UiT THE ARCTIC UNIVERSITY OF NORWAY

School of Business and Economics

Alga from the Arctic: A new avenue for commercial Carbon Capture Utilization?

Developing a market strategy based on innovation and commercialization potential

—

Kamilla Marie Borrebæk

Master thesis in Business Creation and Entrepreneurship - June 2018

ACKNOWLEDGEMENT

I would like to thank the research group at UiT and Finnfjord AS for letting me take part in their project. I am grateful to Hans Cristian Eilertsen, the project leader, for always keeping his door open for me at all times. It has been challenging, educational and very interesting to work across different fields of science and business. I hope this thesis can contribute to the ongoing work at Finnfjord.

A special thanks to Lene Foss, the main supervisor of this thesis, for professional and constructive guidance. The guiding has proven to be very helpful. I also have to thank Dagfinn Sætra, the co-supervisor for his guidance and support throughout the project, and for always having an open door, and constructive advice.

Additional thanks to all the people who made the market study a fun journey with different perspectives, educational and valuable insights.

Lastly, thank you to friends, family and classmates for support and encouragement throughout the process.

ABSTRACT

This thesis looks at the commercialization possibilities for alga as an ingredient for fish feed producers within the Norwegian aquaculture industry. It is a master thesis for the Business Creation and Entrepreneurship (BCE) program at the School of Business and Economics in Tromsø (HHT). Through this case study the thesis aims at providing analysis, evaluation and developing a market strategy for this innovative product.

This thesis is based on an ongoing project at UiT – the Arctic University in Norway. The technology presented is an innovation in mass cultivation of alga originating from the Arctic. Research at UiT and collaboration with Finnfjord AS (smelting plant) has made the technology of mass cultivation possible on an industrial scale. Growing alga is performed inside the smelting plant, and uses waste products, such as CO_2 and NOx, as resources in the process of cultivation. The outcome of the cultivation is a highly advantageous ingredient for fish feed. This thesis aims to investigate and evaluate the innovation and connect the innovation to the target market, the Norwegian aquaculture industry. Through literature the market is analysed and evaluated. A strategy for the alga to develop a sustainable business is presented. Data collection revealed that the alga has the potential to penetrate Norwegian aquaculture, and becomes an indispensable element of the value chain. As a conclusion of the thesis, a business plan is presented. This part stands alone, in the sense that this takes on the whole commercial potential and development for the project presented in the previous chapters.

Key words: commercialization, alga, aquaculture, innovation, CCU

Glossary

ALA – Alpha-linoleic acid, omega-3 fatty acid

AS – Aksjeselskap (limited company)

B2B – Business to business

BFE – Faculty of Bioscience, Fisheries and Economics

BCE – Business Creation and Entrepreneurship

CCS – Carbon Capture Storage

CCU – Carbon Capture Utilization

CO_2 – Carbon dioxide

Diatom – type of microalgae, has a shell of silica

Dioxins – toxic chemical compounds

DHA – docosahexaenoic acid, omega-3 fatty acid

EPA – eicosapentaenoic acid, omega-3 fatty acid

FTO – Freedom to operate

IPR – Intellectual property rights

HHT – Handelshøgskolen i Tromsø, School of Business and Economics in Tromsø

Lipids – Type of fat

Microalgae – primary step in the ecosystem in the ocean, creates nutrients using light, seawater and chemical ingredients to grow, such as CO_2

N – Nitrogen

Net pen – (net cages) where the fish is farmed, directly in the water.

NOK – Norwegian kroner

NOx – Nitrogen oxide

P – Phosphorus

Pelagic fish – fish from the pelagic zone, such as herring and sardines

Pellet – the feed for fish

Photobioreactor – cultivation tank

UiT – The Arctic university in Tromsø

Table of contents

List of Tables

List of Figures

1 Introduction

1.1 Background

Traditionally a university is seen as a place of education and research. However, over the years the potential outcome has differed. The possibility to commercialize research is attracting more attention now than ever before (Foss & Gibson, 2015). Technical transfer offices (TTO) can be found at most places of higher education. Through a TTO the innovation or invention is evaluate based on the commercialization possibilities, often in regards to intellectual properties. To be able to create spin-outs and commercialize is becoming more important for universities, as this is a new mean of revenue (Siegel, Veugelers, & Wright, 2007). When investigating the commercialization potential of a research case, often early stage, the complexity of doing so rises with the earlier stage of the product or idea. To examine the possible commercialization depends on insight from the market combined with the innovation. According to a scientist at NOFIMA, it is of high value to involve a business student in this project to assess the market as soon as possible.

This is a thesis that investigates the commercializing potential of a project that started at UiT – the Arctic University of Norway in the 1980s. Marine biologists researched the marine ecosystem of the north, and the result of this is now a project that involves several students and faculty members. It has established a relationship with a near-by company (Finnfjord AS) to facilitate and complete the further development. This collaboration has gained substantially publicity, and the prime minister of Norway, Erna Solberg, opened in 2017 the official Carbon Capture Utilization (CCU) centre in Norway at Finnfjord (Industrienergi, 2017). Even the government, through the government budget has decided to help fund this project by granting money to facilitate and keep the project running (regjeringen.no, 2017).

Through the facilitation from UiT, the last component to join this project is the School of Business and Economics in Tromsø (HHT). This case has come to HHT because the research has shown to be valuable, and the need to assess the market and the commercialization potential is now at a critical point. The university is enabling researchers from the biological field, and the studies of entrepreneurial ventures to join and work together as a way of cooperation. Through the master program *Business Creation and Entrepreneurship,* a business development and entrepreneurship program (for more information about this study see chapter 10 in (Foss & Gibson, 2015)), the commercialization potential of the following project is carefully and thoroughly investigated and evaluated.

1.2 The importance of the topic

The world's population is increasing, and estimates indicates that we will be over 9 billion people by the year 2050. With such increase in population, there will also be a need to increase food production. By 2050, an increase of 70% in food production will be needed to meet the anticipated demand. The meat consumption is also said to increase, from 15 kg per capita in 1982, to an estimated 37 kg per capita in 2030. This will have an immense impact on resources and the environment. The food sector contributes with more than 20% of the global greenhouse gas emissions, and around 30% of the world's energy consumption (Ytrestøyl, Aas, & Åsgård, 2015) . Producing more food in the same way that we do today to meet the need for the future, is not sustainable. We need a solution.

The ocean is a treasure chest, and the possibilities are endless. The industries that has the most influence on the Norwegian economy are found in the ocean; petrol and fish. However, the ocean consists of much more, such as algae, other animals and bacteria. With bio prospecting the hunt for genes and molecules is done in a systematic order. By doing this in the Arctic, one is able to get access to organisms that have advantageous characteristics. This can lead to environmentally friendly and energy efficient production (Elvevoll, 2017). The innovation in this project was found and optimized through such a system. The potential has been evaluated, and now a market-assessment is required.

Norway has depended on oil and gas for a long time, however this cannot last. The importance of finding other way to build the country is crucial. The chief executive officer (CEO) of Norske Sjømatbedrifters Landsforening (NSL, the Norwegian Seafood Association) argues that seafood is the golden ticket for Norway. The seafood industry in Norway has grown, and so have the revenues and income. Norway is profiting substantially from this industry, and this is one of the corner stones in the Norwegian economy. However, with increase in demand and price, one has to rethink what will work in the long term (R. Eriksson, 2017).

The solution for increasing food production in a sustainable way, is tuning to the ocean. Aquaculture is relatively new in Norway, and how we utilize these resources is not as clear as they are for agriculture.

The report "Verdiskapning basert på produktive hav i 2050 (Creating value based on productive oceans in 2050)" states that in a positive scenario, the estimate for salmon production in Norway increase by 2050, from producing a little over one million tons currently, to over five million tons. However, in order to reach this goal, regulations and solving the lice challenges are crucial. Even though these are important problems to overcome, the main challenge is the feed situation (Hage, 2017). This report indicates that the industry can grow, but there are factors that slows it down. These can be solved through research and development.

1.2.1 Lice is a problem

For the growth of the industry to become a reality, the most crucial problem is the feed situation. The Norwegian government has decided, however, to pause the growth in aquaculture until the lice challenge is handled. (Christiansen, 2018; Fiskeribladet.no, 2018b; Terazono, 2017). This makes the challenge of lice the main task for the industry at the moment, and the need to find a solution is serious.

The challenge of lice is gaining much media attention. This is a problem that cost the industry around five billion NOK in 2017 (Iversen & Hermansen, 2017). The problem is easy to see from an economic perspective, but with lice in the net-pens, the regulations are strict, and the salmon has to be taken out to go through a delousing procedure that is not favourable, but works for the time being (Fiskeribladet.no, 2018a). Finding solutions to this problem is of high importance, and many are currently working on it. According to an informant, in early 2000 a medicine feed called *slice* entered the market. Slice conquered lice for some time, however, lice adapt quickly, and within few years they became resistant to the medicine. The solutions against lice are reactive, not proactive. The challenges vary in volume from year to year, so to invest before knowing if there will be a problem may not be desirable for the fish farmers. It might be more appropriate to find preventative methods (Fiskeribladet.no, 2018b). This problem is a crucial one for the industry, and a solution is very much required. Using preventative solutions rather than treatments after the facts can be the new approach.

1.2.2 The fish feed situation

Feeding the fish in a positive growth scenario is more crucial than eliminating lice (Christiansen, 2018; Fiskeribladet.no, 2018b; Hage, 2017). Christiansen (2018) argues that for the aquaculture industry, fish oil can be seen as the new lice, the oil is now the most critical challenge to overcome. To further develop and increase the growth, the reduced access to fish oil has to be dealt with quickly. It is necessary that alternative sources for the nutritious omega-3 fatty acids, DHA (eicosapentaenoic acid) and EPA (docosahexaenoic acid), found in fish oil, are discovered. The challenge with fish oil can be even more problematic than the lice situation has become (Christiansen, 2018).

The feed situation for farmed salmon has changed over the years. Figure 1 illustrates a shift in the ingredients in fish feed. In the early 1990s salmon ate marine feed, today the feed consists of more plant based than marine ingredients.

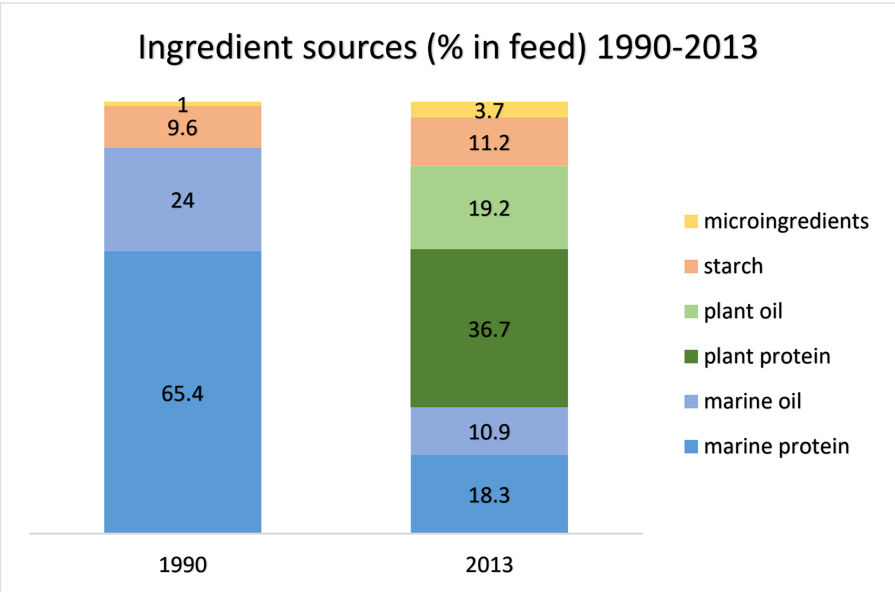


Figure 1: Ingredient source in feed (Ytrestøyl et al., 2015)

Terazono (2017) argues that the aquaculture has an oil problem, and the problem is fish oil. Finding alternative sources for omega-3 has been difficult for the industry. The work towards finding solutions started decades ago, and with the increase in health-consciousness and the need for growth of sustainable food production, this is even more relevant today. For the industry to grow, and more salmon to be farmed, the aquaculture needs more feed containing the valuable omega-3 fatty acids, DHA and EPA. Not only to maintain the healthy benefits for human consumption, but for the health and welfare of the fish themselves.

The price of fish oil is high for fisheries. Marine Harvest (one of the largest fish farmer in Norway) has cut the proportion of fish oil in the diet of commercial salmon from 24 per cent in 1990 to 9 per cent today. This is arguably because the cost is too high to maintain. This again influences the healthy omega-3 fatty acids in the fish (Terazono, 2017). However, investigating the market today, one informant stated that the price for kilogram (kg) salmon sold in contrast to the price per produced kg is quite advantageous. The production cost is about 30 NOK/kg, while the salmon was sold for around 60-70 NOK in 2017. This means that the fish farmers can afford to keep the ingredients of these valuable nutrients high. One must keep in mind the change in market prices, however, and a possible fall in salmon sales. The price may not stay this high, as the market shifts.

The industry is aware of the limited supply of the omega-3, which mainly comes from fish oil. As a result of this there are several companies striving to become the one to find the new source. According to Terazono (2017) there are two possible solutions. Either the use of algae as the source for omega-3, or genetically modify oilseeds from plants such as canola and soy. It is possible to grow more soybeans, but there are limited amounts of pelagic fish (fish that is harvested for oil, such as anchovies and sardines (NOAA, 2017)) in the ocean.

The importance of marine omega-3

A research project with NOFIMA and NMBU (Norwegian University of Life Science), reviled that salmon needs marine omega-3 to be able to grow and be healthy. "The experiments showed that the long omega-3 fatty acids, EPA and DHA, are necessary in salmon's feed to protect their good health and robustness" (Kraugerud, 2017).

The healthy omega-3 fatty acids are often derived from pelagic fish. Figure 2 illustrates the marine food chain. Starting with the primary producers and ending with predators. Accumulations of toxins occur throughout the marine value chain. An organism higher up in the food chain will consume more than its own weight. Substances that are not broken down or separated from the organism tend to accumulate. Concentration of these substances can eventually lead to toxic effect.

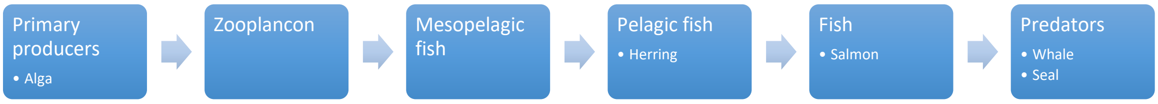


Figure 2: Marine food chain (derived from interview, see appendix 2)

Dioxins are to some degree, not harmful for human consumption. There are, however, guidelines and recommendations when it comes to how much one can consume eat overall and to pregnant women. Dioxins are fat-soluble and less biodegradable, that is why they continue in the food chain from fish to animals and humans. Dioxins are found in fat fish, mainly in the liver of lean fish, meat, eggs and dairy products. The danger with dioxins is that they can cause cancer-, and malformations on foetuses (Havforskningsinstituttet, 2014; Uggerud & Langård, 2009).

1.2.3 From waste to nutritious feed – both for humans and salmon

The solution presented in this thesis is an ingredient for fish feed producers with a combination of benefits that are highly required and very valuable. The ingredient is a substitute for the fish oil used today, because of the high levels of the omega-3 fatty acids EPA and DHA. Being non-toxic and effective against lice are also valuable contributions of the ingredient. The ingredient is a high-performance alga form the north.

The story of the algae is unique, and results from a collaboration between UiT and Finnfjord. Research at UiT has made it possible to cultivate and grow nutritious and beneficial algae from the Arctic, using emissions such as CO_2 and NOx. The plant is based in Finnsnes, Troms, at Finnfjord' facilities, where there is a 300.000 litre tank at the moment, but the upscaling for the next step has already started, and the new tank is set to be three million litres.

The alga provides value to society, using waste-products such as CO_2 and NOx, and supplying a diet that is non-toxic with regards to dioxins. Value is also provided to salmon, through a nutritious diet. Most importantly it creates value for the fish farmers and fish feed producers because of its nutritious effect, being an alternative to fish oil with constant supply and reducing lice.

1.3 Research design and research questions

Through the BCE program, the aim is to gain knowledge on how to assess innovation within specific markets, often through case studies. This research design is based on case study. The design in case studies differ from other designs in research by being limited in focus, and the research digs deeper into an area or problem, i.e. in-depth examination. This thesis is a case study of feed within the aquaculture industry in Norway, and more specifically regarding the application of algae in feed. The aim is to examine if there is a possibility to commercialize the alga as an ingredient in feeding salmon. Bryman and Bell (2015) argue that research questions are important in order to be clear on what will be researched. This thesis, therefore has one main research question, and sub-research questions for the innovation chapter and market chapter. Thus, providing the reader with understanding of what will be dealt with in each section. Research questions will guide the literature, what kind of research design to use, data collection, analysis, writing the data, keeping the focus and helping the reader understand the context (Bryman & Bell, 2015).

Consequently, the main research question in this thesis is:
What is the commercialization potential for the alga as an ingredient in fish feed for Norwegian aquaculture?

The innovation chapter evaluates innovation through literature and framework combined within the aquaculture industry by answering the sub-research question:
How is the use of this specific alga in feed innovative and in what way does it bring innovation to the industry?

As the innovation is analysed in the innovation study, the market chapter provides understanding of the commercialization potential for the alga. Here the goal is to understand, analyse and evaluate the market the alga aims to penetrate by answering the second sub-research question:
How can the market for the alga within Norwegian aquaculture be assessed? What will be an applicable strategy for a new company to enter this market?

The business plan in the final chapter aims to show a possible business case for the alga project. The goal of the business plan is to describe the commercialization and development potential, as well as provide estimates on profit, market share, risks and opportunities for the alga. The business plan will present the alga in a way that makes it desirable for investors to invest, and trust in the new business venture.

These research questions look at the possible commercialization of the alga in the Norwegian aquaculture. The guide for commercialization is presented, and the questions provides insight into the respective areas that are important to focus on when commercializing a certain innovation, as well as trying to answer the main question.

The methodology used is a qualitative approach taken into account how the industry works, in order to gain knowledge, information and obtain responses. The empirical or primary data is gathered through observations, interviews and written correspondence (P. Eriksson & Kovalainen, 2008), this will be further elaborated on in section 1.5. The secondary data is gathered through news articles, podcasts, documents, journal articles and web sites. This is exists data (P. Eriksson & Kovalainen, 2008). The thesis has a triangulation approach, which means that data comes from more than one source (Bryman & Bell, 2015). Although this approach is often referred to in quantitative methods, it can also be used for qualitative research; combining observations, such as the secondary data in this thesis, and following up with interviews to grasp the understanding and avoid bias. The secondary data became a basis before gathering the primary data, and was revisited to seek confirmation (P. Eriksson & Kovalainen, 2008; Johnson, 2017).

1.4 Theoretical frameworks

The different chapters depend on different frameworks and literature. Therefore, this thesis is divided into two main parts, innovation study and market study. The last chapter, business plan, can be seen as a stand-alone chapter that uses all the information gathered from the previous chapters. In order to provide a clear understanding of each of them, they are described separately below.

