

**GERMANY'S BIOFUEL MARKET: AN ANALYSIS OF
CONSTRAINTS AND OPPORTUNITIES FOR NORDIC
BUSINESSES**

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**Author: Lisa Margarete Naeve
Subject: Corporate Environmental Management
Supervisor: Bonn Juego**



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ABSTRACT

Author: Lisa Margarete Naeve	
Title: Germany's biofuel market: An analysis of constraints and opportunities for Nordic Businesses	
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<p>Abstract</p> <p>This thesis examines the potential constraints and opportunities Nordic companies might face when aiming to operate on the German biofuel market. Governmental decisions regarding climate change mitigation and aiming to reduce emissions in the transportation sector through increased shares of biofuels, have created a sizeable biofuel market in Europe and Germany. The European biofuel market is highly dependent on policies and legislations. Due to the different implementation of the European Union's biofuel policies into the national legislation of the member states, multiple inner European markets have been created that can open business opportunities for stakeholders from foreign countries, such as the Nordic countries on the German market. This thesis aims to investigate which potential constraints and opportunities might arise for Nordic businesses.</p> <p>Undertaking a profound literature review, and conducting interviews with stakeholders from the Nordic countries, have allowed to identify multiple interconnected constraints and opportunities for Nordic businesses aiming to operate on the German biofuel market. Constraints analysed are legislative ambiguity, bureaucratic communication challenges, resources, language barrier, and information insufficiency. Analysed opportunities are the rationale of the legislation in support of sustainable business, economics, the German market size, a potential competitive advantage of the Nordic countries in the biofuel sector and European Union's and regional-level support for sustainability, renewables and green energy transition.</p> <p>The analysis shows that there are multiple interconnected constraints and opportunities for Nordic businesses operating on the German market. Though some of these can be anticipated, there will be a certain degree of uncertainty for businesses in the biofuel sector especially due to quick changes in policies and other governmental decisions.</p>	
Key words German biofuel legislation, biofuel market, Nordic businesses, constraints, opportunities, policies	
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TIIVISTELMÄ

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<p>Tiivistelmä</p> <p>Tässä tutkielmassa tarkastellaan mahdollisia rajoitteita ja mahdollisuuksia, joita pohjoismaiset yritykset voivat kohdata pyrkiessään toimimaan Saksan biopolttoainemarkkinoilla. Hallitusten päätökset ilmastonmuutoksen hillitsemisestä ja pyrkimyksestä vähentää liikenteen päästöjä lisäämällä biopolttoaineiden osuutta ovat luoneet huomattavat biopolttoainemarkkinat Eurooppaan ja Saksaan. Euroopan biopolttoainemarkkinat ovat erittäin riippuvaisia poliittisista käytännöistä ja lainsäädännöstä. Johtuen erilaisista Euroopan unionin biopolttoainepolitiikan käytännöistä jäsenvaltioiden kansallisissa lainsäädännöissä on syntynyt useita Euroopan sisäisiä markkinoita. Nämä voivat avata liiketoimintamahdollisuuksia ulkomaisille sidosryhmille, kuten Pohjoismaille Saksan markkinoilla. Tämän tutkielman tavoitteena on tutkia mitä mahdollisia rajoitteita ja mahdollisuuksia pohjoismaisille yrityksille voi syntyä.</p> <p>Perusteellisen kirjallisuuskatsauksen ja pohjoismaisten sidosryhmien haastattelujen avulla on voitu tunnistaa useita toisiinsa kytkeytyviä rajoitteita ja mahdollisuuksia pohjoismaisille yrityksille, jotka pyrkivät toimimaan Saksan biopolttoainemarkkinoilla. Tutkimuksessa analysoidut rajoitteet ovat lainsäädännön epäselvyys, byrokraattiset viestintähaasteet, resurssit, kielimuuri ja tiedon puute. Mahdollisuuksia puolestaan ovat lainsäädännön perustelut kestävän liiketoiminnan tukemiseksi, talous, Saksan markkinoiden koko, Pohjoismaiden mahdollinen kilpailuetu biopolttoainealalla sekä Euroopan unionin ja aluetason tuki kestävyydelle, uusiutuville energialähteille ja vihreälle energiamurrokselle.</p> <p>Analyysi osoittaa, että Saksan markkinoilla toimivilla pohjoismaisilla yrityksillä on useita toisiinsa liittyviä rajoitteita ja mahdollisuuksia. Toisaalta, vaikka osaa niistä on mahdollista ennakoida, biopolttoainealan yrityksille aiheutuu epävarmuutta erityisesti politiikan nopeista muutoksista ja muista hallituksen päätöksistä.</p>	

Asiasanat Saksan biopolttoainelainsäädäntö, biopolttoainemarkkinat, pohjoismaiset yritykset, rajoitukset, mahdollisuudet, politiikat

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Abbreviations:

ARA	Antwerp Rotterdam Amsterdam
BLE	Federal Agency for Agriculture and Food
CFPP	Cold Filter Plugging Point
CTO	Crude Tall Oil
EU	European Union
EU ETS	European Union Emission Trading System
EUA	European Emission Allowances
FAME	Fatty acid methyl esters
GHG	Greenhouse Gas
HVO	Hydrotreated Vegetable Oil
ILUC	Induced Land Use Change
LCA	Life Cycle Assessment
LPG	Liquid Petroleum Gas
RED	Renewable Energy Directive
UCO	Used Cooking Oil
UCOME	Used Cooking Oil Methyl Ester

1 INTRODUCTION

During the first decades of the 2000s the introduction of bioenergy, energy made from biomass, has been pushed by multiple governments around the globe. This has also led to the creation of policies in the participating countries and consequently to new trade regimes and patterns that depend on the set policies (Lamers et al., 2011).

In 2021 Chiaramonti et al. (2021) published a forecast on the development of the role and the quantity of biofuels in the EU and predicted an increase of biofuels until 2050 while total fuel consumption is foreseen to decrease. The authors claim that biofuels are an important factor to fulfill the climate targets that the EU has set, especially regarding GHG reduction in the transport sector. They especially point out the important role that advanced feedstocks will play for the energy transition and the success of the Green Deal.

The EU plans to ban the production of fuel driven cars from 2035 onwards (European Parliament, 2023) and at this stage there is not yet much information available on a possible outlook of the development of biofuels due to this decision. The German government has negotiated with the EU that at least e-fuel driven cars will be allowed to be produced after 2035, despite the e-fuels being still expensive and inefficient at this point of time (Reckmann, 2023). However, until the change comes into force there is still over one decade of time remaining from writing this thesis.

Since 2009 almost 16 % of refineries in the EU were shut down and a decrease in primary refining capacity and utilization rate was observed in the early 2010s leading multiple refineries in the EU to shift to bio-based refining such as processing of lipids into HVO (Hydrotreated Vegetable Oil) (Chiaramonti & Goumas, 2019). But there are other reasons for an increase in biofuel production over the last decade.

Renewable fuels have multiple environmental advantages compared to fossil fuels. The emissions of particles and carbon monoxide from engines run with renewable fuels are much lower than those run with fossil fuels. Additionally, renewable fuels have a carbon renewability allowing to reduce the risk of global warming (Brännström et al., 2018).

From a chemical standpoint renewable fuel deriving from oily plants are favorable because despite having a higher content of chemically bound oxygen than fossil fuels they also have a high energy content and a heating value similar to that of diesel. At the same time the content of sulfur and nitrogen in these oils is relatively low. However, the costs of the feedstocks are high accounting for up to 95 % of the total costs of the final product (Brännström et al., 2018).

Biofuel production in Europe has grown steadily in the past decade before 2022, with annual growth rates of over 5% (Bocksch, 2022). It is estimated that the production will keep on growing at least until 2040 and especially regarding second generation biofuels. Second generation biofuels are for example made from ligno-cellulosic feedstocks. First generation biofuels, that are made from crops, are viewed critically considering for example the land-use change they might trigger and the possible competition between crops for fuel and for human food or animal feed as well as doubts about the effective GHG (greenhouse gas) saving potential (Puttkammer & Grethe, 2018; Sims et al., 2010). The growth of biofuels is supported by political instruments of the EU and their member states (Deppermann et al., 2016).

Sustainable transportation is an area depending on policies and well thought out frameworks (Chiaramonti & Goumas, 2019). The decarbonization of the transport sector is crucial for the EU's climate goals as it accounts to one of the biggest carbon emitting sectors in the EU. It is the only sector with yearly increasing GHG emissions since 1990 until 2015, where it remained stable, in the EU and accounts for approximately one third of the final energy consumption in the EU while the energy sector accounts for 77 % of all Carbon emissions in the EU in 2019 (Chiaramonti & Goumas, 2019; European Parliament, 2021). Until now the transportation sector in the EU is relying on oil to over 90% causing policy making in this field a sensitive topic regarding aspects such as security and costs (Chiaramonti & Goumas, 2019; European Parliament, 2021).

Aviation and maritime transportation are still growing sectors which are until now dependent on liquid fuels and lacking sufficient supply of biofuels from EU refiners. The EU promotes the use of biofuels for aviation and maritime transport in their policies, for example in the RED II, though there are no minimum targets for them respectively (Renewable Energy Directive, Chiaramonti & Goumas, 2019). In the beginning of 2023, the EU agreed on biofuel targets for aviation starting with 2% in 2025 and increasing to 6% in 2030 and 35% in 2035 up to 70% in 2050. Further 1.2% of fuels must be synthetic in 2030 rising to 35% in 2050. Synthetic fuels refer to fuels made from captured CO₂ of the atmosphere. This is claimed to equal out in the CO₂ balance when it is released to the atmosphere again during combustion (Abnett et al., 2023).

The requirement by public policy for mandatory sales of renewable energy has created a new sizable voluntary market of renewable energy. Biofuels are a particularly interesting business field for fuel companies because they have a higher profit margin compared to fossil fuels thanks to the policies created by governments. The market of renewable energies can offer new opportunities regarding an extension and evolution of the product range and a possibility to diversify the business from fossil fuels only (Midttun et al., 2019).

Each member state of the EU and participating in EU renewable fuel legislation has implemented the directives in different ways which leads to multiple fuel

markets with different regulations. This can create business opportunities but also challenges for actors from different countries to operate on foreign EU bio-fuel markets (Midttun et al., 2019).

Arbitrage is defined as “the nearly simultaneous purchase and sale of securities or foreign exchange in different markets in order to profit from price discrepancies” (Merriam Webster Dictionary, 2023) or as a legal definition “the purchase of a security, commodity, or foreign currency in one market for the purpose of immediately selling it at a higher price in another market” (Merriam Webster Dictionary, 2023). In practice, arbitrage is used as an investing strategy, in which people, often traders, benefit from different market prices for the same product. There are different types of arbitrages, but all of them have in common to use a price difference for the same commodity in two or more markets and through a purchase and sell strategy make a profit (Jackson, 2022).

Germany is the biggest producer of biofuels in the EU and can be counted to one of the biggest markets for biofuels with a production of biofuels in 2021 equivalent to 65.000 barrels (Bocksch, 2022). The fast development of the biofuel sector in Germany, especially between the mid-90s and 2012, is largely due to the impacts of the biofuel industry as well as the agricultural sector in Germany (Puttkammer & Grethe, 2018). The German biofuel market and its related legislation has a strong impact on the rest of the EU’s biofuel market due to its size. Germany was the first country linking the biofuel obligations and targets set by the EU to greenhouse gas emissions savings and the German biofuel legislation is complex with regards to e.g. feedstock compliances and production obligations (Puttkammer & Grethe, 2018).

