathering data and it is therefore crucial to how the data are gathered (Bryman and Bell, 2011). This research has conducted a pre-study followed by semi-structured interviews that will be explained in the following sections.

4.3. Data collection

Semi-structured interviews with German chemical manufacturer BASF were used to gather primary data. Because they permit open-ended and follow-up inquiries, semi-structured interview questions are useful (Bell et al., 2022). As a result, although the interviews are extensive, they are also open-ended. Every interview took place between April 16 and April 29, 2024, and lasted anywhere from 15 to 30 minutes. Even though the study might have benefitted from more interviews, four interviews were manageable in terms of both reach and time. Three face-to-face interviews took place, and one interview took place through Microsoft Teams as that person was unable to meet in person. Before the interviews, a consent form explaining the study's goal, the participants' role, and the anonymity of the interviews was sent out.

Determining the appropriate number of participants for interviews hinges on several key considerations. These include the nature of the research question, the type of data to be collected, and the available resources. While there does not exist a fixed number, one guiding principle is to halt interviews when no new insights or different participant behaviours emerge (Merriam and Tisdell, 2015).

Predicting this beforehand is challenging, but according to Patton (2015), setting a minimum sample size initially can be helpful. The complexity and specificity of the research, as well as its alignment with established theories, can influence the required participant count (Malterud et al. (2015). Smaller, tightly focused studies based on well-established theories may necessitate fewer participants.

There are drawbacks to both smaller and larger sample sizes. With a small sample, the concern is whether theoretical saturation will be achieved, while with a larger sample, the focus shifts to the feasibility of analysing and reporting in-depth findings (Marshall et al., 2013). In the case of this study, the author set a minimum sample size of four participants. If no significant variation in responses occurred after the fourth interview, additional participants would have been sought. However, it was determined after the fourth interview that a larger sample size was not necessary.

4.4 Execution of the Interviews

The interviews were conducted in person as well as via Microsoft Teams and transcribed manually. Research has demonstrated that, although in-person interviews are preferable, participants derived numerous advantages from using Zoom or other online platforms for interviews. For instance, it was easier to contact the sample and the costs were relatively low (Gray et al., 2020; Archibald, et al., 2019). According to Mirick and Wladkowski (2019), participants experience a sense of connectedness, solidarity, and validation from both the researchers and the digital world. However, conducting interviews online can also provide technical challenges, such as programme installation issues or lagging in audio, sound, or video (Mirick and Wladkowski, 2019). In addition, a potential issue may arise from the interviewer and interviewee constantly interrupting one another (Archibald et al., 2019). As a result, the author of this paper made sure to test the technology before performing the interviews and took these constraints into account.

Participants were contacted via email and provided with details about the interview duration, the study's purpose (BASF's net-zero CO2 goal), and assurances of data confidentiality (Bryman and Bell, 2011). They were asked to select a convenient time, allowing them to consent without pressure. This transparency helps participants understand why they were chosen and the interview's purpose (Bullock, 2016).

The Interviewer began by restating the study's purpose, confirming recording consent, and addressing any participant questions (Bullock, 2016). To establish rapport, they started with casual conversation before delving into probing, follow-up, and interpreting questions (Bryman and Bell, 2011). Probing questions sought detailed responses, avoiding yes/no answers (Bryman and Bell, 2011). Follow-up questions sought clarification or expansion on specific points (Qu and Dumay, 2011). Interpreting questions ensured mutual understanding (Bryman and Bell, 2011). The interviews concluded with gratitude and assurance of further contact if needed, with recordings securely stored for transcription after the interview had ended.

4.5 Data Analysis

Following the completion of the interviews, the next step involved analysing the responses provided by the participants. In qualitative descriptive studies, researchers often utilise coding techniques associated with grounded theory, which is a widely recognised analytical approach (Bryman and Bell, 2011). Grounded theory, initially proposed by Glaser and Strauss in 1967 outlines a systematic process for analysis. However, over time, various perspectives on the application of grounded theory have emerged (Walsh et al., 2011), leading to diverse interpretations. In the coding process, researchers sift through the data to identify emerging patterns, assign labels to these patterns, and explore their interrelationships. This step is crucial for highlighting the key topics present in the data, as readers typically do not have access to the complete dataset. Therefore, it is essential to choose descriptive labels that accurately represent the identified patterns (Martin and Gynnild, 2011).