1.4.1 Innovation study

The innovation study aims to present the innovation descriptively, analyse and evaluate the project and innovation through relevant literature and frameworks. It is important to understand what innovation is in this context. (Tidd, Bessant, & Pavitt, 2005) argues that innovation is change. However, to be able to see what changes, and how this affects the surroundings is also a part of an innovation. Garcia and Calantone (2002, p. 112) argues that innovation is:

> "… an iterative process initiated by the perception of a new market and/or new service opportunity for a technology based invention which leads to development, production and marketing tasks striving for the commercial success of the invention"

Based on those definitions of innovation, it is clear that innovation is much more than reinventing or focusing on a product, one takes into account all aspects of a solution or product, and makes use of the advantage.

In the innovation study, the project will be viewed from different perspectives. The project will be evaluated through the following structure, literature and frameworks to assess the innovation and level of innovativeness and novelty within the aquaculture industry. This leads to a conclusion where one is able to answer the research question, and connect the innovation to the market.

The packaging approach or *idea evaluation* (Lundqvist, 2014), is used as a structure to follow, with the *idea evaluation report* as a guideline. This guideline is used to describe, show the value and the future of the innovation. Through a technical description, the alga project is thoroughly presented, and the value propositions; customer, social and business utilization is taken into consideration and evaluated. This provides a closer understanding before entering the market analysis, and takes the innovation a step further.

Radical and incremental

Tidd et al. (2005) uses the terms *radical* and *incremental* to determine how novel an innovation is. Novelty is a factor that helps establish how to classify the innovation, the higher novelty, the more radical. These term are also recognised by Garcia and Calantone (2002), however, to classify the innovation, they focus on the innovativeness. The high in innovativeness the more radical. These terms are set to position your innovation, and this can be used in the assessment of the innovation towards the market. *Radical* innovation is often described as something that is new to the world, often talking about a new technology that creates a new market. *Incremental* innovations are innovations that uses what are known, but in a different way. It could be repositioning, modification of a product or redesign in the aim of reducing costs. *More innovative* innovation is a type in the middle of the two extremes, radical and incremental. More innovative are innovations that are the next generation of a product, or new in some way, for example entering a new market for the firm (Garcia & Calantone, 2002; Holahan, Sullivan, & Markham, 2014; Tidd et al., 2005). The alga project can use these term in an attempt to establish the novelty and innovativeness of the project, giving an indication of the level of innovativeness and novelty, and help in the positioning of the project, as incremental, really new innovation or radical.

Keeley, Walters, Pikkel, and Quinn (2013) have also created a framework to understand innovations, *the ten types of innovation*. This framework comes from a long line of research, and also recognises that the innovation goes beyond the product. The framework shows that the potential lies around the product as well as inside it, and the ability to use what you have, in any way is innovative. The more of the different types your innovation cover, the more innovative it is. The ten types are divided in three main section; configuration, offering and experience. For configuration, the innovation is in profit model, network, structure and process. Innovation in offering revolves around the product, and in regards to the performance and system. The experience is about service, channel, brand and customer engagement. Through the ten types one is able to understand more of the project as a whole, and being able to present the different aspects of the innovation in regards to the different types.

Blue ocean (Kim & Mauborgne, 2004) is also used as an indicator that creates a direct link to the market. The blue ocean strategy is an assessment that can help an innovation see the possibilities, and the approach to market. It is a strategy that makes use of either establishing within an industry that already exists, a *red ocean*, or creating a new market. The focus is to create value for both the customers and the company, either entering where there is no competition, or breaking the boundaries.

The different terms and types of innovation differs throughout literature, and I have chosen to use all these approaches in order to give a more consensus and common ground when it comes to categorizing the innovation, as well as assessing the appropriate approach to market. Using these types has helped me understand and present the best approach for the alga into the market. Through literature, the packaging approach, the ten types of innovation and blue ocean, the alga will be analysed and evaluated. The link between innovation and market becomes clearer through this presentation, and will contribute to position the market study.

1.4.2 Market study

Kotler, Armstrong, Wong, and Saunders (2008) argues that understanding the market is crucial for a product to survive and thrive. The market study presented in chapter three is limited to the Norwegian market. The purpose of this chapter is to find the potential market for the alga within the aquaculture industry. The market study is divided into two main parts, with the first part aiming to analysing and define the market for the alga. The second part consists of a possible strategy for the alga to penetrate the targeted market. The strategy part is based on analysis of primary data and literature that supports the route to follow. The strategy will for this innovation involve positioning, branding and sustainable and business to business marketing.

Both parts of the market chapter are based on a market study, literature and frameworks. The analysis is performed with focus on the market, customers, competitors and looking into the environmental factors through literature (Johnson, 2017; Kotler et al., 2008). The analysis is of great value for the present and future of the alga. The customer discovery model from Blank (2013) is used in customers discovery, together with Kotler et al. (2008). The environmental analysis is carried out with analytic tools such as Porters five forces (Johnson, 2017), to understanding the competitive situation. This will indicate the level of competitiveness, and a possible outline on how the market may look in the future based on the collected data. PESTEL (Johnson, 2017) is also used, and gives an analysis of the product environment. This tool makes it possible to see what will affect the alga, and the market at present, which will help develop a strategic approach.

The next part of the market chapter relates to the strategic vision and possibilities for the alga project. Through segmentation, targeting and positioning the basis of the strategy is presented. Going more explicit into the strategy of marketing the alga, the analysis gives an outline of what is currently done, and how this can be applied for the alga. Through sustainable marketing, branding and business to business (B2B) marketing the alga project has the possibility of reaching the desired customers. Sustainability is becoming more relevant than ever, and to be able to use this as a marketing plan is a definite plus. Branding is already use by competitors as a strategy, and this alga can also take advantage of creating a good brand to sell. B2B marketing is a choice that comes automatically because the alga will have to go through different stages before ending up as a business to customer product. The B2B marketing is already in place in the industry, and to follow the guidelines that are already there is smart to get access into an existing market (Johnson, 2017; Kotler et al., 2008). Through analysing and defining the market, and planning the strategy to reach it, this is covered in the last chapter of the thesis, the business plan.

1.4.3 Business plan

The business plan is the last chapter, gathers all the information from the previous chapters into one concise plan for the development of the alga as a business. This is used as an evaluation of the project and presents ideas in regards to opportunity, risk assessments and possible business model. Table 1 presents the structure of the business plan chapter. The business plan is a summary of the thesis, which systematically goes through the information, analysis' and strategies presented in the previous chapters.

Table 1: Structure of Business Plan

TOPIC	CONTENT
Executive summary	This part presents the business plan in brief, providing an overview of the case
Pain	The pain relates to the need in the market, why the solution is valuable for the possible customers
Solution	Brief description of the solution. Explains the technical and beneficial importance of the solution.
Value proposition	Why and how does this solution create value for the different part of the value chain; customers, fish farmers, end-users and social
Market	This section discusses the market, and shows the opportunities for the alga in Norwegian aquaculture
Company Algae and the team	The new company and the team behind the solution will be presented
How to reach market	This part refers to how the product can reach the market in the best way. How the market works, and which approach to take for this solution
Milestones	The milestones are an indication of how far the solution has reached, while still discussing the possibilities ahead
Finance	The finance has to be presented, and in this part different models will provide an overview of the economic perspective
Critical Risk	Critical risk has to be mentioned, and here the risk that will make or break the company are explained

Often a business plan is created to attract investors, and this is the first step in their decision making. The case is already at the third phase, out of five, and starting on the fourth as soon as possible. This indicates that the business has potential, and the trust in the alga is significant. Writing a business plan differs from project to project, and idea to idea. How to construct one will depend on the target groups and the project presented. Sahlman (1997) argues that the criteria for writing a great business plan revolves around four factors; the people, the context, the opportunity, as well as the risk and rewards one can gain from it. The opportunity says something about the market, whether it is rapidly growing or already large. Context means that the entrepreneurs need to be aware and ready for changes that may occur, understanding what they are entering. Presenting the people should focus on what knowledge is in the team, who they reach and know, and whether if they are known already. The reward and risks assessment should be realistic. The future investor wants to know what the liabilities are. Amatucci and Grimm (2011) argues that the business plan has to be re-examined, and focus more on sustainability. Sustainability is explained in terms of three factors; social, environment and economical concern. Their emphasis on looking beyond profit in a business plan is taken into consideration for the alga. The business plan focuses not only on the profitability, but also the value given to different parts of the value chain. This chapter closes the thesis presenting possible investors with the opportunity of getting involved in an exciting and new project. The structure of the business plan is based on courses from HHT, with some modifications to better suit the alga.

1.5 Data collection

Table 2 is an overview of all the participant that contributed to the primary data, with company, position, relevance and what type of correspondence. In the early stages of the thesis, the data was collected mostly from interviews with the project leader, and secondary data. Throughout the process interviews within aquaculture were done, all interviews were based on the alga. The conversation went from the overall perspectives in the industry to the alga as an ingredient, depending on the interviewee. The point of targeting different participants of the industry was to gain as much information and knowledge as possible from all aspects, and understand the industry as well as possible.

Table 2: Primary Data

Company	Position	Relevance and focus	Interview type and correspondence
UiT	Project leader	Project leader/ overall project	Unstructured interviews, mails and seminar
NOFIMA	Head of Research	Leader of lice efficient project	Unstructured interview and mails
	Senior Scientist	Lice project, fish feed and aquaculture	Interview and mails
	Scientist	Lice project, fish feed and aquaculture	Unstructured interview
	Senior Advisor	Lice project, fish feed and aquaculture	Unstructured interview
	Business Development Manager	Business development assessment	Unstructured interview
	Feed Technology Manager, Scientist	Production of feed, how it is made (the test feed)	Unstructured interview and walkthrough at feed plant
Marine Harvest, Fish feed	Operation director Europe	Information on feed, what they would like, use, price. Their new plant	Unstructured interview
Cargill (EWOS)	Category Manager	Information on feed, what they would like, use, price	semi-structured interview and mail
Skretting	Customer consultant	Information on feed, what they would like, use, price	Unstructured interview
BioMar	Sourcing Director	Information on feed, what they would like, use, price	Mail
	Sales Chief	Information on feed, what they would like, use, price	Mail
	Group Source manager, marine ingredients	Information on feed, what they would like, use, price	Mail
Sjømat Norge	Regional manager Havbruk Nord	How the industry works - regulations, overview	Unstructured interview
Sjømat Norge	Director Environment & Health	How the industry works, especially in regards to feed - regulations, overview	Unstructured interview
SINTEF	Special Advisor, Seafood Technology	The report, market, industry and trends	Unstructured interview
Salmar	Production/maintenance manager	Information on feed, what they would like, use, price	Unstructured interview and walkthrough at feed facility
Norway Royal Salmon (NRS)	Head of feed	Information on feed, what they would like, use, price	Unstructured interview
Lerøy Aurora	Project coordinator	Information on feed, what they would like, use, price	Unstructured interview
Lerøy	Technical Manager	Price on alga	Mail
Havforskninsgsinstituttet	Fiskerifaglig forum	Not that relevant. Much pelagic fish could be used or human consumption rather than in fish feed	Conference - see appendix 4
BFE, UiT	Team from UiT, Science	Overview of the whole project within UiT	Seminar

With aquaculture being very specific, the approach was direct contact and interviews with participants in the industry, from feed producers to all the aspects surrounding the industry. This resulted in unstructured interviews, where the intent and core concept where guided with few questions. The interviews mostly ended up as conversations about the topic where the interviewee became narrator (P. Eriksson & Kovalainen, 2008). This gave valuable insight into the industry's interpretation of alga as new contribution. Gathering information from different sources within the industry justified the major challenges that emerged in the industry as they were mentioned from several participants. This supported the consensus on the major challenges. Through a consensus, this has helped argue that the problems and challenges this industry faces are seen throughout, and the need for a solution is crucial.

The secondary data is gathered from reports, journal articles, news articles, web sites, press releases, podcasts and projects descriptions from UiT. This data has given valuable insight, and helped keep the thesis up to date in a relatively fast-evolving industry. Using secondary data has made the understanding of the industry manageable, and assisted in focusing on the primary data collection.

1.6 Limitations

There are some limitations in this thesis. This is a very specific case, with clear assumptions on product and market. To step away from that, and rather follow the data from the market study took time, and changed the utilization of product. This was always a possibility, but made some parts more challenging than originally anticipated.

A limitation appearing during the data collection, was the ability to gain insight, especially when it came to information about the economy. The aquaculture industry is very secret and confidential when it comes to finance and recipes. This made work towards understanding the financial aspect, and to a certain extent the applicability of the alga challenging. Nobody gave a clear answer regarding finance, cost of ingredients and feed. However, estimates were given and are used.

Having merely one semester to work on the thesis, is a limitation in itself. To get in contact with all aspects of an industry, and gain as much information as one needs and hoped for was difficult, as well as getting hold of the right people was challenging. The author being a business student, gaining knowledge in a very different field took time, and the more one learned the more thoroughly the author wanted to dig into this field of business. However, this is done with help of the science team, following the information gathered, and to the best of the author's ability.

1.7 Conclusion

This chapter has given an overview of the thesis, thus introducing what the reader can expect to find. The main purpose of the thesis is to see whether or not there is a potential commercialization opportunity for the alga in aquaculture in Norway.

The innovation study aims to understand the innovation, and analyse and evaluate it through literature and frameworks. Through a description of the algae, most parts are explained and shows the uniqueness of the innovation. Through the different types of framework and literature, such as Garcia and Calantone (2002), (Tidd et al., 2005), Kim and Mauborgne (2004) and Keeley et al. (2013), the innovation is analysed, categorized and made the basis for an approach towards the market chapter.

Through the market chapter the aim is to see the potential market for the alga in regards to Norwegian aquaculture. This is based on primary and secondary data, and using relevant literature to further argue the market for the alga, and eventually develop the best strategy into the market. The analysis consists of literature such as the principles of marketing from Kotler et al. (2008), using the analytical part, and the strategic relevance in regards to segmentation, targeting and positioning. The customer discovery model from Blank (2013) is used to understand the customer in combination with the product. The strategies are based on Johnson (2017), and the emphasis of PESTEL and Porters five forces are used. Sustainable marketing, branding and a business to business approach is regarded applicable strategies for the project. The market is shown, with an opportunity to penetrate for the alga. The need is so serious and a possible solution is welcomed by all in the industry.

The business plan provides an overview of the development of the alga. This part informs the reader of the opportunity, risk and economy behind the project, as well as the estimated profitability. This section revisits the previous chapters, giving a description of the innovation, both technical and beneficial, listing the market, the size, growth opportunities, risks and possibilities, while providing estimates on the potential profitability of the alga. The business plan targets investors that are looking for the opportunity to join the blue revolution with a profitable and sustainable innovation.

The thesis indicates that there is a potential commercialization opportunity for the alga. With high levels of innovativeness and novelty, in different aspects of the innovation, it delivers a valuable product for an evolving industry. Through the commercialisation possibilities the market indicates a need the alga can fulfil. The possibility for this specific alga to become an ingredient in aquaculture in Norway is high.

As a final statement in this introduction, even though the scope of this thesis is based on Norwegian, the potential is much larger. Aquaculture is an industry that goes back centuries in Asia, and is a sizable industry in South America, Canada and Scotland to name som. To be able to feed our rapidly increasing population, the need to turn to the ocean is clear, and the possibility for the alga goes beyond Norway.

2 Innovation study

The aim of this chapter is to present, analyse and evaluate the alga regarding to innovation theory and relevant frameworks. This chapter is guided by the sub-research question: *How is the use of this specific alga in feed innovative and in what way does it bring innovation to the industry?* In order to answer this, first, the project will be presented with its benefits, characteristic and technical background. Then, through a variety of literature and frameworks, such as Garcia and Calantone (2002), Tidd et al. (2005), the *Idea Evaluation (Lundqvist, 2014),* the *Ten Types of Innovation* (Keeley et al., 2013) and *Blue Ocean* (Kim & Mauborgne, 2004) the project will be analysed and evaluated. The conclusion of the innovation study will establish a link to the market study.

2.1 Project idea

This project reviews the possibility to deliver the alga as a component to the aquaculture industry, either as a *whole feed* (only microalgae) or as a feed ingredient. Figure 3 illustrate the process of the innovation. The fume, which is high in e.g. CO_2 and NOx, is bubbled into a cultivation tank, *photobioreactor*, with microalgae with optimized physiological and chemical properties, i.e. organisms that grows rapidly and has a high nutritious content (lipids, omega-3 and essential amino acids. The microalgae are photoautotrophic organisms, hence needs energy as light and inorganic building stones (N, P, CO_2, micronutrients)). A centrifuge is used to dewater the microalgae culture, and this results in algae biomass that potentially can be processed further. The biomass can then be utilized, here specified within aquaculture.

Figure 3: Process of the innovation

The innovation can be split into two main parts. The first part is the technical side; smoke with CO_2 and NOx provides the opportunity to cultivate the algae, this is the technical side. The other part of the innovation is the utilization of algae, this relates to the value the biomass brings within aquaculture. According to the project leader, today's total algae cultivation volume approaches 15 000 tons. This is meagre, considering that industries have tried to boost microalgae cultivation for > 100 years. The reason for this slow development, that have resulted in that algae biomass only is used for special purposes, is simply that large volume cultures is fiercely limited by short light depths due to high self-shading. This has been overcome by the present project, and is the basis for the upscaling performed at Finnfjord as. At present, there is a pre-industrial 300 000 litre (L) tank, but much larger volumes are necessary, and projecting of this is on the way.

2.1.1 The background of the project – UiT and Finnfjord

A collaboration between UiT and Finnfjord AS was established in 2010. Finnfjord, located in Troms, is one of Europe's largest producers of ferrosilicon. Finnfjord wants to become a zero-emission smelting plant, and through this collaboration they are now able to realise this aim. Researchers from the Bioscience, Fisheries and Economics faculty (BFE) at UiT have been working in the marine sector for a long time, and investigated the possibilities in the ocean (Osvik, 2017). The alga that is used has been thoroughly researched, and the next step is to assess the utilization of algae within aquaculture.

2.1.2 The technical background – From CO_2 to alga biomass

The technical part of this project relates to the cultivation of algae. Algae cultivation is not new, but the approach and scale presented here is. Figure 4 illustrates the process of the cultivation at within Finnfjords existing facilities. The red arrow indicates the fume supply with CO2 from the plant bubbled into the photobioreactor (the green 300.000 litre tank), with help of the EL-central (a renewable energy technology at the plant). The seawater is accessed from the same supply as the factory uses for its heat retrieval cooling system. The new tank at Finnfjord is the largest of its kind in the world at present, but though in this context is only termed *pre-industrial*.

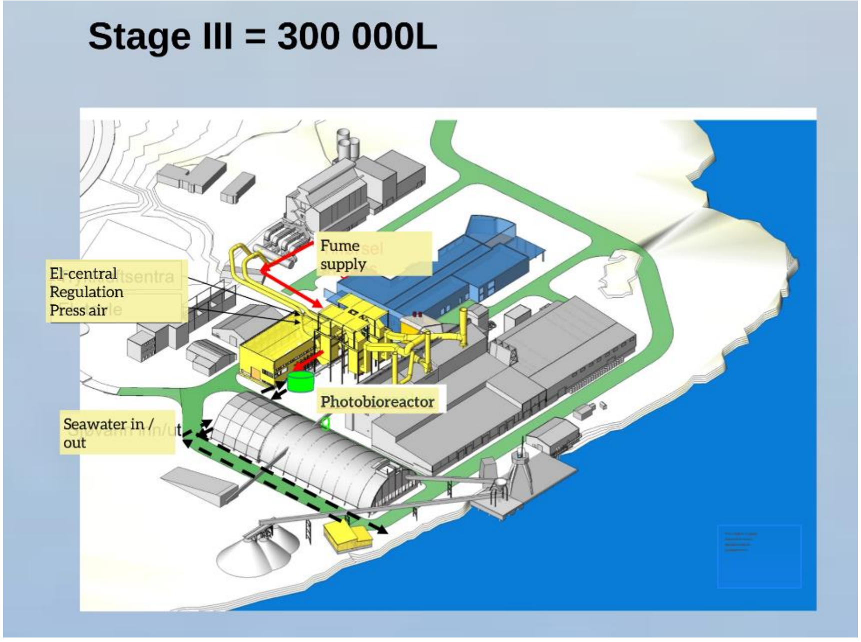


Figure 4: Process of production at Finnfjord (Copyright Finnfjord AS)

Figures 5 and 6 illustrates the new 300.000 litre tank, in which they will start cultivation in 2018. As one can see, from Figures 4, 5 and 6, the production of algae is set inside the facilitation at Finnfjord, making this production a part of their existing plant.