However, according to Umweltbundesamt (2023), in Germany the amount of renewable energy in the transportation sector is low compared to other energy sectors such as electricity or heat. The German Federal Environmental Agency points out that the transportation sector in Germany is the country’s sector with the lowest rate of renewable energy sources.

Chang et al. (2017) state that the renewable energy sector is of crucial importance for the sustainable transition on our planet. They outline further that companies play an important role in the sustainability transition as they apply laws and regulations aiming at this respective purpose and if companies would not be included in the transition process it could hardly be achieved.

Sree Kumar et al. (2020) argue that governments and legislation play a major role when tackling climate change in businesses. However, they are in a critical role as legislation regarding the reduction of GHG emissions might lead to conditions in which economic growth might be challenged. Therefore, legislation must be well thought through up to the very details. The authors outline further on the

example of Australia, that despite previous lobbying during the phase of the policy creation, once the legislation was implemented companies comply with it and make necessary efforts to reduce their environmental impact according to the law.

This thesis aims to investigate how the EU (European Union) biofuel policies implemented in Germany creates constraints and opportunities for companies operating in the renewable fuel sector within the Nordic countries aiming to also operate on the German biofuel market. This thesis highlights that the complexity of the EU biofuel policies implemented into different national legislations is not always fully clear to businesses operating in the sector. Through interviews that could be conducted with experts in the biofuel sector, it was revealed that the German biofuel legislation is not always easily understandable or accessible for actors in the industry especially from foreign countries and that communication with authorities can be challenging. Therefore, the identification of opportunities and constraints that the legislation might offer can be challenging to identify and no similar studies could be found during the research. Further, no similar research analyzing constraints and opportunities for business due to the different implementation of EU law into national law regarding the biofuel sector could be found. Consequently, constraints and opportunities that are related to operating on the German market as a foreign company in the business will be identified and analyzed.

The main research question which potential constraints and opportunities exist for Nordic companies aiming to operate on the German biofuel market will be explored through investigating the following questions that help understanding the deeper meaning of the research. The questions this thesis aims to answer are what were the key policies and economic/market forces that shape the German biofuel market? Which are the key laws to know in order to understand the German biofuel policies? Which authorities are involved in the German biofuel market development? What kind of constraints or opportunities can be determined for Nordic companies that want to operate on the German biofuel market?

First a thorough understanding of the way the German biofuel market works shall be outlined with special attention to legislation implications and incentives that are set by policy makers. In the same step responsible authorities shall be identified.

In a second step the thesis aims to gain understanding of how the policies of the German market affect companies operating in the biofuel sector in the Nordic countries and which practical aspects that implies for their production processes. Then the main question will be investigated, what the constraints and opportunities of the German biofuel market are for Nordic companies.

In order to do so, the question of what constraints and opportunities exist needs to be answered. Also, it will be defined what German biofuel market, Nordic businesses, constraints and opportunities mean in the context of this thesis.

In this thesis constraints and opportunities for Nordic businesses aiming to operate in the German biofuel market will be investigated.

The German biofuel market:

The German biofuel market implies for this thesis all business activities that include actions under Nabisy and involve trading renewable fuels on the German market.

Nordic businesses:

Nordic businesses imply all companies operating in the renewable fuel sector in Finland, Sweden and Norway and having headquarters in one of these countries.

Constraints:

Business constraints can be something that interfere with the profitability of a business or its goals, which includes that in order to improve the company's business profitability any constraints should be limited as much as possible. Regulatory, timely, management or financial concerns can be constraints that companies face often (Glass, 2017).

Opportunities:

De Ternay (2023) defines a business opportunity as a combination of circumstances that opens up possibilities for companies to create a value for their customers and as such gain profit for the company. Further, the author points out three important factors defining a business opportunity, which is the need for the product or service by the potential customer, the availability of the respective product or service possibly better than the competition or already existing products or services for the need and thirdly, a possibility to supply the product or service to the customer and as such the market.

Baron (2006) confirms that a business opportunity is the identification of a set of circumstances or an interconnection between factors of external conditions that offer ideas for new potential ventures. Such conditions can be of many aspects such as political, juridical, technology, market or demographics and other.

2 THEORETICAL FRAMEWORK

To find out if business opportunities for Nordic countries on the German biofuel market exist, policies and legislation documents of the EU and Germany will be checked in relevance for the biofuel sector. Further, semi-structured interviews with relevant stakeholders from the industry will be conducted.

Midttun et al. (2019) state that in reaction to environmental, economic, or social challenges, governments have multiple ways to enforce changes in public or institutional policies. Such can be for example projects for the promotion of research and development, tax incentives, subsidies, promotion of exports or changes in regulations and standards.

Technology, demand, and policy are the three main opportunities to create transformation. Further, the three main factors that lead to changes in industrial leadership are the occurrence of a window for opportunity, that can be caused for example by new technology, changes in policies or demand, in combination with existing capabilities and a suitable strategy for the window of opportunity created by the affected actors (Lee and Malerba, 2014).

In relation to the development of the biofuel market in the EU, Midttun et al. (2019) point out that companies like Neste Oyj could become world leader in biofuel technology, because they created their own biofuel production, for example of HVO (Hydrotreated Vegetable Oil), whereas companies like Esso or Equinor have fulfilled their biofuel mandates by purchasing externally produced biofuels at the time they published their article and not investing in own biofuel refining. As a result, the two latter companies have a different position on the market, considering that biofuel production and distribution create opportunities for climate friendly marketing and branding.

The authors explain further that companies in the fuel sector are eager to change to multi-energy stations, and integrate renewable energy further into their company strategies, though the intensity of the desired transition varies between the different fuel distributors in the Nordic market.

Moreover, the biofuel production strategy of energy companies often focuses on being flexible regarding their feedstocks in order to achieve the best possible gain if a business opportunity appears on the market (Midttun et al. 2019).

The use of feedstocks that are crops and can be used as food and especially palm oil has been regarded critically for the production of biofuels due to environmental reasons (Singh et al., 2023). Therefore, the EU biofuel legislation has been revised in order to promote biofuels made from feedstocks based on waste and residues. Finally, import and export conditions on different markets can cause complex systems for the trade with biofuels (Chiamonti & Goumas, 2019).

2.1 Demand in biofuels

According to the IEA (International Energy Agency) (IEA, 2022) the demand for biofuels worldwide has increased again in 2021 after a drop in the previous years due to the Corona pandemic. The IEA outlines that an increase in biofuel supply by annually 16 % would be needed to reach the levels that would be sufficient to reach a Net Zero emissions target by 2030. Furthermore, the feedstocks need to shift more towards waste and residue, which need to account for 45 % until 2030 compared to 8 % in 2021 to achieve the Net Zero target. Concerning the road transport sector biofuels accounted for 3,6 % of the fuel energy demand worldwide but in order to reach the Net Zero Target by 2030 the volume of biofuels would need to increase up to 15 % by that year respectively, which would be around one fifth of the fuel demand. The development of the different fuel types was uneven. While the demand for ethanol was 7% lower in 2021 compared to 2019, the demand for FAME (Fatty Acid Methyl Ester) increased slightly from 2020 to 2021 by 0.3 %. The demand for HVO (Hydrotreated Vegetable Oil) grew 65 % higher in 2021 compared to 2019.

However, the IEA (2022) underlines that HVO and FAME are made from the same feedstocks meaning that there is a risk that they limit each other's growth. Another fuel type the IEA mentions is biojet kerosene, whose supply would need to increase from 0,1 % in 2020 to 5 % in 2030.

In figure 1, the discrepancy between the current supply of renewable fuels and the necessary amount by 2030 if the Net Zero target shall be achieved is displayed. It is visible that the volume of bioethanol in 2030 needs to be almost four times as high as in 2021 to reach the Net Zero target. Most engines used up to this day cannot tolerate ethanol contents in the gasoline higher than 10 %. Only vehicles with flex-fuel motors and some other models such as light-duty vehicles produced after 2001 can be driven with higher ethanol contents (EIA, 2023). Thus, for increasing the ethanol content for gasoline driven vehicles a technological change might be needed as well. No such technological limitations of biofuels are known for diesel driven vehicles. Moreover, the volume of bio-based diesel must be tripled to reach the target. Biojet kerosene has almost no volume in the year 2021, yet it is crucial to increase its volume for a successful transition towards sustainable transportation in the future, according to the chart published by the IEA.

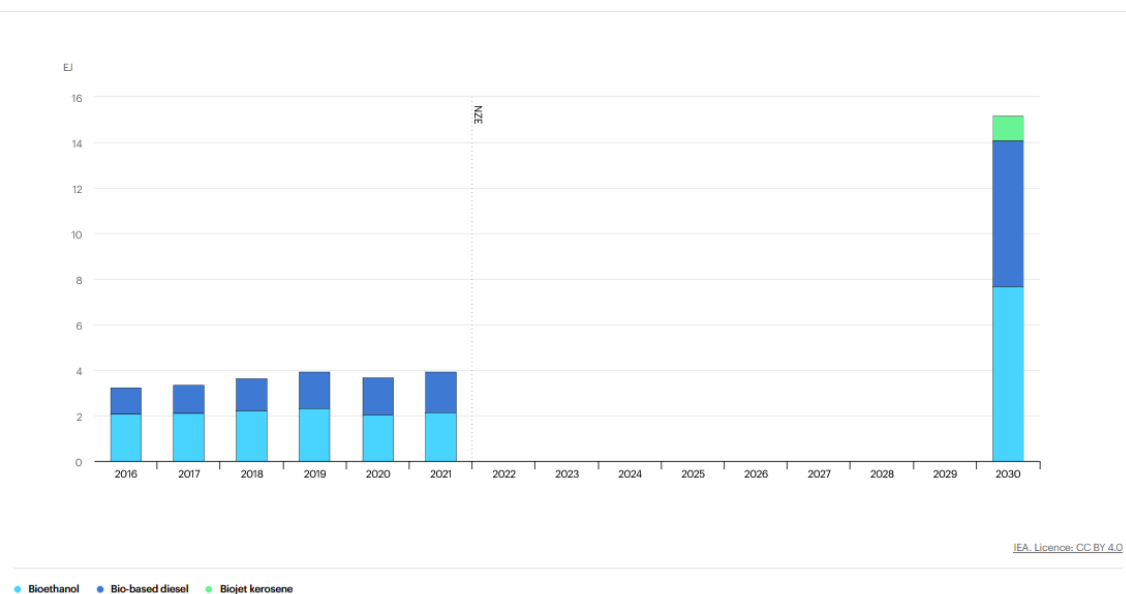


Figure 1. Global biofuel demand in transport in the Net Zero Scenario, 2016 - 2030 (IEA b), 2022)

2.2 European biofuel legislation

The European biofuel legislation creates a framework for the biofuel sector on the continent and is designed through various directives. Key documents are the RED (Renewable Energy Directive), the FQD (Fuel Quality Directive). Further the ETS (European Union's Emission Trading System) plays a crucial role. Maes et al. (2015) underline the pioneer position that the EU holds in the establishment of regulations regarding sustainability and renewable energy that are taken as an example for other countries in the establishment of their own sustainability and renewable energy policies. Therefore, it is important to have a close look at the respective policies.

2.2.1 RED (Renewable Energy Directive)

In the EU the framework for the promotion of renewable energy is laid out in the RED (Renewable Energy Directive), affecting all sectors in the EU and aiming to

strengthen the collaboration between the EU member states towards the common climate goal (European Commission, 2023).

