

ON A MISSION OF REDUCING METHANE BURPS:
A CASE STUDY OF COMMERCIALISING A LOW-CARBON INNOVATION
IN THE FOOD INDUSTRY

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June 2022

Master thesis

MIOM05 Degree Project in Production Management

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ABSTRACT

Commercialising low-carbon innovations implies complex issues to be managed but is a necessity to attain a transition of industries for a sustainable future. This thesis investigates how an innovator can facilitate the adoption of their low-carbon innovation among stakeholders within the food industry. The case of Volta Greentech's commercialisation of methane-reducing feed supplement for cattle is studied to explore commercialisation on industry and consumer markets simultaneously, which has so far been limitedly researched.

The research was based on a qualitative case study, performed in an iterative process where data was collected through interviews and document sampling. Through interviews with stakeholders of the innovation, a mapping was conducted over these as well as their interests and barriers to adopt the innovation. The thesis uses theories such as the power-interest matrix and diffusion theory to analyse how the innovator should position themselves in relation to their stakeholders and manage commercialisation decisions. In addition, a revised framework for the food system in which Volta Greentech's innovation operates is suggested as a tool for understanding its interdependencies.

In conclusion, key activities include being attentive to early adopters' needs for product and business model modifications, creating testimonials through collaboration with direct stakeholders, and communicating these to attract authorities' attention.

Keywords: low-carbon innovation, b2b and b2c commercialisation, methane-reducing feed supplement, stakeholder mapping, sustainable food system

PREFACE

This thesis is founded upon five years of studying a M.Sc. in Industrial Engineering and Management at LTH and serve as a final mark of our journey here. As our interest towards the end of our studies have been further directed towards sustainability issues and how the field of business and innovation can facilitate the implementation of sustainable solutions, it has been a pleasure to have the opportunity of conducting this thesis in collaboration with Volta Greentech.

Writing this thesis had not been possible without the help from our mentor at Volta Greentech, Linus Holmsäter, who has guided us through the challenges of being a start-up in the Swedish food industry and provided valuable feedback along the way. Further, we would like to thank our mentor Izabelle Bäckström at the Department of Production Management for making sure we stayed on the right track throughout the process.

Lastly, we would like to thank all of those participating in interviews representing a stakeholder group, who gave us their time to answer our questions. This thesis was made possible through the answers and insights you provided us, thank you!

Lund June 2022

Clara Swanbeck and Saga Ising

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1 INTRODUCTION

This chapter serves the purpose of presenting the scope of the thesis and introducing the case company, Volta Greentech, and their innovation. Moreover, the problem and research gap are discussed which serve as background for the research questions of the thesis.

1.1 Background

In the light of climate change, new innovative solutions are emerging with the aim of curbing our greenhouse gas emissions. Reaching climate goals requires not only new technologies, but also new business models and markets. An increase in green technology investments have been observed during the past years, indicating a potential that decarbonization can stimulate economic growth rather than hinder it (Chandaria, et al., 2021).

The rise of low-carbon innovations, meaning innovations offering a low-carbon option to incumbent technologies or practices, is observed in various industries as a means to combat climate change (Pettifor, et al., 2020). These innovations all have the characteristics of contributing to the public without forcing the consumer to give up the quality of the traditional product. However, an implementation of such innovation is a large undertaking affecting various stakeholders, which highlights the issue of how such innovation should be commercialised to reach a large-scale adoption.

Specifically in the food industry, a growing demand for meat and livestock farming contributes to high rates of greenhouse gas emissions, land and water usage as well as antibiotics resistance (Chandaria, et al., 2021). These issues call for action as the food production continuously faces need for upscaling due to an ever-increasing population. Green-tech companies are emerging with innovations to tackle these various sustainability issues within the food industry (Chandaria, et al., 2021), and Volta Greentech is one of them, focusing on climate change. To successfully target consumers with methane-reduced meat and dairy products and the industry with its methane-reducing feed supplement for cattle, Volta Greentech needs to find a place in the food system where their innovation can reach its full potential.

1.1.1 Methane emissions from cattle industry

Methane emissions is one of the most abundant anthropogenic greenhouse gases (GHGs) causing global warming. Compared to CO₂, methane is 25 times more potent at trapping heat in the atmosphere and account for around 20 % of the total global emissions (EPA, 2022).

Looking at the cattle industry in the world today, it contributes yearly emissions of 5 gigaton CO₂-equivalents, solely through the methane gas produced from digestion during the animals' lifetime. These enteric emissions from meat and dairy cattle correspond to 4% of the world's total anthropogenic GHGs (Volta Greentech, 2022). Enteric methane emissions are produced in the cow's rumen as a waste product of the microbes helping the cow's digestion (ibid.). Looking at the entire supply chain of livestock, including the enteric process, manure management, feed production and other energy consumption, the enteric process makes up by far the greatest share of emissions, amounting to 44% of it (FAO, 2022). According to UN environment program (2021), reducing human-caused methane emissions is moreover considered one of the most cost-effective solutions to limit global warming.

Zooming in on Sweden, the agriculture sector stands for 15 % of Sweden's total territorial emissions and is one of the areas in the Swedish overall climate strategy in need of further involvement of instruments to reach the net zero goal by 2045 (Naturvårdsverket, 2021). Out of these 15 %, enteric methane emissions make up 42 %, resulting in 6.3 % of Sweden's total GHG emissions, a higher number than the global average. This indicates that there is a big potential of reducing emissions from the meat and dairy industry in Sweden, through solutions that can reduce enteric methane emissions, and it is here that Volta Greentech comes into the picture.

1.1.2 Volta Greentech

Volta Greentech is a Swedish green-tech company with the vision of mitigating climate change with innovation, started in 2018 by Fredrik Åkerman, Leo Wezelius and Angelo Demeter. Their first mission is set to reduce the methane emissions from the cattle industry with their product Volta Seafeed, a feed supplement based on the red seaweed *Asparagopsis taxiformis*, which bioactive

ingredients block one of the enzymes that enables the methane production in the rumen of the cattle (Volta Greentech, 2022). By replacing 0.1-0.6% of the regular feed with the Volta Seafeed into the daily routine of feeding the cow, enteric methane emissions can be reduced by up to 90% per day, resulting in a total reduction of 30-90% for a final food product (Volta Greentech, 2022).

The red seaweed has previously not been produced at scale, and this is what Volta Greentech is striving to accomplish in a sustainable way in their facilities on land (Volta Greentech, 2022). With one pilot production site in Lysekil and one more upcoming, Volta Greentech is now undertaking the challenge of commercialising their feed supplement to the Swedish food industry. This is planned to happen in partner with a food retailer and farmer later this year, with a launch of a new line of methane-reduced meat products available to consumers.

Though Volta Greentech's primary innovation is an industry product, it simultaneously gives rise to new consumer products on the market – conventional meat and milk with reduced methane emissions, hereafter to be called *the final food products*. This implies the involvement in a food value chain dependent on several actors and activities, farmers who feed their cattle with the supplement, meat and dairy companies who aggregate and sell methane reduced meat and milk, food retailers who distribute and sell the food products, and the consumers choosing a more sustainable alternative. Hence, Volta Greentech must deal with a value chain of interdependencies and a classic “chicken and the egg” – problem in demand and risk taking among actors. It can in this commercialisation context thereby be discussed which the most important stakeholders are, how willing they are to engage for the innovation's success and what role they play in the commercialisation now and in the long-term perspective.

1.2 Problem discussion

As stated in the former section, consumer adoption of the final product is a vital condition for adoption of Volta Greentech's innovation. Though, the somewhat complex value chain brings many other important aspects to be considered to make this innovation successfully commercialised on a larger scale. Theory suggests that innovations influencing multiple actors in a system

and their interconnections, particularly calls for a strategy to gain network adoption, with the aim of obtaining support from critical actors to enable mainstream diffusion (Frattini, et al., 2012; Salehi, 2022). Thus, this research aims at looking at the commercialisation problem from a more high-level perspective including all the stakeholders of Volta Greentech's innovation. Furthermore, to fulfil the sought purpose of a low-carbon innovation - mitigating climate change - this type of innovation needs to target a larger mass of users, making early adopters insufficient. Relating the commercialisation issue to stakeholder theory thereby becomes a way of investigating how the innovator can attain largest possible adoption throughout the industry and thereby, the largest decrease of total emissions.

Research wise, this is deemed relevant firstly due to the limited research on commercialisation of low-carbon innovations within the food industry as became evident from the literature review. Secondly, because of the lack of research on simultaneously targeting industry and consumer markets. Most commercialisation research on low-carbon consumer products mainly focuses on consumer attributes (Pettifor & Wilson, 2020), or investigating their potential to mitigate climate change (Wilson, et al., 2018). Meanwhile, research on low-carbon innovation in the industry focus on areas such as steel and energy, which does not involve any B2C perspective (Vogl, et al., 2020; Lema, et al., 2015). Thus, little research exists on commercialisation applicable for innovations such as Volta Greentech's, which involves both a B2B and B2C perspective simultaneously. In parallel, existing literature on sustainable food systems suggests future research to add the perspective of engaging different stakeholders such as government, academia, and society (Bocken, et al., 2020). Additionally, there is a gap of addressing transdisciplinary efforts to illustrate how food systems can be transformed to achieve sustainability (Kennedy, et al., 2021).

1.3 Purpose

The purpose of this thesis is to investigate how Volta Greentech's innovation can be commercialised on a larger scale, considering all stakeholders involved. The purpose is thereby firstly to identify and understand the stakeholders, what their interests are and what roles they play in the diffusion. Secondly, use this

to bring insights on how the innovator can facilitate the adoption of their innovation. By using the case of Volta Greentech's commercialisation of Volta Seafeed, the goal is to provide more general insights on important factors for a successful diffusion of low-carbon innovations in the food industry, and to provide possible paths specific for Volta Greentech.

1.3.1 Research question

The main research question is: **“Commercialisation of low-carbon innovations within the food industry: How can the innovator facilitate adoption of the innovation among the stakeholders?”**. To properly answer this question, two sub-questions RQ1 and RQ2 need to be investigated as well.

RQ1: Who are the stakeholders of the innovation and what are their motivational factors and barriers to engage in the innovation?

RQ2: What role do the network of stakeholders play in the diffusion, given the business environment of the innovation?

The answers to these research questions, aims to contribute with insights to the industry and its stakeholders as well as to the academia on large-scale commercialisation of low-carbon innovations in the food industry.

1.4 Delimitations

This thesis is limited to analysing the commercialisation context from a stakeholder perspective, given the point in the commercialisation process where the case company currently is. The focus of the study will only include the actors in the network applicable to Volta Greentech. Further, the study will only focus on the Swedish market when considering stakeholders and commercialisation preconditions.

1.5 Target audience

The main target audience of this thesis is the team of Volta Greentech, primarily as a support for the decision making during the commercialisation

process of Volta Seafeed. The thesis also targets academics and other stakeholders within business and innovation management as well as the food industry.

1.6 Thesis outline

Chapter 1 – Introduction

The introducing chapter gives a background context of the thesis, presents the case company as well as states the purpose and delimitations of the thesis. The research question is presented and divided into two under-arching sub-questions.

Chapter 2 – Methodology

This chapter presents the methodological strategy and design of the research study, and motivates the methodological decisions made. It further describes how data was collected and analysed, as well as provides a discussion on the trustworthiness of the study.

Chapter 3 – Theory

The third chapter has two main purposes, provide the theoretical framework in which to analyse and discuss the findings, and investigate what has been concluded by prior research in the field of commercialising low-carbon innovations.

Chapter 4 – Findings

This chapter describes the findings from interviews and the document study about the specific case. The findings are divided into common areas of discussion from interviews and complemented with document sources when more information was needed to understand the full picture.

Chapter 5 – Analysis

The findings presented in chapter 4 is analysed related to the theoretical framework from chapter 3. The analysis is structured around the three themes *Business environment*, *Stakeholder analysis* and *Commercialisation analysis*.

Chapter 6 – Discussion

This chapter brings the insights from the analysis in chapter 5 for further discussion of how these insights can contribute to answering the research questions.

Chapter 7 – Contributions and conclusions

The last chapter summarises the discussion and provides answers to the research questions. Furthermore, theoretical and practical contributions are stated and as well as suggestions for future research.

2 METHODOLOGY

This chapter presents the methodological choices made and approach used in this thesis. It includes a description of research strategy and design, data collection and analysis as well as a discussion of trustworthiness of the study.

2.1 Research Strategy

Defining the research strategy should be done prior to the beginning of the research. When considering what type of research strategy to use as an approach, the first step is to conclude what type of research question the study seeks to answer. Yin (2009) states that the research question does not only contain a substance (i.e., the issue the question seeks to address) but also a form (i.e., the way the question is asked) and that the form determines the appropriate research approach as different strategies have the possibility to answer different forms. Furthermore, Yin (2009) advocates that a case study is favoured over other types of research methods when the aim of the study is to answer a “how” or a “why”- question, whereas for an exploratory “what”-question, a case study is as good as other options.

As the research questions of this thesis are trying to gain a deeper understanding in *how* the commercialisation of the innovation can be facilitated as well as *what* importance the different actors in the value network holds in the success of the innovation, the research is both contemporary and explorative by nature. These characteristics further indicate that research strategies such as histories and surveys will not favourably serve the aim of the study and can be excluded. Instead, Denscombe (2017) emphasises that the characteristics of a case study are distinctive and favourable when there is a need of investigating relationships and interplay between factors, and that the holistic perspective can promote a deeper understanding of these. In the same line of argumentation, Yin (2009) claims that a case study is superior to other methods when the aim is to deepen the understanding of events that are contemporary and cannot be controlled by the researcher. As a further argument for the suitability of a case study in this context, Dubois and Gadde (2002) mean that case studies are unique in the way insights can be concluded from empirical data in a specific context to build theory. This would favour the thesis in the aim of filling a theoretical research gap with help from insights from the

specific commercialisation context of Volta Greentech. It is thereby supported by numerous authors that the most suitable research strategy for this thesis is to perform a case study research on the upcoming commercialisation of Volta Seafeed.

Further, case study research is a broad concept, and to construct the research design decisions need to be made whether to use a single- or multiple case study as well as if the research should be of qualitative or quantitative nature or a mixture of both approaches.

2.1.1 Qualitative vs quantitative approach

A qualitative research approach can generally be distinguished from a quantitative research approach by the usage of words primarily to numbers, open-ended research questions in favour of close-ended hypotheses, and the choice of research strategies such as qualitative case studies, over strategies such as quantitative experiments (Creswell, 2014).

In contrast to quantitative research, which aim is to test objective theories through a deductive analysis of quantitative data, a qualitative research approach is built on inductive theorising with the purpose of exploring new directions of the problem (Bansal, et al., 2018; Creswell, 2014). A qualitative research process includes the development of questions and procedures, data collection and analysis in an inductive way resulting in general themes, and a final interpretation of the meaning of these findings (Creswell, 2014).

Another aspect is the breadth of focus of the research, where a quantitative approach normally uses a large set of data to investigate a limited set of variables, while the qualitative approach allows for the understanding of multiple linkages between a wider set of factors with less input data (Denscombe, 2017). It is thus evident that a qualitative approach is favoured for problems with a high complexity where there is a need for a context perspective and the data collection is limited.

As the overarching research question of this thesis aims to explore the relations between actors in a given commercialisation process, the use of words will have a stronger relation to the interlinkages between success factors and stakeholders than numbers. Given that the product is an innovation with clearly different characteristics from other existing products there is no existing

data of the market, a qualitative approach is most suitable for the exploration of the market. It should be noted that several authors argue a combination of a qualitative and quantitative approach being the optimal way to provide understanding of a problem. However, the nature of the research question and the data available needs to be considered. As a result, a more quantitative approach does not come naturally for the investigated question, and the suggested main approach of this thesis is a pure qualitative one, strengthened by Bansal et al. (2018) and Denscombe (2017).

2.1.2 Single vs multiple case studies

In the choice between a single- or multiple case study, some scholars argue that multiple case studies strengthen the reliability of the research (Yin, 2009; Bansal, et al., 2018). In contrast to this argument, Easton (1995) points out that it is easy to misinterpret the use of multiple case studies as a means for statistical generalisation, and Dubois and Gadde (2002) argue that a single case study allows for more depth, which is more suitable for complex relationships. As this thesis aims at scrutinising how the innovator can affect the food industry's willingness to adopt the innovation, the complex interrelatedness between factors calls for an in-depth approach. The research approach was therefore conducted as a single case study, although insights from parallel cases in other industries were applied to point in possible directions.

2.1.3 Reasoning Logic

A part of choosing an appropriate research strategy is to decide what principle for logical reasoning should be applied when building theory from empirical data. Historically, there have been two main reasoning principles commonly used, namely an *inductive* way of reasoning or a *deductive* way of reasoning. The inductive way of reasoning implies that the empirical data serve as a foundation for building a theory or a framework, whereas the deductive reasoning has the opposite logic and uses empirical data to confirm a theory or hypothesis (Kovács & Spens, 2005). Though applying either of these two principles strictly has been criticised for achieving the aim of a study – constructing new theories – rarer than often, and this has opened the floor for a third method; *abduction* (Timmermans & Tavory, 2012; Kovács & Spens, 2005).

Timmermans and Tavory (2012) describe the abductive way of reasoning as a way to relate a phenomenon to other similar observations and by so, find hidden cause-and-effect patterns. It can be argued to be positioned somewhere in between induction and deduction, though more creative than both due to the iterative process that gains more in-depth understanding of the investigated phenomenon (Kovács & Spens, 2005; Dubois & Gadde, 2002). Dubois and Gadde (2002) also suggest a method which makes use of a systematic combining of theory and empirical data, thus an abductive reasoning logic, as a way to conduct an appropriate case study research. A framework of the essential parts of an abductive process proposed by Kovacs and Spens (2005), describes a way to conduct the research process abductively, see Figure 1.

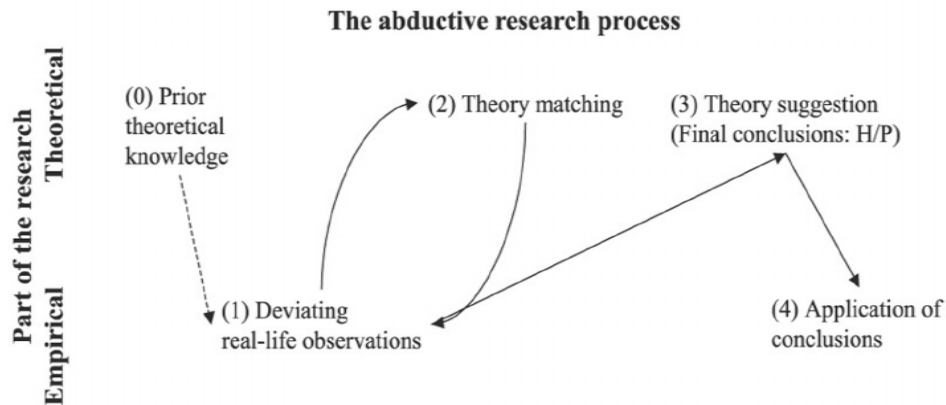


FIGURE 1. THE ABDUCTIVE RESEARCH PROCESS WHICH THIS THESIS WILL APPLY (KOVÁCS & SPENS, 2005)

This thesis will make use of an abductive reasoning principle, as the iterative process of combining empirical data and theoretical frameworks as we go will allow for more valuable insights.

2.2 Research Design

2.2.1 Literature Review

A literature review figures as an important part to set a frame of the research. Partly as a background to understand where there exists a gap in the research

of the related topics and partly as an overview of existing knowledge and frameworks that this research can be founded upon. The literature review thus serves as an early building block to set the right direction and context of the research and to provide the reader a basis for assessment of the thesis's expediency (Denscombe, 2017). With foundation in the systematic combing process, theory does not only serve the purpose of providing a background and direction in the beginning, but also as a way of redirecting later on and by that, should not be done solely in the beginning of the research process (Dubois & Gadde, 2002; Strauss & Corbin, 1998). Another aspect that has been considered in the design of this research is the role of parsimony. As the research develops iteratively, all the literature that was reviewed in the beginning might not be relevant in the final version (Dubois & Gadde, 2002). This indicates a need of being selective with what to include – to exercise parsimony.

In accordance with Dubois and Gadde's (2002) note on selectiveness of key words, Saunders et al. (2006) put emphasis on the iterative process of generating key words, conducting searches, and redefining key words to find more precise and relevant material. This suggested methodology is evident in the literature review of this thesis, as it started with scrutinising the areas of commercialisation in the context of green innovations, using keywords such as "commercialisation", "green", "sustainable", "go-to-market", "innovation". It thus became clear that the field of "green innovations" was too broadly defined compared with the characteristics of the intended case, and future searches then rather included key words such as "low-carbon" and "climate". In this field there was little research and hence, served as a foundation for finding the gap in existing research where this thesis can contribute with its findings.

Moving forward, as the research aims to understand the food industry where there usually exist several actors in the value chain between an innovator and the end-consumer, it also became relevant to include the perspectives of stakeholder theory and business environment to get a holistic picture of the potential barriers and opportunities.

Hence, the literature review conducted consists of two main parts: commercialisation theory and stakeholder theory, complemented by a chapter covering business environment. The review on the first part aimed to give a

foundation for understanding diffusion of innovation mechanisms, as well as to get directions from earlier empirical studies on low-carbon innovations' adoption. The second part of the literature review served the purpose of giving tools to analyse the stakeholders involved in the case study. Lastly, the business environment chapter contributes with frameworks for analysing the context in which the innovation is operating and how it is affecting the commercialisation of it.

The literature review was mainly performed by using databases such as LUBsearch, Google Scholar and ResearchGate. Some physical libraries in Sweden also provided relevant background literature.

2.2.2 Research Process

The design of the case study has been inspired by Dubois and Gadde's (2002) theories of systematic combining, an iterative way of performing case studies. The approach of systematic combining builds on an abductive reasoning logic, as the one earlier suggested by Kovac & Spens (2005). Thus, this implies the research process will not be the typical linear process as would be the case in many other forms of research strategies, and particularly those for case studies. Dubois and Gadde (2002) claim that the potential advantages of case research are best captured by iteratively going back and forth between research activities such as empirical data and theoretical frameworks, which allows for a deepened understanding of them both along the way. Dubois and Gadde's suggested research process dives into the iterative part of Kovac & Spens' framework, namely the iterations between real-life observations and theory matching, and provides a more in-depth process framework.