In this study, the researcher maintained a research diary and recorded each interview. Subsequently, the data were segmented into codes, grouped into categories, and further synthesised into overarching themes.

4.6 Ethical Issues

When conducting research, ethical responsibilities are essential, particularly in interview settings where the researcher has a duty to ensure the well-being of the interviewees. Ethical considerations centre around the role of values in the research process and potential concerns, including participant treatment, consent, anonymity, and honesty (Bryman and Bell, 2011). To address these concerns, the researcher made it clear to the participants that they could withdraw from the interview or decline to answer any questions if they felt uncomfortable at any point in time. Moreover, the importance of maintaining participant confidentiality was stressed at the beginning of each interview session, with participants agreeing to be identified only by assigned letters in the final study. However, it is important to note that while participants remained anonymous to the broader audience, they were known to the researcher due to the convenience sampling method used, where at least one researcher was familiar to the participants. Despite this, none of the participants raised any objections, and the establishment of trust between the researcher and participants was fostered by the participant's awareness of their ability to end the interview at any time.

4.7 Data Limitations

When performing a qualitative case study, there are a number of validity and reliability-related restrictions that must be acknowledged. Since open-ended questions are a part of semi-structured interviews, there were some differences in the format and follow-up questions between the interviews. This makes it more difficult to compare the different interviewees' answers and get a full understanding of the sample's overall perspective.

Diffusion of treatment or group cross-contamination is another issue related to internal validity (Creswell & Creswell, 2018). The first interviewee suggested the second interviewee, whereas the third interviewee suggested the fourth interviewee. For example, this raises the possibility of unintended consequences when the representative recommends staff members who have the same views on the subject (Emerson, 2015). However, given that the recommendation was made before the interview subjects were informed of the study's goal and that the participants did not keep in touch with one another during the interviews, this risk can be partially disregarded.

When conducting a case study, preventative approaches for external validity must be used, as indicated by Creswell & Creswell (2018). This speaks to the dangers associated with generalisability and the fact that the researcher can only draw conclusions depending on the conditions under which the study was carried out. For example, the findings of this case study cannot be applied to all German chemical companies following the European Transition Pathway for the Chemical industry, much less to the entire (European) chemical sector. To be more precise, only one of the roughly 2,900 chemical firms in Germany in 2018—96 percent of which were SMEs with fewer than 500 employees—was interviewed (Germany Trade and Invest, 2021).

In addition, all interviews were conducted in English to facilitate the transcription process. However, all interviewees were of German nationality and thus did not have English as their first language. This in turn led to them having difficulties in expressing themselves and using the right vocabulary, which led to some challenges while transcribing. In fact, Marshall & While (1994) claim that language barriers can pose challenges in interviewing respondents with English as a second language.

5. Analysis

This thesis has two sections that make up its analytical portion. It begins by examining the importance of the chemical industry in Europe and presenting the BASF business profile. The interviewees' responses are covered and divided into specific themes in the second section. The chemical corporation BASF and its difficulties putting the new regulatory standards into practice are the main topics of discussion here.

5.1 The Chemical Industry

Because of its scale and high GHG emissions, the chemical industry is vital to the EU. In order to achieve its sustainability goals, the industry is essential due to its significant role and environmental impact.

5.1.1 Implications of the European Green Deal on the Chemical Sector

The new regulations and framework of the European Green Deal also apply to the chemical industry. According to Switch to Green (2019), the European Green Deal covers all sectors of the economy, including industries such as chemicals.

One of the initiatives of the roadmap was the publication of the Circular Economy Action Plan in March 2020, which is pertinent to the chemical industry. Producing sustainable products is the goal of this Action Plan, with an emphasis on resource-intensive industries including plastics, electronics, building, and textiles. As a result, the chemical industry must consider two issues: (i) how much it can encourage its own production of sustainable goods, and (ii) how circularity affects the demand for each product among different consumer segments (e.g., textile, construction, electronics, and plastics). The chemical industry is crucial to the discussion of climate change because: (i) it produces products that are necessary for many low-carbon technologies, such as housing, mobility, and renewable energy; (ii) chemistry is required to create resilient materials, such as those that can withstand harsher weather conditions; and (iii) chemical production uses a lot of energy and carbon dioxide. The chemical sector is therefore categorised as “difficult to reduce” (Thormann et al, 2021).