According to the European Commission (2023) the RED was first introduced in 2009 and the promotion of renewable energy led to constant growth of renewable energy supply in the EU during the following years with a share of 22 % in 2020. A revision was introduced in 2018 and a new legally binding version was published in June 2021. In the version of 2021, the new target for renewable energy deployment in the EU is set as well as standards for the procurement of renewable energy and the support schemes as well as sustainability criteria for biomass amongst others. The revised directive has a strong focus on the transport sector and technologies regarding heating and cooling. It aims to enhance the energy transition through incentives for investments and cost reduction in technologies. A new revision was proposed in May 2022 that is currently going through the consideration process of the European Council and the European Parliament and might be approved during 2023.

The main aspects regarding the volume of biofuels produced from advanced feedstocks in transport fuels are summarized by Chiamonti et al. (2021), who also outline the mandatory gradual increase of biofuels from advanced feedstocks in the EU until 2030. The targets regarding biofuels from advanced feedstocks are a sub-target of the 14 % target of renewable energy sources in transport. These targets can be found in Annex 2 of the RED II. They outline an increase from 0.2 % that were to meet in 2022 over 1% in 2025 up to a minimum of 3,5 % of biofuels from advanced feedstocks that are due in 2030. The RED II allows an option of double counting for the biofuels from advanced feedstocks, meaning for example that for reaching the target of a share of 3,5 % by 2030 the volume must only reach 1,75 %. The double counting of advanced feedstocks also applies to comply with the overall target of 14 %.

According to ERAA (2023), in 2023 while writing this thesis, the EU adapted the RED again and introduced the RED III as a provisional political agreement. Main changes are an increase of the renewable target until 2030 for the EU of 42,5 % against the previous target of 32 %, including a raise of renewable energy almost twice as much as the current share. Moreover, the EU wants to achieve a share of 45 % of renewables by 2030. Concerning the transportation sector, which is interesting with regards to the biofuel market, EU member states have two options in which they can introduce the new targets:

A: By 2030 the GHG intensity must be reduced with means of a binding target of 14,5 % in transport from the use of renewable energy

B: By 2030 within the transport sector the final consumption of energy must reach a share of a binding target of 29 %.

Within these targets the EU sets a binding combined sub-target of 5,5 % for advanced biofuels and RFNBOs (renewable fuels of non-biological origin). Advanced biofuels are usually made from feedstocks that could not be used otherwise as food or feed, while RFNBOs include mainly hydrogen-based synthetic fuels or other renewable hydrogen fuels. The binding combined sub-target includes a specification of a 1% minimum share of RFNBOs in the amount of renewable energies in the transport sector by 2030. There are further policies set out for the industry.

The new agreement still needs to be ratified by the European Council and European Parliament. Then all member states need to adapt the new policies into their national legislation.

2.2.2 FQD (Fuel Quality Directive)

According to the European Commission a) (2023), the FQD (Fuel Quality Directive) has been established by the EU in order to ensure that standards of fuel products are met. The FQD applies to fuels used in road transportation such as diesel and petrol as well as biofuels and for fuels used in non-road-mobile machinery such as gasoil.

The aim of the quality standards regarding fuel products set out by the EU is to ensure safe travel, especially in different countries, thanks to the certainty of compatible fuels throughout the EU due to the creation of a single fuel market. And further it aims to ensure the protection of the environment and human health thanks to the reduction of GHG emissions and air pollutants, such as the reduction of the sulfur content in fuels.

Specific targets set out by the FQD were the reduction of GHG intensity by 6 % until 2020 by suppliers, which the member states are in charge of controlling and reviewing. The 6% target can be attained through different methods, of which one is biofuels. Yet the suppliers have other possibilities to reach that target, for example through fossil fuels that have a lower carbon intensity, electricity or RFNBOs / e-fuels.

Furthermore, the European Commission proposes to reduce the upstream emissions in order to reach the target, which can be achieved through changes at the extraction stage, when handling fossil fuel feedstocks.

The target stays in place even after 2020. Important quality standards for biofuels are as well outlined in the FQD that need to be respected regarding the final fuel product together with the RED.

The European Commission a) (2023) defines further how the GHG intensity is calculated. The main aspect is that the calculation needs to include the entire life cycle of the final fuel product, which includes the emissions occurring during extraction, processing, and distribution of the product against a baseline from

2010, that has a value of 94,1 g CO₂ eq/MJ. The European Commission has published exact guidelines to follow when making the calculations for the emission reduction, that all member states need to implement and apply.

As outlined and following the European Commission a) (2023), in accordance with the European legislation the suppliers of energy need to fulfill the respective GHG emission reduction targets. Concerning biofuels, they can only be counted towards this quota if they comply with specific sustainability criteria. These criteria have as one aim to reduce potential negative effects on the environment during the production phase. The EU has set exact numbers of reduction percentages compared to fossil fuels that biofuels must meet in order to be able to be counted towards the mentioned quota, that also depend on the date that the production facility was first starting its operations. Moreover, there are feedstock requirements regarding the point of origin, especially for crops, that shall not be harvested from areas that have a high carbon stock or are rich in biodiversity.

As mentioned above, the EU Commission also puts more emphasis on the risk of ILUC (Indirect Land Use Change) due to for example the conversion of agricultural land or forest areas to cultivation areas for feedstock crops for biofuels. If this conversion is made, it cannot be guaranteed that the GHG reduction is worthwhile compared to fossil fuels due to the new emissions resulting from the land conversion. In order to prevent or at least reduce this risk, the European Commission had set a maximum value of 7% of biofuels that are able to be counted towards the quota grown on agricultural land until 2020. This includes a range of crops, such as cereal, sugars or oil crops as well as crops rich in starch content.

2.2.3 European Union's Emission Trading System (EU ETS)

According to Appunn and Wettengel (2023) the EU ETS is a market mechanism created by the EU and a system that accounts prices to climate change inducing CO₂ emissions. The EU ETS thus supports industries in reducing their emissions in economical ways. The EU ETS applies to companies in the energy producing sector as well as energy-intensive heavy industries such as the aluminum or cement sector, as well as oil refineries. Companies in the heavy industry are entitled to some number of European Emission Allowances (EUA), that will be attributed to them for free in order to assure that these companies can compete with other companies that are not obliged under the EU ETS and do therefore not need to follow as strict climate targets. The EU ETS applies further to civil aviation companies. The EU obliges actors in these energy intensive sectors to acquire allowances that match their CO₂ emissions, which results in higher prices for the use of fossil fuels or coal in the energy production but on the other hand, sets incentives to use renewable energy sources of the power production in these sectors. The EU ETS is based on a principle that can be called cap & trade. The EU is

setting an annual cap that will be adapted each year in order to reduce the allowed emissions. Actors of industry and energy sectors then need to buy European Emission Allowances (EUA) that correspond to the volume of tonnes of CO₂ emitted during the year. Moreover, there is a possibility to trade the EUA bought with other actors that require to purchase these. However, at the end of each year, each actor needs to be able to transfer the amount of EUA that corresponds to the CO₂ emissions emitted. If a company fails to be able to surrender the amount of EUA according to their emissions and their emissions exceed the available EUA of the company, this actor will need to pay a fine of 100 € per tonne of CO₂ emissions that could not be covered with an EUA. This results in motivating the companies to improve their processes in order to be in less need of EUAs and having the possibility to trade the EUAs that exceed their actual emissions. During the time from 2005 until 2021 the EU ETS has been a major tool in the decarbonisation process of the EU's industry and energy system, which resulted in a reduction of emissions by around 35 % in the mentioned period from 2005 to 2021. For the future until 2030 the amount of EUAs will be reduced by 2,2 % annually in order to prompt the goal of a 40 % emissions reduction of the emissions from the year 1990 in the EU until 2030.

Appunn and Wettengel (2023) outline further that the EU ETS was adapted in December 2022 in order to fit the EU Fit for 55 climate package.

Since the EU agreed to reduce the emissions by 55 % until 2030, the EU Parliament, EU Council and EU Commission agreed on an extension of the EU ETS and including a system for the transportation and the heating fuels.

2.3 Implementation of EU biofuel policies in Germany

As all EU member states, Germany needs to implement the EU policies into national legislation. Kaup and Selbmann (2013) point out that Germany played a leading role in the beginning of the transition towards a more environmentally friendly transportation sector in the EU and the introduction of biofuels in the fuel distribution.

In 2010 blending mandates on both the German and the French market had a great impact on the consumption of biofuels in the EU (Sorda et al., 2010).

3 GERMAN BIOFUEL MARKET

3.1 German biofuel policies

Germany implemented the EU policies regarding biofuels and biofuel productions into several national policy documents. The German Federal Office for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung, 2023) published an overview of the legal basis and administrative regulations for the production of biofuels on their homepage. The main basis is the Directive EU 2018/2001, mentioned above.

The EU legal basis has been implemented and partially expanded in various national legal texts.

The laws relevant for the German biofuel legislation have been identified by scanning websites of involved authorities, see chapter 3.2. The German customs office and the BLE (Bundesanstalt für Landwirtschaft und Ernährung) that operates Nabisy (Nachhaltige Biomasse System) publish relevant laws on their homepage. The following are the key laws regarding the German biofuel legislation:

3.1.1 Erneuerbare-Energien-Gesetz (EEG) - Renewable Energy Sources Act

The EEG is mainly focusing on electricity from renewable sources, which has been in use since the year 2000. The electricity can originate from different sources such as wind, solar or biomass, which could be relevant with regards to this thesis. The aim is to reduce carbon emissions in the electricity sector and contribute to the protection of the climate and environment in the energy sector (Umwelt Bundesamt, 2021).

3.1.2 Energiesteuergesetz - Energy Duty Act

The Energy Duty Act follows the EU regulations RL 2003/96 which regulates the taxation of energy products such as fossil and biogenic fuels, gas, liquid gas, coal and renewable energy products as well as electricity. The Energy Duty act regulates how and to what extend energy products are taxed and which possible tax reliefs exist for certain energy products (Stromerzeuger Lexikon, 2022).

3.1.3 Bundes-Immissionsschutzgesetz (Federal Emission Control Act) in German

According to the German Federal Environmental Agency (Umwelt Bundesamt, 2022) the Federal Emission Control Act is the key policy regarding the immission control law. It is the national law that governs the protection against harmful environmental effects such as air pollutants, noise, vibration and similar. In this law also other EU regulations concerning environmental protection are implemented.

3.1.4 Biokraftstoff-Nachhaltigkeitsverordnung (Biokraft-NachV) (Biofuels Sustainability Regulation) in German

According to the German Federal Ministry for Food and Agriculture (BMEL, 2023) the Biofuels Sustainability Regulation implements partly the Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. This regulation states requirements for renewable fuels and their feedstocks if these fuels shall be counted towards the biofuel quota, a tax reduction or remuneration under the Renewable Energy Sources Act (EEG) in Germany. This is only possible for renewable fuels having a proof of sustainability. Key elements are values regarding the greenhouse gas reduction potential and policies regarding possible land use change caused by feedstock production.