In a systematic combining process, a starting point is generally taken in a preliminary framework of assumptions which, by gradual analysis of empirical data, is developed to give new directions for the research. This means that the evolved framework can direct research into new areas of data collection or give new theoretical insights along the way, which in turn might bring the need for further modifications or expansion of the framework. Dubois and Gadde mean that this research strategy is a way of matching theory with reality, that allows for capturing the advantages of both the empirical world and theory. The underlying argument is that data should not be forced to fit a theoretical frame, while categorising data without a theoretical platform often brings less

understanding of it. By intertwining various elements of the research process, as seen in Figure 2, systematic combining becomes a strategy which rather develops and redefines existing theories than invents new ones (Dubois & Gadde, 2002). An essential part of reaching final insights through this research strategy is the carefully considered selection of findings and redescription of the case. Some parts found during the research process will have a vital role in learning and redirection for the researcher but might appear confusing for the reader of the final study (Dubois & Gadde, 2002). Therefore, the result presented in this study will contain a selection of the findings made along the research process.

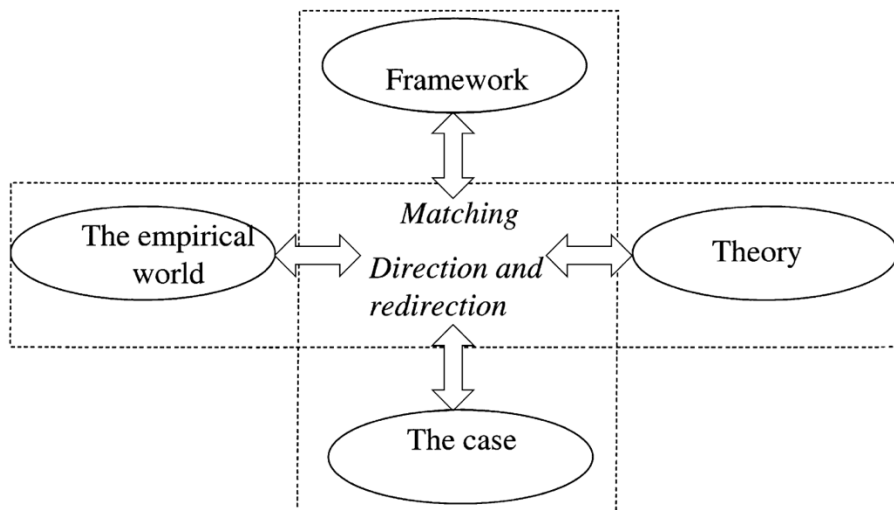


FIGURE 2. THE PARTS AND PROCESSES OF SYSTEMATIC COMBINING (DUBOIS & GADDE, 2002), WHICH HAS INPIRED THE PROCESS OF THIS THESIS.

As a conclusion of the previous mentioned arguments, the research process of this thesis was set out to be an iterative one. In practice, this was conducted by a combination of the classical steps of a case study but re-evaluated along the way as the theoretical building block was built and the data collection process started. In other words, the direction of the research (i.e., the research questions) was altered after the first collection of data was matched with literature to mirror the implications of these findings. This is in line with argumentation by Strauss and Corbin (1998) which states that a qualitative research question usually starts off open and broad and then turns more specific as issues emerge during the process.

The process will in short words contain the following activities; a literature review to attain a theoretical foundation, a qualitative research in the form of semi-structured interviews and document collection, an analysis matching theory with the empirical observations and lastly, a presentation of a framework and insights. Though, as previously stated, the activities will not occur in that specific order but rather as building blocks in a constant process of evaluation and redirection.

2.3 Data Collection

Due to the qualitative character of the research questions followed by the qualitative approach chosen, the primary relevant data to collect is qualitative. Scholars further emphasise combining data collection methods as a strength in the case study research (Dubois & Gadde, 2002; Denscombe, 2017; Yin, 2009; Eisenhardt, 1989). Therefore, the collection of data will include interviews with stakeholders of the case and documentation from these stakeholders, as well as some external documentation to provide for context setting. The following chapter will explain in more depth how these methods of data collection are used and how the data contributes to answer the research question.

2.3.1 Document

Document as form of data collection include various types of documentation that can help the researcher to deepen the understanding of the case. This includes internal documentation such as protocols, reports, and marketing material as well as external documentation such as press, official statistics, and websites (Denscombe, 2017). The external documentation serves as a means to use topical information to build a context for the case whereas the internal provides information about the organisation that compliments interviews. Strauss and Corbin (1998) advocates that non-technical literature (i.e., documentation) serves as a valuable supplement to interviews and observations when performing qualitative case research.

Document or non-technical literature was collected partly through Volta Greentech in the form of previous studies performed by them, marketing material and other company information. Furthermore, reports by various stakeholders as well as their websites and company or organisation reports

served as compliments to interviews to understand their interests and conditions. Lastly, secondary data such as press, statistical data, industry related reports and empirical studies on consumer willingness to pay for sustainable food products was collected to understand the business environment of the food industry. These are mainly present in the business environment section and occasionally presented along with the interviews in the findings chapter.

2.3.2 Interviews

Interviews are an effective data collection method in the investigation of complex phenomena, to help the researcher understand subtle opinions and experiences of individuals and groups. Particularly, interviews often serve the purpose of providing privileged information from key players in the explored field (Denscombe, 2017). Furthermore, interviews are suitable to use when the goal is to explore new dimensions or versatility of the research topic (Blomkvist & Hallin, 2014, p. 70).

There exist different ways of conducting an interview, where each type of interview serves different purposes. A *structured* interview uses closed questions, usually with binary or scaled answering options and is thus a quantitative interview method. Qualitative interviews could either be *unstructured* or *semi-structured*, where an unstructured interview requires no more than an overarching theme of the interview. This could be useful in the explorative phase of the research; however, a semi-structured interview is most commonly used to collect empirical data (Blomkvist & Hallin, 2014, p. 70).

The intention of a semi-structured interview is to prepare a list of topics which should be discussed but still allow for spontaneous formulation of questions depending on the flow of the interview (Blomkvist & Hallin, 2014, p. 71). This is the approach that was used when constructing the interview guide and conducting the interviews in order to touch upon all the relevant theories. More specifically, the literature review together with a priori interview with the case company served as a basis for relevant themes to discuss (i.e. commercialisation, stakeholder and network, and business environment) and resulted in a general guide, presented in appendix A.1. The general guide was then adapted to each stakeholder iteratively, though still structured by the same themes.

2.3.2.1 Interview sampling strategy

When selecting interview objects for a study, a suitable sampling strategy needs to be chosen for identifying interview objects. This strategy can be either based on random or purposive selection, where a random sampling is more suitable for a survey study, while a purposive selection is more favourable for conducting qualitative interviews. A purposive sampling strategy means that categories of interview objects are identified, from which a selection of objects is made based on their assessed importance and the perspectives they can contribute to the data collection with (Devers & Frankel, 2000). This way of sampling limits the possibilities of drawing general conclusions about the identified categories; however, it allows for exploring the overall area qualitatively in-depth (Höst & Regnell, 2006).

This study employed a purposive sampling strategy by identifying different system areas affected by or affecting the innovation, which, based on activities, was further divided into stakeholder groups. Within each stakeholder group, example stakeholders were identified through discussion with Volta and through research of the market. To select interview objects, a prioritisation system was introduced, where the priority of interviewing different stakeholder groups was assessed according to Must, Should, Could or Would. The prioritisation was set based on the assessed importance of the stakeholder group in the commercialisation as well as the potential information they could contribute with. For the interviews, stakeholders who already had an established relationship with Volta Greentech or who were evaluated as influential in their group were prioritised. It should be noted that the interview objects of the stakeholder group *Consumer*, were set to be experts and researchers on consumer behaviour related to sustainable food products (i.e. from the stakeholder group *Research Institutes and Academia*), instead of individual consumers. This to give an as representative picture as possible of a bigger mass of consumers, instead of personal preferences. Within the system *Process & Aggregation*, a distinction is made between meat and dairy *aggregators*, having the function of aggregating and selling to other brands, and meat and dairy *companies* selling under their own brand. The possessing of an own consumer brand gives the meat and dairy companies characteristics concerning competitiveness towards consumers that motivates their placement in different stakeholder groups. The grouping of stakeholders as well as given priority for interviews are shown in Table 1.

As evident from Table 1, five stakeholder groups were given the priority “Must”, and three stakeholder groups were given the priority “Should”. Thereby, the initial strategy is to conduct 8 interviews, starting with the “Must” category and thereafter the “Should” category, after which interviews with the remaining three “Could” - prioritised actors will be held. In total, 11 interviews were held, with a detailed summary of interview objects found in Table 5 in appendix A.2.

TABLE 1. LIST OF STAKEHOLDER GROUPS, INTERVIEW PRIORITISATION AND INTERVIEW EXECUTION.

System	Stakeholder Group	Example stakeholder	Interview priority	Interview held
Innovation	Innovator	Volta Greentech	M	Yes
Agriculture	Farming	Farmer X	M	Yes
	Distributor of forage	Lantmännen Svenska foder	W	No
Process & Aggregation	Meat & Dairy aggregators	Distributors to food retailers' brand	C	No
	Meat companies	HKScan Sverige Jakobsdals charkuterier Svenskt Butikskött	S	Yes
	Dairy companies	Skånemejerier Arla Foods Norrmejerier Wapnö Gård	S	Yes

System	Stakeholder Group	Example stakeholder	Interview priority	Interview held
Distribution of food	Food retailer - Individual Store	ICA Coop Hemköp Willys	M	Yes
	Food retailer - Central function	ICA Coop Axfood	M	Yes
	Restaurants & Hotels	Jureskogs Max Scandic Hotels	W	No
Regulatory Power	Swedish Government and authorities	Näringsdepartementet Livsmedelsverket Naturvårdsverket Jordbruksverket	S	Yes
	International	EU - CAP UN	W	No
Consumption of final food product	Consumers	Non-vegan, climate caring consumer X	C	No
Stakeholder Organisation	Innovation networks	Sweden Food Arena Bloomer	C	Yes
	Agriculture interests	LRF Svenskt Sigill Kött från Sverige Lantmännen	C	No
Research Institutes and Academia	Research Institutes and Academia	SLU KI RISE	M	Yes
Financial	Investors	Venture Capital Private Investors	W	No
Society	Society	Society	W	No

2.3.2.2 Interview execution

In the act of interviewing, it is beneficial to have a strategy of how to behave to gain the interviewees trust and receive as comprehensive and in-depth answers as possible. Denscombe (2017, pp. 279-280) provides some examples of such strategy; initiate the interview with questions that are comfortable and easy to answer (e.g. an introduction of the interviewee), keep neutral and attentive of the interviewees' feelings to not affect the interviewees' inclination to share valuable thoughts and lastly, use the silence to let the interviewee think. By not disturbing the silence and thereby being a more passive interviewer, Dubois and Gadde (2002) argue, allow for data that will not only lead to a confirmation of the interviewer's assumptions but rather to new discoveries.

The interviews were executed with these techniques in mind and took place virtually (e.g., Zoom). Considering the time frame of the thesis as well as the amount of time each interview object can be expected to set aside, each interview session was planned for a duration of 30-40 minutes.

2.4 Data Analysis

The main themes deducted from the literature review served as a basis for the main interview guide as well as the adapted ones to ensure consistency in the data collection. Following, for analysis of data from the qualitative interviews the approach suggested by Kvale (2007) consisting of three steps: coding, condensation, and interpretation, was used. The first step, coding, refers to attaching key words to segments of the data text. The approach was to go through the transcripts of interviews and mark main discussion points and statements. Common discussion subjects, together with relevant topics identified in the literature review were then applied as categories, which were coded after the appropriate theme. This was performed iteratively as interviews were held, and by going back and forth between literature and interview transcripts. The second step, condensation, is the phase bridging meanings of the interview subjects to compressed statements and was performed through concluding interview answers within the earlier identified categories. The presentation of this analysis was chosen to be in the form of a matrix, as this would properly highlight the themes, categories, and interview objects in relation to each other, which can be found in appendix A.3. This matrix was

then used as a basis for the final interpretation of the data, and to obtain an overview of the interview findings. As stated by Kvale, the interpretation goes beyond what was directly said during interviews by critical interpretation, which results in broader structures of meaning of what has been said. In this step, the theories and frameworks presented in the theory section were used as tools for analysing and for structuring the interpretation.

2.5 Trustworthiness

Trustworthiness is important to discuss to ensure the quality of the research and for qualitative research, Denscombe (2017) suggests basing the evaluation on following four parameters: Credibility, Dependability, Transferability, Confirmability. The research has been structured to attain trustworthiness according to Denscombe's suggested strategy for each dimension.

Credibility

Credibility relates to ways in which the researchers have assured their collected data to be accurate and appropriate. In this thesis, credibility has been attained by triangulation through usage of multiple sources and data collection methods. Interviews were combined with documents from multiple independent sources, which allowed to support interview statements with secondary sources as well as to gain perspectives from different actors. Further, collected data was within some relevant areas checked through respondent validation with the case company for increased credibility. However, for most stakeholder groups only one stakeholder was interviewed which slightly diminished credibility. Though, within stakeholder groups, interviewees were chosen either as a large actor representing their group or as the stakeholder most specific to the case, such as Naturvårdsverket representing regulatory power. Noteworthy, the interview findings are not to be assumed to be the views of the entire organisations', but that of the representatives from these.

Further, some of the interviewees were actors with an established partnership with the case company, which indicates a risk of bias in their answers. In these cases, the authors have been aware that their answers are not necessarily

representing their entire stakeholder group and taken this into account when analysing their answers.

Dependability

The question of dependability relates to the researchers' "self" making up a part of the research process, meaning whether the study would provide the same results if executed by another researcher. To gain full transparency of dependability, the research process has in this thesis been thoroughly described in the section 2.2 Research design, and each methodical decision has been clearly motivated. Furthermore, all interviews were recorded and transcribed, available for auditing.

Transferability

Transferability refers to whether the findings and insights can be applied to other cases, thus how much of the research that can be generalised. In this case study the case of the commercialisation of Volta Greentech's methane-reducing feed supplement has been investigated, though a lot of the discussions with interviewees concerned climate innovations within the food industry in general. This implicates that some findings relate specifically to the investigated innovation and other to a more general view on low-carbon innovations within the food industry and the opportunities for these. The study's delimitations of addressing the Swedish market and focusing on innovations for reducing methane emissions, implies that the findings cannot be fully generalised internationally. However, the context of the study has been clearly stated, allowing for other researchers to understand which parts that can be considered transferable to other cases.

Concerning the commercialisation part, an innovation with similar characteristics, such as methane or CO₂ reduction in food production with a higher price than its conventional equivalent, could apply a lot of the insights from this case study. For the stakeholder part, some of the main actors within the Swedish food industry were interviewed, which further indicates that stakeholder characteristics of similar innovation is transferable.

Confirmability

Confirmability is the extent to which the researchers and their own interpretations form the findings, hence relates to the objectivity of the results.

It should be noted that no qualitative research is ever completely free from the researchers' interpretation, which in this case is most likely to have affected the semi-structured interviews. However, to attain as high objectivity as possible, the data analysis was executed according to the process described in section 2.4 Data Analysis. The coding, condensation and interpretation was executed through both authors of the thesis reviewing and discussing all transcripts to avoid bias from their individual interpretations.

Another point of confirmability is the way in which the researchers have been influenced by the case company in their design and execution of the study. Decisions, such as choice of interview objects and interview questions to be asked, were continuously discussed with the case company, whose perspective is likely to be reflected in the results. However, as external actors with no relation to the case company also were interviewed, the authors claim the objectivity to be sufficient. A critical review has also been conducted by a supervisor and other students of the faculty to identify potential lack of confirmability.

3 THEORETICAL FRAMEWORK

This chapter provides a theoretical foundation for the analysis of the case study as well as presents what has been concluded by prior research in the field of commercialising low-carbon innovations. The chapter consists of three main parts: Commercialisation theory, Stakeholder theory and Business environment for low-carbon innovations.

3.1 Defining low-carbon innovation

When reviewing existing research on innovations with environmental performance, one quickly realises that multiple names are used. It was discussed in section 2.2.1 Literature Review, how concepts such as “green innovations”, “eco-innovations”, “environmental innovations”, and “sustainable innovations” all appear in the literature. Although these concepts can be used interchangeably, according to Schiederig et al. (2012), it is for the scope of this project, however, relevant to go even more narrow as the invested case is about methane reduction specifically, and lowering GHG emission in general, and not about all environmental aspects. Thus, the concept of climate innovations or low-carbon innovations is a more relevant concept as it relates to innovations lowering GHG emissions to combat climate change.

Usually low-carbon innovation research relates to the energy transition, which is defined by Lema et al. (2015) defining low-carbon development as “...the process of transforming the current fossil fuel-based economic system, particularly the energy system, towards the goal of CO₂ neutrality.” Thus, another definition is needed to be relatable to Volta Greentech’s innovation.

Building on the theories of disruptive innovations by Christensen (1997), Wilson et al. (2018) bring the low carbon perspective and define Disruptive Low-Carbon Innovations (DLCIs) as “technological and business model innovations which offer novel value propositions to consumers and which can reduce greenhouse gas emissions if adopted at scale”. This definition can be related to Volta Greentech’s innovation as it utilises both a technological innovation to reduce greenhouse gas emissions and an alternative business model compared to the industry standard.

Thus, to obtain accuracy in the research, research about low-carbon innovations, methane-reducing innovations and climate innovations should be prioritised as it is the rationale behind Volta Seafeed.

3.2 Commercialisation theory

The research question of this thesis can be related to decision-making in the commercialisation process, why commercialisation theory becomes a key building block in the theoretical background.

The definition of commercialisation has been framed and expressed differently by various researchers throughout the years. Some argue the act of commercialisation being decoupled from the innovation itself, while others as an incorporated part of the innovation. However, a general description of commercialisation can be explained as a number of entrepreneurial activities, either as part of an innovation configuration or simply required to bring this innovation to market (Datta, 2015).

Commercialisation of innovation is widely known to be a critical process, which seems often to be a reason of market failure despite technological performance of the innovation, both concerning consumer and industry markets (Datta, 2015; Bianchi, et al., 2017), although more existing research focuses on consumer products (Bianchi, et al., 2017). The emergence in literature on the subject shows an increased insight of the importance of commercialisation for innovation success.

3.2.1 Diffusion of innovation

Several publications (Bianchi, et al., 2017; Datta, 2015) build on Moore's traditional theory of diffusion of innovation as a framework for understanding commercialisation of technological innovations.

The theory of innovation diffusion originates from Everett Rogers' diffusion model published in the 1960s, which has ever since been widely debated and studied through multiple different angles (Bianchi, et al., 2017). The original diffusion model describes how innovation diffuses into different categories of adopters based on these groups' distinct characteristics. Rogers' model builds the theory that product characteristics are the main initial drivers of diffusion among early adopters, whose adoption thereafter triggers the adoption among

later buyers. Early adopters being the group of clients adopting a product soon after its launch, and who constitute a sizable portion, but not major group, of the potential market. The motivation for this group of clients to purchase the innovation before others is the aim for an enhancement in their business or life, depending on whether a consumer or industry market is studied. However, other authors argue dissimilarities in the purpose of adoption between early adopters and later buyers to be too distinct for early adopters to work as a mainstream-market trigger. The phenomenon is described as a chasm between these groups of adopters, making it a complex issue for commercialising firms to go beyond the first adopters and reach a mainstream market with their innovation (Moore, 1991).

3.2.2 Types of innovations

The studied literature identifies types of innovations defined by two main dimensions, namely for an innovation to be radical or incremental and discontinuous or continuous (Frattini, et al., 2012). Differentiating between radical and incremental, a radical innovation is a product containing new technologies that significantly changes market behaviour, while an incremental innovation works by improving an already existing benefit of a product. Discontinuous innovation requires an extensive change in the infrastructure supporting it in order to deliver the innovation's value, in contrast to a continuous innovation, which works to its full potential in an already existing infrastructure.

Frattini et al. (2012) argues these dimensions of innovation to be vital for understanding the relative importance of various commercialisation decisions for success, and the definitions are further applied in the commercialisation theories of the following chapter.

3.2.3 Success factors for commercialisation

Various scholars have during the years come up with different theories on which factors that most highly impacts the success of innovation commercialisation.

Focusing on consumer products, Chiesa and Frattini (2011) suggests a framework of seven commercialisation variables, having varying impact

depending on the type of innovation considered. According to this theory, commercialisation decisions regarding the suggested variables determine i) the support from the innovations adoption network and ii) the post-purchase attitude of early adopters, which in turn is decisive for market success. The adoption network refers to an infrastructure of actors that support the innovation in terms of complementary products, services, and distribution channels (Chiesa & Frattini, 2011).

This theory has been further developed by Frattini et al. (2012), building on the same underlying concept of dividing market into early and mainstream targets, as well as categorising the innovation according to two dimensions: incremental/radical and continuous/discontinuous. Depending on the type of innovation, different factors of the commercialisation process have varying importance for the commercialisation success. An effective commercialisation should thereby be organised around three interconnected sub-strategies connected to the different factors:

Early adoption strategy – commercialisation decisions that stimulate adoption in the early market and foster a positive perception of it.

Adoption network configuration strategy – commercialisation decisions with the aim of obtaining support from critical actors of the adoption network sufficient to enable diffusion in the mainstream market.

Mainstream adoption strategy - commercialisation decisions that stimulate adoption in the mainstream market.

The mainstream adoption strategy becomes essential independently on the type of innovation, while the early adoption strategy and the adoption network strategy are more essential for the radical respectively discontinuous innovations.

The relation between sub-strategies and innovation categories are presented in Figure 3.