Figure 6: 300.000 litre tank inside Finnfjord smelting plant (photo: Hans Christian Eilertsen)

Figure 5: 300.000 litre tank (Photo: Hans Christian Eilertsen

2.1.3 The alga – diatom from the arctic

In the marine ecosystem, the most important organism is not fish or crustacean, but marine microalgae. They are the oceans photoautotrophic primary producers and hence form the basis for all marine life. Microalgae depend on CO_2, sunlight and inorganic nutrients and seawater to grow. Through this process they create biomass, with proteins and fatty acids such as omega-3 (ALA, EPA and DHA). Although microalgae are small (10-100 um), they absorb around 50% of the global CO_2 emissions worldwide, and contribute with 50 % of the oxygen production. The microalgae used in this project, are diatoms. They are separated from other microalgae because they have a shell of silicate (Osvik, 2017). The healthy omega-3 compounds in e.g. salmon comes from diatoms, because microalgae are the sole producers of omega-3, i.e. in the marine food chain lipids accumulates from organism to organism, as illustrated in Figure 7. Figure 7 illustrate that for aquaculture to use pelagic fish as the source for omega-3, the road is long. The use of algae, can shorten the process to: diatoms/microalga → aquaculture.

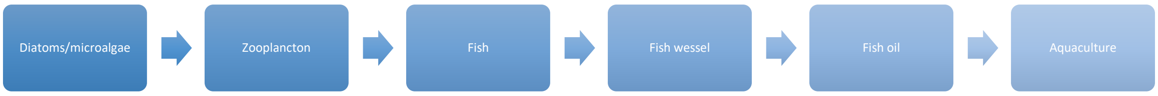


Figure 7: Marine food chain, combined with chain of omega-3 within aquaculture

Because the applied alga comes from the Arctic, they are adapted to low light intensities and low temperatures, which is advantageous for the cultivation process. Figure 8 shows the penetration of light in cultures (the mix in the water containing alga). Light penetrates deeper into the culture when the cells are large (the one on the right, the clear water). This allows the cultivation to take place in simple photobioreactors that are large in volume, and have little surface area (such as the one in Figures 5 and 6).

Figure 8: Penetration of light in cultures with different alga (Photo: Hans Christian Eilertsen)

The alga has specific characteristics that makes the technological aspect of cultivation a possibility, and also makes it applicable for production in an industrial scale. The benefits are not only in the ability to upscale. Through collaboration with Finnfjord, CO2, NOx and other fumes are now used as resources instead of waste. Because of the vast benefits when it comes to nutrition, the hypothesis regarding lice reduction is; using this alga will have an effect on lice infestation? These benefits will be thoroughly described through in the different utilization perspectives in section 2.3.2.

2.1.4 The original plan vs. what the market demands

Cultivation of algae generates biomass that needs to be utilized. Blank (2013) argues that making hypothesis throughout the process of understanding the product and market is important. This will help understand your product, the market and the whole environment for your solution. The original hypothesis was that the product was going to become an adequate and sustainable fish feed. Testing the hypothesis within aquaculture revealed that the market was in higher need of an ingredient, rather than a new feed. An informant stated:" *It is hard being small… don't know if it is impossible"*. With three larger actors, the ability to penetrate as a feed producer seems though. The need is more towards ingredients rather than

Through the data collection there where clear indications that this was a much-wanted product, but maybe not as a feed. When Marine Harvest (one of the largest fish farmers in Norway, with around 20% market share) created their own feed plant in 2014 they supplied around 60 % of their own locations, this cost them around 1.1 billion NOK. In 2018, they supply 95 % of their locations in Norway. Not only does this show that the cost of building a plant is a huge investment, but this also affected the other feed suppliers. With Marine Harvest now being close to self-sufficient with feed. An informant mentioned the production capacities the feed producers have, and stated: "*At the moment, it is a bad time to enter as it is already overcapacity*". The feed producers are not producing at maximum capacity. This indicates that the demand for feed is not as severe as the need for ingredients.

This made it more difficult to validate the original hypothesis. Another factor was because the several informants claimed that an adequate feed with all the ingredient that fish needs is a science in itself, and more complicated than just drying biomass from alga and make pellets. On informant stated: "*You need expert knowledge in different fields to make it happen… it's a science*". Form this information, the opportunity to create a feed directly form alga biomass was not verified. The best solution for utilization of the biomass seems to be to distribute the alga biomass as an ingredient, which is also very welcoming from the industry.

The aim of the alga project is to develop an ingredient for fish feed. This ingredient can be viewed as a substitute or a supplement for what is currently in the market, fish oil from pelagic fish. However, more tests have to be done before confirming which nutrients the alga can substitute. The goal for the product is to become a viable and sustainable ingredient in fish feed compared to what is harvested and used today.

2.2 Intellectual property rights (IPR) and freedom to operate (FTO)

In order to understand the rights to this research, evaluating the IPR and FTO are critical factors the new company must take into consideration. An FTO provides insight in the market, and the actual operational opportunities. It is important to make sure that one does not infringe on someone else's work. For this innovation, the FTO is relatively easy, the alga originates from research performed at UiT. The technology, based on Barsanti and Gualtieri (2018), reveals that this scale of production and approach has not been done before. This is also emphasised from the team, stating that the new cultivation tank is the largest in the world.

Regarding IPR, this is currently assessed and under development. An application for a patent will be filed soon, however what this patent will be, is not yet decided. The novelty that will be looked into when it comes to a patent is the species of alga, and the characteristics. There are other elements of the concept that are considered as well. This is currently discussed with Onsagers, a firm specializing in patents, and will become a protection for the innovation eventually (Onsagers, 2018).

Other aspects of IPR consists of design, copyright and trademark protection. For the alga, a trademark seems like a possible IPR protection to look into further. A trademark provides the opportunity to protect a future brand. There is a possibility to make the alga a brand. Competitors are utilizing the opportunity of a brand on their products, this will be explained further in section 3.2.5. By constructing a trademark, the brand can use this as a way if recognition, and be advantageous for the future use of the alga in aquaculture, or probable other markets.

2.3 Assessing the alga project as an innovation

When assessing the alga as an innovation, the first step is to establish if the project actually is an innovation. Tidd et al. (2005) merely states that innovation is change. The company recognise the opportunities and connections, and use this to its advantage. Garcia and Calantone (2002, p. 112) defines innovation as:

"… an iterative process initiated by the perception of a new market and/or new service opportunity for a technology based invention which leads to development, production and marketing tasks striving for the commercial success of the invention"

The alga can be classified as an innovation because it is based on novelty in technology of the cultivation of alga, and will lead to production. This production will lead to marketing tasks, enabling commercialization of the product. This is evident in a thesis that aims to assess the market, and direct the strategy for the alga in a specific market. From the notion that innovation is change, the alga makes it possible to change the utilization of the plant facilities at Finnfjord. At the same time, it creates an optimal ingredient for the aquaculture industry, changing the utilization of the resources in the ocean. Based on the definitions from Garcia and Calantone (2002), the project has mended into an assumption that there is a clear market for the alga, and the research has led to development in term of a new start-up, upscaling production to industrial phase, and analysing the market for commercialization potential and strategy.

2.3.1 Radical, really new and incremental innovations

Radical, *really new* and *incremental* are classifications of innovations, these are often determined based on the level of *novelty* or *innovativeness* (Garcia & Calantone, 2002; Tidd et al., 2005). Tidd et al. (2005, p. 12) argue that the degree of novelty goes form incremental, where the novelty is low, to radical innovations, which are innovation that "… transforms the way we think about and use them".

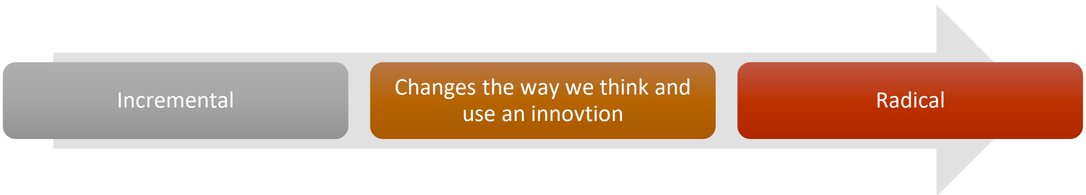


Figure 9: Incremental to radical innovation process (Tidd et al., 2005)

Garcia and Calantone (2002, p. 113) splits innovativeness, from a macro perspective, they say innovativeness is "… the capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure in the industry", and from a micro perspective it is defined as "… the capacity of a new innovation to influence the firm´s existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy".

Radical innovation

Radical innovations are high in novelty and innovativeness. (Tidd et al., 2005)states that radical innovations can be identified as innovations where a new technology creates a new market. Here one creates a demand in an unrecognized market, such as the world-wide-web did (Garcia & Calantone, 2002).Holahan et al. (2014) also defines radical innovations as innovations that are new-to-the-world. The alga cannot be classified as a radical innovation because the application of alga in aquaculture is not new, neither is the technology behind the cultivation. The level of novelty is not so high that it changes the way we use or think about fish farming, algae or carbon capture utilization.

Really new innovations

Really new innovation can be the next generation of current products, an addition to what they have in the product line, or they can be innovations that are described as product lines in an existing market, but are new to the firm (Holahan et al., 2014). Garcia and Calantone (2002)differentiate on a macro level where these innovations can either refer to a new market or a new technology, not both. On a micro level, really new innovations could mean both market and/or technological discontinuity in the company. The micro level is clearly affected with the alga in both market and technology. The production takes the waste from the plant into use, and the market changes for both companies involved. On a macro level the technology transfers CCS to CCU, and makes industrial scale cultivation possible. It also contributes with a highly beneficial ingredient.

Incremental innovation

Holahan et al. (2014) states that an innovation is incremental when there are modifications to a product, repositioning of it, or redesign based on achieving reduction in cost. If the technology or market already exists, then it is an incremental innovation (Garcia & Calantone, 2002). The alga is not a modification or reduction in cost, the level of novelty and innovativeness is much higher.

Figure 10 illustrate the alga (blue start) classified as a really new innovation because it is going into an existing market, however, it is new to both the firms. Algae has already started to emerge as an ingredient in aquaculture, this approach to cultivation is, however, not yet constructed for industrial scale. With the technology behind the alga, this can be seen as a next generation of ingredient that the market requires. The alga as a species can also be seen as a really new innovation, the benefits and characteristics of this species are so high that the utilization might become even more radical than really new innovation. If the hypothesis regarding lice efficiency is valid, the market as we know it will change.

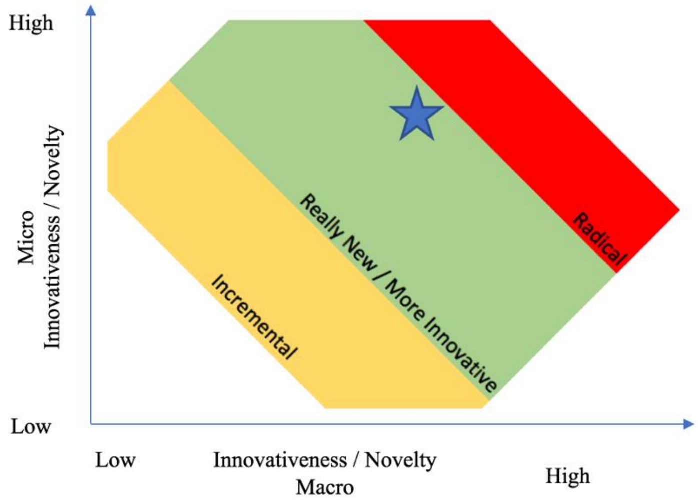


Figure 10: Classification of alga in aquaculture. Innovativeness/novelty in macro and micro perspectives

Cultivation in photobioreactors have been done before, so have use of omega-3 fatty acids in feed, however the source is new. The source is not new to the world, and that it creates a new market is an overstatement. The effect on lice reduction can be classified more towards radical. If this hypothesis is confirmed, the market will be strongly affected.

2.3.2 The packaging approach – idea evaluation

The packaging approach (Lundqvist, 2014) is used to understand and present the innovation. This is the first step in developing a sustainable business. To use this approach successfully, one has to see the idea in the possible future situation, and at the same time be realistic when it comes the current state. Idea evaluation evaluates the utilizes in three aspect; social, business and customer. The model has four steps, *summary*, which can be seen as the executive summary in the business plan, section 4.1. *Idea description*, which already has been presented in this section, 2.1.2, *value visions* and *next step*. The last two steps will be used in assessing the innovation, as these two steps create a connection to the market.

Value visions – customer utility

It is crucial to know how, where and for whom one can apply an idea and put it into use, this will support the work towards creating a business. Customer utility starts with understanding that you actually have a potential customer, and then look at what the customer wants and needs. One has to find out how and who will pay for the solution (Lundqvist, 2014). For the alga in aquaculture, there are two important needs to fulfil, the need for an ingredient that adds valuable nutrition in the feed, and a solution when it comes to avoiding lice. This is a clear link between the solution and requirement. This means that there are potential customers. With the benefits of the alga, the problem with limited ingredient high in omega-3 can be solved. There are currently fish farmers in Norway that has alga as an ingredient in all their feed, so the use is recognised. The alga compared to other algae is more beneficial, meaning that this alga contains both the valuable omega-3 fatty acids, EPA and DHA. Also, the effect that the alga might have on lice means a lot for the industry, and solves a tremendous problem. This problem is a massive cost for the fish farmers, and the willingness to pay for a solution is high. Using alga as an ingredient also means that the supply can be consistent, which is not the case with the fish oil used today.

The customers presented in the paragraphs above are paying customer. It is obvious that aquaculture is an actual industry, and that the need for ingredients to create feed is there. There is also a requirement for a cure for the lice challenges. Algae are already traded as an ingredient in fish feed, so we know there is potential to build a viable business. The assumption is that there is a way to develop this as a sustainable venture for the future, based on the link between customers and the solution.

Value visions – social utility

The whole lifecycle of the product is taken into consideration when assessing the social utilization (Lundqvist, 2014). The technology behind the cultivation, as well as the benefits are highlighted in this utilization. The term CCS has become a common concept of dealing with carbon pollution, however, in this project storage is changed to utilization; carbon capture utilization (CCU). With CCU, CO_2 is now taken into use. This is an advantage both for the cultivation of alga, and from a social point of view. Turning waste into a resource is a step in the right direction. Another benefit that can create value for society is the fact that the algae does not contain dioxins, which means they are non-toxic. This is especially important when it comes to pregnancies and foetuses, as this is where the toxins can be harmful. Being able to upscale the project is a utilization is a positive social utility.

Value visions – business utility

Lundqvist (2014) states that the last utility one has to look at is the business aspect, to make sure that one develops something that generates return. The business has to be sustainable when it comes to the financial aspect, and show how value is created and captured. The opportunity to upscale and use this solution other places is relatively manageable. This means that where there are plants with high CO_2 emission, this solution can be implemented and used. Even though the alga is focused on use in a specific market, aquaculture in this case, the assumption is that with further development, it has potential to be used in several different markets. This means that the possibility to make this an investment opportunity is high, not only now, but also in the future.

The benefits and characteristics demonstrate the utilization possibilities of the alga. A quick glance shows that form this there will be less CO_2 emissions, access to more nutritious feed that is non-toxic in terms of human consumption and a prevention of the lice in aquaculture. All this from a sustainable plant in relatively close proximity to potential customers. Upscaling the solution and moving into other markets, indicates that the business opportunities are enormous.

The next steps

With this being a start-up, there are limitations on the scale of production at the moment. However, the project has upscaling planned with a five million litre tank at Finnfjord as the next step. Figure 11 illustrate the first (the blue dot) of 20 (the green dots) five million litre tanks at Finnfjord. This will be the full-scale version of the project at Finnfjord, and will produce a steady supply of the much-needed ingredient. The market needs indicate that the assumption for this to become large in scale is valid. This will be further elaborated on in section 3.2.2. The need for an alternative ingredient is there, and the need to make use of waste such as CO_2 is welcoming. This project has the potential to grow, being a much-needed solution. When it comes to profitability, the sales of fish oil and alga oil are indicators. The prices have gone up and down, and the price for algae oil is estimated to be twice as high as fish oil, and with potential effect on removal of lice the product can be seen as even more profitable.

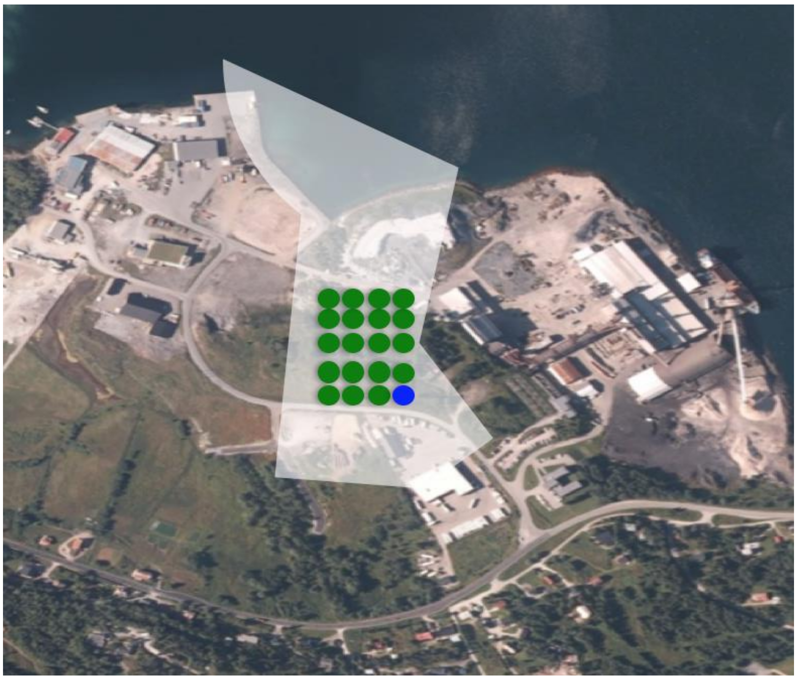


Figure 11: Potential tanks at Finnfjord (Copyright Finnfjord AS)

The last two steps in the packaging approach provides an overview of the utilization potential. As a nutritious ingredient, with lice removal and the ability to maintain a constant supply, the customer utilization will be realised. The technology behind it, going from CCS till CCU, and the lack of dioxins creates value from a social utilization aspect. The business can, first of all be scaled up, and aids the blue revolution, and the potential to yield from this innovation now, and in the future, are all within reach. This innovation creates different kinds of utilization, some in more ways than others, where one can clearly connect the innovation to the market. The needs in market and benefits of the alga overlaps perfectly, and results in a positive approach to the market.