3.1.5 Biomassestrom-Nachhaltigkeitsverordnung (BioSt-NachV) (Biomass Energy Sustainability Regulation) in German

According to the German Federal Ministry for Food and Agriculture (BMEL, 2023) the Biomass Energy Sustainability Regulation implements parts of the Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. The Bavarian state office for the environment (Bayerisches Landesamt für Umwelt, 2023) explains that the Biomass Energy Sustainability Regulation regulates which biomass can be used for the generation of electricity in accordance with the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz - EEG)

3.2 Development and Demand of biofuels in Germany

The German Federal Environmental Agency so called Umweltbundesamt (2023), has determined that the amount of renewable energy in the transportation sector in Germany is low compared to other energy sectors such as electricity or heat. In fact, the German Federal Environmental Agency states that the transportation sector in Germany is the country's sector with the lowest rate of renewable energy sources. They outline that the share of renewable energy in the transportation sector amounted to between 5 % and 6 % per year between the years 2008 and 2019. These numbers include renewable energy used for electricity production that is needed for example in railroad transportation. For many years between 2007 and 2019, the share of renewable energy sources used in the transportation sector remained stable, reaching a new high in 2020. This increase in renewable energy in 2020 can be largely attributed to an increase in the GHG quota from 4 to 6 percent. In 2021 the share of renewable energy in the final energy consumption of the transportation sector decreased again slightly, which was due to the reduction of biofuels in the overall use of energy. The German Federal Environmental Agency claims the reasons for this development are special carryover provisions as part of the adjustment of the GHG reduction quota from 2019 until 2021 as well as increased crediting of so-called upstream emission reductions of fuel production to meet the GHG quota. Moreover, the total energy consumption in the transportation sector decreased by 1 % compared to 2020 which is another factor related to the diminishment of the share of renewable fuels in the German transportation sector in 2021 compared to 2020. In 2022 the sales volume of biofuels remained stable compared to 2021 despite an increase of the GHG quota of 1 percentage point from 6 % to 7 %. The Federal Environmental Agency points out that mainly the sales of biodiesel reduced, while an additional consumption of bioethanol could be observed. Additionally, the share of electricity in the transportation sector increased. However, the share of fossil fuels increased, too, which leads to the stable share of biofuels compared to the previous year. Further, it is worth mentioning that the shares of the different renewable energy sources in transportation were subject to great variations throughout the entire time period since 2008.

In the figure 2, the mineral oil and biofuel use in Germany in the year 2021 is visible. The graphic clearly shows that the share of biofuels is rather small compared to the total use of oil in Germany in the year 2021. Moreover, some types of oil do not show any share of biofuels according to the graph, such as Jet and Heating oil. However, due to the change of legislation regarding a minimum mandate of biofuel in the fuel mix for Jet and maritime vessels, as mentioned earlier, it is safe to say that there will be a share of biogenic oil in the category of Jet in the future. Further, as figures 4 and 5 show, the total demand for biofuels

has increased over the course of a 20-year period until 2021 and therefore it can be estimated that the trend will continue in the future, especially regarding the effort of the EU towards a more sustainable energy sector.

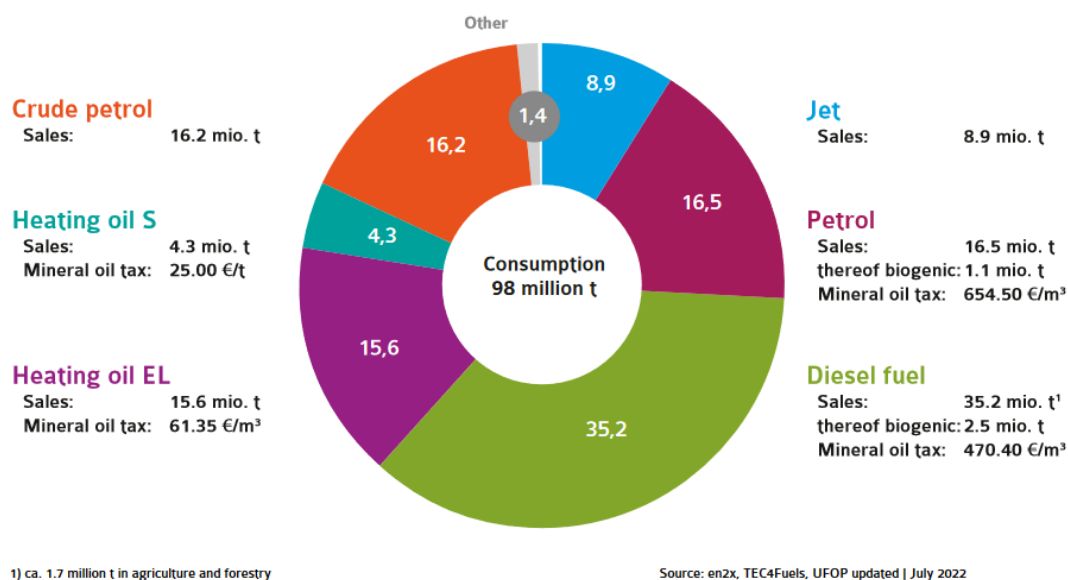
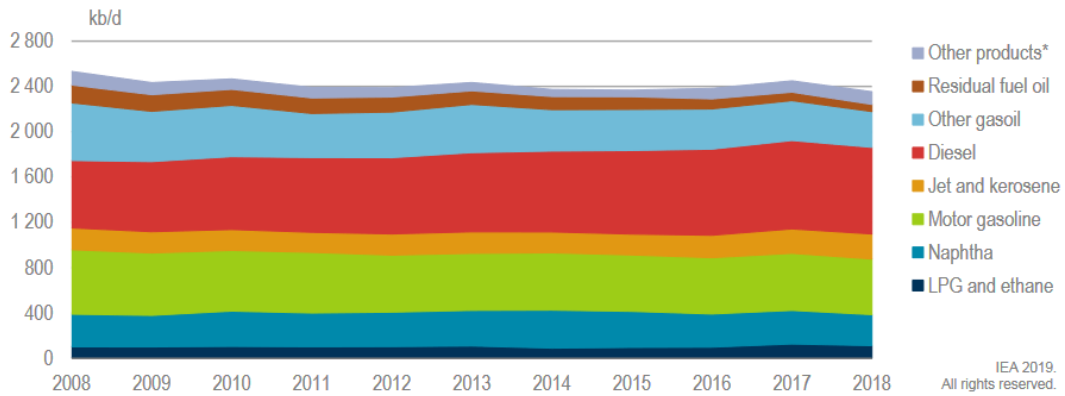


Figure 2. Mineral oil / biofuel use in Germany 2021. (Bockey, 2022).

Figure 3 shows that despite a slight decrease in the demand for oil products in the period from 2008 until 2018, the demand almost remained stable over the course of the respective time period. It seems that the share of the different oil products has also remained almost stable although a slight increase in the demand for diesel is observable. Considering the trend shown in the figure 3 one could consider that the demand for oil products and their share will stay stable over the upcoming years. However, political decisions and changes in policies, especially regarding restrictions of specific products, or the planned development for a shift to electric vehicles, as mentioned earlier, might impact the future oil demand in an unforeseeable way. Therefore, the market has to be observed closely in order to react appropriately on time and estimate the demand of oil products and biofuels in the future.



Germany's total oil demand has been stable over the last decade with increasing diesel demand for transport.

*Other products include crude oil, "other" NGLs, synthetic fuels, Orimulsion, hydrogen, synthetic crude, refinery gas, aviation gasoline, naphtha-type jet fuel, white spirit, industrial spirit (specific boiling point [SBP]), lubricants, bitumen, paraffin waxes, petroleum coke, tar, sulphur, aromatics and olefins.

Note: LPG = liquefied petroleum gas.

Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics/.

Figure 3. Oil demand in Germany by product 2008 - 2018. (IEA, 2020).

Figures 4 and 5 show the total energy supply by source for Germany from 1990 until 2021. It is visible that the energy supply has shown a decreasing trend over the 20-year period. Further a shift of the different energy sources can be observed. Coal and nuclear power show a trend to decrease. The German government has decided and implemented a complete phase out of nuclear power in 2023, causing the energy supply of nuclear energy to be missing in the future energy mix (Lengenfelder, 2023). How the nuclear energy supply will be replaced in the future remains to be seen as well as how it might potentially impact the renewable fuels sector. However, as seen in figure 4 and 5, the total energy supply of biofuel and waste for the German market has constantly increased in percentage terms as well as in energy volume, especially since the turn of the millennium. Further, it is visible that no other energy source has shown a similarly strong increase as biofuels and waste products have during the time of the 20-year period represented in the graphs. Considering the efforts, the EU is making towards a more environmentally friendly energy sector, especially regarding transportation, as mentioned above, it is plausible that the demand for energy from biofuels and waste products will continue to increase in the future.

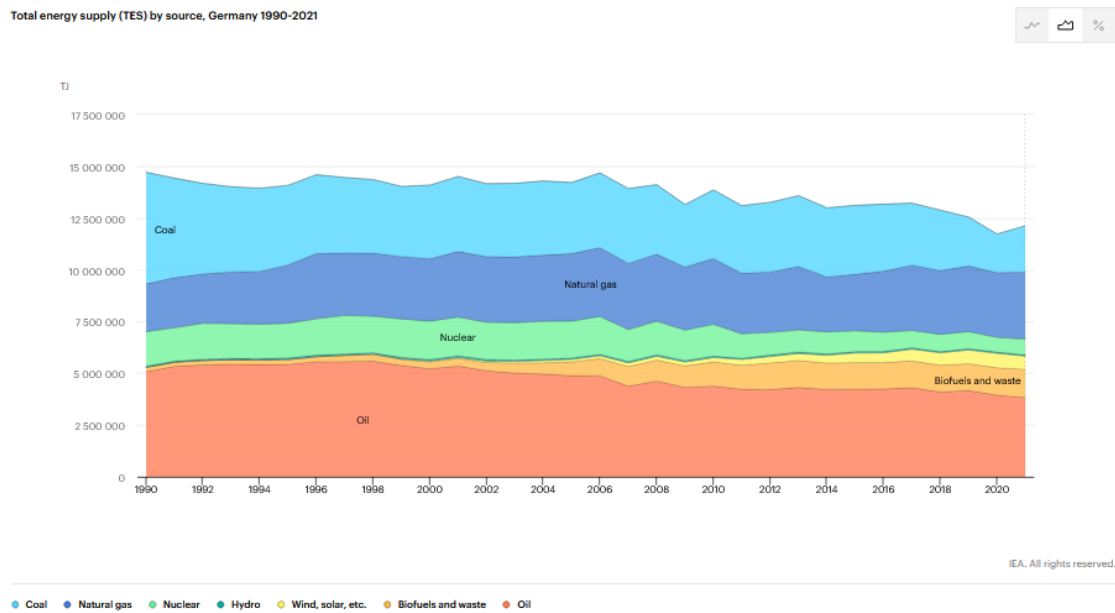


Figure 4. Total energy supply by source in TJ, Germany 1990 - 2021. (IEA, 2023).

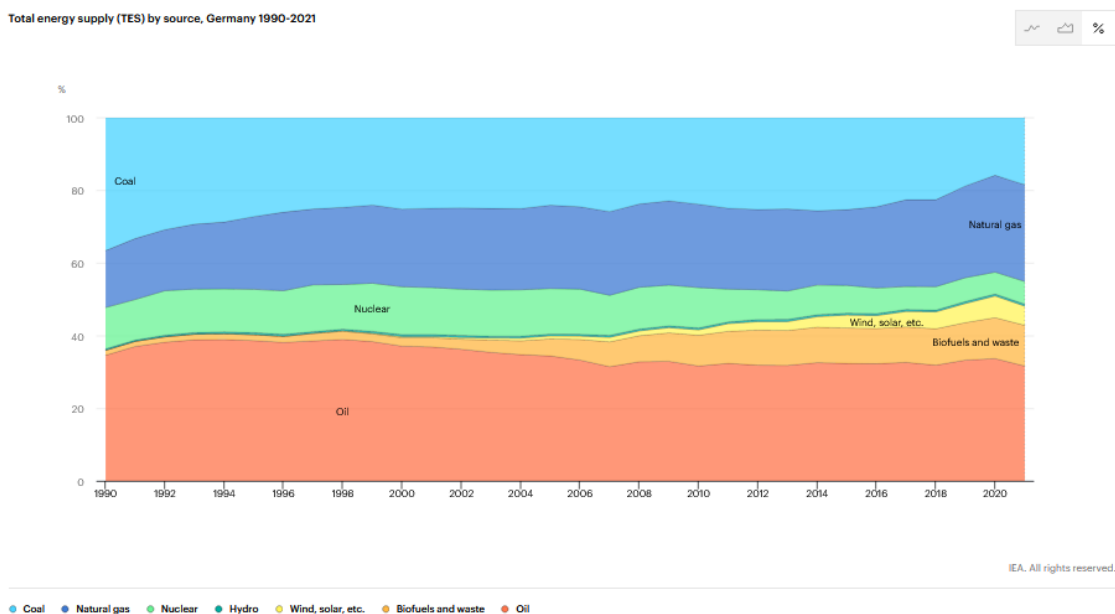


Figure 5. Total energy supply by source in %, Germany 1990 - 2021. (IEA, 2023).