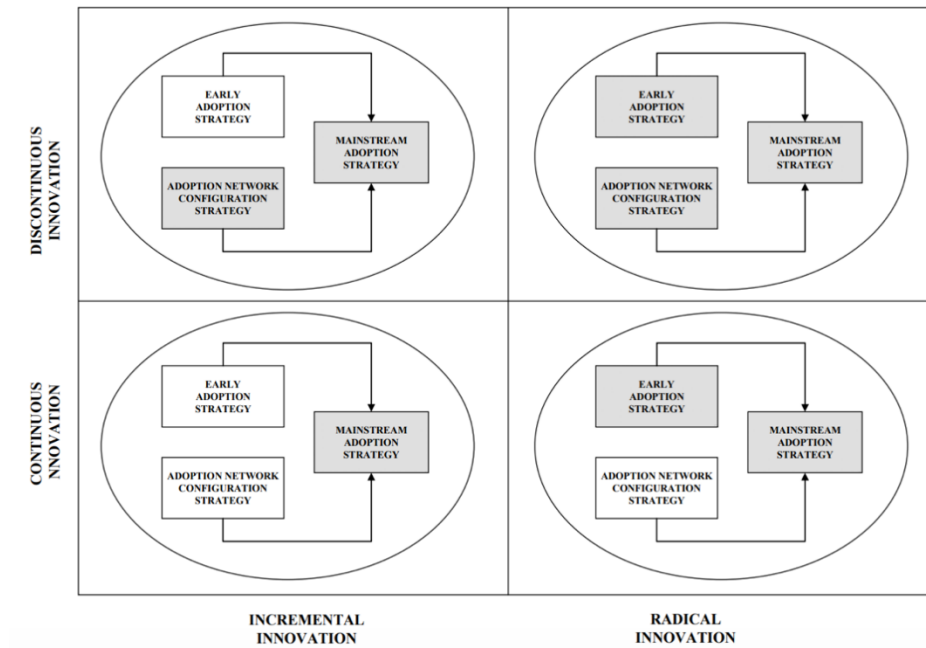


FIGURE 3. RELATIVE IMPORTANCE OF THE COMMERCIALISATION STRATEGIES, EARLY ADOPTION STRATEGY, ADOPTION NETWORK CONFIGURATION STRATEGY AND MAINSTREAM ADOPTION STRATEGY, DEPENDING ON THE TYPE OF INNOVATION (FRATTINI, ET AL., 2012)

A framework which connects the eight factors of commercialisation to be considered within each of the three sub-strategies is further suggested by Frattini et al. (2012) according to Figure 4 and a description of the factors in Table 2. These factors of commercialisation should be considered according to the type of strategy which they are ought to serve, however still together provide a coherent set of decisions.

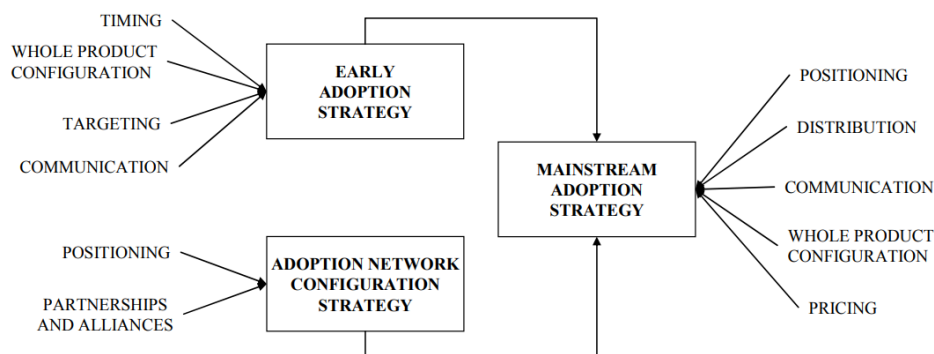


FIGURE 4. THE MOST IMPORTANT COMMERCIALIZATION DIMENSIONS FOR EACH SUB-STRATEGY (FRATTINI, ET AL., 2012).

TABLE 2. LIST OF COMMERCIALISATION DIMENSIONS AND THEIR MEANING (FRATTINI, ET AL., 2012)

Dimensions	Description
Positioning	<ul style="list-style-type: none"> • Position of the innovation on the market and how the innovations is perceived by users compared to competitors and substitutes, on critical attributes • Compatibility with existing products and systems
Partnerships & Alliances	<ul style="list-style-type: none"> • External organisations to partner with • Type of partnerships/agreements
Timing	<ul style="list-style-type: none"> • Timing of innovation launching into the market
Whole Product Configuration	<ul style="list-style-type: none"> • Set of complementary products or services incorporated in the innovation offering.
Targeting	<ul style="list-style-type: none"> • Target customer market for the innovation, i.e. a group of customers who have similar buyer behaviour characteristics and who are responsive to the innovation's offering
Communication	<ul style="list-style-type: none"> • Type of channels for communication • Type of message communicated, e.g. focusing on innovation characteristics or company brand
Distribution	<ul style="list-style-type: none"> • Type of channels to distribute the innovation • Critical functions delivered by the distribution channel
Pricing	<ul style="list-style-type: none"> • Pricing tactics, e.g. skimming vs. penetration. • Pricing of whole product configuration.

With the above-described definitions and theories in mind, Frattini et al. (2012) suggests commercialising managers to take support in their framework through a three-step approach:

Step 1: Define the type of innovation through assessing its radicalness and discontinuity.

Step 2: Identify the most critical commercialisation strategies considering this type of innovation.

Step 3: Identify for each strategy a set of commercialisation decisions within the suggested commercialisation dimensions which are internally coherent.

Although the framework by Frattini et al. (2012) has been used to determine success factors for high-tech products on the consumer market, the framework can be argued to be applicable to the case of Volta Greentech as well. Being a food-tech innovation with new technological improvements both for the industry and in the consumer product, there are enough similarities with high-tech products to be able to adapt the framework to the food industry and gain valuable insights.

Meanwhile, Bianchi et al. (2017) have investigated commercialisation of industry products in three different markets and concluded that a successful diffusion is dependent on the targeting of a group of early adopters which can stimulate further market acceptance. This group of early adopters must take on either the role of a word-of-mouth trigger or an industry benchmark. This perspective could in combination with the framework by Frattini et al. (2012) argue for the suitability of the framework in Figure 3 to be applicable to an industry product and its diffusion as well. Further, Bianchi et al. (2017) underline that the commercialising firm should be open to changes in the innovation for a better fit with the targeted early adopters, which makes the diffusion an iterative process.

Other research argues that diffusion of innovation is rather dependent on the business model through which the innovation is commercialised (Urbinati, et al., 2019). Building on the framework of business model canvas, it has been empirically investigated that certain configuration of business models can lead to a faster diffusion and more successful commercialisation. Although no specific success configuration for different industries or characteristics of innovation has yet been determined, research points at the importance of testing a company's business model in terms of speed of diffusion conditions as a part of the commercialisation (Urbinati, et al., 2019).

3.2.4 Commercialisation of low-carbon innovations

Despite the insights that can be drawn from general commercialisation and diffusion theory, there is limited understanding of diffusion of low-carbon innovations and which attributes that bring customer acceptance (Pettifor, et al., 2020). Pettifor et al. (2020) mean that part of the complexity lies in the fact that low-carbon innovations are not solely differentiated from conventional products through their reduced emissions but offer customers a broader range

of value-adding attributes. It is therefore argued that low-carbon innovations should not simply be compared to conventional ones based on their emissions, price, and performance, as is the case in many existing empirical studies (Pettifor, et al., 2020). However, Pettifor et al. further mean that the complexity of diffusion of low-carbon innovations additionally lies in the challenge of understanding how to appeal to a broader mass of customers. For the innovation to significantly reduce carbon emissions, the adoption of early adopters is not sufficient, and diffusion needs to go beyond this group (Pettifor & Wilson, 2020).

Moreover, Chandaria et al. (2021) identifies four different types of climate innovation solutions based on the dimensions, innovation of business model and technology innovation. The most ground-breaking approach, deep tech, is usually characterised by contributing to at least one of the goals in Agenda 2030, the development of a physical product, centring in a deep, interconnected ecosystem and lastly, often combining technologies. Deep tech can be found in many areas, including agriculture and food, where an agri-tech company aiming at reducing the need of synthetic nitrogen fertiliser by engineering microbes, is provided as an example. Further, the emphasis on the success of a deep tech innovation is put on the importance of a supporting and collaborating ecosystem, where each actor should strive to find the optimal way of contributing. The ecosystem has a unique ability to overcome economic, technological, and structural barriers via risk sharing, pooling of resources and the capability to stimulate a demand and put pressure on regulation favouring the reduction of emissions. (Chandaria, et al., 2021)

3.2.4.1 Barriers for commercialising low carbon innovations

Looking at diffusion of low-carbon innovations specifically within the agricultural sector, there are additional factors which bring complexity to the diffusion. According to Liu et al. (2020) there is a generally slow diffusion of low-carbon agricultural technologies, which has underlying reasons and challenges on both the demand and supply side. These authors argue that the demand side (i.e. farmers) is characterised by lack of capital for investments, limitations in awareness and knowledge, and individual and family characteristics. Meanwhile, factors characterising the supply side of low-carbon agri-tech, mainly concerns high costs, long cycles and high risks associated with it (Liu, et al., 2020).

In contrast to these arguments, Ulvenblad et al. (2019), point out that many managers of agri-food companies strive to pursue a sustainable way of business, and that the challenges lie within the characteristics of the food value chain, with different sized actors and different focus on sustainability.

Finally, another aspect that has been discussed by numerous scholars is the impact of policies for the diffusion of low-carbon innovations, which will be further reviewed in section 3.4.2.

3.2.5 Consumer acceptance of low-carbon innovations

As the purpose of Volta Greentech's innovation is to enable production of methane reduced consumer products within the food sector, it also becomes relevant to present theory which brings insights on consumer acceptance of innovations.

Diffusion research emphasises the relevance of product attributes for consumer acceptance, and Pettifor and Wilson (2020) argue that this also applies to low-carbon innovations. As a contribution to the discussion, Pettifor and Wilson (2020) suggests a modified version of the original Levitt's ring model as a framework to analyse attributes of low-carbon products. The suggested framework is presented in Figure 5.

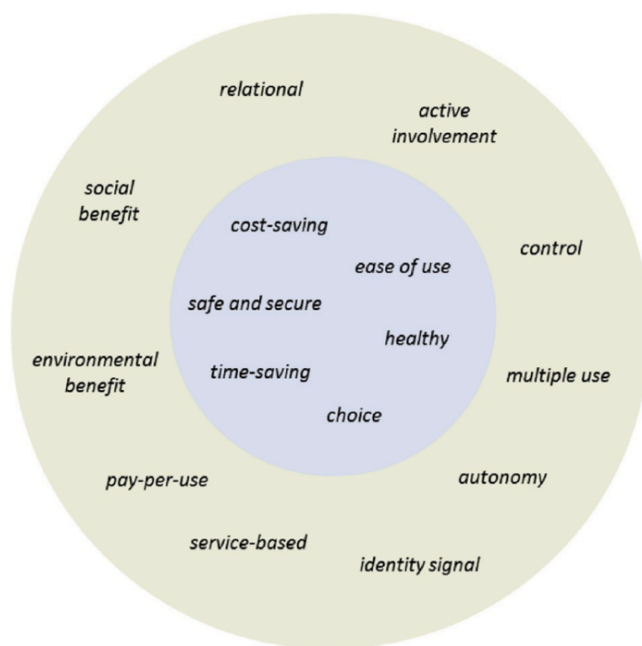


FIGURE 5. CORE AND NON-CORE ATTRIBUTES OF LOW-CARBON INNOVATIONS (PETTIFOR & WILSON, 2020)

According to their empirical study based on this framework, the attributes that showed to be most important for products within the food sector were all six core attributes together with two of the non-core attributes: *environmental benefit* and *social benefit*. Among core attributes, low cost, ease of use and timesaving, were significantly important for low-carbon food products to appeal mainstream consumers and are argued to be means by which these innovations can compete with incumbent technology (Pettifor & Wilson, 2020).

3.2.6 Consumer willingness to pay for low-carbon products

Another aspect of the business environment of low-carbon innovations is the general perception of value these innovations bring to society by consumers, and how this perception of value is transferred to an actual willingness to pay more for the low-carbon characteristics. The choice of which food product to purchase is dependent on many factors, where Shepherd (2001) suggests the choice of food to be based on three main areas: product related factors such as sensory attributes and the physiological effects, individual factors such as personality and psychological factors, and environmental factors such as economic, cultural and social factors. Fernqvist (2021) argues further sensory

attributes (e.g. taste) and health aspects to be the most prominent aspects, followed by price. In relation to choosing organic products, price is considered the most important trade-off, especially for low-income consumers.

To determine the price premium customers are willing to pay for the alternative of a more sustainable product, the measure willingness to pay (WTP) is commonly used in research. The WTP is defined as a percentage increase compared to willingness to pay for a conventional product. Further, in empirical estimations of consumers' willingness to pay for sustainable food products, a commonly used method is to introduce a label informing about the sustainability consequences of the product, which further explores how information about products' impact and visual design of labels affect consumer choices (Carlsson, et al., 2021; Edenbrandt & Lagerkvist, 2021). The study conducted by Carlsson et al. (2021) was based on a purely hypothetical choice experiment presenting climate impact with colour coded labels – green, yellow, and red. Similarly, the study performed by Edenbrandt and Lagerkvist (2021) combined hypothetical surveys with actual purchase data. The study investigates carbon labelling's impact on consumers' substitution of proteins, also using a colour-scale stating the climate impact of the product. The result of these studies showed Swedish consumers to be more likely to buy a sustainable food product when it is carbon labelled – either simply with the carbon footprint in numbers, or a traffic light colour indicating it. Additionally, consumers seem more willing to choose a substitute when climate impact is displayed over meat.

The authors underline, however, the question of subjectiveness in determining what appropriate behaviour is, when using colour-based labelling as a policy instrument. Additionally, carbon labelling brings other challenges, such as the risk of information overload for consumers, which underlines the complexity of labelling as an instrument to encourage willingness to pay for sustainable food products (Carlsson, et al., 2021; Edenbrandt & Lagerkvist, 2021).

3.3 Stakeholder theory

As RQ1 aims to map who the stakeholders in a commercialisation of a methane-reducing food innovation are, as well as their motivational factors and barriers, and RQ2 aims to explore what role a network of these stakeholders

play in the adoption of the innovation, stakeholder theory is a fundamental building block to answer these questions. Performing a stakeholder analysis is an important part of any commercialisation strategy to understand which actors are involved and what their interest is. Except for identifying key players, Aligica (2006) highlights the assessment of potential support or opposition of the players as well as their roles and inter-linkages as crucial for any social change initiative.

To be able to analyse and identify the organisation's stakeholders it is crucial to have a clear understanding of what a stakeholder is and what characterises it. Freeman (2010, p. 46) was one of the first to define the stakeholder as "any group or individual who can affect or is affected by the achievement of the organisation's purpose" in 1984. With this definition in mind, all possible stakeholders to the organisation's purpose as well as operations should be identified to make use of stakeholder analysis tools such as stakeholder mapping.

3.3.1 Stakeholder mapping

One way to map the stakeholders is by using the power interest matrix suggested by Eden & Ackermann (1998). By analysing the power the stakeholders can exercise on the organisation, as well as the interest they have in its activities, relative to one another, the power interest matrix serves as an important tool for categorising the stakeholders. Further, the power interest matrix is a top-down approach for determining the influence or relevance of each stakeholder and has been used by many scholars in the field of sustainability and renewable energy (Guðlaugsson, et al., 2020).

The aim is to classify the different stakeholders according to the power and interest criteria into one of the four pre-fixed clusters, namely: Players, Subjects, Context Setters and Crowd, see Figure 6.

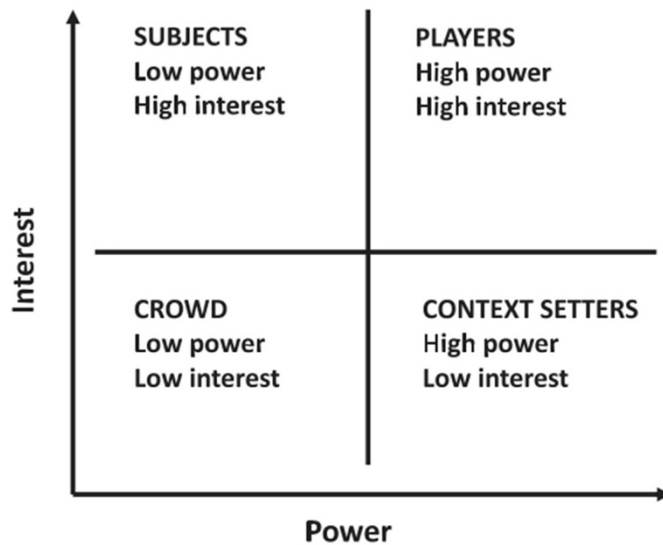


FIGURE 6. THE POWER-INTEREST MATRIX. SOURCE (GUÐLAUGSSON, ET AL., 2020)

Though earlier scholars suggest the matrix to be used solely to understand the business environment of the organisation, Eden and Ackermann (2011) suggest that it can be applied as a way for management to define a proactive stakeholder strategy. As each of the clusters corresponds to a specific combination of influence (i.e., power) and stake (i.e., interest) these should be managed differently depending on their positioning.

- Players are obviously the key stakeholders to manage, and these deserve the management’s attention. Here, by differentiating if this is a positive or negative influencing stakeholder, management should in the positive case encourage stakeholder engagement or in the negative case, take actions to diminish their interest or neutralise the power of the stakeholder.
- Further, the Context Setters should be kept satisfied and, in some cases, encouraged further to increase their support for the organisation’s purpose, while Subjects mainly should be kept informed. However, a proactive strategy against Subjects could be beneficial and executed by assisting them in finding strategic coalitions to gain power.
- Lastly, the Crowd is somewhat considered a potential stakeholder rather than an actual stakeholder, and as both their interest and power

are low, management are best off by putting minimal effort on these stakeholders. (Eden & Ackermann, 2011)

Other aspects to consider when mapping stakeholder is the influence of the network of the organisation and the interplay between the stakeholders. Eden and Ackermann (2011) states that the actions of a stakeholder will affect the dynamics of the other stakeholders, and in the same way is the power of the stakeholder a result of a relative power in the network. More recently, scholars has developed the discussion about the stakeholder network to the role of stakeholder collaboration in the transition towards sustainability and sharing economy (Cui, et al., 2022) and the low-carbon economy (Ribeiro & Lopes de Sousa Jabbour, 2017), as a means for development in these areas. Ribeiro and Lopes de Sousa Jabbour (2017) highlight customers and governments as the most prominent stakeholders in the adoption of environmental practices, either as drivers or as barriers. Similarly, Cui et al. (2022) suggests that one way to increase environmental performance is by collaborating with other stakeholders such as consumers, governments, and non-governmental organisations.

Thus, to understand the network of Volta Greentech's innovation as well as answering RQ1 and RQ2, it will be vital to identify all the stakeholders, their interdependencies, and relations in the network as well as their power and interest relative to one another.

3.3.2 Stakeholders in food systems

Looking at the stakeholders within the food industry, the food value chain would be a good place to start. The Food and Agriculture Organisation of the United Nations (2014) presents a framework for the sustainable food value chain, though also emphasising that the value chain does not operate in isolation, but rather as a subsystem. This subsystem is then linked to other subsystems such as market systems, the environment, political systems, infrastructure systems and legal systems. Further, FAO (2018) argues that a food system approach is necessary to gain a better understanding of how different functions are critical as well as their interdependence. For this reason, stakeholder mapping of an agri-food innovation should therefore rather consider a non-linear food system as a starting point. This argument is further

strengthened by Fernqvist & Göransson (2021) which proposes a combined value chain and food system framework to map out the drivers of the system.

The food system is thus characterised by high complexity, which is displayed in the framework by HLPE (2017), see Figure 7. This framework is intended to illustrate the diversity of challenges in the system, upon which a future design of a sustainable food system can be built (HLPE, 2017). Kennedy et al. (2021) discuss that though similar views on the importance of the food system approach, major questions are yet to be unanswered and recognises a lack of empirical evidence to guide policy makers with decisions around sustainable agriculture and the environment. Further, the authors identify six categories where there exists a gap to be filled, namely: 1) reinvent agriculture; 2) transform food environments for healthy diets; 3) mitigate climate change; 4) engage the private sector; 5) influence policy priorities; and 6) establish true cost accounting.

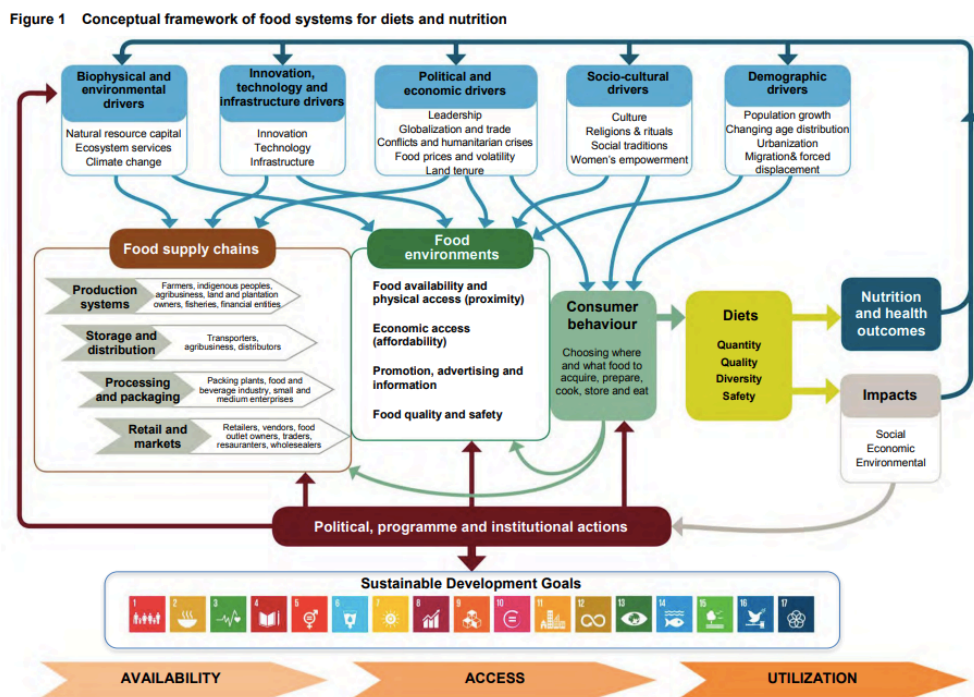


FIGURE 7. CONCEPTUAL FRAMEWORK OF FOOD SYSTEMS (HLPE, 2017).