2.3.3 Blue ocean

Blue ocean (Kim & Mauborgne, 2004) strategy is used as a way of evaluating the innovation directly in connection with the market. Blue ocean is seen as a contrast to *red ocean*. Red ocean represents the markets we know, and the existing industries, where the rules of competition and boundaries are clear and accepted. For this case, Norwegian aquaculture is seen as a red ocean. In contrast, a blue ocean looks into the unknown markets, and creates the demand. The strategy in blue ocean is to do business where there is no competition or by altering the boundaries. Such as the alga entering aquaculture. Instead of focusing on competition, this project has the possibility to focus on creating value for both buyers and the company by pursuing differentiation and low cost (Kim & Mauborgne, 2004). The opportunity here is to create the demand for a feed that provides benefits in several ways, such as nutrition, lice reduction, production technology and using waste as one of the main ingredients of production. The alga is a boundary breaker in a red ocean that wants to grow. The industry wants to grow, however, with the lice situation being a challenge, the need for someone to contribute with a solution to this problem is crucial. For the growth to take place, supplying the right ingredient is critical.

2.3.4 Ten types of innovation

Keeley et al. (2013) also argues that innovations is much more than an invention. The framework aims to make the field of innovation less mysterious, and apply it systematically as a disciplined science. Ten types argue that there is strength in numbers. Your innovation can, and should be considered several types of innovation in order to be successful over time. The ten types vary within three main categories; configuration, offering and experience, which provides the opportunity to look at the innovation from different perspectives. Presented in Figure 12, are six types that can apply for the alga when evaluating the innovation; profit, network, process, product performance, product system and brand. These types strongly suggest that the alga is high in novelty and innovativeness (Garcia & Calantone, 2002; Tidd et al., 2005). Other aspects of the alga can be classified as more incremental modifications; profit model and brand innovation.

YES	YES	NO	YES	YES	YES	NO	NO	YES	NO
Profit	Network	Structure	Process	Product Performance	Product System	Service	Channel	Brand	Customer Engagement
Configuration				Offering		Experience			

Figure 12: The alga evaluated through ten types of innovation (modified form Keeley et al. (2013))

Profit model is about the way your company makes money (Keeley et al., 2013). In the industry today, the suppliers of raw material and feed producers have to negotiate the price every quarter because of uncertainties in harvest. According to an informant, when the storm, *El Nino* entered South America, this had a huge impact on the pelagic fish, and therefore on the fish oil supply. It also affected the price. With cultivation, the production will be steady and consistent, with little to no interference, therefore the pricing and negotiations may keep it steadier. This can have an impact on the financial aspects for both the customers as well as new company as a supplier. However, these are modest changes, but still something that innovates the present industry.

Through innovation in *network*, one takes advantage of another company, and with a collaboration work together to create value. One uses someone else's assets to be able to capitalize of the innovation (Keeley et al., 2013). This is part of the plan and intention for the alga. It all started as a collaboration where UiT has the research and optimized algae, and Finnfjord is involved because of their CO_2 emissions. Together they are able to realise the innovation and cultivate in an industrial scale to create value.

The process relates to how the work is performed. The operation and activities, the core competence differs from others, this can be the core competence or patents, which may yield advantages for decades (Keeley et al., 2013). The core competence and IPR are essential parts of the project, and this is where the project really stands out compared to the rest of the industry. The cultivation process is not done in a similar industrial scale anywhere. Through this cultivation, the resource of omega-3 is no longer limited and shifting, but it can now become a constant supply of the much-needed ingredient.

The product performance means that your offering is better than the alternatives. The features, values, quality and benefits of the product lies in this model (Keeley et al., 2013). The product that comes out of the alga is complex in the sense that it brings several benefits to the market. The combination of a critical ingredient combined with the effect on lice, solving two major problems in aquaculture is rare. These two challenges are seen as the major setbacks when it comes to growth, lice as a governmental adjusted setback, and the resources being a limitation even if the lice problem is solved. The alga is definitely a product performance innovation.

Product system innovation is performed in the alga in the sense that the end product utilizes the production of a smelting plant, combined with the result of research and creates a new product (Keeley et al., 2013). The uniqueness is in the process of creation. The product form Finnfjord; the fume, combined with the service; the research, from UiT creates a scalable production system of mass cultivation of alga. The system is innovative in the sense the waste and alga complement each other.

When talking about *brand* as an innovation, this is to help the customers and user recognize and remember your offering, so they choose your solution instead of the competitor brand. A brand might help showcase values for a company. When it comes to B2B, the ability to brand ones' products and make customers aware of the contributed value from your product can help build the bargaining power and the preference with your customers' customer (Keeley et al., 2013). To use the algae as a brand is a clever way to showcase all the benefits and characteristics this alga has to offer, compared to the solutions that are already there. This relates to the IPR strategy, and the implication it could have for the alga to be protected in regard to the future use. The representation of the alga can become an important part in making it as successful as possible.

The ten types of innovation present a more in-depth overview of the actual innovation the alga contributes. It is said that the more innovation you strive to have, the higher the chance of success, the alga has potentially six, and even though some classified towards incremental, they still play a huge part in the innovativeness of the project. All the types connect the innovation to the market. With multiple benefits, and the possibilities to utilize them clearly presented, this is an advantage when starting to approach the market.

2.4 Conclusion

Using algae as an ingredient in fish feed is relatively new, there are some companies working towards realising it, but the technology to do this on an industrial scale is not clear yet. The novelty in this project, with all aspects; process of cultivating using CO_2 from a smelting plant, the alga with its unique characteristics and the effect on lice makes this a truly innovative product with high level of novelty. The literature presented in this chapter supports the indication that this is in fact an innovation, and will alert aquaculture as we know it to some extent. However, it is not new to the world, and cannot be classified as radical, but rather a really new innovation. This being a lice efficient ingredient, technological breakthrough in cultivation of algae and carbon capture utilization or simply regarding the nutrition, all the benefits this ingredient provides, prove that the innovation is highly innovative.

Through the frameworks and literature, the alga can be classified as a really new innovation. it does not create a new market, but breaks the boundaries in a red ocean. This product has a great combination of benefits, which makes it seem like a product that stands strong in the future of the aquaculture industry. However, to be able to say for certain that this product will thrive or even survive in this industry will depend on the actual market.

3 Market study

3.1 Introduction

Kotler et al. (2008, p. 12, p. 12) states that “a market is the set of actual or potential buyers for a market offering”, and within set market the buyers have the same want or need, and through exchange these needs are satisfied. The aim is to create profitable relationships with customers. For this to happen, the one offering the product or service needs to find the customers, identify their needs, design it for set market, take the right price, promote in a way that sells and deliver the product as the customer wants.

The purpose of this chapter is to investigate the potential market for the alga in aquaculture in Norway. Through this chapter, the aim and objectives are to analyse, evaluate and strategize the target market for the alga project. It answers a two-part sub-research question using primary and secondary data form the industry and theoretical framework when it comes to market and marketing strategies:

How can the market for the alga within aquaculture in Norway be assessed? What will be an applicable strategy for a new company to reach the market?

3.1.1 The alga project

Based on the background presented in section 2.1.2, the assumption is that through a new company, Finnfjord and UiT will distribute the alga as an ingredient for fish feed producers. The innovation in this project lies is in mass cultivation of algae, and the characteristics the product will bring to the industry. The mass cultivation performed in this project has never been done in industrial scale, and delivers a critical step in the technological future of cultivation. The characteristics of this alga transforms the utilization of EPA and DHA in fish feed. Fish feed depends on marine ingredients for it to be nutritious enough for fish and the alga has the potential to become a substitute for fish oil. The alga is more beneficial not only when it comes to nutrition, but has characteristics that fish oil does not have; lice efficiency, is non-toxic (dioxins), and uses CCU technology as a part of the production.

3.2 Market study

For aquaculture to grow, there are several challenges to overcome. Government regulation plays a major part in whether or not the growth is possible, stating that growth will not happen unless the lice challenges are taken care of. The emphasis on the lack of marine ingredients, such as fish oil, is gaining more attention, however these developed through science and research. SINTEF made a report in 2012 assessing the productivity in the ocean, saying that there are three possible scenarios for the fish farming industry in the future, they are shown in Figure 13 below (Hage, 2017).

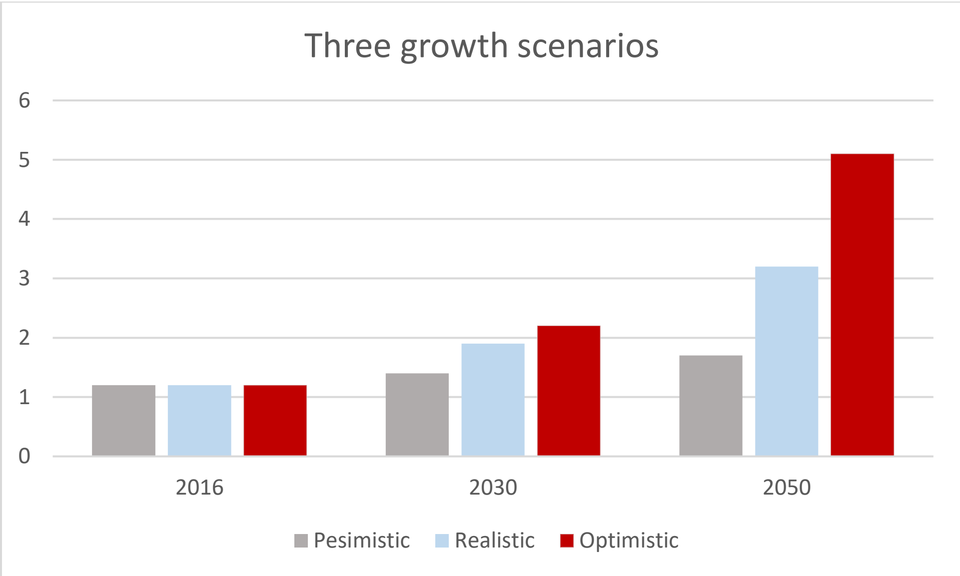


Figure 13: Growth scenarios presented from SINTEF (Hage, 2017)

This report was in 2017 again highlighted through a fishery magazine in Norway. In an interview, one of the author insisted that the optimistic scenario still is a possibility (Hage, 2017). The goal can be reached, there are just certain challenges that has to be solved, the largest problem being the feed. The regulation and other part will come eventually, but to be able to feed the fish in the optimistic scenario (Figure 13) is the most crucial element for the industry to be able to grow.

The challenges that surfaces, and gets attention in regards to aquaculture in Norway are listed in Figure 14 (Castle, 2017; Kraugerud, 2017). As the market study has revealed, the lice and access to marine ingredients are the absolute critical challenges to overcome.

Figure 14: Challenges in aquaculture

According to several informants, escape from the locations has decreased, this is no longer considered a critical problem from the farmers point of view. The improved technology and systems at the locations are moving rapidly and can be seen as a solution to this problem. One of the informant's states that the problems with mix between wild and farmed salmon is no longer there in the same way anymore as the has escape decreased.

3.2.1 Industry overview

Fish farmers often sell and distribute their product through their own brands, or through organizations put together from the industry. According to several informants, farmers negotiate deals with feed producers every two years. Almost every quarter they have to look at prices on raw material, and regulate the prices if needed. Feed producers negotiate with the suppliers of the raw material, this happens more often than farmer and feed producer, every quarter. Informants mentioned that the alteration in price can be caused from a number of reasons, such as natural phenomenon's like *El Nino*. This affected the price. Another informant stated that, during negotiations it is important to keep in mind what the customers want; certifications on products and the ability to track all the steps backwards in the value chain. This is performed because of the importance to illustrate that your product derives from a sustainable value chain. According to one of the fish farmers, the ability to use an ingredient further on in the value chain is efficient, perhaps most in regards to reputation, but might not affect the price. For a feed supplier, it might be different.

3.2.2 A brief overview on salmon in the farming industry in Norway

The lifecycle of salmon gives an indication of when, and how long they are fed. Figure 15 illustrates the lifecycle of salmon; form broodstock to sales and distribution. The first one and a half month, from broodstock till initial feeding the eggs hatch and they feed themselves from a yolk sack. From initial feeding, they are fed with pellets. Smoltification is when the fish transitions from freshwater to the ocean. The on-growing is when the fish is in the net-pens. The pellets are now getting larger to fit the size of the fish, and give the right amount of nutrition. They are fed all the way till harvest and processing (Salmar, 2018).

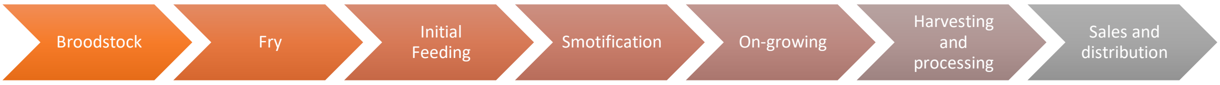


Figure 15: Lifecycle of salmon (Salmar, 2018)

The alga is investigated as an ingredient for feed from smoltification to harvest and processing. It takes around three years from the hatching to the fish is ready for retailers. The fish is fed from 1,5 moths and till the wellboats takes them to the slaughterhouse, which means that they need feed for around 95% of their lives, and over half of this time is from smoltification (laks.no, 2018).

3.2.3 Market analysis

A market analysis is concluded to assist management and decision makers to create, change or retain a business or corporate strategy (Kotler et al., 2008). However, analysing the market is important not just to give a guideline to management, but also to understand the problems your customers actually face. Blank (2013) argues that by understanding a situation one is able to show potential customers that one cares, instead of simply trying to penetrate an industry.

According to an informant, the positive scenario (presented in Figure 13) can truly become a reality. Substantial work is conducted, and the marine ingredient are constantly in focus. Today the majority of the marine ingredients comes from pelagic fish, but research is now focusing on mesopelagic fish, zooplankton and other parts of the possibilities by going further down the food chain in the ocean, such as alga. Table 3 presents the production of feed in Norway today in the positive scenario (Figure 13) in 2050. The feed produced in Norway contains 9% fish oil in average, which indicates that the producers needs around 180.000 tons for production. In 2050, the need will increase to almost 900.000 tons. This indicates that growth in the industry, demands an enormous growth in the marine ingredients to be able to supply the need.

Table 3: Production of feed in Norway - today and in 2050 (source: see appendix 7)

	Fish feed production in Norway (tons)	**Fish oil in feed tons (average 9 %) 2017**	**Fish oil in feed tons (average 9 %) 2050**
Total	1.998.000	179.820	899.110

There are obstacles for the growth of Norwegian aquaculture. However, if the regulations are favourable in the future, the major challenges ahead are the availability of marine ingredients, such as fish oil and fish meal, there are only so much pelagic fish in the ocean, and the challenges with lice.

The need for omega-3

The access to fish oil is limited, because this comes from pelagic fish, which is a limited resource in itself. As a consequence of this, feed today consists of about 70% plant based ingredients, which reduces the levels of the healthy omega-3 fatty acids in the salmons' tissue and organs. The competitions for these resources will increase in the future, which will mean that there is a need for something to help keep the levels high enough for the fish. In a research project the levels of EPA and DHA (omega-3 fatty acids) was tested from 0-2% in the feed. The study showed that one per cent in the feed would be sufficient for the salmons' own production to function, however this would not work in the harsh environment in the net-pens at sea. The levels are a lot higher in the commercial feed today compared to this project (Kraugerud, 2017).

Former research takes on the consequent of little marine omega-3 in the feed throughout the life of salmon. Three different cases were studied and compared, feed with 0 %, 1 % and commercial feed with around 2,2 % marine omega-3. The researched revealed that all had a satisfying growth, however fewer salmon with 0 % and 1 % survived the trial period than salmon with 2,2 %. Also, the salmon with lower levels of marine omega-3 was paler than the ones fed with the commercial feed. They found a connection with the ability to make astaxanthin, an antioxidant and the red pigment, and the amount of omega-3 in the feed. The study left a hypothesis that low levels of marine omega-3 in the feed, and expose the fish for stress might cause the fish to use more of the antioxidant astaxanthin (Ytrestøyl & Krasnov, 2016). According to an informant, astaxanthin used as an ingredient in the feed to make sure that the salmon gets the red colour desired from the customers. From these studies the omega-3 can also be an indicator that the fish becomes the desired colour when the right amount of omega-3 is there instead of more synthetic ingredients, such as astaxanthin.

The data collection supports the assumption that the alga can become a part of Norwegian aquaculture. On informant stated: *"It is better to derive earlier in the food chain"*, another informant stated: *"I think algae as coming at full speed within a few years. It is all about volume and price"*. This emphasises the need for marine ingredient, and the trust that the industry will adapt to other resources of EPA and DHA.

Lice

From 2012 to 2016, the productions cost for farmed salmon increased with 50%. The cost that got the most attention is the one for resistance of lice, however this is not the cost that is the main reason of the increase, which is the feed. The cost per year to fight lice is around five billion NOK per year. This is just the actual cost, not taking in the loss of growth, and the reputation that will go down because of this (Iversen & Hermansen, 2017). According to an informant, one of their locations had a huge problem with lice. This problem was clearly stated in their books with a cost of about 7-8 %. With a variation in price on salmon, depending on the market, these costs are crucial to get down.

3.2.4 Customer analysis

A company has to decide who they will target. Customer analysis is the first step in understanding the market, and what the customer needs and wants are (Kotler et al., 2008, p. 8). The old notion that marketing is “selling and telling” is no longer the way it works, now marketing revolves around understanding customer needs, and satisfying them.

According to Blank (2013) customer discovery is crucial when starting a new venture. The notion that start-ups creates products to fulfil customer needs in an already existing market is not the way it works anymore. On creates a product, and at the same time it is important to understand and find the first customer for this product. This approach to the new start-up is becoming more and more emphasised, and the importance of understanding and finding the first customer is knowingly more critical.

The target customers for the alga are the fish feed producers. According to most of the informants, there is a consensus in the needs and wants in the industry. The previously mentioned difficulties when it comes to the marine ingredient in feed, and the problem with lice is again confirmed through the informants.

Value proposition

Kotler et al. (2008, p. 15) states that a value proposition is “… a set of benefits or values it promises to deliver to customers to satisfy their needs”. The value proposition is a way to position and differentiate your product in the market. To create a strong value proposition is important, and a huge advantage in the company’s target market.

The value for the customers of the alga is an ingredient that is high in nutrition, non-toxic, have effect on lice and is derived from a sustainable plant. The technology used is innovative, turning greenhouse gasses like CO_2 into the need in the industry. This is thoroughly examined in the value visions form the packaging approach in section 2.3.2.

Value chain

The advantageous elements of the product can be used throughout the various parts of the industry. This means that the benefits from the alga can be used as a contributing part further on in the value chain. The possible value chain for the alga is presented in Figure 16. Figure 16 indicates that the customer and the end user is not the same for the alga. According to Blank (2013) understanding all parts of the value chain is important to understand the customer.

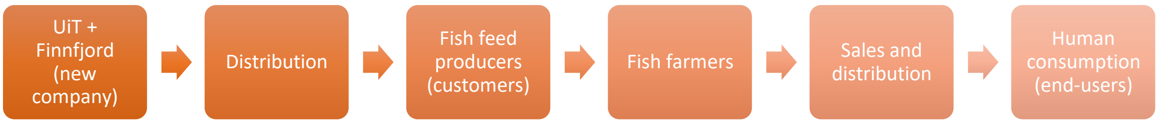


Figure 16: The value chain

According to one informant, the suppliers of the ingredient often distribute their products by boat to the feed producer’s plants. The best way for the new company the be able to maintain this chain of supply is to partner up with an existing distributer, preferably already in the value chain. Based on the market study, this is the best scenario at present. However, over time the possibilities of doing the distribution directly from the new company are there.