Bridges et al. (2023) critically review the EU CSS, which the EU adopted in 2020 and is part of the EU’s zero pollution ambition – a key commitment of the European Green Deal (European Chemicals Agency, n.d). In terms of chemicals, a fully integrated CSS is essential. It should comprise an objective assessment of the current state of affairs, taking into account the effects of "chemicals of concern" throughout their life cycle, as well as sustainability issues. Additionally, it should include a framework that encourages the development of innovative chemistry-based approaches to address each of the major sustainability issues (Bridges et al., 2023).

5.1.2 BASF Company Profile

With its headquarters located in Ludwigshafen Am Rhein, in the southwest of Germany, Badische Anilin- und Sodafabrik, or BASF SE, founded in 1865, is a chemical corporation that engages in research and development (R&D), manufacture, marketing, and sales of chemicals, plastics, crop protection goods, and performance items. Chemicals, Materials, Industrial Solutions, Surface Technologies, Nutrition & Care, and Agricultural Solutions are the company's six reportable business segments. With roughly 112,000 employees and about 82,000 customers from various sectors in almost every country in the world, it is one of the most important major chemical firms in Germany, along with Bayer and Merck (BASF, 2023a; Statista, 2024).

Figure 3 compares the total GHG emissions of the three chemical companies in 2023, the year in which the Transition Pathway for the Chemical Industry was adopted by the European Commission (BASF, 2023a; Bayer, 2023, Merck, 2023). To clarify, scope 1 emissions are direct emissions or emissions from production processes and scope 2 emissions are indirect emissions or emissions from purchasing energy (BASF, 2023a). For all three companies, scope 1 emissions amount for the largest share of GHG emissions. The graph also indicates that BASF emits the largest amounts of GHG emissions, with 16.92 million metric tons of CO2 equivalents, compared to 3 and 1.46 million metric tons of CO2 equivalents of Bayer and Merck, respectively. However, the reason why Bayer has such low GHG emissions could be due to the fact that it separated its chemical division which is now known as ‘Covestro’ and was established as a legally independent company in 2015 (Covestro, n.d). Consequently, Bayer itself has had remarkably lower GHG emissions since then. Thus, BASF is a suitable candidate for a case study examining how they can drastically reduce their emissions in order to adhere to the Transition Pathway for the Chemical Industry.

According to the 2023 Annual Report, BASF (2023) aims to focus on renewable energy, CO2 abatement as well as circularity in order to reduce its GHG emissions. In fact, one of BASF’s global targets is to reduce GHG emissions by 25% by 2030, which means reducing GHG emissions from 21.9 million metric tons to 16.4 million metric tons. It has practically almost achieved this goal in 2023 (see Figure 3). However, BASF blames this low amount in comparison to previous years being caused by a weak economy which led to persistently low production volumes and therefore lower emissions. Furthermore, in 2023, the percentage of electricity derived from renewable sources in total electricity consumption increased to 20% from the previous year. However, by 2030, BASF wants to obtain more than 60% of its electricity from renewable sources.