3.4 Business environment for low-carbon innovations

3.4.1 Macro environment

In a commercialisation context, an important step to consider is how the adoption of the innovation will be affected by the macro-environment of the innovation and identify threats and opportunities for its success. One model for identifying and analysing the external environment of which the organisation operates in, is the PESTEL analysis. Yüksel (2012) suggests the PESTEL analysis as a relevant tool for providing data for prediction of future scenarios that the organisation might encounter and thus, a basis for strategic decision making. The PESTEL framework consists of the parameters Political, Economic, Socio-Cultural, Technological, Environmental, and Legal to cover different aspects of the macro-environment. Limitations of a PESTEL involve the fact that it is a holistic and qualitative analysis tool, leaving measurement and evaluation difficult (Yüksel, 2012). Though, as this thesis already consistently practises a qualitative approach, the PESTEL will serve as a sufficient tool for analysing the macro-environment of Volta Greentech.

3.4.2 Policy interventions for low-carbon innovations

As part of the PESTEL model, the legal and political context is an important part of the environment of the organisation. Further, Chen et al. (2022) argue that if low-carbon innovations are to succeed, the government needs to actively take measures to motivate enterprises to take on the risk and initial investment a low-carbon innovation implies. With this background, understanding the current and possible policy instruments that the Swedish Government or European Union could apply to promote low-carbon innovation is essential in the commercialisation context of these.

Where there exist numerous policies of different effectiveness aiming for decarbonisation in general (Peñasco, et al., 2021), the alternatives for commercialisation of low-carbon innovation within the food industry are not as many. Chen et al. (2022) provides a schematic overview, see Figure 8, of how three actors, the government, the enterprises and the public, influence each other when considering the adoption of a low-carbon innovation.

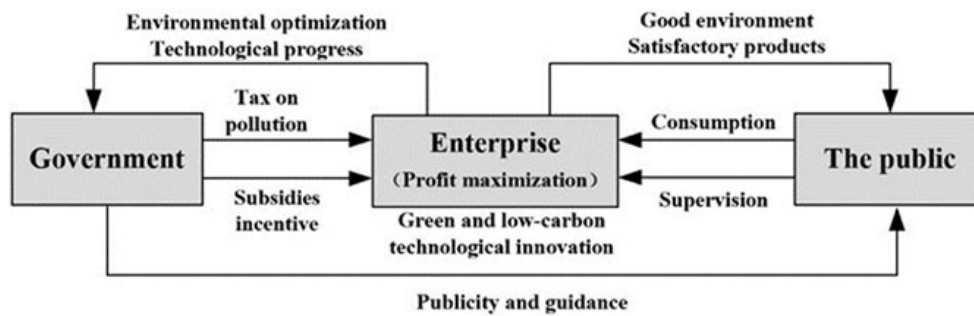


FIGURE 8. THE STAKEHOLDERS OF A LOW-CARBON INNOVATION (CHEN, ET AL., 2022)

From a meta-analysis of 165 studies on policy assessment on low-carbon technologies, a few factors for successful effects were distinguished, namely: allowing for flexible measures for a common goal and stating a clear, long-term goal which provide some certainty for investments (European Commission, 2014).

One industry with high emissions and new, low-carbon technologies emerging to curb these, is the steel industry. However, these new technologies are not yet commercially viable as the cost of low-emission production is superior to current production (Vogl, et al., 2020). As transforming the steel industry requires systemic changes, industry actors are now asking for policy interventions to reshape markets and enhance economic feasibility for a sustainable supply chain (Vogl, et al., 2020).

Putting the spotlight on diffusion of low-carbon agricultural innovations, various scholars state different theories about the impact of low-carbon policies. Some argue carbon tax policies to be the most impactful strategy (A. Freibauer, 2004), while others argue for innovation subsidy (W. Adzawla, 2019). Parallely, some scholars believe that monetary policies are not what is most important to increase the diffusion but put emphasis on the need of technical training and farmers' views on environmental issues and climate change (C. R. Foguesatto, 2019). Berglund et al. (2010) advocates that relevant policy instruments such as carbon taxes on meat products, would only serve its purpose if put on the consumption side, as a tax on the production side would risk benefitting imported meat instead and by so, not attain the desired effect. Berglund et al. (2010) further argues that more flexible approaches designated at agriculture, allowing for farmers to choose an applicable measure to reach the target are more cost efficient as preconditions of the farmer differ.

4 FINDINGS

This chapter presents the findings from interviews according to three themes, Stakeholders & Network, Commercialisation and Business Environment, which are further complemented and strengthened by findings from documents, reports, and other studies. The interview analysis conducted to determine common discussion points are summarised and presented in appendix A.3.

4.1 Stakeholders & Network

4.1.1 Overview of Stakeholders

An overview of the stakeholders of a methane-reducing feed supplement innovation is presented in Figure 9 and further described below. The various stakeholders were discussed with Volta Greentech.

- Innovator
 - The innovator who seeks to commercialise their innovation. In this case Volta Greentech.
- Food retailer
 - Companies that develop and sell their own as well as other brands' food products in their grocery stores. The food retailer normally has a procurement agreement with milk and meat aggregators on volumes and prices. The food retailer interviewed was one of the three main actors on the Swedish market, currently partnering with Volta Greentech. The role of the food retailer is discussed both as from a large company and brand perspective and from the perspective of the distributing store.

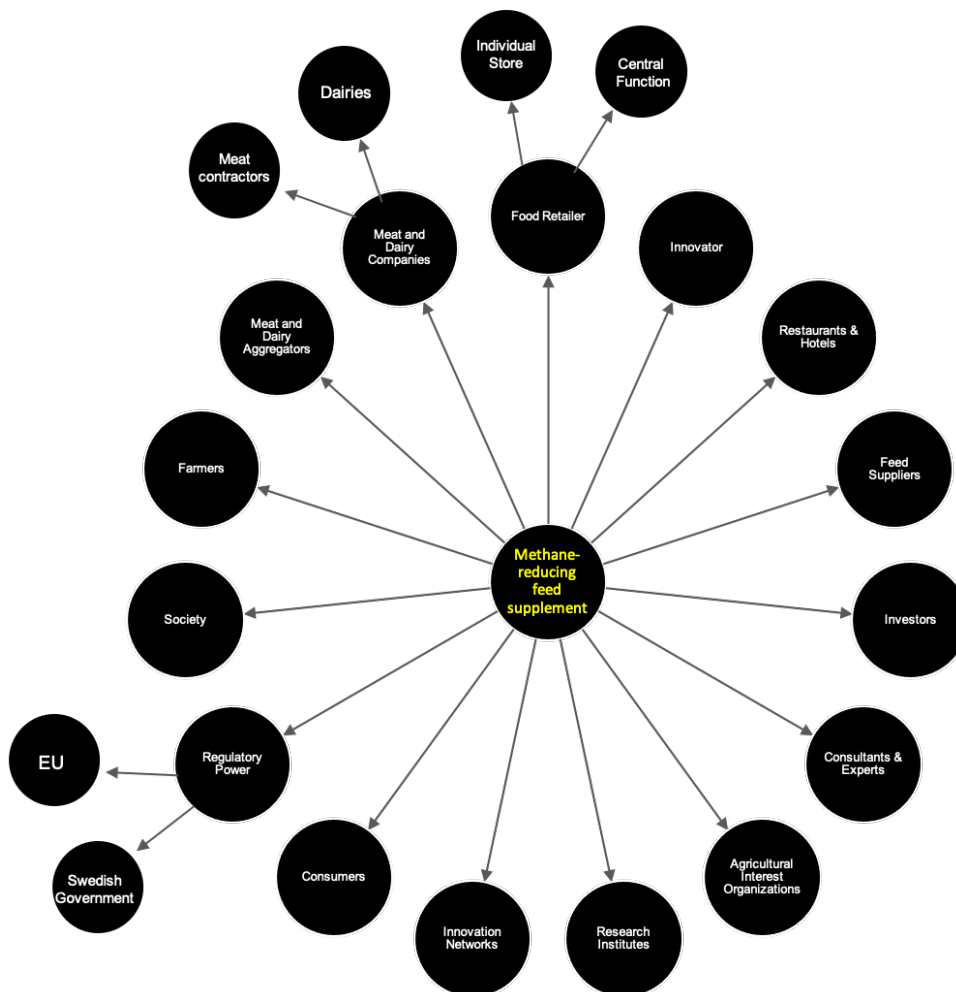


FIGURE 9. THE STAKEHOLDERS OF A METHANE-REDUCING FEED SUPPLEMENT

- Farmers
 - Individual farmers, either connected to a cooperative, or individual suppliers to aggregators. The interviewed farmer is currently participating in the pilot project with Volta Greentech.
- Meat and dairy aggregators

- Companies that aggregate milk or meat from farmers and supply to food retailers or meat or dairy companies for them to sell under their own brand. It could have the function as both butcher, packager, and distributor.
- Dairy companies
 - Companies that produce and sell dairy products and possess their own food product brand. They aggregate milk from individual farmers and sell to food retailers, either as part of the retailer's brand or their own.
- Meat companies
 - Companies that produce and sell meat products and possess their own food product brand. They aggregate meat from individual farmers and sell to food retailers, either as part of the retailer's brand or their own.
- Feed suppliers
 - Distributor of forage to farmers.
- Swedish Government
 - The Swedish Government, and more specifically those who initiate and decide on regulations and policies in the agri-food sector. Näringsdepartementet is responsible for the Swedish National Food Production Strategy and the agriculture sector. The instances Naturvårdsverket, Jordbruksverket and Livsmedelverket are the main departments influencing policies for agriculture, environmental issues, and food production.
- The European Union
 - The Common Agriculture Policy (CAP) is the overarching agriculture policy within the EU, supporting farmers in the union. This is the most influencing international regulation on the Swedish agriculture sector as it sets minimum requirements and distributes financial support.

- Consumers
 - Consumers of food products. Relevant consumers in this case are specifically those consuming meat and dairy products and concerned about climate impact.
- Innovation networks
 - Innovation network actors such as incubators and innovation platforms. Volta Greentech has previously been part of several accelerators, including the food-tech accelerator Bloomer and Impact+ at WeWork. A relevant innovation network in the agri-food sector is Sweden Food Arena.
- Research institutes & academia
 - Research institutes and universities which perform research within agriculture, food production and consumer behaviour.
- Agricultural interest organisations
 - Organisations which contribute to the development of agricultural businesses, such as the Federation of Swedish Farmers. Organisations for certifications such as “Kött från Sverige” and “Svenskt Sigill”.
- Consultants and experts
 - Consultants and other experts which consult in the commercialisation process, driven by an engagement in the purpose of the innovation.
- Investors
 - Companies and private persons which invest in the innovating firm.
- Restaurants and hotels
 - Purchaser of meat and distributor of meat towards consumers. Potential customers and distributors of methane reduced meat.

4.1.2 Volta Greentech's Value Chain

As an added perspective to the stakeholders of the innovation, the current partnerships and the value chain of Volta Seafeed was communicated in interviews with Volta Greentech. A representation of these relationships is presented in Figure 10.

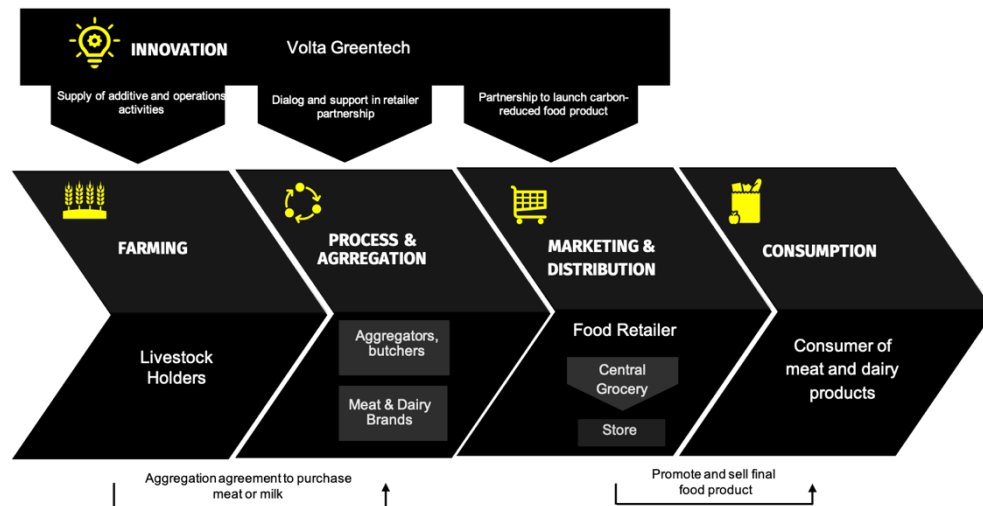


FIGURE 10. THE CURRENT VALUE CHAIN OF VOLTA SEAFEED.

The illustration shows the current value chain of Volta Seafeed, considering existing partnerships and business model, which include a farmer, an aggregator and a food retailer. However, as future partnerships might be developed with meat and dairy brands, Volta Greentech's relation to actors in this step of the value chain may become more similar to the relations to Farming and Marketing & Distribution simultaneously. This meaning both supply of operational activities as well as partnership to launch food products would be involved in the flow from Volta Greentech to Process & Aggregation.

4.1.3 Important Stakeholders

Important stakeholders were mainly mentioned in relation to the importance of that stakeholder's engagement in the diffusion of the innovation. Further, the topic important stakeholders also cover the importance of the mentioned

stakeholder related to the interviewee itself and their business relationship. Important stakeholders included the following actors:

- Consumers
- Swedish Government
- EU
- Food retailer
- Farmers
- Research institutes
- Meat and dairy companies
- Volta Greentech

The role of the consumer was deemed an enabler of the innovation's existence. Several interviewees described the group of consumers as one with power to affect what type of products will appear in the stores and that the market in general is consumer driven. This opinion was also shared by the representative from the food retailer, who stated that the retail side probably could affect the consumer with their choice of supply, but that the supply rather is a result of the demand.

The food retailer was also described as an important stakeholder by almost all other stakeholders, as there are only a few big players operating in the Swedish market, setting the prices and requirements. Both the interviewed dairy and meat company highlighted the food retailers' requirements and demands as very influential for their businesses. The consumer researchers further highlighted the retailers' size as an enabler for implementing requirements and initiatives that they perceive valuable. For instance, the case of MSC-certified fish and shellfish was mentioned by three different stakeholders, where the food retailers cooperated on only allowing sales of certified fish. This initiative transformed the ownership of the purchase decision from the consumer to the food retailer.

Another stakeholder that was highlighted as important by several interviewees, was the farmer. This, as the farmer's support and knowledge are needed to feed the cows with Volta Seafeed. Likewise, research institutes were indicated as an important stakeholder by several actors, as research work is vital for a safe implementation of the innovation in the production, as well as related to a general estimating of consequences of methane emissions from agriculture.

Lastly, future support from authorities, either the Swedish Government or the European Union, was mentioned as important by many as they possess the role of setting requirements and providing incentives.

4.1.4 Motivational factors to engage

In general, all actors believe that the innovation is a possible and desirable solution to reduce the methane emissions from cattle. Regarding motivational factors to engage, environmental concern was a common factor among the actors, innovator, farmer, and consumers. For the food retailers as well as the interviewed meat and dairy companies, the environmental concern was also present, though a demand from customers and competitiveness was communicated as stronger motivational factors. The dairy pointed out that requirements from authorities as well as demand from food retailers and in turn consumers, spur the development towards more sustainable production. Though as one of the leading companies within the sector, they strive to remain in the forefront and take the lead in these issues to sustain competitiveness. Similar views were mentioned by the meat company, and who additionally pointed out demand from investors and employees as drivers. The partnering food retailer mentioned a strive to be part of shaping the future, both because of intrinsic values, perceived demands, and competitive advantage. Meaning that investing in innovations for the future is a way of securing competitive advantage with the younger population at the same time as they can do their share of contributing to lower emissions.

The farmer, on the other hand, speaks less about competitiveness and more about the love for the soil, fields, animals, and nature. Drivers for contributing to this kind of project are communicated as a fun and viable way to contribute to future solutions for achieving a more sustainable food production. Emphasis is also put on the importance of preserving the nature from which they support themselves and where they live. However, for continuous

adoption after the pilot project a main qualifier is to get financial coverage for the increased workload connected to managing the supplement as well as the cost for the supplement.

From a consumer perspective, the researcher from RISE pointed out that consumers want to “do the right thing”, though what is considered the right thing differs a lot from person to person. In addition, it is often difficult to understand what the right thing is when new directives and findings constantly are presented, and food packings do not necessarily disclose all relevant information. The researcher believes that a motivational factor to purchase a product with clearly informed benefits, is a perceived sense of control in the purchase decision.

4.1.5 Barriers for adoption

Concerning barriers for adoption, one barrier stands out as it is mentioned by all stakeholders – price. Consumer-wise, there is a willingness to pay a certain level of premium for certain types of products, however the methane-reducing properties compete with other value-adding attributes and the food market is generally a price-sensitive market. Other sustainability attributes mentioned as competitive are organically produced, health, antibiotics usage, animal welfare and locally produced.

The price aspect is also an important barrier from the industry perspective as the food industry is a sector characterised by tough competition on all levels. The representatives from SFA and Naturvårdsverket both suppose the inability to take risks due to low profitability in the industry, to be a main barrier for industry adoption of the innovation. The representative from Naturvårdsverket underlined the absence of a cost or reward system for products, depending on their carbon impact. Without neither allocating a cost to emissions, nor rewarding emission reduction and carbon sequestration, give the perception of little or no profitability for such measures in the agriculture and food industry.

The interviewed meat and dairy companies both mentioned lack of research on this innovation in the long-term perspective as a barrier for them. Insecurities in how Volta Seafeed affects animal welfare and product quality over time, was underlined as a high risk. As these actors are not direct owners of the farms, they are dependent on their supplying farmers' willingness to feed their animals

with Seafeed. The lack of research is therefore perceived to be a barrier both in relation to the farmers and from a brand perspective, considering insecurities that may arise from consumers.

It was also discussed that farmers might be hesitant to use a novel type of forage because of a potential increase in administration or disruption in production flow. A representative from Jordbruksverket, raised insecurities in effects and costs, and traditional views on agriculture as potential barriers. The interviewed farmer suggested administrative work as a barrier if more administration would be put on the farmer than currently is. Further, the interviewed farmer pointed out disrupted flow as a potential barrier if increased costs of distribution are not compensated for. Regarding traditional views, the farmer made a difference between the younger and older generation of farmers, where the older farmers tend to be more traditional and sceptical towards new solutions, while the younger are more open-minded and motivated to engage in sustainability initiatives. A generally low level of education was additionally brought up by SFA as a potential barrier within the agricultural sector, which is in line with the statement by Liu et al. (2020) arguing that farmers are resistant to low-carbon innovations due to limitations in knowledge and awareness.

From the consumer perspective several psychological aspects were mentioned as barriers for adoption of the final products. Lack of understanding of food products' climate impact in combination with a confusion caused by the broad spectrum of labels, certifications and products marketed as sustainable is one of them. Interviewees highlighted this as two-folded barrier; a lack of understanding of these certificates and products' relation to various sustainability aspects, and the competition from other sustainability attributes being valued higher, particularly those perceived as more individually impacting than climate change. The researcher from RISE also highlighted the preference of tangible sustainability aspects as a reason for climate change being less prioritised. An example of this is the choice of organic primarily being made because of the health benefits, rather than the environmental benefits connected to it.

Another considerable barrier is the time frame. The interviewed retail store highlighted that they are always open to give new products and local producers a trial period in their stores. Although this is a great opportunity, it is needed

that a consumer demand is evident within two-three months to keep a place on the shelf. As there is a risk for the store of needing to waste unsold products, a trial period is their way to continuously improve their selection without too much risk. Apart from the time frame, there is also needed for the supplier to be accepted by the central function, from where the store selects what products to include in their own selection.

4.1.6 Support needed from the network

Support needed from the network refers to measures from other actors which would facilitate for the stakeholder in question to adopt the innovation or the final food product. The innovator has the main need from other actors closer to the consumer in the value chain, to take a risk towards the consumer, meaning investing in production and marketing of the final product. Specifically, a long-term order commitment from customers was mentioned as crucial for scaling up production. A key activity the dairy company expressed a need for was for other actors to show that a consumer demand exists, to pave the way and make sure there is a consumer awareness. Meanwhile, investigating the consumers, both consumer researchers expressed the importance of accurate and sufficient information being provided to the consumer for them to consider buying a methane-reduced food product instead of a conventional one.

The farmer, being the one distributing the feed supplement to the cows and turning it to a food product, discussed support mainly of practical character. In the current research project, it has become evident that this current distribution is rather inefficient as it must be mixed and only distributed to a small number of cows, as the trial was limited in the number of cattle it targeted. The farmer suggested pellets as an alternative way to ease the distribution and reduce their workload and cost, something that in that case would have to be produced on initiative by Volta Greentech. Further, the food retailers need to express a demand for methane reduced meat as it must be their choice to include the final product in their selection to motivate a continuous use for the farmer. This also includes expressing demanded volumes and time spans, for the farmer to make calculations on the implied costs per animal. Related to calculations, the interviewed farmer expressed a need for support with performing calculations on the costs of introducing Volta Seafeed from an external party, such as a consultant.

The representative from SFA provided a more generalised view of how the networks' actors need to support each other and emphasises the importance of collaboration and information sharing between actors. Testimonials established through partnerships to motivate more actors to adopt the innovation was suggested. The interviewee also underlines, in accordance with Volta Greentech themselves, that risk taking among actors is necessary to allow for disruption in the food system. Further, expanding partnerships to reach outside of Sweden, with help of Business Sweden, or to other industries was mentioned as ideas to increase total impact and growth of the innovation.