Customers

Blank (2013) argues for four phases in the customer discovery. Phase one is where you state the hypothesis, here are all the assumptions the company makes about market, product, demand and so on. Much like the scientists in this case did with the alga being a feed. The second phase is where you test your problem. Here the key is to listen to potential customers, you gain knowledge within the area the solutions is to be implemented, and understanding the needs. Such as the problems with lice and the limited access to omega-3 in feed. In phase three you test your product with the customers. Here the goal is to validate the hypothesis form the first phase, not to sell the product. which for the first hypothesis could not be done. The final phase is where you verify your product or pivot through the phases again. This can be seen as the understanding of aquaculture, and creating the new hypothesis that alga was more suitable as an ingredient, and then take this hypothesis through the steps again. One has to use and understand the information from the previous phases, and see if your product actually solves the customers need, and if they are willing to pay for your solution. This is a crucial part in the market analysis, and it is important so you know your product has the potential to be sold in the market, or if you have to go back and re-examine your hypothesis (Blank, 2013). Through the use if this process, the solution of use of the alga changed, and became a better fit between the market need and the solution.

There are not many fish feed producers in Norway, as Figure 16 illustrate. There are three major producers in the industry; Cargill, Skretting and BioMar. According to an informant, the three major feed producers are relatively even in production. Marine Harvest and Polarfeed differs from the other three, in both production size and ambition. Polarfeed is a small-scale producer, and Marine Harvest, which is relatively new, are for now only serving themselves. The producers will be presented with focus on their value proposition.

SKRETTING a Nutreco company	Cargill	BioMar	marineharvest	POLARFEED För på fiskens premisser
543.000 tons	approx. 540.000 tons	approx. 540.000 tons	approx. 340.000 tons	35.000 tons

Figure 17: Possible customers with production in Norway (source: see appendix 7)

Skretting

Skretting is said to be the world leader when it comes to production and supply of feed to aquaculture, with the vision: *Feeding the future*. They use their knowledge about ingredients, and the nutritional need for fish and shrimp to develop innovative solutions with optimal nutrition value, sustainable production and economic results. In 2016 Skretting produced 543.000 tons of fish feed in Norway (Skretting, 2018).

Cargill (EWOS)

EWOS was one of the three large ones in fish feed, and in 2015 Cargill did a friendly takeover of the company for an astonishing 1.35 billion €. Cargill is a major player in the animal feed industry, and with this buy, they are now working towards growth in the salmon farming industry, and aims to become leading in this field. They state that they have world leading competence in research, nutrition and sustainable development for feed solution. EWOS produces 1.2 million tons of feed every year, in Norway, Chile, Canada and Scotland (Cargill; Nodland, 2015).

BioMar

BioMar present themselves as the world leader in high-performance diets. Serving over 45 different fish and shrimp species in 80 countries. The company's legacy is a long-lasting commitment for development in the aquaculture in a responsible and sustainable way. The main focus is to aid the customers deliver healthy and tasty seafood. The delivery is performed with efficient supply, safe and nutritious feed products that creates small environmental footprint (Biomar, 2018).

Marine Harvest

According to an informant, Marine Harvest is one of the largest salmon farming companies in Norway. In 2014, they opened their own feed plant. This makes them the only farmer in Norway that now has the whole value chain from feed production to sales and distribution. They started with producing 220.000 tons of feed in 2014, and has been able to expand their plant and now aims to produce around 340.000 tons of feed in 2018. Producing this amount of feed means they will be able to supply around 95 % of their locations in Norway with their own feed.

Polarfeed

Polarfeed is the smallest in this industry in Norway, focusing more on special feed rather than standardize feed. They develop, produce and sell marine feed products. Polarfeed have a plant in Øksfjord in Finnmark, with a production of 35.000 tons of feed. Polarfeed focuses on delivering feed with high features of marine raw ingredients. Having high values of marine ingredients in the feed is healthy for the fish, and maintains welfare (Polarfeed, 2018a, 2018b).

The value propositions, and statements from the possible customers indicates the importance of nutrition, quality, sustainability and innovation within the production and value chain. The insight gathered from the data collection, also emphasises this. The benefits and characteristics the alga contributes with can be used as a valuable element further on in the value chain. The possible customers are open for new ingredients to supply the need of marine ingredients.

Polarfeed might be the possible first customer for the alga. Being a smaller producer, and more focused on marine ingredients, this collaboration seems suitable. The production is not that grand, which could be good for the new Algae company, since the production capacity is not yet at industrial scale. They are also located in semi-close distance from Finnfjord, which makes it convenient for both companies.

3.2.5 Competitor analysis

To build profitable relationship with customers in today's competitiveness is crucial. A company needs to deliver more, more in terms of value and satisfaction for customers, than the competitors in order to gain advantage. Planning a marketing strategy, builds on understanding and research of one's competitors. Investigating close competitors when it comes pricing, products, promotion and so on, highlights the competitive advantages and disadvantages (Kotler et al., 2008).

According to an informant, the ability to track and trace the whole value chain for the farmed fish is important. Customers of ingredients are eager to see where they originate, and the production process. Other informants mentioned the need to consider the environmentally friendly focus of today, and examine the elements that creates their product in order to maintain or better the reputation. How this effect for the farmers vary. Data collection revealed that for farmer to use the brand of an ingredient might not have economic advantageous. However, brands on ingredient are used in report for feed producer as a compelling element of production, and showcases a sustainable and environmentally friendly process of production (Biomar, 2016).

Competitors of the alga are differentiated to producers of similar products; ingredients that can satisfy the omega-3 need and lice solutions. These two aspects of the alga have been separated because there is no direct competitor when it comes to the high nutrition combined with lice efficiency. Fish oil producers are not regarded as direct competition because they are not contributing and producing the same product as alga.

TerraVia AlgaePrime

Biomar has started using algae in the feed they deliver to their customers today through their supplier TerraVia. They too are using microalgae to get the marine omega-3 needed in the feed. Even though what they are delivering is similar, it is an ingredient that is high in only one of the valuable omega-3 fatty acids, DHA. The way of cultivation and benefits are not that same. TerraVia are currently doing the cultivation is done in a way of fermentation in a plant in Brazil. Sugarcanes are the main ingredient to make it work. One can see from Figure 17, they are using the waste from the sugarcanes to power both the sugar mill and the fermentation part of the process, and the sugar is an ingredient in the fermentation process. BioMar argue for this process by saying that this is a more sustainable way to get the marine omega-3 needed in the feed than what is currently done today (Algaprime, 2018; Biomar, 2016).

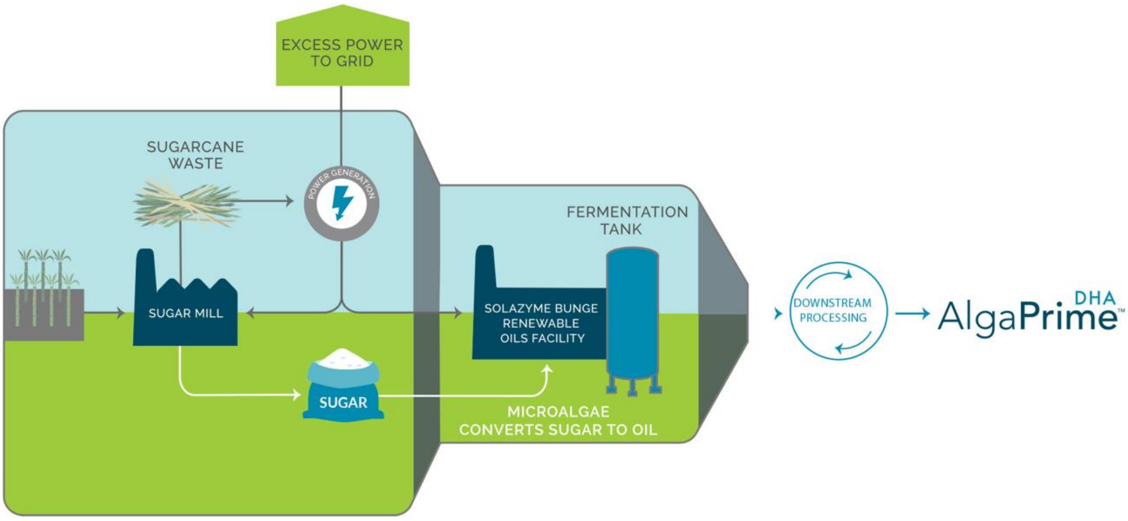


Figure 18: TerraVia AlgaePrime Production (Algaprime, 2018)

Veramaris

Veramaris is a new joint venture from DSM (cultivation of marine organisms and biotechnology) and Evonik (fermentation process in large volumes). Their aim is to fill the gap between demand and supply of marine omega-3. The product is an alga oil that contains the omega-3 fatty acids EPA and DHA from microalgae. Veramaris is the only competitor that supplies both, and claims that their innovation is a breakthrough. Their approach to aquaculture is to highlight the need, and maintain all elements of the value chain integrated in their approach in the market. In 2019, they are opening for commercial sales, this makes them the most critical competitor for the new alga company (Veramaris, 2018a, 2018b).

Onavita

ADM (Archer Daniels Midland Company) is introducing Onavita™ DHA Algal Oil. This oil can be seen as an indirect competitor, because their focus is on supplements and human consumption of alga oil, not towards aquaculture. Their oil is only high in DHA, which means they provide less benefits than the alga from UiT and Finnfjord (ADM, 2017).

Veramaris, TerraVia and Onavita are algae oil producers that are important to follow, especially Veramaris. However, none of their algae oil claims to contribute in the regards to efficiency on lice, which gives the alga from the north a potential competitive advantage. The focus on sustainability and brands on ingredients are emphasised, and indicates the need to implement and emphasis this in regards for the alga.

Gen modified organisms (GMO)

NOFIMA has tested canola oil that is rich in the marine omega-3 fatty acid DHA. They found that fish fed with the canola oil had the same omega-3 levels as fish fed with fish oil. The analysis only showed effect from how much oil that was added. GMO is a possible ingredient, depending on regulation. This is at moment not allowed in Norway. For this to be used in the future, the industry will have to choose if this is something the they want to implement or not when the regulations allow it (Ruyter, 2017). Data collection revealed that the industry is open to GMO, and recognise the need in the market and possible implementation of this. According to an informant, the feed producers are currently working on GMO as a possible solution to the marine ingredients in their feed. The research indicates that the fish fed with GMO are well compared to fish who have been fed with feed containing fish oil.

Many of the informants argue that regulations will open for GMO in the future. Opening up for GMO will create tougher competition for the alga as a supplement to fish oil. However, this would mean that the possibility to increase the production of salmon can become a reality. The four competitors listed are possible supplements or substitutes for fish oil, and direct competitor for the alga as an ingredient in feed. Algae and GMO focuses only on the nutrition, while the alga of the north hypothesis the effect on lice, therefore the following competitors are related in terms of lice.

Breeding

Aqua Gen investigates breeding of lice-resistant salmon. Through a tool of genes, they are able to breed salmon that keeps a third of the lice away. However, this approach is meet with scepticism. Lice is a species that has short generation time, this means that for one generation salmon, there might be 20 generations of lice. Breeding salmon for lice resistance will help, but not take away the problem, it will only take longer for the lice to adapt. This work will have to be done in indefinite time, because the lice will adapt as salmon is breed differently (Jensen, 2016). Although there is scepticism towards breeding resistance, this is a possibility and further research will generate answers in the future (Fiskeribladet.no, 2018a).

Lice Tube

A prototype of *Lice Tube* is currently tested in Bergen. This product claims to be able to remove lice when salmon swims through the machine in the net-pens. The method comes from studying wrasse. When the machine detects lice, an arm reaches out and pluck the lice. Lerøy and the inventor have started proto-testing. The prognoses are relatively good (Klokeide, 2018). This is a possible competitor in the lice efficiency. Orders of the product have already come in from the industry. They call it a spa treatment for fish. The goal it to commercialize within a year.

Closed net-pens and land based farming

The industry is investigating the possibility to close the net-pens. Lice will not be able to penetrate, and longer be a problem for the industry. However, this will increase the costs in of net-pens drastically. Net-pens used today are similar to the once from the start in the 1970s, with modifications. For a large location, the cost is about 50 million today. This includes all of equipment, from net-pens to the vessels. Iversen and Hermansen (2017) investigated the facilities used today in comparison to the possible facilitation on land. Their estimations are made on 1 million m^3 of farming volume, which costs 50 NOK per m^3 farming volume. With closed net-pens, the investment will increase to about 5.000 NOK per m^3. For land-based farming this cost might increase to 20.000 NOK per m^3. Turning away from the ocean might not mean that farming no longer will be profitable. The way of farming fish will have to change, it will have to become much more intensive. Iversen and Hermansen (2017) states that fish growth and welfare has to be considered when approaching this scenario, and more knowledge is need before turning to these facilitations.

The different competitors are presented in Table 4. Table 4 considers EPA, DHA, how the production is done and where, lice efficiency and commercialization. The aspect of where and how to produce relates mainly to algae production. The producers all emphasis on the course of production, arguing that their solution in favourable in terms of sustainability, environmentally friendly and leaves a low carbon footprint.

Table 4: Comparison of competitors

Product	EPA	DHA	Production/phase	Lice efficiency	Commercial scale
UiT + Finnfjord	YES	YES	CCU, eco-friendly cultivation. Troms. Pre-industrial phase	NO	?
Veramaris	YES	YES	Fermentation with sugar, eco-friendly. Nebraska. Industrial upscaling	NO	2019
AlgaPrime	NO	YES	Fermentation with sugarcane, eco-friendly. Brazil. Industrial scale	NO	Already in market
Onavita	NO	YES	?	NO	?
GMO	YES	YES	Plant based/land Canola and soy	NO	Soon, legal issues in Norway
Breeding	?	?	Depending on research and trials	?	?
Closed/Land based	NO	NO	Development in ocean/huge land areas needed. Science and research needed	YES	?
Lice Tube	NO	NO	Prototyping/testing	YES	Within a year

The competitor analysis illustrates direct competitors; Veramaris, TerraVia, Onavita, GMO, Lice Tube, technological innovation of net-pens and breeding of salmon. The competitors that will have most effect on the alga is Veramaris. Their product is high in both EPA and DHA, which means it can be seen as a substitute for fish oil. The other algae products are high in one of the two. The lice competitors are most important in an economical aspect. If other solutions work, it might have an effect, but the need for nutrition in feed is still there. Land-based aquaculture is highly expensive, and so is closed net-pens compared to today’s facilitations. Changing this aspect will influence the industry in a severe way financially. The alga is a complementary product, that solves these two problems in one. None of the competitors have the same set of benefits and characteristics. The technology behind the alga is also a positive remark. Competitors production is costly, and demands much more than the facilitation at Finnfjord does. Taking the sustainability into consideration can create more positivity in regards to the alga, as the waste from the plant is turned into a resource.

3.2.6 Environmental analysis – PESTEL and Porters Five Forces

To be able to understand the environment of the alga is important. Analysing the environment can relate the product to other parts of the market, the overall structure and society. The following analysis' indicates on how to strategize and market a product in an existing market can. The analysis tools used are PESTEL and Porters Five Forces (Johnson, 2017).

PESTEL analysis

PESTEL analysis is used as a tool to evaluate and analyse the market. The analysis highlights six factors in the environment; political, economic, social, technological, environmental and legal. The analysis does not only give intel in the market environment (suppliers, customer, competitors). These factors revolve economy, but also the nonmarket (factors that does not focus on economy, but can have an impact on it) (Johnson, 2017). For the alga within aquaculture in Norway, all the six parts of the analysis will be dealt with, this because they all contribute as a factor for the alga to thrive in aquaculture in Norway.

Political

The aquaculture industry is one of the most regulated industries in Norway, and the regulations often originates from the government. The growth today is limited because of the challenges with lice. Before there is granted more location and facilities to farm salmon, the lice situation has to be dealt with (Fiskeribladet.no, 2018b). This is a critical part for the alga, the hypothesis is as mentioned, that the alga will help with this specific challenge. If it is proven in the next stage of development, this can help the industry eventually grow. For a political point, the industry wants to grow, and it needs to. Norway depends on oil and gas, but this being the second biggest industry means solutions to keep it moving forward is critical.

Economic

The economic factors are crucial in this industry. It is an industry that contributes a lot in the Norwegian system, being the second biggest industry, after oil and gas. In 2017 Norway exported salmon for almost 65 billion NOK (NorgesSjømatråd, 2018). According to an informant, feed is around 50% of the production cost of farmed salmon. When it comes to this economic aspect in regards to the alga, it is difficult to find numbers, this because the industry is closed and confidential. However, we know that fish oil is a crucial ingredient in the feed, and the alga could be a substitute for this. With the algae as a substitute with more benefits, there is a possibility that the product is a *more for more* product. With the alga one can take twice as much as for fish oil, and with efficiency in regards to lice, the industry will pay to solve this, so to say that this can be a good that will contribute economically is clear. Regarding price on the alga, an informant mentioned: *"If there are enough marine ingredients, and you have a renewable resource for it, and the positive impact on the salmon, then we could probably pay a few kroners more. It is always related to cost/benefit"*. This indicates that if proven to be as beneficial as stated, the alga could become high-value product, which would lead to economic profits. This project will contribute with more employment at the plant facilities, and raise several positive economical outcomes.

Social

Growing up in Norway one learns that fish is healthy. Fish oil is a part of the Norwegian diet. The nutrition in fish is important for humans, and should be part of a normal diet. The nutrition in salmon is high enough for human consumption, but levels of dioxins can limit the consumption of salmon, and therefore also the rich omega-3 fatty acids. Another aspect is the welfare and health of the fish. According to informants and scientist in the project, lower levels of the valuable fatty acids are not favourable for fish (Kraugerud, 2017). The alga can become an ingredient that can aid fish maintain health and welfare in the ocean.

Technological

The technology transforms CO_2 into algae biomass. Turning CCS into CCU. Even though this part of the innovation is not that emphasised in this thesis, this is an element of development that must be taken into consideration. The technology makes it possible to create a product from a little desirable waste product. The cultivation is a milestone in itself (Barsanti & Gualtieri, 2018). The species combined with the technology makes mass cultivation of algae a possibility.

Environmental

The environmental aspect this can be seen in regards to the project in several ways. Instead of polluting, one now uses CO_2 gas as an ingredient. The welfare of the fish is central in the use of algae in the feed, so the fish gets enough of the right fat for them to grow in a healthy way. The importance of being able to track all products that contribute to the feed for farmed salmon is important. For the fish farmers, it is important to be able to show where the ingredients in your products comes from, and track all part involve.

Legal

Aquaculture is highly regulated, and restrictions are many. Producing alga for feed causes you to comply with laws and regulations. Mattilsynet (The Norwegian Food Safety Authority) in Norway provides the guideline of how to ensure the legal guidelines (Mattilsynet, 2013). Before starting mass production, the legal aspect has to be taking into close consideration.

Concluding the PESTEL analysis indicates that for the wanted growth to become a reality, the lice solution has to be feasible. The alga can help the Norwegian economy to grow. Growth in employment, revenues and taxes, and the growth of the industry. Transforming waste into a resource (CCU) can yield an economic advantage. The social aspect indicates that the need for nutritious feed is crucial for fish to maintain their health and welfare. The human population can be influenced in terms of no dioxins in the feed. Through the advanced technology, the cultivation of alga in industrial scale can now become manageable. A needed resource has the possibility to be manufactured in through a sustainable process, making an impact on the environment. The ability to use waste as a resource is a key factor of the technology. Tracking within aquaculture is important to maintain and build a good reputation. The alga can become a valuable component for the whole value chain. For the alga to actually penetrate the market the legal requirements must be recognised.