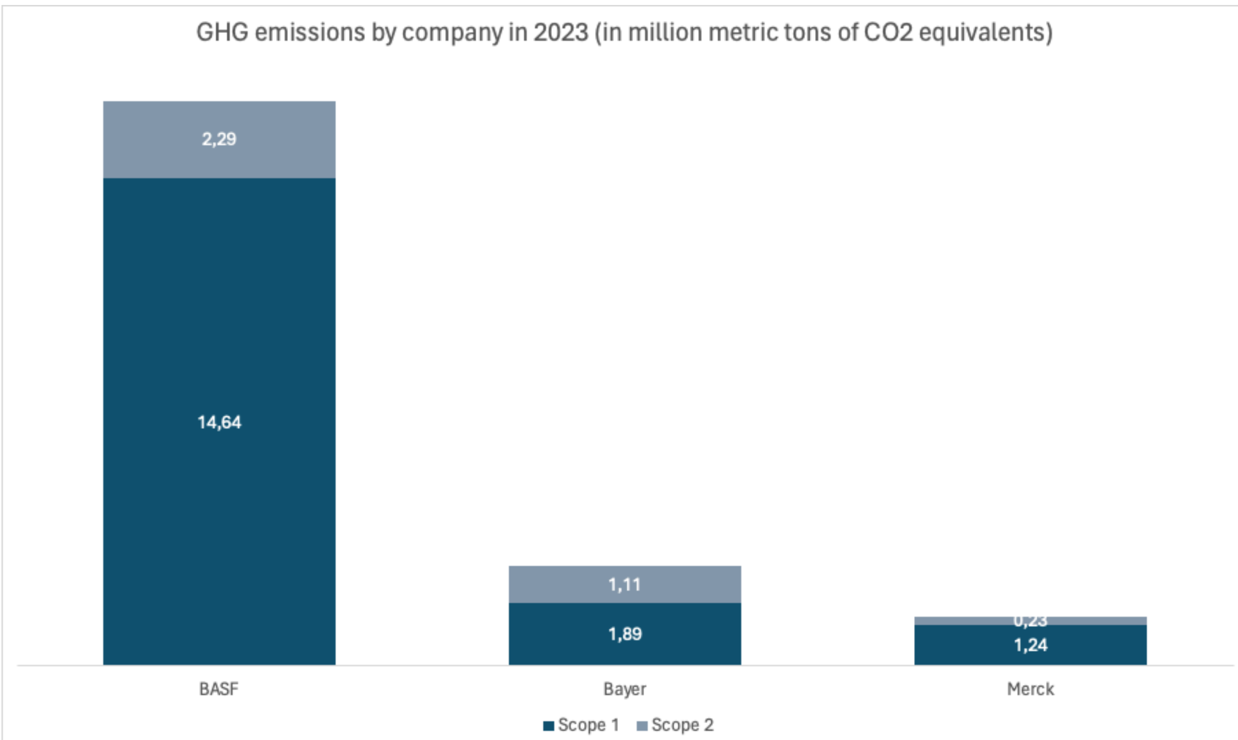

Figure 3: Comparison of GHG emissions by company (in million metric tons of CO_2 equivalents) in 2023 (BASF, 2023; Bayer, 2023, Merck, 2023)

5.2 Presentation of Interviewed Entities

Interviewee A

Interviewee A has a Ph.D. in Polymer Chemistry and is both Senior Project Manager of the 'Project Chemicals Strategy for Sustainability' as well as team leader of the so called 'Corporate Projects in Product Safety'. They have been at BASF for many years and are thus an expert when it comes to BASF and its sustainability efforts.

Interviewee B
Interviewee B has a Ph.D. in Biotechnology and just like interviewee A is also working on the 'Project Chemicals Strategy for Sustainability'. They have not worked for BASF for a long time but have many years of experience in the field of sustainability and project management.

Interviewee C
Interviewee C has a Ph.D. in Chemistry and is the Senior Manager for energy and climate policy at BASF. This person has also worked at BASF for many years and is specialised on the topics of European and International energy and climate policy. Besides following EU legislation in this field, this interviewee is also participating at the annual Conference of the Parties (COP) meetings of the UNFCC.

Interviewee D
Interviewee D also has a Ph.D. in Chemistry and is Senior Vice President of the two following units: 'R&D Performance Materials' and 'Modelling, Formulation & Technology Incubation'. This interviewee has many years of experience within the scientific and technologic part of sustainability. Furthermore, this person is Chairman of 'SusChem' which stands for Sustainable Chemistry and is a so-called European Technology Platform (ETP). These ETPs are intended to bring Europe forward in several technological fields like sustainable chemistry and industrial biotechnology and to make these topics more visible in the European research framework program.