Furthermore, several actors highlighted that this type of innovation would need interventions from the Swedish Government, either in form of support, incentives, or regulations. This was suggested as an enabler of mainstream diffusion as the cost of Volta Seafeed was believed to be too high to attract a larger mass of consumers, especially if the consumers are to take the full bill. More specifically, some of the interviewees suggest that policies should lower the cost for the farmer or provide economic incentives for the farmer to use methane-reducing feed supplement in the production. Others suggest policies targeting consumers instead, either with financial incentives, requirements on climate labelling or with instruments aiming at providing information or counselling to consumers to make it easier to make the right choice. The representatives from Jordbruksverket and Naturvårdsverket, suggested that in addition to financial policies, authorities should provide counselling and support to the industry. The representative from Naturvårdsverket further suggests larger investments in innovation programs which take a holistic approach in terms of research and policy development, to foster innovation within the industry. However, they advocate requirements to be set not only by authorities, but from the industry as well.

4.1.7 Additional value of the innovation

Although the innovation in question has the purpose to produce final products identical to conventional meat and dairy products, only distinguished by a reduction in methane emissions, additional value than its methane-reducing ability was identified. Consensus prevails among all commercial actors that competitiveness is an important value. For the farmer however, branding does not only include their individual competitiveness as a farm, but a stronger branding for Swedish agriculture and its related food products in general. The

meat company further mentioned increased resource efficiency due to less forage needed as a potential added value. For the entire society, the representatives from SFA and Naturvårdsverket both mentioned benefits such as farm circularity and a maintained resilience in meat reserve as benefits from preserving the Swedish cattle industry. They proposed Volta Greentech's innovation as a means for sustainably justifying this perseverance of livestock in the long-term perspective.

4.1.8 Market characteristics of the Swedish agri-food sector

Something which was indicated in interviews but called for further investigation through other sources was the market structure of the Swedish agri-food sector in which the identified stakeholders operate. According to the OECD, Sweden has an efficient food supply chain, reaching a high standard when it comes to environmental performance compared to other countries, although with a rather low competitiveness internationally. The agricultural market is somewhat fragmented as farms are often small and individual, though organised in larger co-operatives to achieve the benefits of economy of scale. Consequently, some of the market leading actors in the food sector are organised in co-operatives, such as Arla Foods for dairy products and Lantmännen for cereals. In contrast, the retail side is rather characterised by a market concentration, with three large groups (ICA, Axfood and Coop) and one small standing for 90 % of retail sales of food (OECD, 2018).

4.2 Commercialisation

4.2.1 Facilitators for consumer adoption

As the consumer adoption of the final product was discussed as one of the main drivers for adoption of the feed supplement itself, several actors touched upon the topic of consumer behaviour and possible actions to facilitate consumer adoption. There is consensus among several actors on consumers' lack of understanding of product consequences and bias in the choices they make. The farmer pointed out how consumers do not see differences between different qualities of meat, and the simplified perception of avoiding meat is taking climate action. An information bias aspect brought up was choosing recognised sustainability certifications and overlooking those that one does not understand in the broad selection of different certifications and statements. This also brings the risk of losing the consumers trust, according to the consumer researcher from SLU. A measure suggested to tackle the information complex of problems and to facilitate for the consumer to make a sustainable product choice, is implementing environmental labelling of food products. The innovation leader at SFA similarly emphasised higher transparency in the food value chain and about actual impact of products, as a means to empower consumers to make the right choice. A note on this topic was that Volta Greentech perceived difficulties in the industry of reaching a common view of measuring the impact of methane emissions due to its specific characteristic as a short-lived GHG.

A resistance to changing food habits and a general fear of new products is mentioned. The food retailer described the consumer behaviour in the stores as “autopilot”, and that awareness-raising measures of any kind is a key for change. The resistance for changing habits was brought up by both consumer researchers as potentially both a negative and a positive aspect for Volta Greentech, as their product is new, but that meat is one of those categories hardest to give up. In line with this, the researcher from SLU pointed out particularly meat products as a category where the price must increase a lot to achieve the global climate goals and referred to their research saying that less than a third of the Swedish population is willing to give up meat.

The researcher from RISE further discussed the role of personal agency related to purchasing behaviour. Despite wanting to make the best choices for

ourselves, people have a desire to be in control of our choices and what we put in our body. Curiosity has become an important aspect in our choices of food.

4.2.2 Consumers' willingness to pay

A general opinion from the interviews was that the additional price for the methane reduced meat must be paid by the consumers. This puts a spotlight on understanding how the consumers' willingness to pay may play out. Several actors believed there is a group of people willing to pay a premium for environmentally friendly products, though the size of the group to be limited. Both the researcher from RISE, and Volta Greentech estimated a group about 20 % of the population to be inclined to pay a premium in general. Out of this group, the climate aspect competes with other sustainability aspects, which suggest the size of the group to be significantly smaller than 20 %.

Further, the willingness to pay was discussed to be dependent on the product, socio-economic level, and concern about climate change. Product-wise, meat might have a benefit when it comes to premium prices, as people are inclined to spend more on premium meat than they would on plant-based alternatives, stated by the RISE researcher. Likewise, the researcher from SLU argues the price elasticity for meat to be higher than that for other food products. This topic is debatable though, as other researchers within the field instead argue the demand for meat products to be more price sensitive than for dairy as well as vegetable base products (Berglund, et al., 2010). Regarding willingness to pay a price premium regardless of food product category, the researcher from SLU further discussed that the WTP for a more climate friendly alternative is high in general but the margin low.

Looking further at numbers, empirical studies have been conducted on consumers' willingness to pay a price premium for more sustainable food products. A meta-analysis of 80 world-wide studies covering a variety of food categories as well as sustainability attributes resulted in a WTP price premium for different categories (Li & Kallas, 2021), according to Table 3. Noteworthy, comparing different sustainability attributes against each other, such as organic or environmentally friendly, consumers showed a significantly lower WTP for food products with the specific attribute "environmentally friendly" (Li & Kallas, 2021). This is consistent with the findings of a study on Swedish consumers by Carlsson et al. (2021), which concluded that consumers are

willing to pay a price premium of 20% for food products with a label indicating lowered climate impact.

The findings of Li and Kallas’ meta-analysis further showed that studies conducted on a hypothetical basis generally showed a higher WTP than studies conducted based on actual purchasing choices, which indicates a bias among consumers about their own preferences (Li & Kallas, 2021). This was also discussed with the researcher from SLU, whose study confirmed that hypothetical WTP was higher than actual behaviour (Edenbrandt & Lagerkvist, 2021).

TABLE 3. LIST OF WTP FOR DIFFERENT CATEGORIES OF FOOD AND ATTRIBUTES

Study	Product	Attributes	WTP
Li & Kallas (2021)	Food overall	Multiple	29,5%
	Meat	Multiple	29,4%
	Dairy	Multiple	34,9%
	Food overall	Environmentally Friendly	21,3%
	Food overall	Organic	38,1%
Carlsson et al. (2021)	Food overall	Climate Impact	20%

4.2.3 Business model

As Volta Greentech is providing a low-carbon innovation in a traditional industry, the business model for Volta Seafeed does not follow the same structures as for regular forage or feed supplements. Hence, Volta Greentech deemed the high costs from production together with the need for measuring results as factors sufficient for pursuing an alternative business model, rather than selling directly to feed suppliers. Currently, Volta Greentech collaborates directly with a food retailer, and argue this to be a way of avoiding added margins from all the other actors in the value chain and by so, keeping the price lower towards the consumer. Though, the innovator expressed the current business model to be designed for creating an initial awareness of their innovation and is planned to be adapted to target a larger consumer group once viable.

Concerning business models there were some conflicting thoughts among the stakeholders of who should take responsibility for the use of the feed supplement. The farmer suggested it should be paid by someone other than the farmer and the dairy company thought the ideal solution would be to have it integrated in the feed supply streams and handled by the farmers. The partnering food retailer highlighted that the business solution for the pilot project was a special case. The meat company raised that further investigating what additional value might be attained, could argue for a higher cost should be done prior to a potential partnership.

If there exists a common way of measuring climate impact in the future and transparency prevails, the representative from SFA suggested potential business models to include the trade of emission rights. More generally, both representatives from SFA and Naturvårdsverket expressed a need for new and better business models in the food industry to distribute costs in the food value chain and to obtain a sustainable industry.

4.3 Business Environment

4.3.1 Trends within the food sector

Consumption behaviour and trends on the Swedish food market was a widely discussed topic during interviews. Several stakeholders confirm the growing trend of buying more sustainably produced food, considering several sustainability aspects. Further, Fernqvist (2021) states that there is an increasing demand for sustainably sourced food as consumers want to feel closer to the food and demand more fresh and less processed food. Swedish Trade Union (2018) notes an increased consumer interest in sustainable products, particularly within the food industry. A study from 2018 shows how 36% of asked Swedish consumers stated the supply of sustainable food products in store to be too small, an increase by 5% from the previous year (Svensk Handel, 2018).

Despite the drastically increased total consumption of meat in Sweden over the past decades, both interview findings and studied documents point at the recent gradual decrease in consumption observed over the past few years.

Between 2016 and 2021 this consumption decreased by 10 % (Jordbruksverket, 2022). The trend seems to be attributable to a raised awareness of the environmental and health consequences as well as an improvement in the alternative product categories parallelly, particularly plant-based proteins according to Jordbruksverket (2022) as well as stated by the RISE researcher. However, the researcher from RISE believes this change to be mainly consumer driven, rather than company pushed. Concern for animal welfare as well as increased meat prices are also potential underlying reasons, which shows that price and economic conditions still have a high importance for many consumers (Jordbruksverket, 2022).

Further, the dairy company has noted a decrease in milk consumption over the past few years, while other dairy products have increased in sales. Similarly, statistical data states a long-term decrease of milk consumption in Sweden and a gradual increase in consumption of cheese (Naturvårdsverket, 2020). The dairy company does not see a general replacement of dairy products by plant-based alternatives, but rather as a complement in some categories (e.g., milk).

Interview findings also point at the increased demand for Swedish produced food, including meat and milk. Something that statistics confirms and is believed to be explained partly by the drastically decreased restaurant visits during the pandemic, but also by increased awareness and interest for meat production and benefits of purchasing Swedish food products (Jordbruksverket, 2022).

4.3.2 Climate targets and policies

When discussing a methane-reducing innovation, the topic of climate change and climate goals is inevitably relevant. From the consumer perspective, higher interest in attaining a sustainable lifestyle has put pressure on the retailers to supply accordingly. Both the dairy and the meat company speak about their climate targets and means to reach them because of consumer demand. For instance, the dairy company strives to align with the 1.5° C target until 2030, set in the Paris Agreement and the meat company highlighted the science-based targets as a means the industry uses to ensure that all suppliers comply with set targets. On the same topic, the interviewed food retailer stated sustainability and climate as aspects often discussed with suppliers and

mentioned their new tool for declaration of impact, as a way of increasing both consumer awareness and supplier power.

Targets or policies specifically connected to methane reduction are yet to be developed according to several interviewees. Recent events implies that the topic of decreasing methane emissions have appeared on the political agenda. At the UN climate conference in November 2021, COP26, 103 countries agreed to cut methane emissions by 30% until 2030 (Fortuna, 2021), Sweden being one of them. The pledge mainly focuses on enhancing technical measures, such as feed supplement, to reduce the human-caused methane emissions in the agriculture sector.

Zooming in at Sweden, OECD (2018) identifies Sweden as a leader when it comes to environmental policies, as it was one of the first OECD countries where awareness was raised, and environmental policies were established. However, Naturvårdsverket highlights that future policies and instruments need to address other aspects such as Sweden's national food strategy, with intention to increase domestic production, and other sustainability goals such as biological diversity (n.d.). Compared to other EU states, the extent of environmental policies affecting the agri-food sector in Sweden generate a more sustainable food production in various aspects. Though these requirements also come with consequences in forms of higher input costs and lower productivity growth, which pose difficulties in competing on the international market (OECD, 2018).

The researcher from SLU highlighted that potential tax policies would do better close to the customer since a regulation or tax on the production side only would affect Swedish producers. Further emphasising that it would imply a risk for an increase in consumption of imported goods instead, not fulfilling Swedish environmental requirements in general.

Existing policy instruments for the green transformation in the agri-food sector mentioned during the interviews was "Klimatklivet", managed by Naturvårdsverket. Moreover, the representative from SFA emphasised the announcements for innovation in the food industry that is available through them, with lots of support to apply for. Though that support for innovations in the food sector was fragmented throughout the country and in general difficult to understand, making it less utilised.

From the interview with the farmer, a lot of emphasis was made on the difficulties in sustaining a competitive agriculture business in Sweden when requirements are high, price is pressured by food retailers and there is little support to be collected from the state. The policy “Klimatklivet” was mentioned as an option, but as the farm was denied support for investing in an electric truck or solar panels, this policy was not considered to be enough to support the transition toward a more sustainable food production in their opinion.

Although the latest version of Naturvårdsverket’s report brings up measures for methane reduction, the representative emphasised research being limited and no focus on feed supplements or additives related to the topic. According to the representative, the industry, on the other hand, has expressed a wish for methane reduction targets, although on rather small reductions. There is also a wish for differentiating between carbon dioxide and methane emissions, which is currently not made in targets. The representative from Naturvårdsverket further underlined the sensibility for the government in setting requirements on food production and consumption. Partly as regulating what we eat is a sensitive topic, but also due to conflicting challenges such as competitiveness against international agriculture and sustaining food resilience.

4.3.3 Technical environment

As a result of increased attention to methane’s effect on climate change and its relation to agriculture, and more specifically cattle, this has initiated more research and innovation on mitigation techniques over the past years. According to Naturvårdsverket (2021) the number of cows in Sweden has been reduced by 47 % since 1990, implying a reduction by a third of the total methane emissions, and yet the production has increased by 50 % since then. This increase in efficiency could be traced to measures for increased farm productivity, a reduction in number of livestock, new forage mixes and increased animal health (Naturvårdsverket, 2021; Hellstedt, et al., 2014; OECD, 2018). However, methane reduction through feed supplements for cattle has so far been sparsely investigated.

Further, the innovation environment in Sweden was described as top-rated internationally by SFA. Though, this did not apply to the agri-food sector which only reached 14th place. The representative from SFA highlighted this

as an important issue to address from both the industry and the Swedish Government if a transition towards a sustainable food system is to be implemented. Internationally, the interest in tech-innovations within the agri-food sector has increased significantly recently considering the amount invested in agri-foodtech startups (Burwood-Taylor, 2019).

Another aspect highlighted by the representative from SFA was the emergence of a blockchain for the agriculture sector in Sweden, Agronod, which is intended for sharing data, for example climate calculations from producers.

4.3.3.1 Methane-reducing feed additives

Similar solutions, methane-reducing feed additives for cattle, have been developed parallelly outside of Sweden. Regarding the ones that are most similar to Volta Greentech in a commercialisation context and furthest ahead, there are three other solutions that stand out. A comparison of characteristics of these solutions made by Volta Greentech are presented in Table 4. Noteworthy, the dairy company Arla Foods recently presented their collaboration with DSM for participating in a large-scale pilot project (DSM, 2022).

TABLE 4. OVERVIEW OF METHANE-REDUCING FEED ADDITIVES. SOURCE VOLTA GREENTECH

	Volta Greentech	DSM (Boaver)	Mootral	Agolin
Methane-reducing effect	Up to 90 %	30 %	<30 %	< 10 %
Sustainability in production	Very high	Low	Medium	High
Type	Plant based	Chemical	Plant extract	Plant extract
Increased animal productivity	Up to 20 %	No	No	No
Current cost	€€€	€	€€	€

Depending on the type of additive, documented benefits of usage, except for methane reduction, include increased efficiency of feed utilisation due to less energy spilled on methane production as well as stand for a source of energy alone (Curnow, 2022). The same study also brings up some risks, which mainly concerns commercialisation and measuring difficulties (Curnow, 2022).

4.3.4 Economic situation

The current economic situation in Sweden has also been brought up during the interviews as a potential threat to the ongoing commercialisation. As of now, the economic situation in Sweden is above all characterised by the ongoing economic and geo-political turbulence. The post-pandemic scene, an ongoing war in Europe with major economic sanctions, higher energy prices and an increasing inflation has all contributed to the economic volatility currently ruling. The interviewed food retailer highlighted that some of these events have had major effects on the consumer demand. For example, the interest in organic products has decreased during the global pandemic, probably as a result of less purchasing power. These more recent events have influenced increasing food prices in general and from the food retailer a concern about the timing of launching meat with Volta Seafeed this year, was expressed.

The interviewed farmer also expressed worries about the economic situation as a few years of dry summers and increased costs for diesel has had tremendous effects on their profitability. Further, it is pointed out that the food industry in general is a slow one, which means that effects on consumer prices do not mirror the increased costs of the farmer.

4.3.5 Legal aspects

Various sorts of legal considerations affect the business environment of Volta Greentech, both considering feed additives, food production and sales of food products. The use and marketing of animal feed additives is in the EU regulated by the Feed Additives regulation, which means that additives must go through an authorisation process before being marketed and used. This regulation is currently under evaluation by the European Commission, to assess whether it meets the current needs of businesses and authorities as well

as identify possible burdens it causes (European Commission, .d.). The EU has in the beginning of 2022 approved the first chemical feed additive for reducing methane emissions for cattle, Bovaer, developed by DSM (Fortuna, 2022). Regarding Volta Seafeed is it classified as feed *material* and not feed *additive* due to its natural ingredients, which means no such approval is necessary. Though, for full recognition, the European Commission needs to evaluate the feed material for a permanent position in their Feed Catalogue. This is currently in process for the red seaweed and is likely to be confirmed shortly.

Considering legal circumstances for food production affecting Volta Greentech, the interviewed researcher from SLU states that there are currently no legal restrictions for levels of methane emissions in food production. Neither exists in Sweden any legal requirements for declaring and labelling food products with associated emissions, though the researcher provides Denmark as an example where it has been suggested by the climate council to be governmentally implemented and is currently being investigated. The researcher from SLU further means legal requirements like this to be one of the possible measures having the largest positive impact on the adoption of Volta Greentech's innovation.

5 ANALYSIS

This chapter will, with an outside-and-in approach, present applications of the theoretical models on the findings of the case study, starting with the business environment and finishing with commercialisation decisions for Volta Greentech.

5.1 Business Environment

5.1.1 PESTEL

An analysis of the findings related to the business environment of Volta Greentech is realised with a PESTEL framework, where an overview is presented in Figure 11. The following section will bring up and analyse the effects of the most important factors.

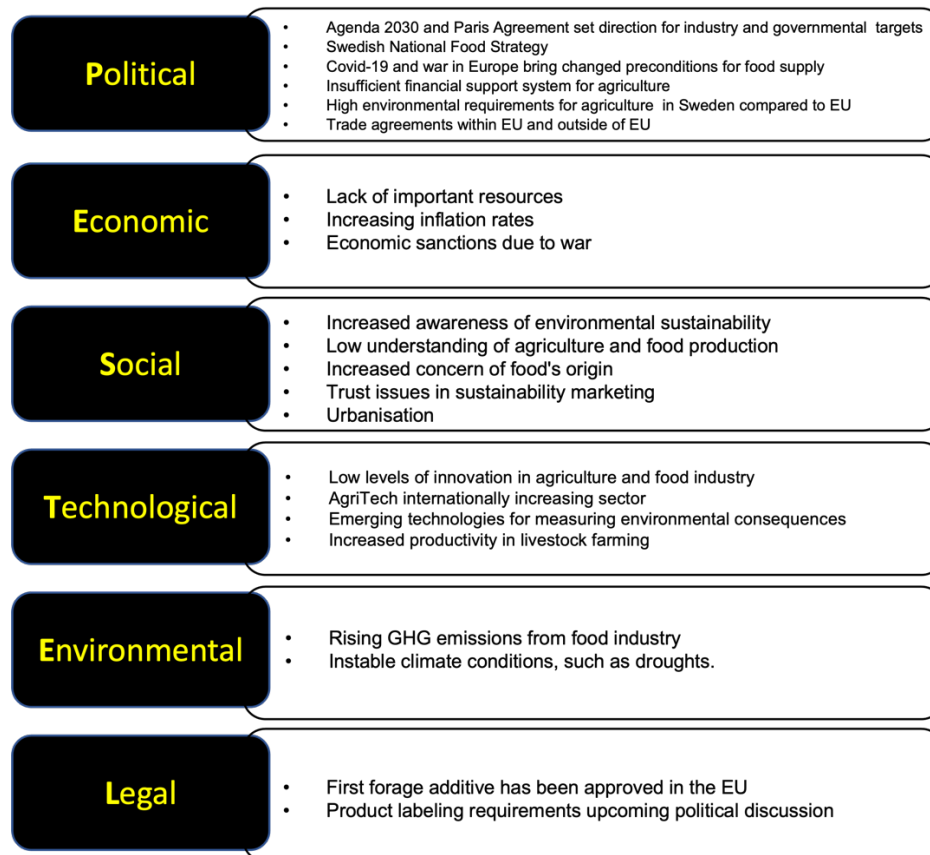


FIGURE 11. PESTEL ANALYSIS OF VOLTA GREENTECH'S BUSINESS ENVIRONMENT.

It is inevitable that the political factors affecting the agri-food sector in Sweden, and Volta Greentech in particular, are many. On the top level, agenda 2030 and the Paris agreement sets a direction for government prioritisations, influencing the Swedish political agendas which sets conditions for Volta Greentech's commercialisation. Relating the political business environment to the stakeholder situation, it became clear through the interviews how the overarching climate targets affect the actors of the value chain's climate targets and measures for more sustainable production, and thereby their interest in the innovation. An example is how the lack of methane specific political targets and requirements is reflected in the industry's lack of methane specific measures and requirements. Thus, how the political climate in which Volta Greentech operates is to change during the upcoming years is a determinant for the mainstream diffusion of their innovation.

Another highly important aspect of the political environment discovered, is the current support system for Swedish farmers constituting a barrier for adoption. A perceived difficulty in gaining financial support for climate initiatives among farmers, as well as an administratively fragmented system for innovation support in the agrifood sector, points at how inefficiencies in design of current national support systems need to be addressed. Through such improvements, the adoption of the innovation can be facilitated among farmers and food producers. Technological-wise, a combination of progressivity among farmers and innovation support from authorities and policy makers would create a stimulating business environment for innovations within the sector. The findings highlighted a willingness for progressivity within the sector and for a transition towards fossil free production and circularity, implicating an area of opportunity. Although the agri-food sector has been expressed as traditional, where innovation is lagging compared to other sectors in Sweden, improvements seem to be accelerating especially when it comes to incremental innovation for increased productivity. However, what is missing is a facilitator and support for more long-term investments in sustainable farming and food production, since much available support, such as Klimatkivet, is currently aimed at one-time investments. It is thereby desirable that the increased emergence of new agri-tech companies internationally will cause a spill-over effect on interest among Swedish policy makers, although not likely to happen in the close future.