Porters five forces

The competitiveness of an industry can be analysed through the five forces. The tool identifies how attractive an industry is to penetrate, based on five factors: *Rivalry, Threat of substitutes, entry, buyer power, supplier power* (Johnson, 2017). *Threat of substitutes* are products that offer similar benefits, such as the other producers of algae for feed. *Threat of entry* establishes how easy it is to enter an industry, this is influenced by the degree of competition. Where the barriers are high, there are few competitors and the industry is attractive. *Buyers power*, the purchaser of the product, and the power they have. Concentrated buyers mean higher power. There are few, but large customers. The buyers are concentrated, few feed producers in aquaculture. However, the difficulties of growth create an opportunity that diminishes the buyer power. *Suppliers power* is likely to be high where there are only a few suppliers, the suppliers have more power than the buyers. The more differentiated the product is, the more power the supplier has. With the need presented from the industry the supplier power is high in aquaculture. The alga is also a more beneficial product, which creates even more supplier power (Johnson, 2017).

Comparative industry structure analysis

Johnson (2017) recognises the need to assess the competitive five forces in a possible future, as well as the current state. A *radar plot* examines the forces at present and over time. Five axes illustrate the five forces, where power decreases the longer out on an axe you are. High power indicates small areas. The area increases the lower the power is. The profit potential is larger with a larger area.

Figure 18 represents the competitiveness in the feed market today's (red line), and the possible market in 10 years (blue line). Substitute threat are identified as low in the current market with limited producers of alga. The importance of mending the gap between supply and demand of marine ingredients in the industry highly emphasised, therefore the potential substitutes are expected to rise in the future. The supplier power is quite high in the market today because of the limited marine resources and the high demand. Over time this is expected to decrease because more substitutes are predicted to enter the market. The present demand for marine ingredients provides a medium buyer power. In the future market this power is anticipated to decrease because of the growth scenarios in the industry combined with the resource need. The threat of entry is estimated as the highest power in the plot. The barriers in the market are high, and there are only few competitors, ergo the market is attractive. In the future threat of entry is estimated to decrease. It is hard to predict the future barriers of the industry. GMO-research and other possible approaches to mend the gap will quickly determine the future once they are more set in the industry. The four previous forces indicate that the rivalry is low today, and will not increase that much in the future.

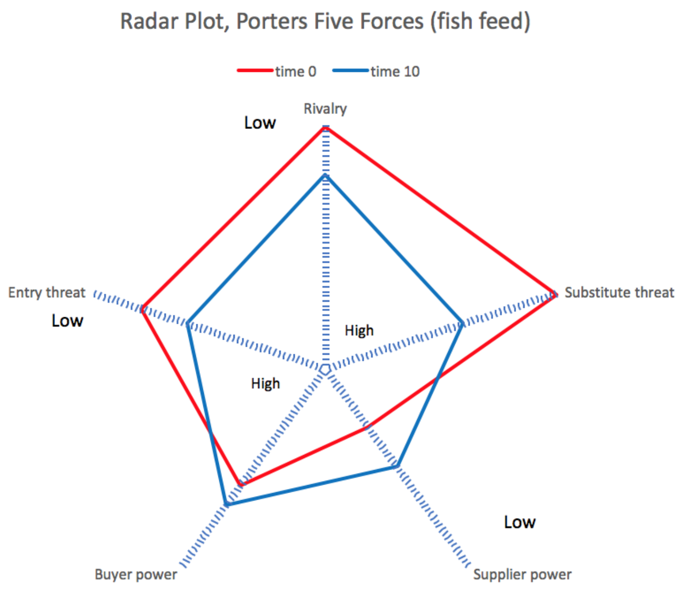


Figure 19: Radar plot Five Forces – alga in fish feed

The competitiveness indicates that it is attractive for an ingredient to penetrate the feed market. The main power lies with the suppliers at the moment, and will only decrease a little over time. Rivalry, entry, substitute and supplier power are estimated to increase over time, however not enough for the alga not to penetrate. The buyer power is estimated to decrease over time, this is especially influenced from the growth scenarios in the industry. The plot illustrates a large area, which indicates that the profitability is high.

3.3 Market strategy

To reach the target customers a company have to be aware of whom they will serve. This is done by segmentation and targeting. Knowing your customer, and targeting the once you are able to serve can result in a profitable venture (Kotler et al., 2008). Mending the gap between the need and supply can create opportunities.

3.3.1 Segmentation and targeting

Johnson (2017) states that a market segment is where a group of customers in a market have similar needs that differs from customer needs in other parts of set market. Kotler et al. (2008) states that segmentation is to split the market into well-defined sections, and by doing so the chance to deliver value to customers increases for a company. After evaluating the segments, companies have to evaluate their opportunities and choose which segment to target. The market a company targets, is the one who have a set of customers that share common needs or characteristics that the company is able to serve (Kotler et al., 2008). For the alga, this is already presented. The target market is aquaculture, and the segment is the feed producers. These customers share the same need of a marine ingredient. an additional value for them could be to contribute with an ingredient that contributes as a solution towards the difficulties regarding lice to maintain and continue growth in the industry.

3.3.2 Positioning

After the market is segmented and targeted, it is importance to create the value proposition, the value proposition indicates how your product can be different, what value it gives, and the position the product will have in the segment. The customer's interpretation of your product compared or others relates to the positioning. The position a product is complex. It focuses on feelings, impressions and perceptions from customers compared to similar products. Even though customers position the product in their minds, marketers will not leave it to chance (Kotler et al., 2008). Figure 19 presents the alga as a *more for more* product.

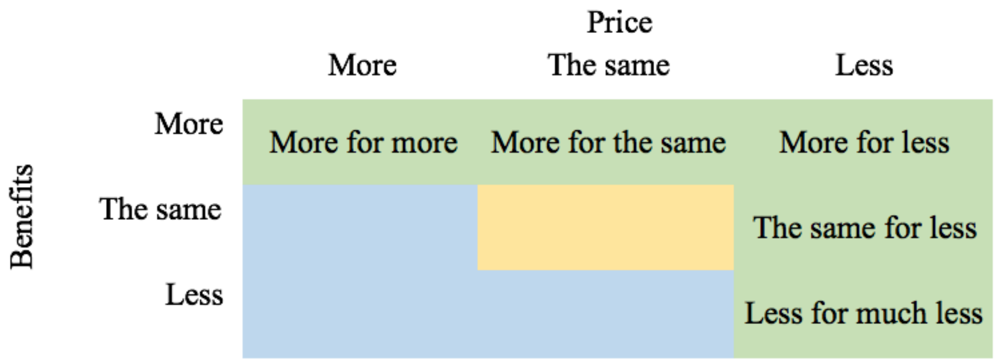


Figure 20: Benefit and Price (Kotler et al., 2008, p. 442)

The alga is positioned a more for more product because of the benefits it contributes with to the industry. An informant stated: *"Often higher levels of omega-3 increases the price of feed".* The technology using CCU, the nutrition without dioxins and the possible effect on lice are all important factors that comprises the product as highly beneficial. Testing on the hypothesis towards lice has to be concluded to verify or falsify the assumption. However, the benefits even without the lice solution will still be a more for more product. This indicates that the positioning of the alga as such a product is a valid statement.

3.3.3 Sustainable marketing

Kotler et al. (2008) highlights social values and responsibilities as more important now than ever before. They emphasise the importance of keeping in mind the renewable and environmental movement. A company has to fulfil its responsibility and deliver their products in a social and environmentally responsible way. In the future, this will only become more important, and the customer will demand more from the companies. Forward-looking companies are accepting this change, and takes the responsibilities the customers demand (Kotler & Armstrong, 2012). This approach in marketing could and should be utilized from the new company. The opportunity of doing well in terms of a business by doing good, should be taken advantage of. The world is becoming more aware and focused on every aspect of production, and consumers want information. According to several informants the importance of being able to track all the parts of production is necessary. The alga can use the story of the alga to market itself as a sustainable product with focus on environment.

3.3.4 Branding

Branding contributes to differentiate one product from another. Marketing today often builds and manages a brand. Several aspects are focused on in regards to branding, e.g. the design, symbol, name, sign or a combination of these creates a brand. The value and benefits your product can give customers can also be utilized through a brand, such as the value proposition (Kotler et al., 2008). Ten types of innovation also recognise the brand opportunity, and regards this as an innovation in itself. Through a brand, an offering can transform from a commodity to a prized product by giving value, intent and meaning to your offering and enterprise (Keeley et al., 2013).

Branding in this level of the market is already utilized from the competitors. BioMar' sustainability report (Biomar, 2016) uses AlgaPrime as a brand to showcase their sustainability as feed producers. The uniqueness of the production, and sustainability of the algae can be used as arguments on how advantageous the feed is. An informant mentioned: *"If we can market the fish in a way that we can sell the fish for 60 cents more, then there is no question".* This indicates that benefits from other parts of the value chain, can be utilized further on. The alga can should its advantages through a brand. Informants from the industry mention that a brand with a compelling story might contribute further on in the value chain. Creating a value proposition that will give insight in the value the alga supplies can aid possible customers and be marketing strategy for the alga to follow.

3.3.5 Business to business (B2B) marketing

A business market often consists of fewer, however larger buyers. In B2B marketing it is important to understand the business market and the behaviour of the once purchasing your product. Relationships with customers are also important in B2B marketing, as they are in business to customer marketing. B2B includes the geographical aspect. Location influences your product, and makes sure it is a viable solution for the next step in the chain of production (Kotler et al., 2008). Fish oil mainly comes from Peru today (Mereghetti, 2017; appendix 3). The possibility to manufacture a business closer makes it easier to negotiate, and approach the customers. B2B situation are more complex, and relay on formal negotiations. This is why if often takes longer to make a decision in a B2B scenario (Kotler et al., 2008). There are few producers of fish feed. The formalisation is important to uphold once the approach in the market is ready. Informants highlights that this is already how the industry operates. For a new component to enter, one has to follow the rules, and enter on the terms that are known.

3.4 Conclusion

Through an analysis of the Norwegian aquaculture, the market for the alga has been assessed. The need complements the benefits of the alga. There is a consensus in aquaculture that marine ingredients are limited and scares. For the industry to grow, this is seen from the inside as the most critical problem to solve. The lice situation will be dealt with, one way or another. Whoever delivers the solution will be reimbursed in terms of revenue. Solving the problem with lice will also contribute with opening the further develop of the industry. Possible customers are not many, but the market is large. If the regulations open up for more farming, the industry will need more marine ingredients from sustainable and renewable plants.

The alga can be separated from its competitor based on the characteristics and the benefits it supplies. The value the alga contributes can be highlighted through a brand. The competitors in marine ingredients are already using this as a market strategy. Competitor range from alga producers to lice solutions, and early stage research, thus making the evaluation of them though. The most critical competitor to focus on is Veramaris. Delivering both EPA and DHA makes them a possible substitute for fish oil.

The strategy for the alga to penetrate aquaculture is though branding, sustainable and business to business marketing. The innovation presents a sustainable production of marine resources. The approach in the market should be though B2B marketing. This is a formal and confidential industry, which means that the importance of establishing relationships with customers are crucial. Negotiations and formal structures are the way to get in touch with the customers, and that is how the new company should approach the industry. The sustainability aspect of elements within the value chain seems to be emphasised as important locks to build on.

The ocean actually is a treasure chest, and the possibilities for the alga are tremendous. Even if the lice problematic has to be verified before one can commercialize this element, the alga is still beneficial and has potential within Norwegian aquaculture. The possibilities to commercialize alga in aquaculture is there. The most important step now if to approach the possible customers correctly, and illustrate that this product is as good as claimed.

4 Business plan

4.1 Executive summary

Mass production of alga derives from a collaboration between Finnfjord AS and UiT and their work combining carbon capture utilization (CCU) and cultivation of algae. Aquaculture has two severe challenges, lice and access to the marine ingredients. By 2050 Norway has the possibility to increase production of salmon from a bit over one million ton, to over five million tons. Improvements and development especially when it comes to the feed and lice are crucial for this to become a reality. Norwegian salmon is a product that is sold and distributed all over the world. The population is becoming more aware and concerned with what they eat, and how the production behind the product is. Developing food for the future has to go together with the mind-set and progress of the population. The focus on sustainable and environmentally friendly food, has to be emphasised and developed for the future.

The solution from Finnfjord and UiT offers a highly nutritious ingredient for fish feed. The ingredient is non-toxic, can offer a constant supply through innovative technological solutions such as carbon capture utilization, and last but not least the efficient on lice. The ingredient is cultivated using CO_2 to grow – tuning waste into a product. the ingredient is alga from the north.

The end-user and the customer for this product is not the same. The end-users are people purchasing farmed salmon. Customers are the fish feed producers, in need of marine ingredients to maintain the supply. The market indicates that the whole value chain is important when selling the end product to end customers. Therefore, this alga can be taken into consideration and become an important part throughout the whole chain.

The feed from alga will be offered as an ingredient, and as a substitute or supplement for fish oil used today. The feed will be distributed from the facilities at Finnsnes through a partnership within the existing value chain. The possible first customer is a smaller producer of feed, Polarfeed, focusing on marine ingredients.

4.2 The pain

Food and Agriculture Organization of the United Nations (FAO) has stated that the population will increase substantially, and reach 9 billion people by 2050. This means that we will need to produce more food. Continuing food production as it is done today will not meet the demand in a sustainable way. The solution is to farm in the ocean rather than on land. Turning to fish and seafood, instead of meat. Growing food on land contributes with substantial greenhouse gas emissions. The utilization of carbon is an approach that turns carbon capture storage, into utilization. Creating a resource of a waste-product.

Since the beginning of farmed salmon in the 1970s, the increase of Atlantic salmon farmed in Norway has had a rapid increase. Increase in salmon, means increase in fish feed production. Production of salmon in Norway is estimated to exceed 5 million tons by 2050, that is five times higher than what is produced today. To achieve the goal of production in the future, there are several obstacles that has to be solved. The main challenge is to supply the marine ingredient to the fish feed. For fish farmers, the cost of producing salmon is around 30 NOK/kg, the feed stands for about 50 % of theses cost. Currently the feed consists of around 70 per cent plant based ingredients. The marine ingredients in the feed originates form fish oil, which is mostly derived from pelagic fish. pelagic fish is a limited and scares resource that could have been utilized as human consumption. For the industry to grow, the government have decided that the lice situation has to be solved. This problem cost the industry around five billion NOK in 2017. Through the marine food chain, toxins accumulate. Alga is a primary producer in the ocean, which means they do not contain toxins. Using alga in fish feed can contribute to growth in one of the most important industries in Norway. At the same time, the production utilizes greenhouse gases as a resource and creates a highly beneficial and valuable product.

4.3 The solution

Our solution turns greenhouse gasses like CO_2 and NOx into alga biomass using innovative technology like carbon capture. Alga is a relatively new ingredient in fish feed, only supplying 2 % of this market at the moment. The alga presented here is high in the omega-3 fatty acids, EPA and DHA, is non-toxic in terms dioxins and able to upscale and maintain production, so the supply can will last over time and with growth. It also has an effect on lice.

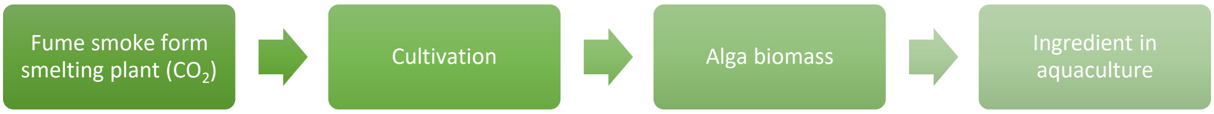


Figure 21: Process of cultivation

Using alga in fish feed, and this approach of cultivation is unique, and relatively new. The characteristics of this alga creates a high-value product that benefits different parts of the industry and society. As a start-up, there are limitations on scale of production at the moment.

4.4 Value proposition

There are several elements in the product that can create value to different components of the value chain. The focus is to create value to the customers, end-user, fish farmers, and society.

4.4.1 Customers

The value provided to customers is the nutritional value. The marine ingredients are limited, and the need to maintain the healthy concentration in feed is critical. the feed producer are the customers of the alga. the alga is manufactured, which means that the supply can become constant. Today the marine ingredients area harvested through fisheries, and If lice efficiency is proven, this will also make it possible for customers to take advantage of it.

4.4.2 Fish farmers

Fish farmers are provided in the effect on lice and nutritional value is generates. Lice is an enormous problem in aquaculture, and affect the profits. The healthy and sustainable resource of marine ingredient also creates an opportunity to satisfy the need of the fish, as well as human consumption.

4.4.3 End-users

The end-users are taken into consideration because the value chain of the alga does not stop at their customer. End-users are the people purchasing and consuming the farmed fish. The alga has the potential to become an element that creates value throughout the value chain. The characteristics presented indicates this. The route of production, and benefits of the alga can all be evaluated as contributing elements for the end-user to consider during a purchasing decision. This may affect the economic scale, but can contribute in the reputational building of the industry.

4.4.4 Social

Finnfjord has the highest emissions of CO_2 in Troms county, and uses half of the overall electricity. Production of alga open the opportunity for Finnfjord to cut their emissions in the goal of become a zero-CO_2-emission smelting plant. The technology, turning waste into a resource aids all of Norway, not just Finnfjord. The alga is a primary producer, which means that there are no dioxins in the biomass. Dioxins are toxic in large quantities, and less intake is beneficial.

4.5 The market

The market is based on Norwegian aquaculture, specified in salmon farming. For this industry to grow in the optimistic scenario illustrated in Figure 20, the most crucial challenge is to be able to supply the marine ingredients in feed.

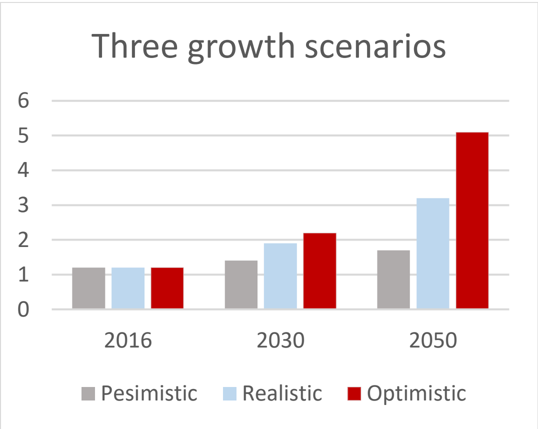


Figure 22: Growth scenarios SINTEF (Hage, 2017)

In Norway, seafood was in 2017 sold for over 94 billion NOK, Atlantic salmon stood for about 70 per cent. On an average, the content of fish oil in feed is about 9 % in Norway. Table 4 illustrates the feed production in Norway today, and in the optimistic scenario in 2050. This indicates if the growth of the industry is going to become a reality, so will the growth of marine ingredient production. The alga has the opportunity to become the solution to this problem, and realisation of the growth.

Table 5: Content of fish oil in feed today and estimate for positive scenario in 2050 (source: see appendix 7)

	Fish feed production in Norway (tons)	Fish oil in feed tons (average 9 %) 2017	Fish oil in feed tons (average 9 %) 2050
Total	1.998.000	179.820	899.110

4.5.1 Customers

There are five producers of fish feed in Norway. Figure 21 illustrates the different companies, and the scale of resent production.