5.3 Interviewee's responses categorised into themes

5.3.1 Innovation

To expand and keep their competitive edge, established industries and nations alike must create new uses and commercial strategies. This necessitates a structural shift driven by innovation that will draw top people, reward creative entrepreneurs, and provide them with far greater chances to launch and expand new companies (Zaušková et al., 2013). Similarly, interviewee B expresses his concern about this matter: "*We need state support to make such new innovations viable*." Interviewee C also stresses the need for new innovations: "*BASF is developing technologies to make the transition possible because it is not the political ambition but in fact it is the* *development of new technologies which will make it possible.*" When the interviewees were asked about BASF's initiatives to reach net zero emissions, most of them mentioned one project of theirs which is the offshore wind farm off the Dutch coast called 'Hollandse Kust Zuid'. It is a project in cooperation with the Swedish energy supplier Vattenfall and which was inaugurated in September 2023 (BASF, 2023b). Another project of BASF that was often mentioned during the interviews was the solar park at its Headquarter site in Ludwigshafen, Germany. It is planned to be built in 2026 and if completed, will cover 100 hectares and is expected to produce 140.000 megawatt hours (MWh) of green energy per year (BASF, n.d. a). However, interviewee D claims that it is not enough for companies to invest in renewable energy; instead, they state: "We also have to rely on the public sector investing in green power." As companies are coming up with new practices focusing on environmental friendly projects and investment, such as alternative sources of energy like wind, solar, bio-fuel, biomass and waste, investment is being drawn to these energy-efficient technologies as well as other emerging energy sources, which was challenging in the past. One of the main forces that can propel the global economy as a whole and make it sustainable over time is green financing. This has prompted players in the public and commercial markets to come up with new procedures and provide substantial funding for avant-garde initiatives aimed at curbing global warming. Thus, public sector banks play a role in promoting green financing, leading companies to focus on environmentally friendly projects and investment in alternative energy sources (Prasad & Ansari, 2015).

5.3.2 Willingness to Pay

Willingness to pay is the maximum price a customer is willing to pay for a product or service. It can vary significantly from customer to customer (Stobierski, 2020). This concept is crucial for the energy transition due to it being "too expensive" to reach carbon neutrality by 2050, or it can revitalise economic growth and increase employment, according to Luciani (2020). Unnerstall (2017) expects the German energy transition to cost almost €500 billion, but around 75% of this is due to the nuclear phase-out and massive expansion of renewable energies.

Nevertheless, interviewee C states "*at the end of the day, the consumer will have to pay for the transition and if this willingness to pay is nonexistent then it won't be possible*." Interviewee D has a similar view: "*Saving the world has a price tag. Not everything will be achievable at a low price.*" Kemp (2021) acknowledges that the proposed transition will, in many cases, replace gasoline-fueled private cars with battery-driven vehicles powered by wind power, resulting in lower long-term fuel expenses in exchange for higher upfront capital costs. Thus, the poorest families run the risk of being forced to use antiquated and progressively more expensive legacy energy products since they are least able to pay upfront capital expenses. The energy transition has the potential to exacerbate poverty related to energy and energy inequality if it is not managed correctly.

However, Gaspari et al. outline that people become more interested in changing their energy behaviour as they gain more knowledge and are offered suggestions (2021). Thus, this implies that if the consumer knows what they pay for and are aware of how this helps improve the environment by paying higher prices, people would be willing to do so.

5.3.3 Competitiveness

Interviewee B fears that production is being outsourced due to regulatory restrictions in Europe and higher prices: "*Since this whole framework is so unfavourable we see that more and more innovation is being done outside of Europe*." In fact, Antonietti et al. (2017) found that a stricter environmental regulation is related to a higher probability of production being outsourced to foreign suppliers.

Interviewee C, however claims that there are some policies in place to protect the EU chemical industry from global competition such as the EU Emissions Trading System (EU ETS). According to Joltreau and Sommerfeld's (2018) research, this is partly because of a significant overallocation of emissions allowances that has caused prices to decline and allowed businesses in some sectors to pass costs onto consumers. In turn, cost pass-through and free allocation contributed to some unexpected profits. Furthermore, the average share of energy expenditures in the budgets of the majority of industrial industries suggests that energy prices are relatively modest, which may have restricted the impact of the EU ETS. The authors further contend that up to this point, modest but noteworthy stimulating impacts on innovation have been observed. A number of indicators point to the likelihood that over-allocation will continue to be significant over the scheme's future phases. Thus, they anticipate that the EU ETS will not have any detrimental effects on competition in the years to come.