Considering economic aspects of the business environment, major events in recent years such as the covid-19 pandemic, war in Europe, high inflation rates and a lack of resources leading to increased prices on vital components for agricultural production, has all caused an unpredictable economic situation of today. Affecting the purchasing power of the consumer, the profitability of the farmer and a potential worry among investors have a high impact on the food industry and its stakeholders, which creates a constricting environment for Volta Greentech to launch their innovation in. The current economic instability further sheds light on the social aspect of the food crisis. As the industry is suffering from lack of resources and farmers are struggling to break even, the general consumer seems to be mainly worried about increasing food prices in the supermarket. This shows a general low level of understanding for the agricultural industry and food production, suspectedly as a result of increased urbanisation and distance between the consumer and the origin of their consumed food products. Consequently, there exists further social challenges for Volta Greentech to overcome in communicating the need and potential of their innovation.

Overall, the business environment in the agri-food sector is affected by major global events, changing former views on food production, and questioning the global interdependencies in our food supply. The past and current crisis in terms of war and pandemic and the ongoing discussion about climate change's effects on our welfare has intensified the need for a competitive and sustainable food production in Sweden. Although there are economic and social barriers to overcome, these changes in the business environment also provides opportunities for a low-carbon innovation to disrupt the system.

5.2 Stakeholder Analysis

This section analyses the findings about all the stakeholders and their interdependence in the system of the innovation.

5.2.1 Stakeholder Overview

The stakeholder overview from Figure 9 has been revised in accordance with the authors' analysis from interview findings, and includes additional information to the initial version, see Figure 12. Based on analysis of this case

study's findings, the authors have distinguished between direct and indirect stakeholders. Direct stakeholders, in this analysis defined as stakeholders which are involved in the usage and adoption of the innovation and those included in the value chain presented in Figure 10, are colour coded black. Indirect stakeholders, defined as those holding an interest in the development and diffusion of the innovation among other stakeholders, are coloured grey. Yellow indicates stakeholders which are evaluated as potential future stakeholders. Additionally, stakeholders are differentiated by size according to importance.



FIGURE 12. THE STAKEHOLDERS OF A METHANE-REDUCING FEED SUPPLEMENT WITH THE DISTINCTION OF DIRECT (BLACK), INDIRECT (GREY) AND FUTURE (YELLOW) STAKEHOLDERS.

5.2.2 Stakeholder Map

Before further analysing the role of each stakeholder in the food system, the dynamics of each stakeholder's power and interest relative to one another is to be understood, for which the power-interest matrix is suitable (Eden & Ackermann, 2011). In this mapping the parameter *interest* is defined as the stakeholders' interest in the innovation in question, while the parameter *power* is defined as the relative power each stakeholder has in the commercialisation of the innovation on the Swedish market. The result of the mapping is presented in Figure 13.

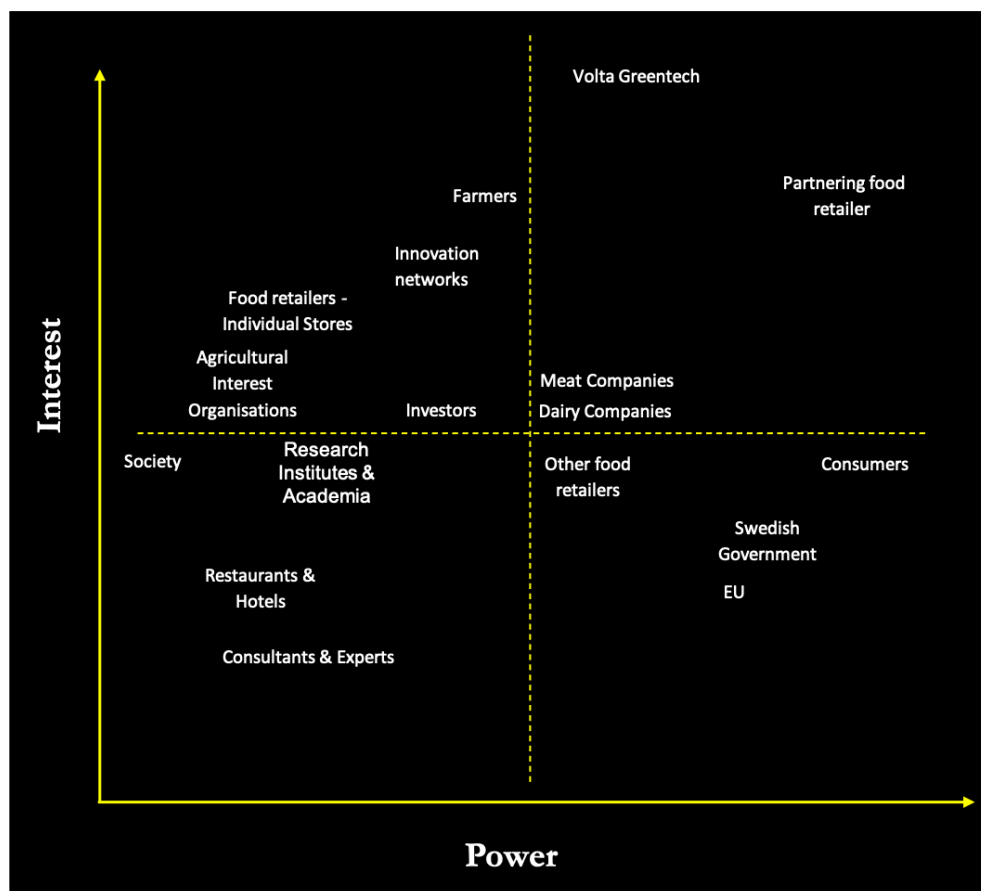


FIGURE 13. THE STAKEHOLDERS OF VOLTA SEAFEED IN A POWER-INTEREST MATRIX.

Players

The stakeholders of high interest and high power are identified to be Volta Greentech, meat companies, dairy companies, and the partnering food retailer, and are therefore to be considered the key stakeholders (Eden & Ackermann, 2011). Firstly, the innovator naturally has a high power as they are the owner of the innovation and in control of the commercialisation decisions of the innovation. Though their power is somewhat limited due to the strong dependencies on other actors in the value chain, dependency mainly on other actors' systems for food production, distribution, and consumer relations. Simultaneously, offering a solution to a societal issue which is gaining increased political attention, as well as being the first company on the Swedish market with a methane-reducing feed supplement gives them a certain level of power towards these actors. However, a key issue for Volta Greentech is to enable a large-scale production of Volta Seafeed, for which high-risk investments in facilities are required. Regardless which form of investors these come from, this issue diminishes Volta Greentech's full control of the commercialisation process.

The partnering food retailer, in the characteristic of one of the largest on the Swedish market, has a relatively high level of power, considering their buying power towards meat and dairy companies as well as influence on the assortment of consumer products on the food market. Being the partner retailer for the first launch of Volta Greentech's innovation, further strengthens this position, both towards Volta Greentech and other actors in the network. The competitive advantage of being a first mover constituting an important driver for this retailer to engage, indirectly increases their power towards Volta Greentech as it limits Volta Greentech's possibilities to establish collaborations with other food retailers while sustaining a good relationship with the partner. By taking the lead, the partnering retailer also gets the power to influence other retailers, meat and milk companies and consumers by creating a buzz around the innovation. Moreover, they get an advantage in reaping the limited market share of consumers ready to pay for such sustainable premium products.

The meat and dairy companies are given the same level of power considering their equal power compared to other actors in the value chain such as food retailers and farmers. In contrast to individual farmers, a meat or dairy

company possesses power through constituting larger corporations implying larger capital, market shares, and power of influence and dissemination of information through their brands. They are both considered highly interested considering their ambitious climate targets and visions to compete with sustainability, which Volta Seafeed can be a means to achieve. However, interviews with these companies revealed a rather low willingness to take risk, showing a high interest in the innovation as a solution but low interest in actually adopting it. The relative interest between these two actors can be differentiated by a couple of different aspects. Firstly, traceability of milk through the supply chain is more complicated than that for meat products and requires a more large-scale feeding of supplement. Secondly, as meat was stated as one of the food products many consumers are less willing to give up, competitiveness in that sector could argue for a higher interest for meat companies. Though, one of the main players on the Swedish dairy market, Arla, has recently introduced a pilot project together with Bovaer, one of Volta Greentech's competitors, which indicates a high interest within the stakeholder group for this type of innovation.

Further, it is also important to identify negatively influencing Players to be able to reduce their power or interest (Eden & Ackermann, 2011). In the position where Volta Greentech is now, no negatively influencing stakeholders are found within the key player's segment. However, a future possible such could be a firm capitalising on a shift from meat and dairy consumption, such as an oat substitute producer, who benefits from bringing the meat or dairy industry into disrepute. In such case, measures could become necessary to reduce this actor's power or to collaborate to show that the two types of products can co-exist on the market. As mentioned in interviews, neither the meat or dairy company experienced the coexistence of plant-based and methane-reduced products in their assortment to be a problem.

Context setters

The most powerful of the context setters is the consumer, whose acceptance is the most critical for a mainstream diffusion. The demand and willingness to pay for food with methane-reducing effects is a conditional matter of existence of the innovation and the power relative to other actors is high. The interest of consumers was on the contrary not as easily established. The estimated potential group of 20 % of the Swedish consumers willing to pay for premium

food products is, with regards to other higher valued attributes such as health, and phenomena like information bias, and confusion about sustainability labelling, likely to be significantly smaller. The total interest of consumers is thus not estimated to be as high. Noteworthy, even though the size of the group is limited, there is an increased interest in food-tech and more sustainable options. This discussion highlights a key issue for Volta Greentech, namely a powerful actor with an unpredictable interest. The consumer should ideally be a key stakeholder, a *Player*, and efforts to increase their interest is therefore of utmost importance.

The regulatory power is another actor who is deemed powerful as their decisions could change the rules of the game completely. Decisions made by the Swedish Government as well as the EU cause effects on the Swedish agri-food sector and its responsiveness towards innovations. These decisions will hopefully be in favour of Volta Greentech as it is the interest of society to lower emissions from cattle. Though there exists a risk for regulations hindering the adoption, such as increased requirements on administration from farmers when handling methane-reducing feed supplements.

Regarding the interest of the regulatory power, it seems like methane emissions from cattle has risen on the political agenda recently, though from the interviews no actor expressed any knowledge of upcoming policies addressing this issue. The lack of interest could have many reasons, one being the constant conflict of various environmental issues in agriculture and other aspects of sustainable food production. As methane emissions is deemed one of the most cost-efficient solutions to combat climate change by the UN (2021), it is remarkable that reducing these emissions is not communicated as a priority by the Swedish Government. Though, as both the consumer and government are considered vital stakeholders for low-carbon innovations (Ribeiro & Lopes de Sousa Jabbour, 2017) and how these two interrelate with the innovating company according to Chen et al. (2022), encouraging the interest would be motivated.

Among other food retailers of the Swedish market, there are other actors with higher market power than the partnering retailer, although this does not necessarily imply a higher power in the commercialisation of Volta Seafeed considering the current structures. Their position indicates, however, a potential of developing towards the role of a *player*, a position that raises the

question whether to encourage further interest or to simply keep these shareholders satisfied. As a launch together with the current partnering retailer is currently approaching, it is for the moment not a suitable time to spend time on the retailer's competitors, however, considering the high market power of the largest food retailers in Sweden, it is important to remain a good communication with these shareholders and not close the door for future collaborations.

The individual stores of the food retailers are differentiated from the central level as they possess power over the diffusion through other means. Each individual store's product selection is dependent on the central function's approval of new products to the central assortment, from which they are self-determinant in which products to include in their own assortment. Although this by some means leaves them with a limited power over the diffusion, being positioned closest to the final consumer gives them the power of influence through food availability as well as over purchase decisions product promotion in stores.

Subjects

The stakeholders with more interest than power, are in this case considered to be agricultural interest organisations, investors, innovation networks and farmers. The agricultural interest organisations and the investors both have a lot to gain from the success of Volta Greentech, increased competitiveness in Swedish agriculture and financial yield respectively.

Power-wise, the purely financial investors play a more important role in the upscaling phase, as they are enablers of further scaling and are taking a risk to do so. Before achieving sustainable revenue, the investor's power will remain high. Though both financial investors and interest organisations are not necessarily deemed to be interested in the physical innovation and its way through the value chain, but rather in the indirect consequences caused by it. Thus, it is sufficient to keep these informed (Eden & Ackermann, 2011).

The interviewed innovation network, SFA, was perceived as very interested in the success of Volta Greentech and moreover, eager to play an active part in supporting the progress of the innovation. As the innovation network possesses some influence towards policy makers and are providers of a networking forum for the agri-food sector, their power to help the diffusion is

higher than the interest organisations' and closing in on investors as their influence has a longer time horizon. Thus, the innovation networks in the agri-food sector should rather be managed as a collaborating partner for a long-term gain.

Lastly, the position of the farmer as a subject can be discussed as many of the interviewed actors perceived farmers as an important stakeholder and their support as a main qualifier for adoption. Though, as the market structure in the agri-food sector in Sweden is characterised by a few large food retailers and higher number of farmers, Ulvenblad et al. (2019) highlights this as a basis for power asymmetry within the sector. Further, the difficulties in sustaining a profitable farm were highlighted by the farmer as well as the representative from Jordbruksverket. This leaves the farmer with less negotiating power toward their customers and less power to invest in the innovation without a clearly communicated demand from the customers (i.e., meat companies or food retailers). Their interest remains high as their care for the environment is somewhat based on dependency on environmental factors for their production.

Crowd

The crowd in general does not motivate the innovator's engagement (Eden & Ackermann, 2011), however, for some actors positioned as crowd there is a note to be made. Restaurants & Hotels have so far not shown a specific interest in the product and are in relation to other food retailers too small to alone have the same kind of power. Though, restaurants tend to be more niched and providers of a situation where consumers are not as price sensitive which indicates a future potential as customers.

Research Institutes and Academia have some power to influence research about methane and methane-reducing feed supplements, as this type of research potentially could have long term benefits for Volta Greentech's innovation. However, in a commercialisation context their power is low as they are far away from the value chain and as research is a slow process.

5.2.3 The system of stakeholders of Volta Greentech

With foundation in the theories about sustainable food systems (HLPE, 2017; Kennedy, et al., 2021; FAO , 2018; Fernqvist & Göransson, 2021), the findings about the stakeholders to Volta Greentech and the business environment for the innovation is analysed and integrated with respect to their roles in the entire system. The food system in Figure 14 has adapted the framework in Figure 7 to the case of Volta Greentech and the system in which they operate, with further inspiration from Figure 8 and Chen et al.'s (2022) theories about stakeholders of low-carbon innovations' relationships. Hence, this food system contains all the important stakeholders, their interconnectedness, and societal drivers. The drivers originate both from the external business environment as well as from stakeholders' feedback throughout the system, arrows illustrate their impact on the food environments and consumer behaviour respectively. Together, the food environments and consumer behaviour subsequently resulting in an actual food consumption. Furthermore, the system describes the outcomes of consuming the final food product (e.g. reduced methane emissions), as well as the long-term impact these outcomes have on society, in terms of environmental, economic and social aspects. Outcomes of the food consumption influences drivers and stakeholders both directly as well as indirectly through the long-term impact they give rise to.

Simultaneously, feedback from consumption influences the regulatory power's political agenda, which in turn has implications on consumer behaviour and sets guidelines and conditions for stakeholders in the value chain. In connection to the regulatory power, it becomes visual how research and academia is an impactful building-block in the regulatory power's further impact on the rest of the system.

Thus, the system represents a feedback-loop where none of the actors or outputs operates in isolation from each other, which is illustrated in the system in Figure 14.

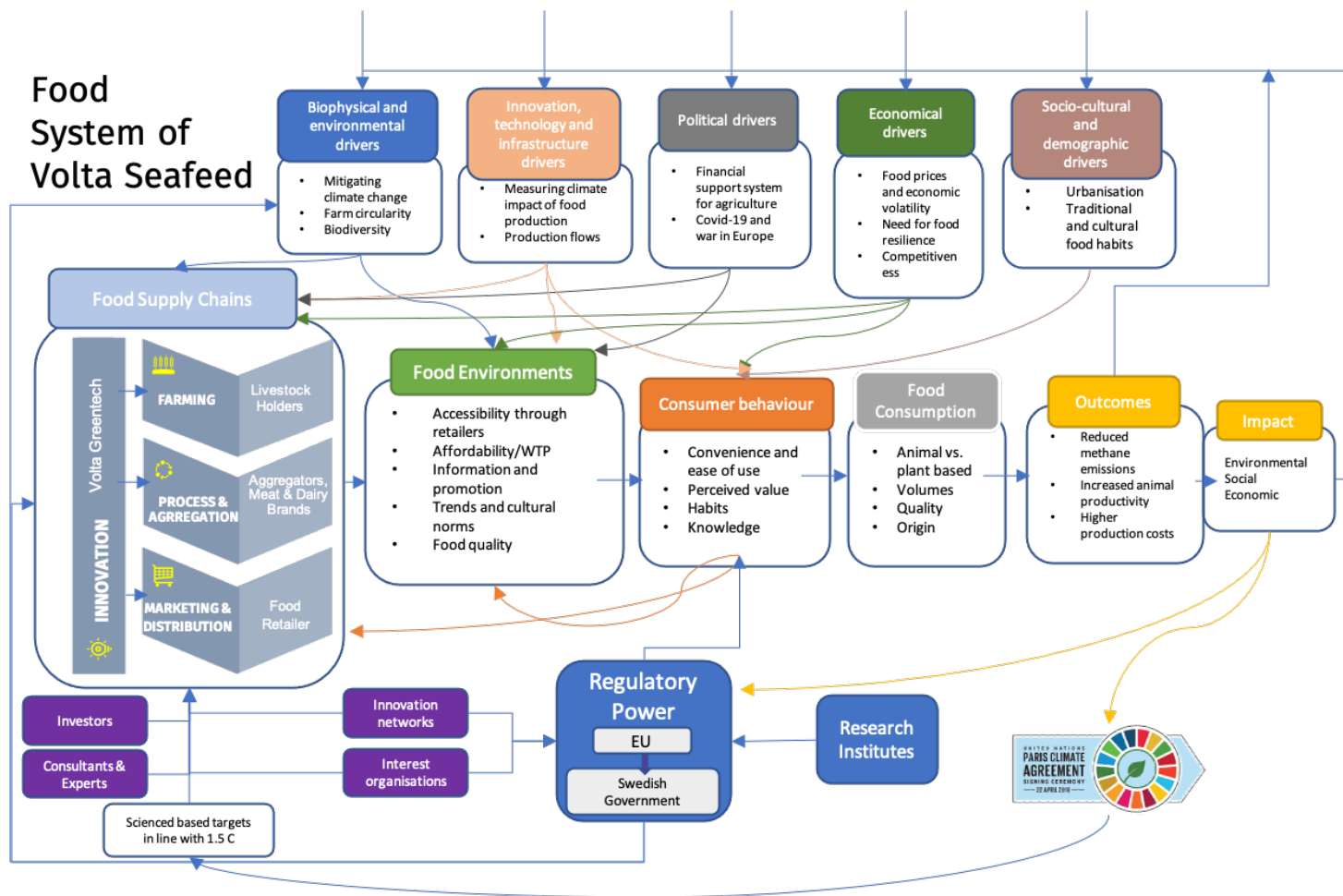


FIGURE 14. THE FOOD SYSTEM OF VOLTA SEAFEED

5.3 Commercialisation Analysis

This section analyses findings gathered throughout the report to understand potential commercialisation opportunities and barriers for Volta Greentech's innovation.

5.3.1 Commercialisation Strategy

This section will, based on the three-step approach suggested by Frattini et al. (2012) in chapter 3.2.3, analyse the current commercialisation strategy and how to effectively improve the commercialisation of Volta Seafeed, considering the innovation characteristics and the aim of reaching mainstream adoption.

5.3.1.1 Identify type of innovation

The first step of Frattini et al.'s (2012) suggested approach is to identify the type of innovation according to the parameters *incremental* or *radical* and *continuous* or *discontinuous* innovation. Looking at the radicalness and continuity of Volta Greentech's innovation, it becomes relevant to distinguish between the industry product and the consumer product. As these are targeted at different types of markets, but at the same time are commercialised as a whole, we need to consider their characteristics in combination with each other.

Evaluating where the innovation should be placed on the scale between radical and incremental, the feed supplement as an innovation speaks for radicalness, while the final food product is more of an incremental innovation. The feed supplement is a new type of product, based on new technology, which clearly speaks for radicalness according to the theory by Frattini et al. (2012).

Meanwhile, it can be discussed for the food product whether more incremental or radical characteristics are prominent. The carbon reduced food product is an improvement of a conventional food product, with regards to its mitigated climate impact, but is not in itself a new product and does not give rise to any major changes in the way of consumption. However, the methane reduction which differentiates it from a conventional food product is a *new* benefit, instead of an improvement of a current benefit, which according to the definition is what defines a radical innovation (Frattini, et al., 2012). Thereby, the final food product can be placed somewhere in between incremental and radical, however somewhat towards the radical direction.

The diffusion of Volta Greentech's innovation, regardless of looking at the feed supplement or the final food product, is dependent on a number of actors in its adoption network to support it in terms of distribution and communicating information, which indicates discontinuity. At the same time, it is debatable whether the innovation should be classified as purely discontinuous according to Frattini et al.'s (2012) definition, as the main physical infrastructure required for delivering its intrinsic value is already in place. However, the commercialisation of it requires a new infrastructure in terms of business model, alliances, and channels, which leaves the conclusion of being more of a discontinuous innovation than continuous.

5.3.1.2 Identify Commercialisation Strategy

With foundation in the radical and discontinuous dimensions of the innovation identified, a relevant commercialisation strategy is to be chosen. The matrix in Figure 3 from Frattini et al.'s theoretical framework suggests a commercialisation approach based on these dimensions. As discussed in the previous section, the technical product Volta Seafeed can be considered both more radical than incremental and more discontinuous than continuous and as it in some cases are difficult to separate between the products, the chosen commercialisations strategy will apply for both. Thus, by using the framework in Figure 3, it is suggested that the products will benefit from a combination of *adoption network configuration strategy* and *early adoption strategy* together with the *mainstream adoption strategy*.