SKRETTING: 543.000 tons
Cargill: approx. 540.000 tons
BioMar: approx. 540.000 tons
marineharvest: approx. 340.000 tons
POLARFEED: 35.000 tons

Figure 23: Fish feed producers in Norway, with production (source: see appendix 7)

The customers are eager to find new, sustainable ingredients for their feed. As a supplier, it is important for them to maintain a focus on their customer, the fish farmers. The industry is facing difficulties in terms of reputation. This means that the alga can potentially aid in the manufacturing of feed, and thereby aid in reputational building of the industry. Polarfeed is regarded as the first customer to target. This because their production is small and the focus is on marine ingredient. The production of alga is not at industrial scale for the time being, and therefore this will suit as a first customer.

4.5.2 Competitor analysis

There are few direct competitor. Only the alga from the north is regarded as a source of marine ingredients and effective against lice. Competitors differ in in regards to these two challenges. Mass cultivation of algae is increasing, and the possible solutions are growing. Table 5 presents the different competitor in terms of marine ingredient, EPA and DHA, production and phase, effect on lice and commercialization.

Table 6: List of competitors

Product	EPA	DHA	Production/phase	Lice efficiency	Commercialization
UiT + Finnfjord	YES	YES	CCU, eco-friendly cultivation. Troms. Pre-industrial phase	NO	?
Veramaris	YES	YES	Fermentation with sugar, eco-friendly. Nebraska. Industrial upscaling	NO	2019
AlgaePrime	NO	YES	Fermentation with sugarcane, eco-friendly. Brazil. Industrial scale	NO	Already in market
Onavita	NO	YES	?	NO	?
GMO	YES	YES	Plant based/land Canola and soy	NO	Soon, legal issues in Norway
Breeding	?	?	Depending on research and trials	?	?
Closed/Land based	NO	NO	Development in ocean/huge land areas needed. Science and research needed	YES	?
Lice Tube	NO	NO	Prototyping/testing	YES	Within a year

These are all possible competitors to the alga. The first five; AlgaPrime, Veramaris, Onavita, GMO and breeding capabilities are the most crucial competitors in regard to marine ingredients. Moving fish farming into closed net-pens or on land will take away the lice problem. Breeding or using machines, such as Lice Tube is still at early stage, and the possible outcome is not yet known. None of the competitors are producing a product that gives a solution to both of the critical challenges the industry faces in one product, marine ingredient and lice efficiency.

4.6 Company Alga and the team

Finnfjord and UiT are in the process of starting a new company that will take over all the operations in regards to the production of alga. Figure 22 indicates that a separate company (Company II) will become the sales company.

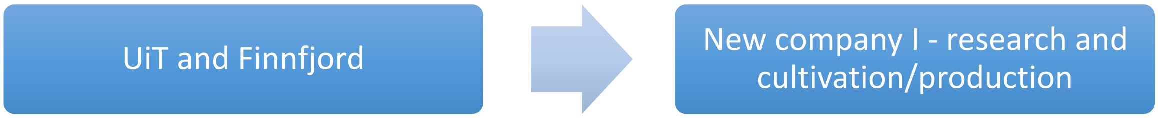


Figure 24: Legal company structure

The organisation at the moment is well functioning with the phase it is in with people from Finnfjord and researchers from UiT, where several faculties and institutes are involved. However, choosing to entre aquaculture means knowledge and intel in this industry is needed. The new company should strive to fill this gap within the new organization. Table 6 presents the key members of the team at the moment, with the need a member focusing on aquaculture. The alga is divided into sub-projects. NOFIMA is currently a member investigating the hypothesis in terms of lice efficiency. An approach towards the farmers have been made, and established.

Table 7: List of key members in the team

Company		Part in project
UiT	Hans Christian Eilertsen, professor in Marine Biology and Project Leader	All
Finnfjord AS	Jo Strømholdt	All
NOFIMA	Ragnhild Whitaker, research chief	Lice project
NEED	?	**Competence in feed and aquaculture**

4.7 How to reach the market

The alga should utilize the benefits of being a sustainable and resourceful plant in their marketing. The sustainable aspect is regarded as a positive contribution in marketing, and attracts attention. This should be taken advantage of. The whole aspect around the product revolves around sustainable production, using waste as a resource, and giving an ingredient that is much needed.

Competitors are using a brand as a strategic tool to market their product. This is a strategy the alga should take into consideration as well. Utilizing, and creating a brand can contribute further on in the value chain. One competitor is currently used as a brand in a feed producer's sustainability report. The value propositions should be emphasised, and utilized in the creation of a brand.

Aquaculture is a confidential and closed market. Approach the market should be done in a formal and structured way. It is a business to business market, and therefore the approach is important. Formal negotiations are the way of advertise and trade one's product. today.

4.8 Milestones

Critical milestones have already been checked off in the project. The pre-industrial tank (300 000 litres) is in place and starting production in 2018. The first industrial tank, 5 million litres, is at a start phase, and this is where the alga has come now.

The next crucial milestone starts in October, when NOFIMA starts testing the alga in feed (as a substitute for fish oil) and the possible efficiency on lice. This will have great impact on the potential pricing of the product, and will be have to be proven for the industry to trust in.

IPR is an ongoing process. Onsagers are currently involved in the application process. The specifics of the patent are not yet clear; meetings are taking place and an application will be filed.

Figure 24 presents the corporate development from today and onwards. The critical aspect is to raise funding (approx. 15 million NOK) for the pre-industrial scale tank (5 million L). Once the new tank is in production the alga can be distributed to the first customer. Approaching the target customers should begin now, as this takes time in such an industry.

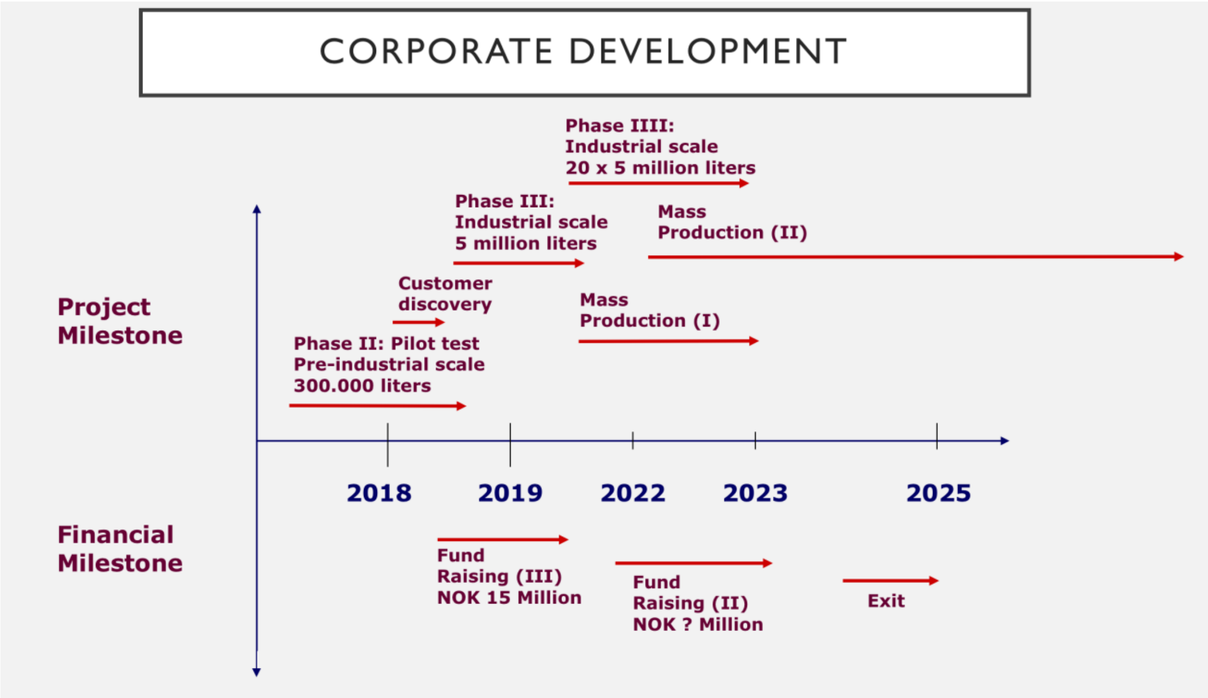


Figure 25: Corporate development - Milestones

4.9 Finance

A feed that is efficient on lice has high value for the farmers, and therefore the willingness to pay is there. Figure 24 presents four possible scenarios of revenue at pre-industrial, mid and full scale. The algae oil used in todays feed consists only of DHA, and cost around 1.000 USD more per ton than fish oil. The alga has high levels of EPA, and DHA. This means that it is more beneficial than the algae oil already in the market, and the price is increased. Figure 24 presents revenues at 5 million litre tank, mid-scale and full scale of production combined with price on fish oil, algae oil with DHA, alga with DHA and EPA, and DHA + EPA + effect on lice.

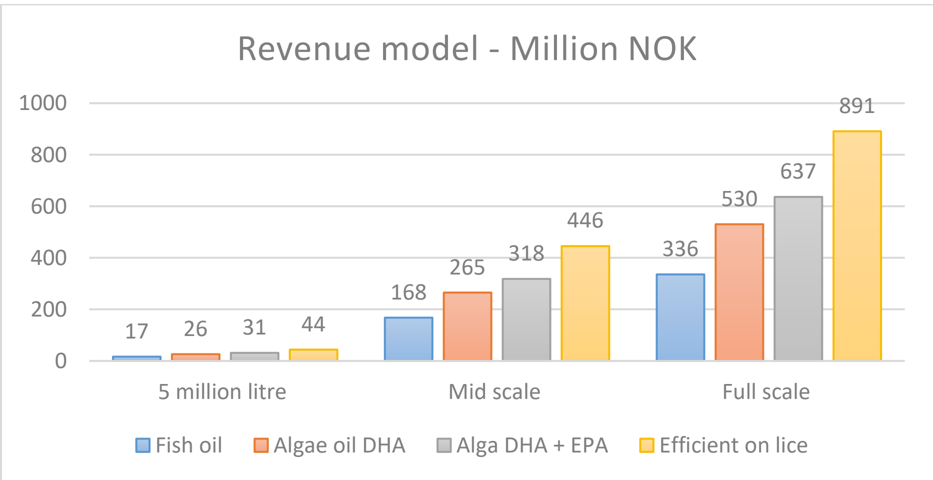


Figure 26: Revenue model

The pricing is based on the industry and actors in it. The price on algae oil today is around 1000 USD more than fish oil (average 1600 USD/ton) per ton. This is one of the worst-case scenario for the alga, creating a revenue of 530 million NOK/year. The Alga from the Arctic has both DHA and EPA, which can generate a revenue of 637 million NOK at full scale. The best scenario is the price on alga is estimated from the assumption if there is an effect on lice, which takes the price up another 40 %, with a revenue of 891 million NOK at full scale. These are all calculated in regards to capacity of production at Finnfjord. The model illustrates that with the right benefits, the alga has the capacity to yield large earnings. The cost of production will determine how profitable the project is. With the critical need for the marine ingredient, an assumption is that over time the price on algae oil will to go down because the production volume is estimated to increase. Therefore, the price on fish oil is presented as well. This indicates the even if the price drops, the revenues will still be favourable. Yielding 336 million NOK at full scale.

Figure 25 present the cash flow of the five million litre tank, with a production capacity of around 1200 tons yearly. The assumption is that development will cost around 15 million NOK (production of 5 million L tank). An estimated revenue of around 2.500.000 NOK monthly. These assumptions are based on price of ingredients (see appendix 3). This is adjusted to wages, production cost and so on (see appendix 6). The financial statements present a positive scenario.

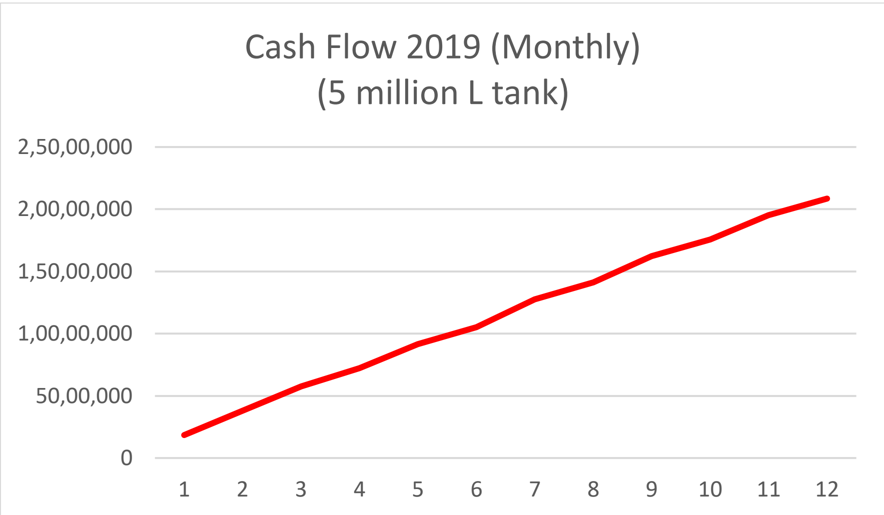


Figure 27: Monthly Cash Flow - producing in 5 million L tank

4.10 Critical Risk

The industrial scale of production is a risk that has to be taken into consideration, this because cultivation done in this way has never been done before. The first testing of the 300.000 litre tank will be evaluated as soon as production starts. Within six months one will know the scalable opportunity. When this is proven to work, industrial scale production development is set to start.

The alga has to be as good as predicted. The alga is said to be a solution when it comes to the challenges with lice, and this has to be proven for the feed producers and farmers to pay more than normal price for the ingredient and the feed. The alga relays on the outcome of the testing that is taking place at NOFIMA. Further testing may also have to be done, as the industry has expressed the need of significant proof.

Another critical risk, or objective is to find and get the first customer. This is crucial for the company. Assessments are made, and realizing them should be focused on. Polarfeed is a Norwegian company located in Finnmark, and their focus is toward marine ingredients and medicine feed. This is suitable for the alga, and the possible opportunity of sale rises. Polarfeed is smaller than the other four producers in Norway, which is evaluated as positive. The production capacity of alga is not yet at full scale, and minding the gap between the producer and supplier has the potential to meet.

Reference list

ADM. (2017). ADM Introduces Onavita™ DHA Algal Oil [Press release]. Retrieved from https://www.adm.com/news/news-releases/adm-introduces-onavita-dha-algal-oil

Algaprime. (2018). INTRODUCING ALGAPRIMETM DHA
A TRACEABLE, SUSTAINABLE, HIGH-QUALITY ALTERNATIVE TO MARINE-BASED OMEGA-3S. Retrieved from http://algaprime.com/

Amatucci, F., & Grimm, R. (2011). 'Reinventing' the Business Plan Process for Sustainable Start-Ups. *Journal of Strategic Innovation and Sustainability, 7*(1), 154-159.

Barsanti, L., & Gualtieri, P. (2018). Is exploitation of microalgae economically and energetically sustainable? *Algal Research, 31*, 107-115. doi:10.1016/j.algal.2018.02.001

Biomar. (2016). *Sustainability Report 2016*. Retrieved from

Biomar. (2018). Om BioMar. Retrieved from http://www.biomar.com/no/norway/om-biomar/tall-og-fakta/ - refid-14540)

Blank, S. (2013). *The four steps to the epiphany* (5th ed.): Quad/Graphics.

Bryman, A., & Bell, E. (2015). *Business research methods* (4th ed. ed.). Oxford: Oxford University Press.

Cargill. Aquaculture Feed and Nutrition. Retrieved from https://www.cargill.com/animal-nutrition/aquaculture

Castle, S. (2017). As Wild Salmon Decline, Norway Pressures Its Giant Fish Farms. Retrieved from nytimes.com website: https://www.nytimes.com/2017/11/06/world/europe/salmon-norway-fish-farms.html

Christiansen, J. (2018). Fiskeolje blir den nye lusa. Retrieved from https://fiskeribladet.no/nyheter/?artikkel=59188

Elvevoll, E. O. (2017). Marin Bioprospektering. *Fiskerikandidaten*, 36-38.

Eriksson, P., & Kovalainen, A. (2008). *Qualitative methods in business research* Qualitative research methods, *Introducing Qualitative Methods series*

Eriksson, R. (2017). Sjømat er vårt nye gull. *Norsk sjømat, 5*, 6-7.

Fiskeribladet.no. (2018a). Håper avlusingsmetodene blir mer skånsomme. *Tekfisk*.

Fiskeribladet.no. (2018b). Lerøys forskningsjef er lei av lakselus. *Tekfisk*.

Foss, L., & Gibson, D. V. (2015). *The Entrepreneurial university : context and institutional change* (Vol. 37). London: Routledge.

Garcia, R., & Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. *Journal of Product Innovation Management, 19*(2), 110-132. doi:10.1111/1540-5885.1920110

Hage, Ø. (2017). Sintef-topp tviholder på laksevisjonene for 2050. *Fiskeribladet,* pp. 4-5.

Havforskningsinstituttet. (2014). Dioksiner, furaner og dioksinlignende PCB. Retrieved from https://nifes.hi.no/forskningstema/trygg-sjomat/uonsket-sjomat/dioksiner-furaner-og-dioksinlignende-pcb/

Holahan, P. J., Sullivan, Z. Z., & Markham, S. K. (2014). Product Development as Core Competence: How Formal Product Development Practices Differ for Radical, More Innovative, and Incremental Product Innovations. *Journal of Product Innovation Management, 31*(2), 329-345. doi:10.1111/jpim.12098

Industrienergi. (2017). Finnfjord vil lage fiskefôr av CO2. Retrieved from https://www.industrienergi.no/nyheter/finnfjord-vil-lage-fiskefor-av-co2/

Iversen, A., & Hermansen, Ø. (2017). Dyr lus, dyrere fôr - og fortsatt dyrt på land. *Næringsnytte,* 8-9.

Jensen, P. M. (2016). – Avl mot lus vil garantert bli et sisyfosarbeid. Retrieved from https://www.kyst.no/article/8211-avl-mot-lus-vil-garantert-bli-et-sisyfosarbeid/

Johnson, G. (2017). *Exploring strategy* (11th ed. ed.). Harlow: Pearson Education.

Keeley, L., Walters, H., Pikkel, R., & Quinn, B. (2013). *Ten Types of Innovation : The Discipline of Building Breakthroughs*. New York: Wiley.

Kim, W. C., & Mauborgne, R. (2004). Blue ocean strategy. *Harvard business review, 82*(10), 76.

Klokeide, O. E. (2018). Her er Lerøys mekaniske leppefisk. Retrieved from https://fiskeribladet.no/nyheter/?artikkel=59416

Kotler, P., & Armstrong, G. (2012). *Principles of marketing* (14th ed. ed.). Boston: Pearson.

Kotler, P., Armstrong, G., Wong, V., & Saunders, J. (2008). *Principles of marketing* (5th European ed. ed.). Harlow: FT Prentice Hall.

Kraugerud, R. L. (2017). Farmed salmon need marine omega 3. Retrieved from https://nofima.no/en/nyhet/2017/05/farmed-salmon-need-marine-omega-3/

laks.no. (2018). Norsk laks fra fjord til bord. Retrieved from https://laks.no/lakseproduksjon/

Lundqvist, M. (2014). *A Packaging Approach for Evaluating Ideas*.