Due to continuous changes in the economic situation in Germany and worldwide, the demand for biofuels in Germany is changing continuously so that not one correct value can be determined for the biofuel demand in Germany (Röder et al., 2023).

3.3 Authorities involved in the German biofuel production, trading and distribution

In Germany multiple governmental institutions are involved in the implementation of the biofuel legislation as well as its application and the monitoring of actors and industry involved. In order to be able to operate on another market it is crucial to know who is involved, especially governmental parties or agencies. Thus, to understand the laws and regulations and in case being able to interact with the respective authorities. The knowledge about the involved authorities will also enable stakeholders to find relevant and related information in an easier way. Dua et al. (2010) point out that the impact of governments on businesses and their value is high compared to other stakeholders. Only customers might have a higher impact on the company's value than governments. Furthermore, the authors point out that there is an expectation of business managers that governments and its authorities are involved in their sectors and industries. Further, actions taken by governmental authorities and the regulations they implement have strong consequences on business operations, opportunities or constraints. Therefore, it is crucial for any company operating or aiming to operate on the German biofuel market to know which authorities are mainly involved in the biofuel operations and responsible for the implementation and potential change of regulations.

The authorities presented in this report were identified through the dialog with experts in the sector and through profound research.

3.3.1 BLE (Bundesanstalt für Landwirtschaft und Ernährung) - Federal Office for Agriculture and Food

The German Federal Agency for Agriculture and Food, BLE, fulfills a wide range of tasks in the fields of agriculture, fisheries and nutrition. As the central implementing authority, it is part of the portfolio of the Federal Ministry of Food and Agriculture (BMEL - Bundesministerium für Ernährung und Landwirtschaft) (BLE, 2023).

Concerning renewable fuels, the BLE is the authority that is responsible for the recognition and monitoring of independent certification systems. These are responsible for the control and monitoring of the entire cultivation, supply and production chain (BMEL, 2023).

3.3.2 Nabisy (Nachhaltige Biomasse System - Sustainable Biomass System)

According to Bundesanstalt für Landwirtschaft und Ernährung a) (2023), Nabisy is a web tool of the German government operated by the BLE which aims to prove the sustainability of liquid and gaseous biofuels from biomass. Nabisy is operated by the German government under the Federal Office for Agriculture and Food (BLE, see above). The web applications aim is to offer a database that allows actors in the biofuel sector operating on the German market or trading biogenic fuel products under German certification to monitor the products they have traded or produced and brought to the market and gain prove of sustainability of their liquid or gaseous products according to German and European laws. For companies that have an obligation to fulfill the German GHG quota, the Nabisy web application is mandatory in order to be able to prove the volume and kind of biofuel that has been marketed and that it fulfills the required demands regarding its sustainability. Further, all companies that operate with biofuels that are relevant for the German market must insert the required information into the Nabisy Web application. Relevant German and EU authorities that monitor and operate data regarding biofuels and quota obligation fulfilments have direct access to the Nabisy web application and its data.

3.3.3 Customs Office

The German Customs Office (Zoll, 2023) takes part in the responsibilities for the crediting of biofuels in Germany and is one of the authorities that is responsible for the monitoring of these respectively. Detailed information is published on the Customs Office's homepage with links to relevant laws and news regarding the trade of biofuels.

3.3.4 Certification systems

According to Nabisy (Bundesanstalt für Landwirtschaft und Ernährung a), 2023) it is mandatory for anyone that wants to operate on the German biofuel market and as such needs to use Nabisy to be part of a national certification system of a member state or to join a certification system that is recognized by the European Commission.

The FNR (Fachagentur für Nachwachsende Rohstoffe e.V.) (2023) explains that certification systems are systems that ensure organizational compliance with the requirements for the production and supply of biomass and biofuels according to the Biokraft-NachV. Such systems have standards that define the requirements for biofuels in detail as well as proving the fulfillment of the standards and for

the monitoring of the proofs. Therefore, the certification systems can be used as a tool to verify the compliance of sustainability requirements and minimum GHG savings in the production of biomass and bioenergy and further confirm this by means of certification. Since 2010 ISCC System GmbH and REDcert GmbH have been granted permanent recognition of their certification systems by the BLE.

Besides the mentioned official actors, ETIP a) (2023) published a list with other organizations and agencies that play a role on the German biofuel market. Though these organizations might not have active power, they might play a crucial role regarding lobbying.

3.4 Demand of German biofuel legislation on feedstocks

The BLE published several documents on their homepage (BLE a, 2023) with information regarding the demand on feedstocks and biofuel production and distribution. One of the key documents regarding the feedstocks is a list in the shape of an excel file regarding the biofuel feedstock published on the homepage of the BLE under the Nabisy (Nachhaltige-Biomasse-System / Sustainable Biomass System) section which is indicating important information about different biomass for renewable fuels and of which the latest update was published in January 2023. The list gives information about the biomass code, which is the characteristic code with which one can identify the fuels according to the feedstock that was used. The second row indicates the type of biofuel or biomass, which could be for example HVO or FAME. The third column states the German name of the feedstock. In the fourth column indications about the biofuel's or bioliquid's production pathway in German can be found, as in the next column the same is indicated in English. Column F of the pathway states the short term of the pathway. In column G it is indicated if the respective feedstock is produced from non-agricultural waste or residue, whereas in column H it can be read if the waste or residue comes from agriculture. Column I indicate if the biofuel is advanced or conventional in accordance with Annex IX (9) of the RED II. Column J indicates if the feedstock is in accordance with Annex IX A or B of the RED II. Column L indicates if the biofuel is waste based according to § 13a / Annex 4 of the 38th Federal Immissions Control Act. In column M it is visible if the fuel is advanced according to § 14/ Annex 1 of the 38th Federal Immissions Control Act, referring to the number in § 14 / Annex 1 indicating the origin of the advanced feedstock. Column N explains the mean ILUC (Induced land use change) value. Column O indicates the ILUC risk according to VO (EU) 2019/807. Column P and Q indicate the specific energy content. In column S the default GHG emissions can be read. Column T states the specific density. Finally in column V it can be seen if the biofuel is possibly creditable to the German quota.

This table is crucial when working in the biofuel sector and trading on the German market as all important information regarding the biofuel and if it is possibly creditable towards the quota on the German market can be found in this table.

Yet there are other factors that are important to consider when operating on the German market.

According to ETIP Bioenergy (2023) Germany implemented the ILUC Directive in 2017. The German government has introduced a crop cap of 6,5 %, which is slightly lower than most member states having the crop cap at 7%. The crop cap has been reduced further throughout the years and was at 4,4 % in 2022, while the use of biofuels made from feedstock palm oil has been banned completely for the year 2023 following (Argus, 2022). Bockey (2022) points out that the crop cap shall be lowered to 2,5 % in 2023 and reduced to 0 % in 2030 because of discussions regarding the food crisis, which would entail an amendment of the 38. BImSchV. The relatively large reduction from 2022 to 2023 is justified by the elimination of palm oil as crop feedstock.

3.5 Implications of German biofuel policy for production

The German customs office (Zoll, 2023) outline on their website how to define a biofuel and under which conditions they can be placed on the market referring to multiple legal texts mentioned earlier: “Biofuels as defined by the Federal Immission Control Act (BImSchG) and the Energy Tax Act (EnergieStG) are energy products made exclusively from biomass as defined by the Biomass Ordinance (BiomasseV) of June 21, 2001 (BGBl. I p. 1234), as amended.

Energy products produced proportionately from biomass are deemed to be biofuels in the amount of this proportion.

Without exception, biofuels placed on the market can only be counted toward meeting the quota obligation if they meet the requirements of the Biofuel Sustainability Ordinance (Biokraft-NachV).” (Zoll, 2023)

According to Zoll (2023), the German customs authorities, there are further criteria applying to specific kinds of biofuels:

FAME (Fatty acid methyl esters) is a type of biodiesel. They can be counted as biofuels if they are produced from oils and fats that are in accordance with the Biomass Ordinance and § 5 of the 10th Federal Emissions Control Act. § 5 of the 10th Federal Emissions Control Act refers to the norm DIN 14214, which is the German and European norm regarding FAME in diesel engines and for heating (GlobalSpec, 2023). Further there are specific conditions on the CFPP (cold filter plugging point) for FAME (Zoll, 2023). The CFPP must reach a value of -10 °C

between the 16th of November and the last day of February, if the producer can guarantee that the CFPP can reach a value of $-20\text{ }^{\circ}\text{C}$ in case of adding further additives.

HVO (Hydrotreated Vegetable Oil) is also used as biodiesel. It can be counted as such if it is produced from biogenic oils or fats that are in accordance with the biomass ordinance and if the hydrogenation did not take place in a refining process along with mineral-oil derived (fossil oil).

By way of derogation, biogenic oils that have been hydrogenated together with mineral-derived oils in a refinery process (cp-HVO) were also considered biofuels (only for the commitment years 2018 to 2020), provided that the agricultural raw materials used in the production of the biogenic oils have been produced sustainably (Section 10 of the 37th BImSchV).

Biomethane is a biogas which can be mixed with natural gas or used in pure form. According to German legislation it can be counted as a biofuel if it meets the requirements of § 8 of the 10th Federal Emissions Control Act. The § 8 of the 10th Federal Emissions Control Act refers to the norm DIN EN 16723-2 issued in October 2017. Table D.1 is of special importance regarding the quality of biomethane. Biogas of quality “L” requires a Wobbe-index of minimum $36,6\text{ MJ} / \text{m}^3$ and a heating value of $39\text{ MJ} / \text{kg}$.

Biogas of quality L refers to low calorific gas and therefore to the content of methane in the gas (EnBW, 2023).

Thanks to the Wobbe-index the energy deliverability can be determined as well as if fuel gases can be interchangeable. Therefore, it is used to determine if an engine can use an alternative fuel source without being modified (Neutrium, 2016).

Biogenic liquid gases can be counted as biofuels if they meet the requirements of LPG (liquid petroleum gas) of § 7 of the 10th Federal Emissions Control Act, which refers to the norm DIN EN 589, issued in March 2019.

Liquified biomethane can be counted as biofuel if its properties meet at least the requirements of table D.1 of the norm DIN EN 16723-2, issued in October 2017. Further, energy products that are produced from feedstocks according to appendix 1 of the 38th Federal Emissions Control Act.