5.3.1.3 Identify Commercialisation Decisions

The next step in the analysis refers to analysing the decision variables for each strategy, with consideration of which strategy it belongs to, according to Frattini et al.'s (2012) suggestions. Further, the B2B and B2C perspective will be considered parallelly, with regards to the technical product and the consumer product.

Adoption network configuration strategy

Positioning

The position of Volta Seafeed in the food system is mainly important to clarify towards the actors; farmer, meat companies, dairy companies and food

retailers, as they are the actors in direct stakeholders in contrast to the indirect ones, e.g. the Swedish Government. An important aspect of the positioning is clarity about the innovations compatibility with existing systems, as a lack of clarity regarding this issue hinders the support from important actors of the adoption network (Frattoni, et al., 2012). In this case an existing system consisting of the agricultural process where the Seafeed is implemented, compatibility of the innovation with the animal is of high importance. As the dairy and meat companies experienced that this was not yet the case, while other actors argue the lack of research not being an obstacle, it can be discussed whether all necessary actors are informed or updated on the current research. Here, a point of improvement in positioning is identified, where more testimonials and communication of these, could be a way of strengthening the positioning towards these actors. For the farmer, on the other hand, the distribution compatibility with other types of forage was the main issue as the distribution to the cattle is inefficient due to a separated flow. For continued adoption of farmers, this issue should be addressed by other actors when designing each business case.

Partnership & Alliances

The partnerships and alliances in this case are those actors in the industry collaborating to create the final food product towards the consumer. This is considered one of the most important aspects as Volta Greentech is a green-tech company and not a food producing company. Important partnerships therefore include those transforming their innovation into a competitive consumer product, such as with the farmer, aggregators, meat and dairy companies, and the food retailer.

In contrast to the above-mentioned partnerships necessary to commercialise Volta Greentech's core product, other partnerships and alliances can be relevant in the long-term commercialisation in order to launch complementing services, such as a system for information sharing of methane emission levels between actors of the value chain. According to Frattoni et al. (2012) firms should let other actors develop software or other complementary products which support the initial innovations underlying technology. For this purpose, it might become necessary to establish partnerships with organisations outside the food system. A possible suggestion for the innovator is to investigate opportunities of an extension of their product to include a data sharing system.

To gain full transparency in the production it is not only important to present evidence of the methane-reducing capacity, but to be able to track measured levels of methane for different farms over time. The expressed difficulties in calculating the impact of methane further argues for the importance of transparency of the emissions. When Agronod launches their database, transparency simultaneously creates an opportunity of collaboration for Volta Greentech.

Early adoption strategy

Timing

Considering the identified growing trends of consuming sustainable food products as well as the current political agendas on the topic, the timing of Volta Greentech's launch lies very well in time. Looking at the state of commercialisation among competitors' products, Volta Greentech has good opportunities for a first mover's advantage on the Swedish market. However, it is on an early market, according to Pettifor et al. (2020), of higher importance to launch a product that is fully developed and perfectly working rather than exploiting a first mover's advantage. As the technical functionality and the innovations impact on animals and products showed to be a highly sensitive question for several actors, this becomes a very relevant consideration for Volta Greentech in the launch of their innovation. The characteristics of food products, being directly connected to our health, further creates a sensitivity of the complete functionality when going to market and consists of high risk in case negative side-effects on animals or human health can be shown. Such outcome could mean devastating consequences for Volta Greentech and partnering actors' brands as well as for the general attitude of climate friendly food products and initiatives within the food sector. Therefore, in terms of timing, it is vital that Volta Greentech continues the launch of their food products in a pace that does not exceed the knowledge of secured impact on animals and products.

Another timing aspect impacting the commercialisation of Volta Seafeed is the current political and economic turbulence causing concerns about profitability and resource resilience in the industry as well as private economy for consumers. As mentioned by several interviewees, when consumers are experiencing their purchasing ability to be less than usual, organic, or other

premium food products take the hit. This implicates that the more price sensitive adopters probably will wait, somewhat diminishing the group of early adopters.

Targeting

Targeting in the early market requires identification of one or more market segments that are likely to adopt the innovation as well as understanding their characteristics to employ a proactive strategy (Frattoni, et al., 2012). For the industry product, choosing the important partnerships mentioned above, with regards to their interest in exploring new solutions in the sustainability aspect, is deemed as the most important enabler. Considering Volta Greentech's current partnerships, these two hold a clear positioning in this aspect. Further, the segment which holds the highest potential of promoting an industry benchmark should be prioritised (Bianchi, et al., 2017), in this case the partnering food retailer should be encouraged to take that role. As theory further emphasises to be responsive to the needs of early adopters (Bianchi, et al., 2017) Volta Greentech should assimilate the interest and barriers of their current partnerships and iteratively make use of these insights for improvements in the product or the business model. This does not imply transforming the innovation itself but rather designing how it is distributed or commercialised.

Targeting among early consumer adopters should naturally consider those interested in sustainability, though even more important, those interested in new products and technology. This group of people are susceptible and not as price sensitive, which allows for the consumer product to exploit a spot in the price premium segment.

Whole Product Configuration

The innovation itself does not have a set of complementary products or services but in the process towards a consumer product, added value from other product benefits can be obtained for industry actors. For the early adopters, taking part in the commercialisation of a futuristic product with benefits for the common good, can be perceived as a value from a branding perspective. The fact that other environmental and competitive values, e.g.,

perception of Swedish produced meat, circularity on farm and beef resilience, was mentioned during interviews as potentially future and indirect consequences, this suggest that there are value-adding attributes, as discussed by Pettifor et al. (2020).

In contrast, the early adopters among the consumers are likely to be attracted by the sophistication of the innovation and the core benefits by it. Hence, focusing on the technical innovation and its methane-reducing effects to enhance the sophistication of the innovation, would be preferred in the early consumer market. It can be discussed whether different sustainability attributes could strengthen each other by presenting a combined product offer, thus if Volta Seafeed should be used on an organic farm, to sell the final food products as “organic and methane reduced”. The arguments for presenting a combination of attributes include taking advantage of more renowned certifications or brands, though this also comes with the risk of intensified confusion or negative spill-over if the certification does not provide positive associations. As the whole product configuration in the early market should highlight the core benefits (Frattini, et al., 2012), this implies that the methane-reducing properties should be kept separate from other sustainability attributes to begin with.

Communication

Communication towards the early adopters should mainly focus on the technical specifications and the newness of the product (Frattini, et al., 2012). For Volta Greentech this means that the technicalities such as transparency with methane reduction and how it is measured should be prioritised. Although the food market does not share the same characteristics as the high-tech market, the importance of communicating and creating a buzz around new tech-innovations is the same. Considering the issue of lack of consumer awareness and autopilot behaviour when grocery shopping, communication outside of the stores and marketing as a tech-product becomes even more vital for attracting consumers’ interest before entering the store. Considering the early adopters’ characteristics, communication should preferably be used for promoting the uniqueness, innovativeness and as a brand for the future. Learnings from other successful marketing cases within the food industry, such as Oatly, could be to stand out to be perceived as a status brand.

Mainstream adoption strategy

Positioning

For mainstream adoption to succeed, an important factor is the positioning of the food product, relative to other similar products with sustainability attributes on the market. Competing with sustainability aspects seems to be twofold, as high interest for sustainable products allow for a premium price, while low understanding of what a sustainable option is, risk consumers instead turning down all attempts of purchasing a sustainable option. For instance, the attributes such as “organic” or “locally produced” indicate an eco-friendlier product, however, the actual difference between them and conventional products are rarely communicated clearly to the consumer. This situation serves as a foundation for confusion of how to make the “right” choice and a lack of trust in the impact of different labels.

The positioning of the food products using Volta Seafeed is clearly positioned as dairy or meat products with a lower amount of methane emission and thus, a smaller impact on the climate. Though above-mentioned issues put difficulties on positioning these products, as the understanding of the value of the products is dependent on a comparison with other products. This puts once again transparency and climate labelling in the spotlight as necessary means to increase the understanding of climate impact of food products and empower consumers to make a conscious choice.

Distribution

For the initial launch, food retailers are deemed to be the distribution channel for the final food product, whereas the Seafeed is physically distributed to the farmers directly by Volta Greentech, through the food retailer as an initiator. Other potential distribution channels for the Seafeed as well as for the food products have been discussed in interviews and by the authors. Distributing the Seafeed through feed suppliers is an alternative channel which is not viable in the current pilot stage but can potentially become relevant in the long-term commercialisation when production is scaled up. This would allow for a smooth flow of feeding products for the farmer as well as for Volta Greentech to focus on other activities than supply chain issues. Considering distribution of the final food products, hotels and restaurants could be considered potential channels, however, not to allow for as strong branding and as high volumes as

by going through food retailers. Though, to overcome the chasm between early adopters and the later adopters discussed by Moore (1991), distributing through restaurants could be a way to make slower adopters try the product, create a connection to it, and be more receptive towards it when encountered in the supermarket.

In their framework, Frattini et al. (2012) bring up other critical functions of the distribution channels such as customer education, which was also discussed in interviews. Food companies' taking responsibility for and interest in informing and educating consumers on the industry's environmental impact is an important means for making consumers adoptable. Therefore, distribution channels should also be chosen with consideration to their interest in taking in the role of an educator.

Pricing

A pricing strategy needs to be set towards the industry actors in the value chain and towards the final consumer. Starting with a pricing strategy towards the consumer could be seen as a common priority to facilitate a mainstream diffusion as the consumer demand has been expressed as vital for industry actors. Thereafter it is possible to distribute the costs and margins to cover risk among the involved industry, which could be motivated by competitiveness.

A skimming price strategy is suggested for commercialisation of high-technological innovations to consumers (Frattini, et al., 2012). However, in the context of Volta Greentech's innovation, the being of a high-technological innovation can be debated as the industry product is clearly a technological innovation, while it is not as evident for the final food product. In addition, being a low-carbon innovation, with a purpose beyond generating revenues, adds complexity to the pricing strategy.

In the case of Volta Greentech, launching with a high price appears necessary considering the high research costs and high production costs due to the current small-scale production. In combination with the final food product initially targeting a limited customer segment willing to pay for premium products, a skimming-similar price strategy might still be favourable. Frattini et al. (2012) emphasises the importance of notably lowering this price when approaching the mainstream market, as these customers are generally significantly more price sensitive. Volta Greentech's intended price premium

for the initial launch is set to be around 20% compared to conventional food products, which is in line with the average willingness to pay for more climate friendly food of 20% (Carlsson, et al., 2021; Li & Kallas, 2021). This indicates a fair starting point in pricing for early adoption, though underlines the need for a price decrease in order to reach mainstream market adoption. Particularly consumers' hypothetical bias generally leading to overestimations of willingness to pay, should be considered when using this data in pricing decisions. How to enable such price decrease for the final consumer will further be discussed in section 6. Discussion.

Communication

In contrast to the communication towards early adopters, the mainstream communication needs to highlight the key issue the innovation is addressing to a greater extent, according to Frattini et al. (2012). For Volta Greentech meaning, through various channels communicate the problems of methane emissions of livestock, solutions to solve it, as well as the overall benefits of maintaining a sustainable livestock in Sweden. To achieve this type of communication, support is needed from other actors with a higher credibility or target reach, such as state authorities.

5.3.2 Business Model Considerations

As re-thinking of the business model of a low-carbon innovation is highlighted as an enabler of mainstream diffusion by both scholars (Urbinati, et al., 2019) and practitioners (Chandaria, et al., 2021), this is suggested to be a key issue to consider. According to the theories of Chandaria et al (2021), Volta Greentech's innovation could be categorised as a deep-tech solution. Mainly, due to the radical innovation characteristics of the industry product discussed in section 5.3.1.1, and the fact that Volta Greentech is re-inventing the feed supplement market for cattle and enabling a new type of low-carbon meat and dairy products to be offered to consumers. Moreover, the current business model already employs a new structure compared to the traditional partnerships within the food industry in Sweden. Though to acquire the best conditions for a successful diffusion, aiming further for an ecosystem approach is recommended, as suggested by Chandaria et al (2021).

A possible business model configuration brought up by both the innovator itself and SFA was the possibility of including trading of emission rights in the business model. Such structure could mean that companies in other businesses pay for the feed supplement in exchange for emission rights, which helps solve the cost problem of commercialising the innovation.

5.3.3 Consumer Acceptance

Regarding how well the consumer is likely to accept the new food products with Volta Seafeed's methane-reducing effect, the product's attributes could be compared with the attributes suggested by Pettifor and Wilson (2020) for low-carbon innovations within the food industry.

The main attributes for acceptance of new products discussed in the interviews was making as small habit change as possible, control of choice, no negative side effects for personal health or animals, low relative cost to other similar products, recognition of product/brand, perceived environmental benefit, and no use of antibiotics.

Out of the six core attributes valued high by food consumers, Pettifor and Wilson (2020) suggested *ease of use*, *cost-saving*, and *timesaving* as the top ones for mainstream adopters, though comparing the attributes found in this study *ease of use* and *cost-saving* are the most relevant. Cost-saving further pointing at the cost issue of the innovation. On the contrary, ease of use can be considered the most prominent for Volta Greentech, as through an offering of a more climate friendly meat and dairy product, allow the consumers using the same recipes and cooking habits as usual. Thus, this is the attribute which should be emphasised when developing a marketing strategy towards consumers.

Combining the theories of Pettifor and Wilson (2020) with interview findings further suggest leveraging the environmental performance and communicating research and testimonials, to ensure the brand to be perceived as safe and secure, as well as a product with added environmental and social benefits.

6 DISCUSSION

This chapter dives into a deeper discussion the analysis and builds upon existing research to provide a foundation for answering the overarching research question.

6.1 Measures to bridge the chasm to mainstream diffusion

Related to the answer of RQ1, this section will discuss what it takes to reach mainstream diffusion considering the stakeholders' motivational factors and barriers for adoption. Findings from the case study will be related to the theories of diffusion of innovation and the difficulties in crossing the chasm to reach the mainstream market.

The mission of reaching mainstream diffusion of Volta Greentech's innovation is twofold: achieving mainstream diffusion of the Seafeed on an industry market, and of the final food products on a consumer market. Involving both a b2b and b2c perspective of diffusion brings complexity to the commercialisation, and has been sparsely researched in this field before, which this discussion will serve as a contribute to understand. Understanding the characteristics of the innovation and how the diffusion of it is affected by some key factors is necessary for facilitating adoption of it.

6.1.1 Clarity about product safety and research

The complexity in bridging the early market with the mainstream market has become evident regarding several aspects: price, reliability of the product's safety and a need for proof of consumer demand. To increase interest from *players* within the food industry, such as meat and dairy companies, Volta Greentech needs to in accordance with Frattini et al.'s (2012) mainstream adoption strategy, take on a clear positioning of their innovation as a scientifically substantiated safe product in terms of animal welfare and product quality. It was noticeable how the interviewed companies did not perceive this position the way as Volta Greentech themselves, who argue these companies to not be updated on the existing research on product-safety sufficient for a large-scale commercial implementation of the feed supplement. It can here be

discussed whether there is a disagreement on the level of research needed to be considered sufficient for commercial implementation among actors, or whether it is a question of lack of communication of the more recent research findings. Regardless, this is an issue that needs to be sorted out in order to find the best measures to address it. As it should be in the interest of the innovator to increase the interest in the innovation of these stakeholders, investigating the research issue and communicating accordingly is a proposed activity to facilitate the adoption.

6.1.2 Consumer acceptance

Another big issue of complexity for reaching a mainstream adoption is unwillingness among later adopters to take a risk in the innovation, without more extended proof of demand for such food products on the consumer market. As highlighted in the stakeholder analysis, consumers is a stakeholder group for whom efforts to increase their interest is needed. These efforts relate partly to creating a general awareness of meat and dairy products' climate impact and Volta Greentech's existing solution to it, and partly to win the consumers' trust and interest in the abundance of sustainable products and sustainability certifications.

In line with the argumentation brought up under *Whole Product Configuration* (p. 80) and Frattini et al.'s (2012) suggestion to focus on core product attributes, the most efficient way to gain consumer trust is likely by solely focusing on the methane-reducing attribute. Instead of collaborating with other more established environmental certifications, it should be prioritised to seek consumer trust through other types of collaborations. The authors of this thesis rather recommend strengthening the trustworthiness through further partnering with established brands such as meat and dairy brands or restaurants.

Further, transparency and a common standard for labelling products according to climate impact is another desirable solution to gain the consumers trust and enabling competitiveness through reduced climate impact.

6.1.3 Creating a willingness to pay

Directly related to consumer acceptance arises the question of pricing and distribution of costs. As earlier stated, the price premium which consumers are willing to pay for the methane reduction is inevitably a determining factor for commercialisation decisions. Although as seen in the literature review (Carlsson, et al., 2021; Edenbrandt & Lagerkvist, 2021) and interviews, establishing such a number without any product launched on the market is rather problematic. Although values of such price premiums found through various hypothetical studies can work as indicators, they should be considered with care. Rather, focus from the innovator should be on creating awareness and the buzz about the final food product to attract both expected and unexpected consumers, to warm up the mainstream market beforehand and *create* a willingness to pay. This activity is also a means for showing potential partners in the food industry, that risks associated with consumer demand are actively mitigated by the innovator. If the lack of understanding consumer demand is still considered a barrier, this is recommended to be researched in collaboration with the intended partner.

The commercialisation analysis using Frattini et al.'s (2012) framework brought up how a price skimming strategy is a potential strategy for the early market but highlighted the importance of enabling a significant price decrease to attain mainstream diffusion. This sheds light on the need for policy compensation or a different distribution of costs throughout the value chain. The second alternative calls for a perceived value among these actors which justifies such cost increase, such as competitiveness or increased animal productivity. In the current collaboration, both retailer and farmer take on increased costs additional to the feed supplement itself. These costs, related to distribution and increased workload, will be hard to motivate without justification after the pilot project is finished.

6.1.4 Measures from the food industry

A recurring topic in the study has been the market power of the Swedish food retailers, and their related power in the diffusion of Volta Seafeed. However, which responsibility this comes with calls for further discussion. It was suggested by several interviewees that food retailers possess the power to set requirements on their suppliers regarding emission levels of meat and dairy

products, similar to the case of MSC certification for fish. Further argued in interviews, was that policy instruments will need a complement from industry-initiated requirements in order to commercialise the innovation on large-scale. Implementing such common industry requirements on suppliers, would need increased interest from these stakeholders as well as an established certification. Problems with initiating such a certification are related to the international market, which implies that a certification must be well established globally. In Sweden, however, introducing a certification for methane emissions could be a measure that Volta Greentech, their partners, and competitors could initiate.

6.1.5 New Business Models

Another means for facilitating mainstream adoption is to evaluate the business model for adaptation to the mainstream market. As stated in interviews the current collaborations are built around a pilot project, which allows for special circumstances. However, as a mainstream market is approached, this business model might call for adaptation, in line with Urbinati et al.'s (2019) suggestion to continuously re-evaluate a business model for speed of diffusion conditions as part of the commercialisation process. As an example, while offering a high-cost input, attracting businesses and consumers will be limited to the early adopters. Therefore, adjustments in the business model to allow for a lower price towards the consumers and other actors in the value chain would serve a purpose of attracting a broader mass. To realise such utopia, it should be considered to receive revenue from other sources to finance the lower price. Leveraging the blockchain Agronod or partnering with companies from emissions heavy industries, such as the flight industry, to have them pay for Volta Seafeed as a way to climate compensate are possible solutions. However, for the latter suggestion there is a risk of eroding the purpose of the innovation if the result is increased emissions in another industry. Regardless, such product configuration, of selling emission rights, lies far in the future as it will require the feed supplement to be wider implemented in the industry before it is viable.

Another possible approach would be to make incremental changes to product or the business model from the iterative insights of the current partnerships. For showing encouragement, their suggestions for improvement are vital to

consider with regards to technical limitations. Such suggestion was, for example, to use pellets as a feeding technique for simplified distribution.

6.2 The system of stakeholders

As evident from the stakeholder analysis in section 5.2, the stakeholders in the case of the commercialisation of Volta Seafeed co-exist in a food system where each of the stakeholders' decisions has implications on the entire system. Thus, leading up to firstly answering RQ2, and secondly the overall research question of how the innovator can facilitate the adoption of the innovation among the stakeholders, it must be discussed how this system can be managed.

6.2.1 The power of joint forces

Using the adapted food system in Figure 14 the need of structural changes becomes present as there are multiple interdependencies in the system. Even though there is a cry for increased innovation, and a larger portion of breakthrough innovations, the societal structures are not fitted to support innovations focusing solely on environmental benefits. One of the core issues is that policies take time to develop, and at the same time needed early on to motivate both the industry and consumers. Therein lies an inertia only possible to address with joint forces - to make a structural change, a collaborative and powerful network is key. As Chandaria (2021) stated, an ecosystem where each stakeholder strives to contribute according to their ability, can leverage both a pool of resources, sharing of risk and influencing power on policy makers.

Using the consumer as an example, it was stated in the interviews that people want to “do the right thing”, though there is evidence that people care mainly about themselves and their closest surroundings. The tragedy of the commons is thus a concept applicable to this case and further points out the complexity in only using altruistic motivations to attract people and businesses. Thus, low-carbon innovations do not compete fairly with other products if no added value is perceived to argue for the increase in price of these products, which is in line with the argumentation of Pettifor et al. (2020). To deliver such added value requires the entire systems' collaboration.

Achieving joint forces is therefore desirable, though not necessarily easily implemented. Considering the different power and interest among the stakeholders detected in the power-interest matrix in Figure 13, collaboration might face difficulties as highly influential stakeholders, such as the food retailer, have high interest in the innovation but not necessarily of collaborating with other, smaller actors and of addressing structural changes and policy makers. Particularly joining forces for policy interventions does supposedly not lie in the interest of these actors as it might complicate their production processes and imply increased costs. Contrasting arguments can be discussed for less influential actors, such as the farmer, as collaborating with influential actors is more likely to be on the terms of the large actor.