5.3.3 Strategic Sustainability and Competitive Assurance

This overarching theme was asked within some of the last questions (see appendix A). Both interviewee A and D were mostly confident when it comes to BASF reaching its net-zero CO2 goal. For instance interviewee A stated: "*As we are working a lot on getting net-zero I am quite confident that we will reach our goals; nevertheless, what we are missing is coherent legislation on a European level*." This answer aligns with Glavič et al. (2023), who claim that the chemical industry can transition to net-zero emissions through cutting edge technologies, efficient energy use, sustainable practices, and alignment with the European Green Deal and Sustainable Development Goals (SDGs), while this in turn can increase the competitiveness of the chemical industry. BASF has demonstrated its commitment to the SDGs by not just participating in their creation but also being acknowledged as a pioneer in their implementation within their strategy (BASF, n.d. b). It is particularly focusing on achieving Zero Hunger (SDG 2), Gender Equality (SDG 5), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Decent Work and Economic Growth (SDG 8), Responsible Consumption and Production (SDG 12) as well as Climate Action (SDG 13).

Interviewees B and C, on the other hand, were less optimistic about it. Interviewee B claimed that the chemical market currently creates a lot of uncertainty, meaning that new innovations need to be economically viable. Similarly, interviewee C stated that since BASF is a global company, it allows them to invest where conditions are best; however, there exist geopolitical risks which means companies such as BASF are not only dependent on the stability of political systems but also on the availability of infrastructure. For instance, chemical companies in China, face high risks and uncertainties due to changing regulatory frameworks and inadequate infrastructure (Tremblay, 1995). Nevertheless, similar conditions are needed in other countries or regions of the world in order for a company to be profitable. Uddin et al. (2017) claim that political stability is indeed a key determinant of economic growth and that political instability can deter economic growth. In fact, business leaders are using political risk analysis to assess the influence of politics on possible markets, reduce risks, and maximise global opportunities as politically unstable nations such as Saudi Arabia and emerging markets like China play a bigger role than ever in investment calculations. However, political risk is less objective than economic risk. Laws being passed, the shortcomings of public officials, and the emergence of popular movements all have an impact on it. Corporate executives must therefore deal with societal intricacies in addition to broad, easily observable trends. Furthermore, those difficult-to-quantify elements must continuously be pieced together into a story that fits historical and geographical settings. Today, with the unparalleled velocity with which commodities, services, information, ideas, and people cross borders, organisations evaluating operational or infrastructure investments abroad require more and more rigorous, objective assessments (Bremmer, 2005).

6. Discussion and Conclusions

6.1 Policy Suggestions

The identified implementation challenges can be used to derive recommendations for future improvements to the Transition Pathway, bearing in mind that it is not yet done and is therefore a continuous process with new pieces of information and publications coming out on a regular basis. The analysis and explanation of the BASF case in section 5.3 show that businesses encountered a range of challenges in the first year of the Transition Pathway for the Chemical Industry, with the majority of the problems arising from the volume and ambiguity of the legislation. Generally speaking, these issues must be resolved in order to properly carry out the Regulation's future needs, and progress must be made towards a deeper comprehension of both the Transition Pathway and the Green Deal.

The Transition Pathway is covered in an abundance of legislative publications, FAQs, studies, and papers, to name just a few sources. Because the Green Deal concerns a number of industries, it can be difficult to find information regarding the implications and requirements that apply to a particular company within that sector. Similar to this, it might be difficult to understand the material provided in the draft reports from the European Commission due to their complexity, which ultimately lowers the likelihood of successful implementation.

The Transition Pathway for the Chemical Industry recognises that industry is being faced with unprecedented challenges (skyrocketing energy prices, increased international competition etc.). As a decline in the industry’s global competitiveness has already taken place over recent decades, any further shift of activities to outside of the EU has to be avoided, also considering ‘ripple effects’ (a situation in which an action has an effect over several different entities) across the EU’s economy. It is positive that the European Commission defines concrete actions to address this. For example, it wants to better analyse impacts of energy and geopolitical developments on the competitiveness of the EU chemical industry and set Key Performance Inficators (KPIs) in order to measure and compare the international competitiveness. This may help adjust course of actions in the future. With the Transition Pathway for the Chemical Industry the chemical industry is recognised as strategic and at the heart of Europe’s major value chains.