3.6 Criticism on policy implementation

Maes et al. (2015) explain that due to the increase in environmental awareness by governments and the challenge to take action against climate change the demand on sustainable biomass for fuel and energy production is rising. This leads to the

necessity to regulate the biomaterial market in order to guarantee the sustainability of such products. However, as sustainability of biomaterials is dependent on many factors the regulations regarding renewable fuels can differ in different countries and regions, for example regarding ILUC, food security or sustainable water use. Further, the authors argue that the evaluation of a renewable fuel product is a complex task especially taking the entire value chain into consideration. As an example, GHG values of products can vary as the evaluation depends amongst other factors on the setting of system boundaries, local conditions regarding feedstocks and other, calculation methods or the design of the production process. The same difficulties apply when the environmental impact shall be determined via an LCA (Life Cycle Assessment) or similar method. Moreover, modern production plants can produce more than just one single product, for example renewable energy products as well chemical products for non-energy use, which makes the calculation of each of the products more complex and possibly hamper the calculations further. The authors even mention studies in which the calculation methods of the RED lead to different results. Hence, implementing a legal framework and binding policies that take these complexities into consideration can be very challenging especially taking into account already existing legal frameworks and policies of the concerned country as well as international legislation that needs to be followed. Further, Sicurelli (2020) explains the complex connection between the EU wanting to be a global normative power in trading and third countries as their trading partner. In particular, the EU is trying to introduce standards regarding for example human rights, or environmentally to trading partners from third countries that might be difficult to be met. It is also possible that the third parties have other reasons why they would not want to integrate the demands of the EU countries on their products, for example political or cultural. Yet in the case of for example biofuels, the EU has a great need in feedstocks from third countries, so it is to be shown if the rules will be able to be implemented and accepted from the third countries in the long run or if other compromises need to be made.

Delacroix et al. (2023) investigated the trading around the EU ETS and EUA on hand of analyses of financial transaction statements of cement and steel manufacturers in France and Spain, that the authors claim to be two of the biggest receivers of EUAs. They found that actors in these sectors use the free EUA to boost their profits and did not invest the money in climate action as it was supposed to. According to the authors in the years from 2013 to 2021, the biggest emitting industries received 98,5 billion euros but invested only a quarter, around 25 billion euros of that sum into climate action. The authors criticize that these industries have received and resold their carbon allowances making profits and not promoting climate action with that money, yet all of this is legal. This can be seen as a disinvestment and a tool that fails to meet its purpose.

4 DATA AND METHODOLOGY

In this chapter the aim for the research, as well as the motivation for the research will be explained. Further it will be outlined which methods have been chosen to conduct the research.

4.1 Aim for the research

The aim of the research is to understand if there are business opportunities on the German biofuel market for companies in the Nordic countries thanks to incentives created by the German renewable fuel legislation, which is the implementation of the EU legislation regarding renewable fuels. The main assumption is that renewable fuels play a key role in the transition towards more sustainable transportation, which is one of the sectors in the EU causing the highest emissions of GHG.

4.2 Motivation for the research

Last year I started to work in an oil trading company. As I learned during my work experience and as mentioned earlier, the German market is the biggest in Europe and even globally relatively big. Therefore, what happens on the German renewable fuel market has a big impact on the rest of the European markets. These markets are regulated by EU and national directives and therefore different conditions and incentives apply in each country. During my work experience I realized that despite the impact that the German market has on trading and prices of renewable fuels in other countries, the legislation is not fully understood by actors in the industry. Further, there is no clear scientific overview of the German renewable fuel legislation and policies available, and the information provided by authorities is not always easy to find. Additionally, governmental regulations and information is not always clear and communication with authorities is needed in order to gain clarification on practicalities regarding the biofuel production and trading. The information, one can receive from authorities regarding the application of the renewable fuel policies usually contain a disclaimer saying that the answers are not legally binding, which often leads to room of interpretation for the companies on how to apply the policies creating a risk to produce or distribute renewable fuels that might be excluded from the possibility to be counted towards the GHG quota.

Moreover, regulations regarding renewable fuels are underlying constant changes due to economic or political developments, which require constant monitoring by companies and can lead to quick changes in the availability of business opportunities.

In this study, I wanted to find out if there are business opportunities for companies in the Nordic countries regarding renewable fuel trading on the German market despite the difficulties that companies are facing when trading renewable fuels on the German market.

4.3 Research Question

The main research question is, if there are business opportunities for companies in the Nordic countries aiming to operate on the German market. The purpose of the question is to find out if the relevance of the German renewable fuel market can create benefits for actors in other markets, in this case the Nordic countries. In order to evaluate the possibility of business opportunities, the renewable fuel demand will be analyzed as well as the legislation, to find out what kind of fuels and feedstocks could be relevant. Further it is important to investigate which feedstocks play a role in the Nordic countries. Sub-questions are how does the German renewable fuel legislation affect energy companies in the Nordic countries and their production of renewable fuels? Which constraints and opportunities do companies from Nordic countries face when operating on the German renewable fuel market? How does the cooperation between German authorities and companies operating on the German renewable fuel market work and which challenges do they face? How do the German renewable fuel policies possibly impact the production and trading of companies operating in the renewable fuel sector?

4.4 Qualitative Study

According to Mahoney and Goertz (2006) the purpose of both quantitative and qualitative research is to find descriptive and causal conclusions. The qualitative research tries to conclude from a small sample to the broad while quantitative research aims to investigate as big data as possible in order to make a conclusion about the average or majority of the data and create a conclusion. According to Denny and Weckesser (2022) qualitative research aims to find information from rather broad research questions that can then be narrowed down to find another

or different aim or purpose of the study. One of the most common techniques used in qualitative research are semi-structured interviews, in which some research questions are already determined and throughout the course of the interview other questions can be added and the information can be collected according to the course of conversation. There is no standardized method to conduct the qualitative interviews as they aim to find out more about the specific interviewee's perspective. Therefore, there is also no minimum or maximum of information that should be collected, but the research continues until it seems satisfactory according to the research aim.

For my research I also decided to conduct semi structured interviews with relevant people working in the renewable fuel sector and from German authorities. Interviewees were approached via email in April and May 2023.

5 RESULTS AND ANALYSIS

Thanks to the literature review and the data collected through interviews and the business news analysis, multiple interconnected constraints and opportunities for Nordic companies operating on the German biofuel market or planning to do so, could be identified. The constraints and opportunities identified in this thesis are of course limited to the available data that has been scanned. The German biofuels market offers both constraints and opportunities for Nordic businesses – related to multiple and interdependent issues of legislation, bureaucracy, communication, resource constraints, economics, etc.

5.1 Constraints

5.1.1 Legislative ambiguity

Tsiropoulos et al. (2022) explain that the EU has changed and adapted their legislation regarding biofuels and climate action, see chapter 2.2, multiple times throughout the period between 2011 and 2021. This includes for example adaptation of the RED, which has been revised again in 2023 during the course of writing this thesis, including new GHG reduction targets. Further points like the inclusion of ILUC have had major impacts on the sector and its stakeholders as well as the market. These continuous changes of legislation that then need to be implemented in national legislation can cause challenges for actors in the sector due to uncertainties in policies and the need of adapting the processes after the implementation of the new legislative environment.

The German biofuel legislation is like for all EU member states based on the EU policies and directives. Therefore, it is clear that minimum targets set out in EU laws must be met as well as specific requirements on the practical implementation of the fuels.

However, the set-out legislation in some cases leaves room for interpretation, for example regarding the implementation in praxis. Experts from Nordic energy companies have pointed out that even though in case of unclarities relevant German authorities can be contacted but that their answers usually contain a disclaimer that they are not legally binding. Despite the fact that these answers give guidance on how the regulation in question shall be executed in practice, it still leaves a degree of uncertainty to the operations of the business in question. In case that German companies that have the duty to fulfil the mandate obligated by the German state, face similar challenges, a constant risk that the interpretation of the legislation in praxis might not fully be compliant with the intention of

the regulation could arise. This ambiguity could spread throughout the sector and foreign companies that cooperate with German companies could be left astonished about the level of uncertainty.

An expert that operated in the Nordic biofuel market for multiple years revealed that the German government tends to make quick changes and adaptations in the policies regarding biofuels that can happen even multiple times throughout a year. In order to anticipate these and be able to adapt business operations on time it might be helpful to maintain contacts with politicians in order to receive relevant information early on.

5.1.2 Bureaucratic communication challenge

Dua et al. (2010) mention that the communication with authorities is often challenging. As the survey they conducted revealed, many responsible executives in businesses that have to communicate with authorities experience encounters that they describe as frustrating and leaving them with an impression of governmental employees not being sufficiently informed about processes and economics of the sector. Further, the importance of approaching and engaging with authorities proactively is underlined by the executives that participated in the mentioned survey. Though the survey did not focus on the biofuels sector nor Germany specifically, it can be assumed that these impressions are similar in different industries. The authors conclude that there are multiple ways for companies to build sustainable and effective relationships with authorities but that these strategies of relationship management are often not established nor practiced efficiently by the relevant executives in companies. The authors conclude that despite the challenges companies have when communicating with authorities, according to them it should be a priority to establish robust relationships with governments, because the impact that governmental decisions have on a company's value and processes is major. They recommend that company managements should lay greater emphasis on the communication with governments throughout multiple business levels.

As multiple stakeholders from Nordic energy companies pointed out, the communication with German authorities can be challenging regarding open questions that arise when they face uncertainties regarding biofuel production or feedstock requirements. Although the authorities are usually available to answer questions, for foreign stakeholders these answers may leave room for interpretation. Further, it has been mentioned that actors from foreign companies often face insecurities on who is responsible for the specific case in question and whom they should contact. The question might not always just be which specific person or position is responsible or the best contact for the matter, but even which authority is relevant and responsible in the situation.

Furthermore, experts have pointed out that there might be limitations, because Nordic companies do usually not have to fulfill a GHG mandate on the German market, and their questions are often concerning a broad range of different aspects rather than focusing on one specific detail. Therefore, it is often considered to rather establish relationships with companies on the market that face similar problems and communicate with these instead of the authorities. This matches the claim by Dua et al. (2010) that companies might feel frustrated with communicating with authorities and often establish stronger relationships with other stakeholders.

5.1.3 Feedstock limits (resource constraints)

As mentioned above the biofuels allowed to be counted towards the German GHG quota have restrictions on their feedstocks. Although renewable fuels made from waste and residue-based feedstocks are more favorable from an environmental point of view, Germany has implemented for example restrictions on renewable fuels made from animal fat as a feedstock. Animal fats of category 3 are completely banned from the possibility to be counted towards the GHG quota while renewable fuels made from feedstocks containing animal fats of category 1 or 2 can only be counted towards the quota if they also fulfill the upper limit for chargeability of waste-based biofuels according to § 13a of the 38th BImSchV (Zoll, 2023).

As outlined in chapter 2.1, the demand in biofuels is seen to be growing in the upcoming years due to multiple factors, such as policies regarding climate change mitigation and the few other alternatives available to replace fossil fuels at this point of time. In order to attain the climate goals, set out by the EU and its member states, the volume of biofuels must increase drastically until the year 2030. An additional challenge will be the mandatory introduction and production of biofuels for air and maritime transportation.

However, it is critical, if there will be sufficient feedstocks available to cover the necessary volume of biofuels that need to be produced in order to fulfill the climate goals and satisfy the demand.

According to IEA a) (2022), suppliers of biofuel products are likely to experience shortages in feedstock supply in the years up to 2027 if the market situation and trends remain similar to the year 2022. Waste and residue feedstocks for biofuel production will be demanded not only in Europe but also in the USA. This is because they fulfill best policy targets regarding GHG emissions savings. It is estimated that their share as feedstocks for biofuels will increase up to 13 % by the year 2027. However, the IEA states that the prices for waste and residues feedstocks that are currently most used increase and the availability might reach their limit. They imply that policy changes, governmental support programs or technological innovations might offer solutions to this potential problem. Crop

based feedstocks face lower risks of reaching their potential supply limits but their demand might not grow as strong as for waste and residue feedstocks.