6.2.2 Disrupting the agricultural sector

With foundation in the missing puzzle pieces in the food system identified by Kennedy et al. (2021), the system around the innovation of Volta Greentech has put further emphasis on the private sector as a key player to spur the commercialisation of the innovation, the need for accounting for the true costs of food with measuring climate impact as a first step as well as reinventing the views on agriculture in Sweden. The influence of the private sector in the food industry was for the commercialisation deemed high relative to other stakeholders, according to the power-interest analysis.

Parallely, old-fashioned views on agriculture as an industry to produce as large amounts of food to as low cost as possible, the competitive international market of which it operates in, and the increased urbanisation leaving consumers far away from food production, has caused an attitude of assuming total availability of food and continuously low prices. Further, the current system was mentioned by many stakeholders to be rigid for new solutions as there are small margins and high risk related to food production. Thus, collaboration and partnerships of the direct stakeholders has the possibility of creating new conditions for low-carbon agri-food innovations to successfully grow before policy makers catch up.

Addressing these structural changes and traditional views on agriculture to include low-carbon innovations, innovators like Volta Greentech have a chance to disrupt the status quo and build new alliances to commercialise their innovation. Together, these partnerships in the private sector have the

possibility to create testimonials over the output and impact. By recognising the output and impact of the innovation, these can work as drivers and basis for decisions for new goals to be set both by the regulatory power and the private sector. Thus, Volta Greentech has with their collaborators a chance to create a positive spiral through the ecosystem in Figure 14 which in the long-term perspective have a chance of facilitating mainstream adoption.

6.3 Potential improvement of policies

While answering the research questions, potential support of policies and regulatory power became evident as a necessary means for reaching a mainstream diffusion. This section will therefore discuss the current policies and potential improvements, to give an understanding of how these affects the diffusion of the innovation, which is important for the innovator to understand as part of facilitating adoption.

The example of commercialising green steel was brought up as a relevant case from another industry, where similarities with an innovation like Volta Greentech's can be identified. Green steel is, like methane-reducing feed supplement, a solution which through technological breakthroughs is a way to produce high-demanding goods with significantly less carbon emissions. Moreover, these solutions have higher total cost than current solutions, in contrast to productivity efficiency solutions, and involve the adoption of the entire value chain. Therefore, the case of green steel transition, where actors have called for policy interventions, could serve as a pointer towards the need of involving policy makers to foster the commercialisation of low-carbon innovations also within the food industry.

As evident from interviews, the current governmental support for the agriculture industry current focus on one-time investments for the green transition, and unlike electricity production, lack policies offering incentives for continuous efforts. This is in line with, Chen et al. (2022) suggestion of policies as a necessary measure to motivate stakeholders to take risk on the initial investment of a low-carbon innovation. However, in the case of feed supplements in the agri-food sector the need for continuous support can be argued to be of higher importance if a transition towards a low-carbon food production is to become a reality.

Further, it became clear that specifically methane reduction up until recently has been a low prioritised climate issue. The reasons for this are debatable, though there is reason to suspect that a reduction in the number of cows has not been desirable by either the industry or policy makers, partly due to the sensibility of putting conflicting sustainability goals such as economic and environmental against each other, as well as influencing people's food choices.

Considering these issues and as Volta Greentech's innovation enables emission decreases at the same time as promoting the meat and dairy industries, it should be in the Swedish Government's interest to facilitate its breakthrough on the market. By providing incentives for methane reduction, other traits of maintaining Swedish cattle can be preserved with a lower total amount of emissions from the industry. An alternative way of providing incentives for methane reduction, or GHG emissions in general, could be by introducing a common system of attributing the costs for society of emitting CO₂-equivalents. This could be a motivator for both regulatory power as well as industrial stakeholders to invest in emission reducing innovations.

The question remains which sorts of policies and governmental measures that would have the highest desired effect. It has been discussed whether a potential taxation on emissions in the agri-food sector would do best on the consumption side or the production side, and how such a system should be designed. An argument for keeping taxation close to the consumer is to let Swedish food producers stay competitive towards international production to avoid a setback in increased import of food (Berglund, et al., 2010). However, an alternative system discussed for implementing policies on the production side is to introduce a weighting system for different categories of environmental taxation such as taxation on fossil fuel usage. This would imply that a producer could compensate for their usage of fossil fuel in the production with a reduction in methane emissions and even out the net taxation. This is in line with the one of the factors for successful policy implementation suggested by European Commission (2014) and Berglund et al. (2010), namely allowing for flexibility for the farmer. However, before designing and implementing actual policies, it must begin with setting overarching goals for methane emissions, to direct such policies as well as the industry. Related to this, methane emissions must be differentiated from general measures of GHG emissions to make goals clearer and the results of measures more transparent. The absence of methane reduction targets might

be explained by the perception of lack of technical solutions for reduction in sight. Thereby, Volta Greentech and its ecosystem has a chance to initiate a change in perspective.

7 CONCLUSIONS AND CONTRIBUTIONS

This chapter summarises the analysis and discussion by answering the research questions. Furthermore, theoretical, and practical contributions of this thesis is concluded as well as suggestions for future research.

7.1 Answering RQ1

RQ1: Who are the stakeholders, and what are their motivational factors and barriers to engage in the innovation?

All the stakeholders are presented in Figure 9, though the most important stakeholders are described here together with their motivational factors and barriers relevant for potential adoption of the innovation.

Farmer – motivated by the will to develop a sustainable Swedish agriculture sector and to protect the nature on which they support themselves. Restricted by low margins, difficulties to get financial support and increased workload connected to feeding the supplement.

Meat and dairy companies – driven by demand and requirements from food retailers, consumers, and authorities. Climate engagement and increased competitiveness with sustainable production are main motivational factors. Insecurities in perceived technical safety, resistance from farmers and high price are barriers to adopt innovation.

Food retailers – motivated by building an innovative and sustainable image together with food-tech companies and gaining competitiveness towards other food retailers. Main barrier for adoption is insecurity about consumer demand and financial risk.

Consumers – motivated by the willingness to make good choices for themselves and for the environment. However, a stronger drive towards choices affecting themselves personally. Restricted by their ability to pay, a lack of understanding of the environmental and social impacts of their food choices, and confusion among different certifications and identification of greenwashing.

Innovation networks – motivated by increasing the innovation rate and types of innovation within the agri-food sector, and consequently increasing the

competitiveness of the Swedish agri-food sector. Barrier for engagement in the diffusion is their limited power to influence the commercialisation process.

Regulatory power – motivated by encouraging a competitive and sustainable Swedish agri-food sector. Barriers involve extensive process for decisions which require prior research, and competing sustainability attributes for prioritisation of policies.

7.2 Answering RQ2

RQ2: What role do the network of stakeholders play in the diffusion, given the business environment of the innovation?

First and foremost, the eco-system of Volta Greentech presented in Figure 14, illustrates how all the important stakeholders are interconnected through their position in the system and how they all play a part for adoption and later, diffusion of the innovation. Though to deepen the understanding of the stakeholders' roles, a further categorisation serves a purpose. The stakeholder analysis provided two means of categorisation, the power-interest matrix, and the distinction between direct and indirect stakeholders. From the power-interest matrix it became clear who the most influential stakeholders were, namely, food retailer, meat and dairy companies, consumers, which should be prioritised when managing the stakeholders. A conclusion that can further be drawn from the power-interest analysis is how the different means of power of large actors and small innovators in combination can facilitate the diffusion. Thereby, by sharing capabilities to fulfil each other's interests they together have a potential disruptive effect on the food system.

The direct stakeholders play a vital role both in the first phase of commercialisation and for mainstream diffusion and should therefore be managed proactively. This, as they are all involved in the value chain of the innovation from B2B product to the production and consumption of a food product. Further, all the direct stakeholders, except for the consumer, are relevant to consider for future partnerships to create testimonials and build a network around the innovation. Alliances among directly involved stakeholders becomes increasingly important to reduce risk aversion considering the current political and economic insecurities.

The indirect stakeholders, such as innovation networks, research institutes and regulatory power, all have a supportive role in the ecosystem. Nevertheless, this supportive role has a lot of power to determine the outcome of the commercialisation in the long-term perspective as they possess a large power over vital factors of the business environment of the innovation. For instance, as both research and policies may have a disruptive effect on the ecosystem, research institutes and regulatory power becomes very influential stakeholders, although indirect. Consequently, as these become important mainly for mainstream diffusion, a good relationship and information sharing with the indirect stakeholders is vital to initiate at this time for facilitating the future diffusion of Volta Seafeed.

7.3 Main research question

RQ: “Commercialisation of low-carbon innovations within the food industry: How can the innovator facilitate adoption of the innovation among the stakeholders?”.

To answer the overarching research question, RQ1 serves the purpose of firstly understanding the stakeholders of the innovation, which helps the innovator to understand which factors to leverage on and which hinders to solve. The answer to RQ2 discusses the role of the network of these stakeholders in the context of the diffusion, which gives directions for how the innovator can position themselves in relation to the stakeholders. Finally, the answers to these two questions results in an answer on how the innovator can facilitate adoption of their innovation among stakeholders, namely:

Testimonials created through collaboration with direct stakeholders is a key activity to build joint forces in a network, such as the current collaboration with the interviewed food retailer and farmer. Thereby the innovator can engage all stakeholders in the system around the innovation, as suggested in Figure 14, to foster adoption and enhance an adoption network configuration strategy as suggested by Frattini et al (2012). Starting by being attentive to early adopters’ needs and open to changes in the business model as the mainstream market is approached, this development can be facilitated. Further, the created testimonials must be actively communicated to attract authorities’ attention,

prove product safety to the industry and pave the way on the consumer market through increased awareness and credibility.

7.4 Contributions

Theoretical contributions

This thesis contributes to the theoretical field in two main aspects. Firstly, bringing the b2b and b2c perspectives simultaneously in the commercialisation analysis, which has formerly been poorly researched. By applying the commercialisation framework from high-tech consumer markets by Frattini et al. (2012) combined with theories on industry commercialisation (Bianchi, et al., 2017) and low-carbon innovations (Pettifor & Wilson, 2020; Pettifor, et al., 2020), the analysis brings new insights about commercialisation of a new type of product with other preconditions than previously researched. Additionally, there is limited research on low-carbon innovations within the food industry and specifically methane-reducing feed supplement in a commercialisation context overall, and this thesis has shown how a commercialisation framework can be applied to these innovations and how the innovator can affect the outcome of the commercialisation.

Secondly, the thesis suggests a system of a methane-reducing feed supplement to illustrate how food systems can be transformed to achieve sustainability within the scope of the innovation, which was suggested by (Kennedy, et al., 2021). This contribution further addresses the gap of existing food system frameworks (Bocken, et al., 2020) and allows for a perspective engaging various stakeholders. This perspective was added through analysing the stakeholders of the system with the power-interest matrix, revealing potential dysfunctionality in the system due to power asymmetry.

Practical contributions

Practical contributions which this thesis provides include a stakeholder analysis with stakeholder-specific information about interests, motivational factors and barriers related to the innovation. Though, the more overarching contribution is the insights on how Volta Greentech should prioritise and manage these stakeholders, together with related commercialisation considerations to be made, for a long-term gain. This is illustrated both in the power-interest matrix and in the food system, which serves as a mapping of the system which Volta

Greentech's innovation operates in and can work as a future decision material for the case company as well as other commercialising firms. The practical learnings of this thesis can further, to some extent, be transferred to more general issues of fostering low-carbon innovation within the food industry.

7.5 Future research suggestions

During the research process of this thesis several areas in need for further research appeared. Further investigation of commercialising other low-carbon innovations as well as further research on a more general food system and potential policy interventions, would support the industry in implementing carbon-reducing solutions.

Firstly, policies have been mentioned from several perspectives during the study, as enablers of innovation and crucial for the transition towards a low-carbon food industry. However, evidently there are differing views on the most efficient policy options. Determining the most favourable policy interventions and activities needed for such implementation requires a more in-depth analysis of policy making and goes beyond the scope of this thesis, why it is left to further research.

Somewhat interconnected, another field in need of further research is the food system and more specifically innovation measures within the food industry. Though this thesis contributes to the research of food systems through Volta Greentech's specific innovation, the field could benefit from studies on other similar cases as contributions to develop an understanding of the general food system. Related to this, research from SFA as well as the Swedish National Food Strategy currently emphasises support for generating innovation, while more research is needed on how to make upcoming innovations feasible and adopted in the industry. A future research suggestion could further be to explore how a cost on GHG emissions could be implemented in the food industry and how it would affect the commercialisation and diffusion of low-carbon innovations.

Lastly, this thesis brings up the need of evaluating alternative business models, which requires further research in order to find the best alternative for this case. As Chandaria et al. (2021) as well as Urbinati et al. (2019) state, different

business model configurations serve the purpose of mainstream diffusion with varying efficiency depending on product category and industry. Considering the unique characteristics of this innovation, a need for further research on an optimal business model for commercialising this type of innovation is therefore suggested.

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A. APPENDIX

A.1 Interview Guide

Generell intervjuguide som modifieras efter målgrupp.

[Presentation av oss och examensarbetet]

Om intervjuobjektet inte är bekanta med Volta Greentech: [Presentation av företaget och innovationen]

- Vill du börja med att berätta lite om dig själv och din roll?

Kommersialisering

- Vad tror ni är de viktigaste faktorerna för att innovationen i fråga ska få spridning i stor skala?
- Vilket värde tror ni att det finns i en innovation som denna, utöver den metanreducerande egenskapen?
- Hur tänker ni kring strategiska beslut för adopterandet av ny teknologi?
- Vilka är era huvudsakliga motivationsfaktorer till att adoptera en innovation som denna?
- Vilka ser ni som de största barriärerna för att ta till er innovationen / Vilka ser ni som de största barriärerna i livsmedelsindustrin att ta till sig nya lösningar för minskad klimatpåverkan?
 - Vad behövs för att dessa lösa dessa barriärer?

Stakeholders & Nätverk

- Vilka ser ni som möjliga intressenter för Volta Greentechs innovation?
 - Vilka tror ni är viktigast i spridningen av den?
 - Kommer någon eller några intressenter bli mer eller mindre viktig i framtiden?
- Hur ser ni på vilken roll ni har i spridningen av en sådan här innovation?

- Vilka aktiviteter av andra aktörer skulle underlätta för er verksamhet att ta till er Volta Greentechs innovation?
- Vilka typer av partnerskap tror ni är viktiga för att möjliggöra framgång av denna innovation?

Affärsmiljö

- Hur ser ni på framtiden för olika tekniska lösningar inom livsmedelsindustrin för att minska klimatpåverkan?
- Vilka krav ställs på er i dagsläget att minska er klimatpåverkan?
- Hur upplever ni att efterfrågan på/betalningsviljan för klimatvänligare livsmedel har förändrats och är på väg?
- Hur påverkas klimatinnovationer inom jordbruksindustrin idag av olika typer av styrmedel?
 - Vilka potentiella styrmedel hade behövts?
- Hur ser ni på framtiden för mer hållbara livsmedelskedjor?
 - Vilka potentiella åtgärder tror ni hade fått störst effekt?

A.2 Interview subjects

TABLE 5. LIST OF ANONYMISED AND UNANONYMISED INTERVIEW SUBJECTS

Stakeholder group	Stakeholder	Role
Innovator	Volta Greentech	Chief Commercial Officer
Farmer	Farmer	Farm owner
Meat company	Meat company	Head of sustainability
Dairy Company	Dairy Company	Head of sustainability
Food retailer	Food retailer – central	Chief of own brands
Food retailer	Food retailer - store	Head of meat department
Innovation network	Sweden Food Arena	Innovation leader
Regulatory Power	Naturvårdsverket	Climate analyst, with focus on emission from agriculture
Regulatory Power	Jordbruksverket	Environmental Objectives Coordinator
Research Institutes and Academia	RISE	Human perception and behaviour researcher
Research Institutes and Academia	SLU	Policy officer at AgriFood Economics Centre

A.3. Interview Analysis

Themes	Categories	Innovator	Farmer	Dairy company	Meat company	Food retail central function
Stakeholder & Network	Important stakeholders	Food retailer Consumers	Consumer Food retailer Swedish Government Butchers	Food retailer Farmers Consumers Research institutes	Farmers Food retailer	Swedish Government Volta Greentech Farmers Feed suppliers
	Motivational factors to engage	Reducing carbon emissions Sustainable business case	Fun to be part of innovative projects. Striving to protect the nature and their animals	Demand and requirements from customers Demand from consumers Competitiveness	Desire to be a part of the solution Competitiveness Demand from customers, investors, employees to engage.	Contributing to a better climate Build innovative image with foodtech companies Competiveness
	Barriers for adoption	Insecure consumer demand of final food product Establishing large-scale production	Profitability Disruption in production flow Potential administration	Insecurities in sideeffects on animal health High cost Dependent on farmers' willingness Potential disruption in production flow	Lack of long-term research on meat cattle. Risk for affected animal welfare Cost No ownership of farms	Consumer demand must come first. Large-scale production available
	Support needed from the network	Larger actors need to take risk towards the consumer Regulations spurring consumer demand or lowering cost for farmers	Measures for easier feed distribution to animals Authorities provide incentives or subsidies Retail needs to express a demand	Show that there is a consumer demand Pave the way by making consumers adoptive	More extensive research on meat cattle	Governmental support to help consumers make the right choice
	Additional value of the innovation	Economic value Branding Environmental Competitiveness	Marketing for Swedish produced meat as sustainable Branding for their own production	Competitiveness	Competitiveness Increased payments Increased resource efficiency	For us competitiveness and strengthened brand Contributing to society

Themes	Categories	Innovator	Farmer	Dairy company	Meat company	Food retail central function
Commercialisation	Consumer behaviour		Consumers tend to think that by only avoiding meat, they are contributing to the climate.	Preferences for natural products, why many consumers choose milk		People have autopilot in the stores Unwilling to take in new information
	Consumer willingness to pay		Hopefully there will be a willingness to pay, because it is vital for the continued commercialisation		Group of consumers willing to pay for climate friendlier meat exists, but limited market.	There is a willingness to pay, but low margin. Probably decreased purchasing power and WTP due to current situation in the world.
	Business Model Considerations	Partnering with food retailer Avoid added margins in the value chain to keep price lower	Someone else should pay for the forage Fair compensation should be given for the extra logistic and time	Feed supplement integrated in existing feed streams. Initiative incorporated in overall sustainability profile. Cost model based on price/kg for milk to farmers	Investigate if there are added value motivating them to take on cost	Current pilotprojekt is a special solution.
Business Environment	Trends within the food sector			Increased interest for Swedish produced food Plant-based increasing sector Decrease in milk consumption, increase in other dairy products	Increased interest in vegetarian products.	Organic has decreased since 2019 Locally-produced has increased recently
	Climate targets and policies		Existing policies fail to deliver Lack of continuous support for sustainable agriculture	Firm goals are aligned with the 1.5C target Decrease emissions 30 % per kg milk by 2030	Applies science-based targets Klimatklivet supports farmers to invest in sustainable production	More governmental support required, financial and methane reduction requirements
	Economic situation		Increased prices of forage and energy. Interest rates and war has caused crisis for farmers.			High interest rates, inflation and war creates an adverse time to launch premium products. Pressured economic situation for farmers.

Themes	Categories	Food retailer store	SLU	RISE	Jordbruksverket	Sweden Food Arena	Naturvårdsverket
Stakeholder & Network	Important stakeholders	Central function Consumers Butchers/ meat companies	Consumers Authorities/policymakers Food retailer	Food retailer Consumers	Swedish Government EU policymakers Research & Academia Consumers Farmers	Farmers Consumers Feed suppliers	Farmers Dairies Meat aggregators Authorities
	Motivational factors to engage	Offer high quality meat Want to give small producers/ niched products a chance to establish on the market	Make sustainable choices	Want to do the right thing Sense of control Environmental concern		Competitiveness is main factor in the industry	
	Barriers for adoption	Central function must approve of supplier Evident consumer demand after 2-3 months trial Pricing	Lack of knowledge on products' impact. Confusion of product and certification Price Change of habits	Change of habits Fear of new products Price Information and trust Competition from other sustainability attributes	Economical Lack of knowledge Insecurities in the effects and costs Traditional views	Industry barriers: Inability to take risk due to low profitability. Low educational level.	Industry barriers: Climate measures not profitable Administrative barriers Lack of continuous support for investments
	Support needed from the network		Policy instruments to make consumers susceptible and willing to pay Requirements on climate labelling	Provide accurate and sufficient information to consumers	Financial policy instruments More research on methane reduction Counseling and support for farmers	Transparency in the value chain Establish testimonials through cooperation Risk taking to allow for disruption	Well-grounded research. Financial compensation Requirements from authorities and the industry.
	Additional value of the innovation			Branding for food retailers	Branding		Preservation of cattle Circularity on farms Resilience with beef reserve

Themes	Categories	Food retailer store	SLU	RISE	Jordbruksverket	Sweden Food Arena	Naturvårdsverket
Commercialisation	Consumer behaviour	Buying less luxury goods when general purchasing ability decreases. Follows habits	Resistance to changing habits. Consumers choose organic for private benefits.	A general fear of new products Changing habits are difficult Information bias Tangability			
	Consumer willingness to pay	Interest from consumers but actual WTP is dependent on purchasing ability Margin relative to other products	A large total WTP, but low marginal WTP. Low price elasticity for meat.	Price premium of 20% for climate friendly meat. Dependent on socio-economic status Stronger for other sustainability aspects.		Transparency in the value chain and impact of product will increase willingness to pay	
	Business Model Considerations			Food industry should consider dynamic business models		New business models needed for a sustainable food industry. Upcoming agricultural blockchain	Need for better business models to distribute costs in the food value chains
Business Environment	Trends within the food sector	Decrease of organic consumption Decrease of red meat	Decreased meat consumption. Organic market share has increased.	Decreased consumption of red proteins, increase of chicken			Continued consumer demand for sustainable products National food strategy Circular thinking
	Climate targets and policies		Policy instruments needed to change consumer behaviour Potential climate taxation most efficient on consumer side		Administrates klimatklivet, a policy for farmer support	SFA has announcements for innovation within the food industry	Lack of measures for methane reduction in national food strategy. Conflicting challenges in food industry
	Economic situation	Decreased purchasing ability is evident in buying behaviour				The agriculture has been rationalised Smaller part of consumers income spent on food	