6.2 Research Ramifications

The objective of this study is to offer a deeper understanding of how the Transition Pathway for the Chemical Industry affects chemical companies in the EU, with significant implications for various stakeholders. The outcomes of this research hold significance for chemical firms, regulators, and policymakers as they grapple with the evolving regulatory landscape of the EU's energy sector. By scrutinising implementation experiences within the chemical sector, this study can assist policymakers and regulators in pinpointing areas needing refinement to better achieve their goals. In essence, this research has the potential to add valuable insights and knowledge across policy, regulation, industry practices, and sustainability. It stands to influence policy-making, contribute to the expanding repository of research on sustainable energy practices, and aid companies in managing regulatory challenges, thereby delivering crucial advantages to a wide array of stakeholders.

6.3 Research Restrictions and Recommendations

It is important to acknowledge the potential limitations of this study. Firstly, there has been limited research on the European Transition Pathway for the Chemical Industry and its impact on the sector. This framework is still evolving, and new publications after the study might affect the findings. To analyse the impacts, this study relies on a wide range of literature since academic research on this topic is scarce. It also considered legislative documents and company reports to understand the framework's effects on the chemical sector.

Moreover, due to it being a recent framework, chemical companies like BASF have limited experience with this regulatory framework. While BASF represents the sector, the experiences of other companies may differ, and BASF's publications might be biased, affecting the generalisability of the findings. Additionally, regulations and classifications related to the chemical industry may change significantly during and after the study period.

Due to the European Transition Pathway for the Chemical Industry being fairly recent, in-depth research on its impacts and implementation is not feasible yet. However, there are several avenues for future research. For instance, exploring the long-term effects of the European Transition Pathway for the Chemical Industry's sustainability and its alignment with the EU's sustainability goals. Further research could delve into the effectiveness of implementing the strategy at the company or even national level over a longer duration and compare it with similar policies. Additionally, one must note that this study is based on four interviews in the field, and one can, therefore, not make any generalisations. Therefore, to fill the research gap within policy-making and the European energy transition, further research using a more extensive sample of interviewed organisations is highly anticipated to investigate the generalisability to a greater degree. Nevertheless, BASF will continue with their active engagement in the so-called co-implementation process with the objectives to implement the Transition Pathway for the Chemical Industry and to translate it into National Pathways in key Member States of the EU.

7. Usage of AI

To ensure proper spelling and grammar when writing this thesis, I utilised Grammarly. I have looked for synonyms and word variations using ChatGPT in order to make sure the language flows well. In addition, ChatGPT has been utilised to locate sample interview questions; however, I have reworked and customised the questions to be uniquely my own. Consensus and ResearchRabbit have been used to find publications.

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Appendix A: Interview Guide

The following guide was used during the semi-structured interviews with the company's employees.

Introduction

1. Do you consent to this interview being recorded?
2. Could you tell me a little bit about yourself and your role at BASF?
    a. What were your different positions within the company?
    b. For how long have you been working at BASF?
3. What is the Transition Pathway for the Chemical Industry and how is BASF supporting it?
4. What specific goals does BASF have to reach net zero CO2 emissions?

Theme 1: Innovation

1. What initiatives is BASF planning to implement in order to reach net zero emissions by 2050?
2. What are some of the challenges you faced as a company during the implementation phase of new technologies, and how do you overcome these challenges?

Theme 2: Willingness to Pay

1. Do you think it is fair to make the consumer pay for the transition?
2. Is there a risk that consumers will not be willing to pay a higher price for your products? If so, what could this mean for your future growth?

Theme 3: Competitiveness

1. Do you think BASF has a competitive advantage against other local and or/ international competitors?
2. Is there a risk that the chemical industry will be wiped out in Europe? If so, what will it lead to for climate and environmental work as well as for European industry?

Theme 3: Strategic Sustainability and Competitive Assurance

- Are you confident that BASF will reach this goal? If so, how do you think BASF will remain being competitive?
- How does BASF plan to integrate sustainability initiatives into its long-term business strategy to ensure continued competitiveness in the global market?

General questions:

1. How does BASF secure appropriate amounts of renewable energy for the transition?
2. What needs to happen to enable the safe and sustainable use of chemicals?

Thank you for taking the time and for being willing to help me with my research!