Hansen et al. (2019) studied a complete transition to biofuels until 2050, replacing all fossil fuels with biofuels including air transportation. Even though a transition to 100 % biofuels would not be more expensive than other solutions such as the electrification of the transport sector, the authors came to the conclusion that this shift is not possible due to resource limitations. The demand for biomass in order to produce biofuels would surpass the potential energy needed to produce from it.

Millinger et al. (2017), state, that according to their sensitivity analysis regarding the future cost competitiveness of different types of liquid and gaseous biofuels, first generation biofuels stay the most probable option also in the future as most cost advantageous biofuels. However, they point out that their analysis is limited due to unknown development of resource availability, future calculations of GHG emissions and ILUC factors, policy developments, market barriers and especially technological developments. These regard especially potential new developments in the production of second-generation biofuels from lignocellulosic materials. They further outline that policies that do not take the technological aspect of the production of biofuels into consideration might have a negative impact on the biofuel production in the future. The inclusion of the production process and technology in policies might have positive impacts on environmental aspects and regarding resource availability. However, the biggest risk for the development of biofuel production that the authors could filter out was the price development, which is highly uncertain and dependent on multiple factors. Furthermore, with regards to first generation biofuels, there is high uncertainty in their calculations due to dependencies on the development of agricultural growing patterns that might change in the future.

Concerning the feedstock restrictions and the risk of feedstock shortage for biofuels, an expert from the sector has underlined that these restrictions might limit the development of the transition in the fuel sector. According to the expert, nothing should be restricted that is already in shortage, especially regarding resources that are for the time being needed to promote climate action.

5.1.4 Language barrier

The BLE publishes all documents in both languages German and English. Moreover, the Nabisy web application provided by the BLE is available in German and English. Thus, all relevant information should be available for actors on the German biofuels market in English and therefore easily accessible. Further it is possible to communicate directly with authorities in English, such as the BLE responsible for the Nabisy application. However, most laws are published in German only and translations of relevant laws to English or other languages are not

easy to access or gather. As experts from Nordic energy companies pointed out, the language can be a barrier limiting smooth operations on the German market. One expert from a Nordic energy company involved in trading renewable fuels pointed out that since trading is based on quick developments, the monitoring of those can be challenging in markets where first-hand information is not published in English. Further, the value of the goods to be traded might depend on policies that might also determine the legality of the goods on the market. Consequently, being able to understand relevant policies and their changes is crucial for smooth operations. Concerning the German market, quick changes are often published first in German and then translated into English at a later point of time. This matches the statement of another expert interviewed for the purpose of this thesis who states that it has happened in the past that the legislation regarding specific feedstocks had undergone multiple quick changes within the course of 2 weeks which could cause challenges in the business operation of companies especially if the monitoring is challenging.

Portuese (2012) confirms that there is a huge economic value in languages. Each language has its own economic value depending on the information it holds and the importance of the information for the stakeholders of the language. Therefore, a market value can be determined for a language that can possibly differ between industries. As concerning the EU, all languages are legally equal yet there is a prioritization between the languages where some languages are more frequently used, independent on the number of native speakers, and thus have a higher market value than other languages.

Kitenge and Lahiri (2022) outline in their study that trading increases if the involved actors use similar languages and that trade can be limited significantly if language barriers exist. Further, if translations are available easily or can be done free of complications it can be beneficial for trade.

5.1.5 Information insufficiency or information asymmetry

Experts from Nordic energy companies have mentioned that they face a lack of information, for example when it comes to rules regarding feedstock restrictions and fuel production and possible restrictions in that regard.

Even if information about specific restrictions of feedstocks for the biofuel production is available, there are no clear rules or guidelines on how to treat operations in case these restricted feedstocks are used for the production of biofuels on other markets. In specific example there is a lack of information, on how the production plant shall be treated if multiple feedstocks are handled of which some are restricted on specific markets, for example how and if the production plant needs to be cleaned or treated before the new allowed feedstock can be introduced, or how and up to which point the feedstock or fuel product has to be stored in different tanks with other feedstocks or fuel products that can be sold

on the respective market and counted towards the quota. Documents and tools such as the Nabisy feedstock list and other information material that can be found on the homepage of the BLE / Nabisy that are available for companies to deal with these issues are said to not always be self-explanatory for actors from foreign companies despite being available in English. In these situations, the companies contact authorities in the specific country, in this case Germany to gain clarification about the situation. However, with regards to 5.1.2 often the authorities leave a disclaimer that their answers are not legally binding which gives little to no legal security about the decisions taken about future business operations in accordance with the statements of the authorities in private conversations.

Additionally, one expert pointed to the fact that the German market offers a much wider range to fulfill the mandate including different incentives. This makes it much more complex for foreign operators to grasp all details and understand them profoundly to also be able to apply their operations in accordance.

Another expert that has operated in the Nordic biofuel market for multiple years, pointed out that big markets like the German one is always vulnerable to the spread of wrong information. For instance, with regards to the suspicion of fraud cases regarding the delivery of wrongly declared sustainability certificates for specific biofuels from waste and residue in 2023, as for example reported by Köller (2023). It is said that the volume of some fuels made from specific feedstocks such as UCO (Used Cooking Oil) or UCOME (Used Cooking Oil Methyl Ester) has risen immensely compared to the previous year to more than twice the volume of 2022. This is raising suspicions if these volumes are denoted correctly or if some volumes are subject to fraud. These suspicions have had a great impact on the European biofuel market. The cause is the change of legislation regarding a sub-quota for fuels, that petroleum companies must fulfill if the volume of fossil fuels is exceeding a specific amount since the year 2020. Since 2022 the said sub-quota can only be met with so-called advanced biofuels, which are made from feedstocks that are not competing with the production of food products. Furthermore, these feedstocks shall not originate from areas that have a high value of biodiversity or a high carbon stock. This is a requirement that must be met in addition to the GHG emissions reduction quota that the share of biofuels needs to fulfill. It is worth mentioning that these biofuels fulfilling the sub-quota can be counted towards the quota with twice their energy content. If there is information that is fraudulent or if no confirmed information can be obtained, it can have a strong impact on business decisions or might prevent companies from being able to take well-founded decisions, according to the source. Concerning this case, no official statements could be found, and companies must rely on information published by the press or institutions like ISCC.

5.2 Opportunities

5.2.1 Rationale of the legislation in support of sustainable business

As outlined earlier, the biofuel market in the EU and worldwide is based on governmental incentives to promote climate change mitigation and limit GHG emissions. Only these governmental engagements make the biofuel market valuable and interesting for the concerned industries.

As outlined earlier, the German biofuel market is strongly impacted by policies as well. The government and the respective governmental agencies create this market in accordance with EU legislation. However, the implementation in Germany is rather complex in comparison to other EU member states as was revealed in the literature review and confirmed by experts from the industry.

As experts from a Nordic energy company explained, the biofuel market would not be valuable for trading without incentives from governments, due to much lower prices of fossil fuel products. This is supported by the IEA (2021) who outlines that the demand for biofuels is mainly driven by governmental policies. Further that specific policy design can have a great effect on the demand and growth of the renewable fuel sector.

Experts from Nordic countries have pointed out that the different implementation of the EU biofuel legislation into the member states legislation offers multiple business opportunities. They outline that these would not exist if the biofuel legislation would be integrated into the national regulations in the same way in each country, which would just create one big European market leaving no room for arbitrage or other economic opportunities to create value through trading. However, they acknowledge that one equal legislation in all member states could have positive effects on the environment as it would for example reduce logistical costs and distances.

The experts have stated that the German biofuel legislation is particularly interesting for trading because it includes many factors that other countries do not prioritize. In the Nordic countries, Finland and Norway introduced their mandates in such a way that the emissions reductions are based on the energy content of the fuel products. Sweden is basing its system on the GHG emissions reduction that can be calculated for the biofuel products. However, Germany's biofuel mandate combines both systems, which makes it more complicated but on the other hand offers more room for business opportunities due to multiple incentives created by policies.

5.2.2 Economics

As explained in chapter 3.1 it is assumed that the demand for biogenic fuel products in Germany will keep growing throughout the upcoming years. Hansen et al. (2019) state that Germany wants to reach a successful transition of its complete energy system towards entirely renewable energy until 2050. Moreover, Reuters (2022) reports that the German government plans the entire energy used in 2035 to be sourced from renewables. Thus, the demand for biogenic fuels can be expected to remain high in the upcoming years.

The attempt to phase out fuel driven cars in the future is not seen as a risk for the biofuels sector according to an expert working in the biofuels industry. Even if the demand for road-transportation will decrease, the demand for aviation and maritime transportation is expected to increase in the future.

As mentioned by Midttun et al. (2019), companies that have their own biofuel production have a competitive advantage over competitors that do not produce the biofuels themselves. As long as the EU legislation will be in force, there will be a demand for biofuels on the European market that needs to be met. Producers that use the incentives created by governments well can impact the biofuel market prices, not only maximizing their profits but also decreasing the end user price (Denizel et al. 2020). Further as mentioned earlier, businesses will have an advantage regarding marketing. The image of companies operating in the oil and gas industry is usually negative regarding climate action. However, the promotion of renewable energies and fuel products by these companies have the potential to improve the company's image towards the public.

5.2.3 Market size of Germany

As mentioned above the German biofuel market is the biggest in Europe regarding demand and supply and counts to the five biggest worldwide. As outlined in chapter 3.1 the demand for biofuels showed a constant increase over the years. Theoretically, implementing the EU regulations in the same manner in all EU countries might create advantages in terms of shorter logistics. However, the different implementations in the member states creates room for arbitrage and An expert from the sector verified that Germany has one of the biggest markets for biofuels worldwide. Changes on the German market can have great impacts on the world market for biofuels, which might seem abrupt if the regulations change often. This contains risk potential as mentioned in the chapter about constraints. However, the expert underlined that it also holds potential for opportunities. The changes on these big markets usually have a spill-over effect on other markets.

Another expert confirms that the size of the German market is causing major impacts on other countries in the EU and the businesses operating there. As the source outlines, not only is the German market the biggest in terms of volumes and population but also it has the highest mandate in the EU. Even if changes are made that seem minor for the German economy, such as a change of a mandate of 1 percent, it can have a major effect on other markets, for example in Sweden, and the feedstock selection the company will make for their fuel production.

5.2.4 Nordic's competitive advantages

Mustapha et al. (2019) highlight that the Nordic countries have always played an important role in the forestry industry and have been world leaders in the sector. However, developments towards more technological information processing have challenged the demand on traditional products from the forestry industry such as paper or paper products. Yet the Nordic countries still have a deep understanding of the production and transformation of forestry products and the technologies that are connected to it. As pointed out earlier, the demand for biogenic fuel products is increasing worldwide, including the EU and Germany. Due to the risk of ILUC for first generation feedstocks such as food crops for the biofuel production, second generation biofuels made from for example lignocellulosic materials are becoming more and more attractive for the biofuels markets. Mustapha et al. (2019) outline that the Nordic countries seem to be an attractive place for investments in the biofuel sector thanks to multiple other factors such as the proximity and abundance of the relevant feedstock, wood, which would decrease transportation ways from the feedstocks to the production plants. Moreover, the possibility to cooperate with other related industries such as pulp milling businesses or the sawmilling industry could facilitate the diversity of the feedstocks, as waste and residue products from those sectors could also be used. However, the authors note that there are differences in the attractiveness of the individual countries depending for example on the labor costs or the feedstock capacity allocation. The authors do not outline the possible trade of the biofuels to other countries. Nevertheless, second generation biofuels are more and more demanded in entire Europe due to the rules imposed by the EU. This could offer an opportunity for the Nordic countries and be used as a competitive advantage compared to other countries, especially inside Europe.

Jastad et al. (2019) underline that biofuels from the forestry industry might play a major role in the future production of second-generation biofuels and that they could play a key role in the efforts to increase the feedstock supply for renewable fuels especially regarding the transportation sector. Moreover, the authors point out the suitability of biofuels from the forestry sector for the fulfilments of the regulations set out in the RED of the EU.

According to an expert from the energy sector in Finland, one relevant feedstock for renewable fuels coming from the Nordic countries is tall oil, a residue from the forestry industry. CTO (crude tall oil) is a more sustainable feedstock for renewable fuel production than other plant-based oils, because it is a by-product in the forestry industry from pulping and it is a crop-based oil that could not otherwise be used as food or feed. There are 1.6 million metric tons of CTO produced annually worldwide (Brännström et al., 2018).

Brännström et al. (2018) outline several positive aspects of plant-based oils compared to fossil oils as fuel feedstocks such as advantages regarding the flash point, biodegradability, aromatic content or sulfur content, which is usually not detected in plant-based oils. Further, plant-based oils are easy to obtain and to transport. However, due to their chemical properties and the technology of the engines used in common transport vehicles, plant-based oils cannot be used as they are in engines and need treatment in order to be used as fuels. Taking CTO as an example, it can cause corrosion, does not have adequate properties without a correct refining process and can cause contamination of the engine.

As an expert from the Nordic countries pointed out, the Nordic biofuel markets are relatively big in Europe because of the high mandate that the Nordic countries impose on their industry. Due to current developments the mandate has been decreased for example in Sweden which for example leads to a reduction in European HVO demand by one fourth.

Millinger et al. (2017) who studied the future cost competitiveness of different liquid and gaseous biofuels in a sensitivity analysis, as mentioned above, found that the competitive advantage of second-generation biofuels is highly dependent on technological developments. Moreover, they propose that they gain a special status in policies. Having in mind that their study dates from 2017, and as outlined earlier, policies in the EU have developed favorable for the use of second-generation biofuels from lignocellulosic products as well as e-fuels and RFNBOs.

According to an expert from the biofuels sector the competitiveness of the Nordic countries regarding the biofuels markets in Europe could be enhanced by their governments. One important aspect is the support and policy regulations that allow producers to build production facilities. Governmental support of investments for production facilities could boost the competitive advantage of the Nordic countries in the biofuels sector. Another important aspect regarding the Nordic countries as a production location is the infrastructure available that is needed in order to allow smooth production. The expert points out that for example Sweden has a well-established electricity grid that is advantageous and reliable to ensure the operations of companies. Additionally, having infrastructure in place that will allow efficient logistics of feedstocks to the production facility and transport of final products to the customer is crucial. These aspects are given in the Nordic countries at least regarding road transportation. The expert mentions that the ARA (Antwerp Rotterdam Amsterdam) region would be an excellent location from a logistical and infrastructural point of view. However,

having operations in that area could imply high costs, which could outcompete the advantages for smaller businesses. Thus, having the needed infrastructure in place for production depends highly on the importance governments build in order to promote the operations of certain sectors in their countries.

5.2.5 EU, regional-level support for sustainability, renewables, green energy transition

As mentioned in the literature review, the EU and its member states have strong climate goals. The EU plans to become the first continent on earth that is entirely carbon neutral. The EU plans to reach that target by 2050, while emissions shall be cut by 55% until 2030 compared to the levels measured in 1990. The written foundation laid out by the EU to reach that target is the European Green Deal. A large part of the proposal has not yet been implemented into binding laws and the realization of the proposed targets would cause major costs for the EU and its member states. However, the European Green Deal could offer a basis for an innovative economy that tackles climate change while staying economically competitive (Meaker, 2023).

The production of energy and its impact on the environment and climate is a principal element of the European Green Deal, as the energy production sector can be attributed to around three fourth of the GHG emissions occurring in the EU (European Commission b), 2023). The European Commission b) (2023) therefore outlines the importance of creating an intermingled energy market in the EU that unites the member states' energy market through tools like digitalization in order to secure a safe and economically valuable energy distribution throughout the continent. One main aspect to reach that target is to focus on renewable energy and promote innovative technology for more efficient energy production. Regarding the transportation sector, biofuels play an important role in this transition.

The plans towards a greener continent made by the EU and its member states offer a great opportunity for actors in the energy sector to adapt their operations to operate sustainably on the EU energy market.

As mentioned in the literature review, the EU is continuously adapting the required share of renewable energy sources for the transportation sector, which will be promoted through the member states in multiple ways. This offers the actors in the energy sector various opportunities to adapt their operations in order to fulfill the GHG quota and other climate targets. Furthermore, the promotion of renewable energy sources offers the basis for the creation of new innovative solutions in the energy producing sector.

An expert from a Nordic energy company states that the policies and possible changes of these have a major impact on where they place investments. This is

for example due to the different implementation in the member states and incentives they create to invest differently for companies according to the market they want to address.

According to an expert working for a Nordic energy company, the German biofuel legislation offers multiple opportunities for businesses. The implementation of an advanced scheme that offers double countability towards the GHG quota for fuels made from certain feedstocks is one of the biggest advantages for businesses according to the source. Further, the expert outlined that to the expert's knowledge, Germany has the widest selection of ways to fulfill the national mandate of the GHG reduction quota. This is particularly the case, if the entire supply chain can be monitored and verified allowing to know exactly where the product derived from and what it contains. Considering the options on the German market compared to values one can get for biofuel volumes on other markets creates multiple opportunities for traders in the biofuel sector to decide where to place which volumes.

6 DISCUSSION

The three interviews with relevant stakeholders from the industry have been conducted in order to gain insider information about the perception of risks and opportunities in operating on the German biofuel market.

This shall complete the literature review and shed light on information that cannot be measured quantitatively. More information about the questions asked can be found in Annex 1. The interviews have been semi-structured so that questions that arose in the course of the conversation could also be discussed.

The main points to be investigated during the interviews were how risks and opportunities are perceived by actors involved in the biofuel markets in Germany, how the communication between authorities and companies is working and whether there are difficulties with regard to the application of the German biofuel legislation.

Interviewees were targeted from companies operating in the renewable fuel sector in the Nordic countries as well as from German authorities.

Interviews with interviewees from companies are anonymized to avoid personal information of the individuals or the companies they work for to spread against their consent.

The interviews were analyzed in order to find common or contradictory statements regarding the constraints and opportunities identified through the literature review and the research made through the monitoring of news articles.

In quickly changing markets like the biofuel sector, that is highly dependent on governmental decisions and policies, it is crucial to stay up to date with news from multiple sources.

According to actors in Nordic energy companies operating in the biofuel sector that were interviewed for this research and in accordance with the information found in the literature review and news articles there are multiple.

The analysis conducted showed that the constraints and opportunities are multiple and interconnected for actors of Nordic biofuel companies on the German market. Though according to the analysis of this thesis it might seem that there are more constraints than opportunities for Nordic companies to operate on the German biofuel market, there was no emphasis laid on the weight of the different constraints and opportunities. Due to resource restrictions, it was not possible to implement a scheme measuring and weighing the points against each other.

However, it is to say that some constraints can be solved easier than others, due to the degree of power the companies have in order to anticipate the respective constraints.

Regarding for example the constraint of language barrier that Nordic companies face when operating on a foreign market, the employment of experts that have

proficiencies in the language of interest can be a simple step to bridge the gap. Not only could this employee understand the news and legislation easily but has additionally the possibility to communicate effectively with authorities and actors on the market.

Other constraints like quick changes in policies or restrictions set by governments are more difficult to tackle, as the power over these decisions is limited by the companies. As experts pointed out, it is crucial to have valuable contacts with important stakeholders to be able to limit the potential negative impacts of these aspects on the business's operations.

As mentioned in the beginning, according to Lee and Malerba (2014), technology, demand, and policies are the main forces to drive a transition. As revealed through the analysis of this thesis, all three factors are playing a crucial role in the German biofuel market, not only driving the transition wished by policy makers but also offering business opportunities for the actors involved in the industry. Due to quick and multiple changes in policies, new windows of opportunities are constantly opened for businesses.

7 CONCLUSION

In this master's thesis the focus was on finding constraints and opportunities in the German biofuels sector for actors from the industry in the Nordic countries. The biofuels industry is for a big part based on incentives created by governments in order to promote climate change mitigation measures and limit GHG emissions. Consequently, it was found that the operations in the biofuels industry are highly dependent on governmental decisions and policy implementations. The more precisely a government implements a policy and the more consistent the implemented policy will be followed, the easier it is for companies to operate on the market and create their business operations in accordance with the legislative requirements.

The potential to communicate with different stakeholders and authorities is a crucial aspect for successful business operations. If the communication possibilities are limited, there is a potential risk for companies not to comply with the legislation as intended by the government. Moreover, following policy updates is crucial to comply with sustainability measures required for feedstocks that allow to produce biofuels that are promoted by governments and offer economic benefits for the companies.

The fact that EU policies are implemented in different manners in the different member states, creates opportunities for arbitrage. Fuels can be traded according to the highest margin in different EU countries allowing companies to maximize their profits.

With adequate support of their governments the Nordic countries can evolve their position of a strong player in the biofuels production in Europe. This might require investments in infrastructure and technology in order to promote new feedstocks especially of second generation, RFNBOs or synthetic fuels such as e-fuels.

To my knowledge, this is the first study conducting an analysis of constraints and opportunities on the German biofuel market for Nordic businesses. In a future study it could be interesting to implement a tool that measures the value different constraints and opportunities have for operators. As mentioned throughout the course of this thesis, policies especially regarding details such as feedstock restrictions, can change quickly in this industry. Further, trade flows in the market might change as well as resource availability. Therefore, this thesis represents a snapshot of the current situation, and it would be interesting for research to follow up on future developments and their impact on businesses in the sector.

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APPENDIX 1

Interview questions:

What is the most challenging regarding the feedstock restrictions on the German market?

Does the Nabisy list help in the process?

How does the communication with German authorities work and is information easy to get and accessible?

Do you plan to have some trading on the German market in the future

What are the main differences between the German market and other biofuel markets for example in the Nordic countries?

How does the German biofuel policy influence business decisions regarding biofuel trading?

How do business operations align with the energy transition strategies of the Nordics and Germany? How do those benefit your operations?

Do you sometimes change your operations because of legislation in another country like Germany?

How do you see the demand for biofuels on the German market and how does that influence your business operations / production processes?

How do you see the demand for biofuels on the German market and how does that influence your business operations / trading processes?

Which risks / opportunities do you see in trading on the German market?

Have you realized significant changes throughout the course of your career concerning the trade of biofuels in the EU, e.g. some trend regarding feedstocks or trade between specific countries?

Could you see specific sectors lobbying for or against some feedstocks that can be used for the biofuel production? If yes, which sectors?

Has there always been a strong impact of the German legislation / market on the European biofuel market / production? Are changes in German biofuel policies causing risks / opportunities for other European biofuel markets e.g. in the Nordic countries?

Why can the German biofuel market be of special interest for trading?

Do you recognise any differences in the potential impact of the German biofuel market / policies on trading behaviors of other markets under the EU biofuel legislation?

Which are the main differences between the German biofuel market and other markets for example in the Nordics?

How does it create risks / opportunities according to your experience?

Did you observe that companies change their operations due to policy changes in other countries where they do not need to fulfill a mandate?

Do you see an advantage for the Nordic countries for biofuel production and trading compared to other EU countries? E.g. feedstocks from the forestry industry.

Which advantages / risks do you see for companies thanks to the different implementation of the EU biofuel legislation in the member states?

Do you think it would be favorable for companies in the sector if all EU countries would implement the EU biofuel policies in the same way?

Do you see some trends regarding the development of the European biofuel sector / market?