Mattilsynet. (2013, 16.08.2017). Krav til fôr. Retrieved from https://www.mattilsynet.no/dyr_og_dyrehold/for/krav_til_for.5567

Mereghetti, M. (2017). Fish oil prices collapse amid drop in supplements market. Retrieved from https://www.undercurrentnews.com/2017/05/01/fishoil-prices-collapse-amid-drop-in-supplements-market/

Nodland, E. (2015). Cargills oppkjøp av EWOS er fullført. Retrieved from https://ilaks.no/cargills-oppkjop-av-ewos-fullfort/

NorgesSjømatråd. (2018). En million tonn laks for 64,7 milliarder i 2017. Retrieved from https://seafood.no/aktuelt/nyheter/en-million-tonn-laks-for-647-milliarder-i-2017/

NOAA. (2017). What are pelagic fish? Retrieved from https://oceanservice.noaa.gov/facts/pelagic.html

Onsagers. (2018). Retrieved from http://onsagers.no/

Osvik, R. D. (2017). Marine Mikroalger - en lys fremtid. *Fiskerikandidaten*, 22-23.

Polarfeed. (2018a). Retrieved from http://polarfeed.no/

Polarfeed. (2018b). Om oss. Retrieved from http://polarfeed.no/om/

regjeringen.no. (2017). Tilskudd til videre planlegging av fullskala industriell utnyttelse av CO2. Retrieved from https://www.regjeringen.no/no/aktuelt/tilskudd-til-videre-planlegging-av-fullskala-industriell-utnyttelse-av-co2/id2553073/

Ruyter, B. (2017). Mulig ny oljekilde til laks. *Næringsnytte 2017*, 33.

Sahlman, W. A. (1997). How to Write a Great Business Plan. *Harvard Business Review - Executive Summary*.

Salmar. (2018). ABC of salmon farming. Retrieved from https://www.salmar.no/en/abc-of-salmon-farming/)

Siegel, D. S., Veugelers, R., & Wright, M. (2007). Technology transfer offices and commercialization of university intellectual property: performance and policy implications. *Oxford Review of Economic Policy, 23*(4), 640-660. doi:10.1093/oxrep/grm036

Skretting. (2018). Fakta om Skretting. Retrieved from https://www.skretting.com/nb-NO/om-oss/selskapsfakta/

Terazono, E. (2017). Fisheries challenged by rising cost of fish oil in feed. Retrieved from https://www.ft.com/content/651ad428-2511-11e7-a34a-538b4cb30025

Tidd, J., Bessant, J., & Pavitt, K. (2005). *Managing Innovation: Integrating Technological, Market and Organizational Change*: Wiley.

Uggerud, E., & Langård, S. (2009). Dioksiner. Retrieved from https://snl.no/dioksiner

Veramaris. (2018a). DSM and Evonik establish Veramaris joint venture [Press release]. Retrieved from https://www.veramaris.com/pressreleases-detail/dsm-and-evonik-establish-veramaris-joint-venture.html

Veramaris. (2018b). Our story.   Retrieved from https://www.veramaris.com/who-we-are-detail.html - valuechain

Ytrestøyl, T., & Krasnov, A. (2016). Lite omega-3 gir blek laks. *Næringsnytte 2016*, 24.

Ytrestøyl, T., Aas, T., & Åsgård, T. (2015). Utilisation of feed resources in production of Atlantic salmon (Salmo salar) in Norway. *Aquaculture*, *448*, 365.

Appendix 1 – Operational review

Prosjektoversikt, stillingstype og tilslutninger assosierte, UiT

CCU partnere (se også egen liste),

NT- stillinger:

1. John Markus Bjørndalen, PhD veileder
2. CCU student 1, ikke tilsatt
3. Kathrin Hopmann, PhD veileder
4. CCU student 2, ikke tilsatt

HSL- stillinger:

1. Øyvind Stokke, PhD veileder
2. CCU student 3, ikke tilsatt

BFE (HHT)- stillinger:

1. Elin Merethe Oftedal, PhD veileder
2. CCU student 4, ikke tilsatt

Master studenter/veiledere:

1. Kamilla Marie Borrebæk, HHT, til 01/06/19
2. Dagfinn Sætra, HHT, Master veileder
3. Marte Ramskjell, Farmasi til 01/06/19
4. Simen Aronsen, Farmasi til 01/06/19
5. Terje Vasskog, Farmasi, Master veileder
6. Terkel Hansen, Farmasi, Master veileder

Andre partnere:

1. Tobias Boström, NT fak.
2. Anni Maria Lehmuskero, NT fak.
3. Ragnhild Whitaker, NOFIMA
4. Sten Siikavuopio, NOFIMA
5. Jens P. Jøstensen, Odd Berg Gruppen
6. Roy Alapnes, Brødrene Karlsen as

BFE (NFH)- stillinger:

Vit. ansatte, faste stillinger:

1. Hans Chr. Eilertsen, Prosjekleder
2. Hans Chr. Bernstein, fra 01.06.18

Lab. Ingeniører, faste stillinger:

1. Gunilla Eriksen, arb. sted Finnfjord/UiT
2. Martina Uradnikova, arb. sted UiT

Lab. Ingeniører, midlertidige:

1. Therese Smelror Løkken, arb. sted Finnfjord, til 31/12/19
2. Marianne Risager Kjøller, arb. sted Finnfjord/UiT, til 31/12/19

Post doc:

1. Andrea Gerecht, p.t.fødselspermisjon ut 2018, til 05/06/19
2. Richard Ingebrigtsen. til 30/11/20

PhD:

1. Jon Brage Svenning, til 31/01/21
2. Renate Osvik, til 31/12/20
3. Nerea Aalto, til 31/12/21
4. Lars Dalheim, til 31/01/21

Deltid:

1. Jeanette H. Andersen, 10%
2. Espen Hansen, 10%

HMD-miljø:

1. Rahman Mankettikkara, 10%

Prosjektoversikt, stillinger og gjøremål, Massedyrking alger, NFH, BFE, UiT

Reguleringsteknikk
1. John Markus Bjørndalen,
2. CCU student ikke tilsatt

Økonomi
1. Elin Merethe Oftedal
2. CCU student Ikke tilsatt
3. Kamilla Marie Borrebæk
4. Dagfinn Sætra

Alternativ CO_2 anvendelse
1. Kathrin Hopmann
2. CCU student 2, ikke tilsatt

Dyrking vs. Samfunn
1. Øyvind Stokke
2. CCU student

Toktvirksomhet, Bioprospektering, Fysisk og Biologisk Oseanografi
1. Hans Chr. Eilertsen
2. Alle andre

Toktvirksomhet, Havmiljødata
1. Hans Chr. Eilertsen
2. Rahman Mankettikkara

Styringsgruppe
Edel Elvevoll, Terje Aspen, Geir-Henning Wintervoll, Jo Heming Strømholt, Hans Chr. Eilertsen
Prosjektledelse
Hans Chr. Eilertsen

Dyrking Finnfjord as / Fysiologi
1. Gunilla Eriksen, leder (75%)
2. Therese Smelror Løkken (100%)
3. Marianne Risager Kjøller (50%)
4. Nerea Aalto (25%)
5. Hans Chr. Eilertsen (50%)

Etter behov:
3. Renate Osvik
4. Jon Brage Svenning
5. Lars Dalheim
6. Richard Ingebrigtsen

Eksperimenter, Lab, BFE, UiT
1. Martina Uradnikova, leder (100%)
3. Gunilla Eriksen (25%)
4. Marianne Risager Kjøller (50%)

Stamkulturer/Taxonomi
1. Martina Uradnikova
3. Marianne Risager Kjøller

Lipidanalyser
1. Jon Brage Svenning
2. Lars Dalheim
3. Marte Ramskjell
4. Simen Aronsen
5. Terje Vasskog
6. Terkel Hansen

Bioprospektering
1. Renate Osvik
2. Espen Hansen
3. Jeanette H. Andersen

Molekylærbiologi
1. Hans Chr. Bernstein
3. Richard Ingebrigtsen

Rubisco/CO_2
1. Andrea Gerecht

Lys/optikk vs. Fotosyntese
1. Tobias Bostrøm
2. Anni Maria Lehmuskero

Miljøundersøkelser/Havmiljø
1. Nerea Aalto
2. Rahman Mankettikkara

Assosierte virksomheter

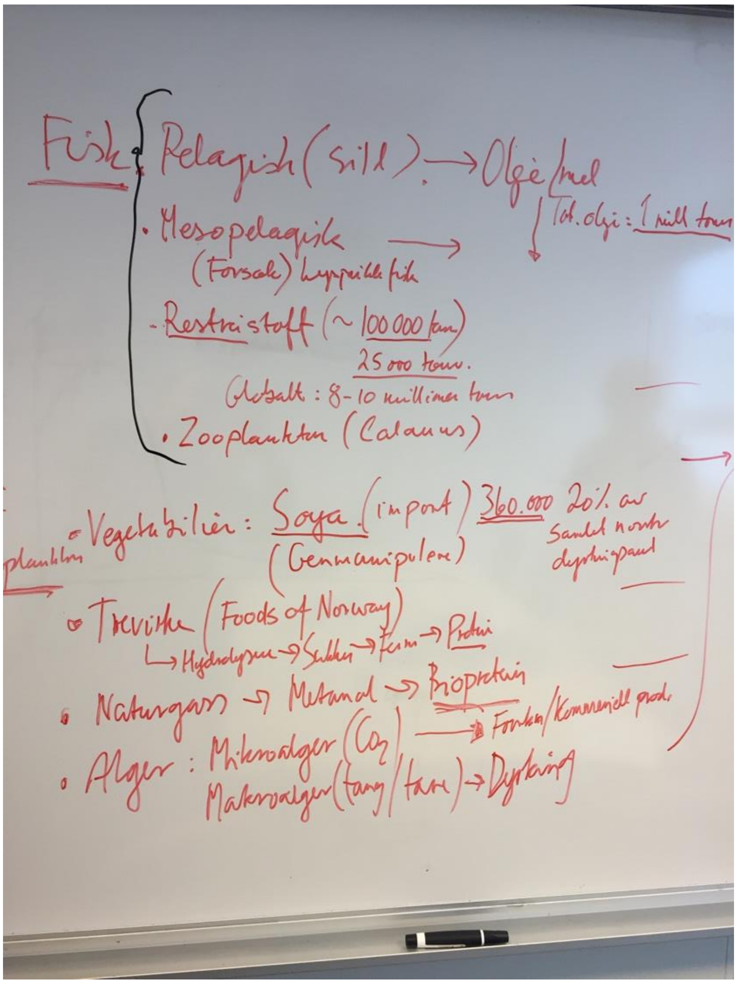
Fiskefôr, fiskehelse
1. Ragnhild Whitaker, NOFIMA
2. Sten Siikavuopio, NOFIMA

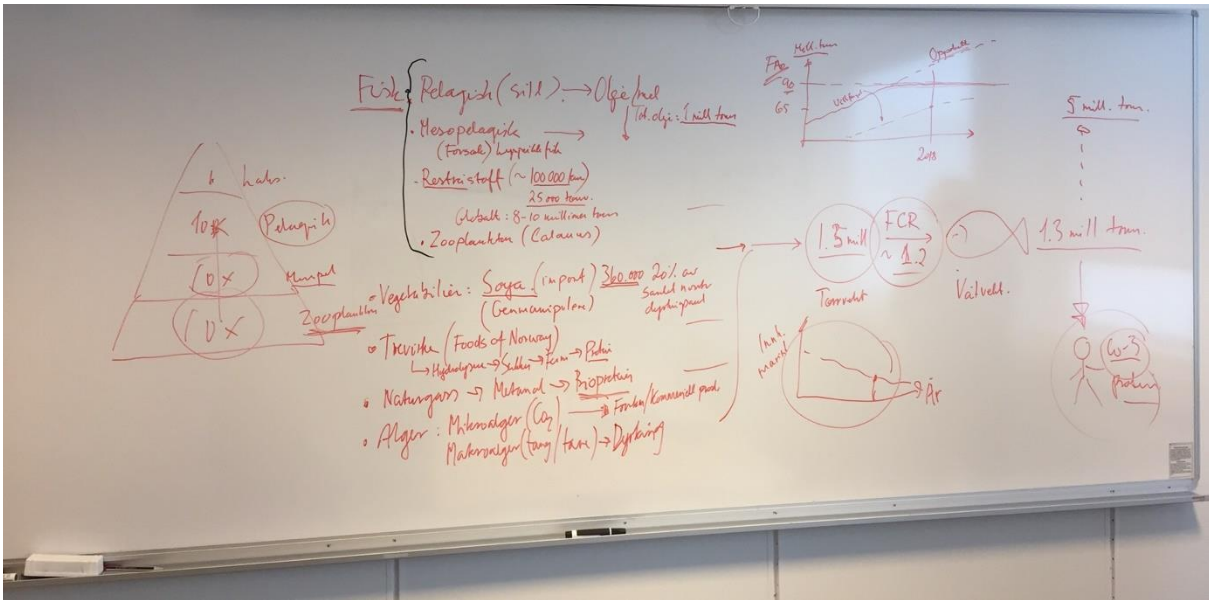
Startfôr fisk
1. Jens P. Jøstensen, Odd Berg Gruppen

Fôring fisk storskala
1. Roy Alapnes, Brødrene Karlsen

CCU partnere
Se separat liste

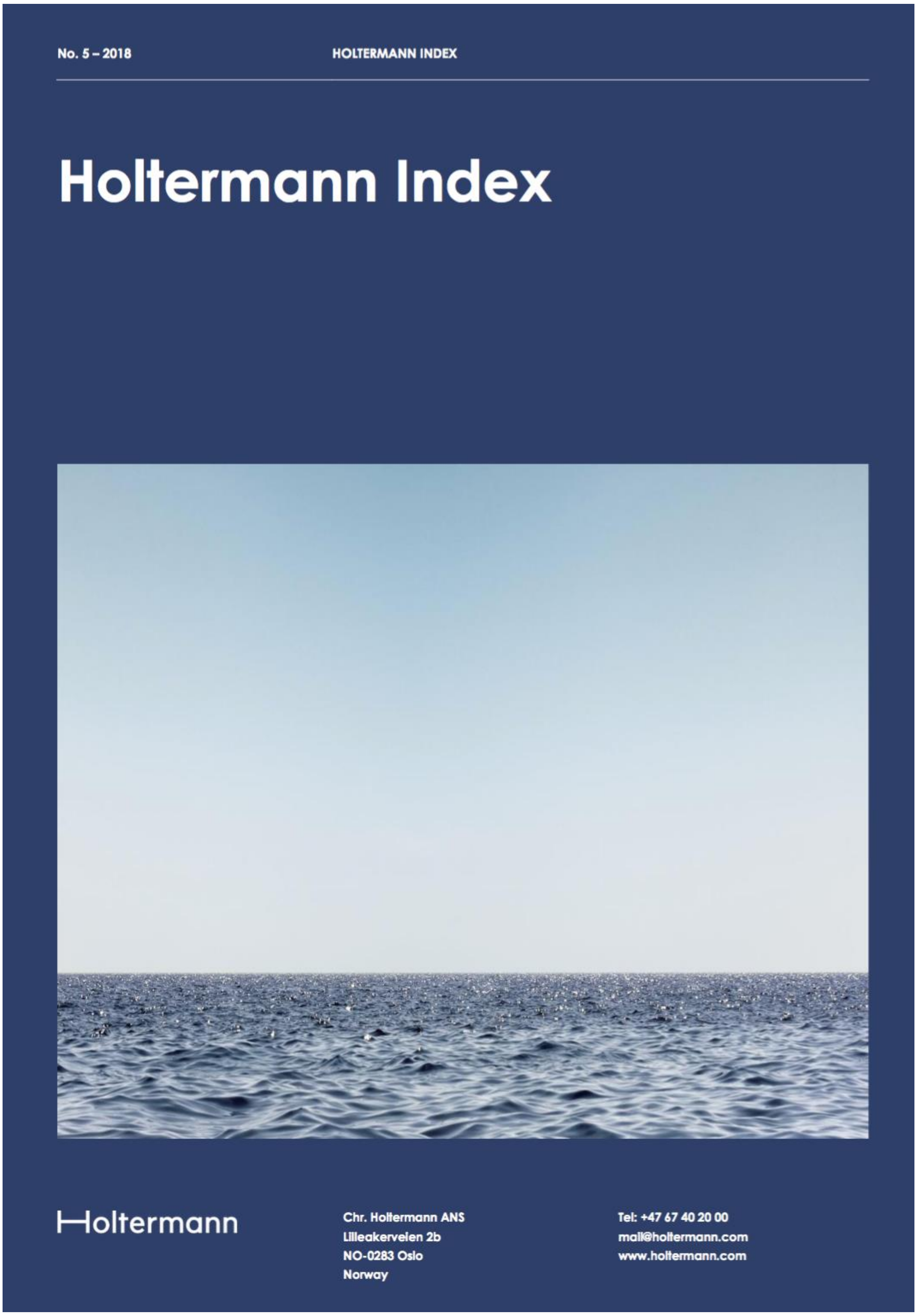
Appendix 2 – Marine food chain





From the interview with SINTEF

Appendix 3 – Price on ingredients



HOLTERMANN INDEX

Report date 20.04.2018

Commodity	20.04.2018		20.03.2018	
LT fishmeal (CIF Norway)	NOK	14286	14825	-3,64 %
NSM fishmeal (CIF Norway)	NOK	14043	14551	-3,49 %
Standard steam dried fishmeal (CIF Norway)	NOK	13869	14352	-3,37 %
Super Prime Peru fishmeal (FOB Peru)	USD	1630	1730	-5,78 %
Standard steam dried Peru fishmeal (FOB Peru)	USD	1420	1500	-5,33 %
Standard FAQ Peru fishmeal (FOB Peru)	USD	1400	1480	-5,41 %
Corn gluten meal, US conventional (FOB Rotterdam)	USD	710	710	0,00 %
Corn gluten meal, US non-GMO (FOB Rotterdam)	USD	n/a	n/a	n/a
Vital wheat gluten (FOB Europe)	EUR	1480	1480	0,00 %
HiPro soybean meal (FOB ARAG)	USD	610	583	4,63 %
Soy protein concentrate (FOB Rotterdam/Brake)	USD	920	875	5,14 %
Sunflower meal (FOB Baltic)	USD	290	275	5,45 %
Rapeseed expeller (FOB North Europe/Baltic)	EUR	291	265	9,81 %
French edible yellow peas (FOB North France)	EUR	230	210	9,52 %
Faba beans (FOB UK)	GBP	169	163	3,68 %
A-Wheat (FOB German-Baltic)	EUR	184	187	-1,60 %
B-Wheat (FOB German-Baltic)	EUR	172	168	2,38 %
E-Wheat (FOB German-Baltic)	EUR	204	202	0,99 %
Rapeseed oil (FOB Rotterdam)	EUR	648	639	1,41 %
Soybean oil (FOB Rotterdam)	EUR	710	705	0,71 %
Fish oil, Scandinavia basis 18% epa/dha (CIF Norway)	USD	1650	2100	-21,43 %
Fish oil, Peru (FOB Peru)	USD	1800	2500	-28,00 %

Currency	20.04.2018	3m forward
USD/NOK	7,80	7,78
EUR/NOK	9,61	9,64
DKK/NOK	128,97	129,32

Appendix 4 – Program, Fiskerifaglig Forum

Fiskerifaglig Forum
Norwegian forum for development cooperation in fisheries, aquaculture and aquatic environment

The Norwegian forum for development cooperation in fisheries, aquaculture and aquatic environment (FFF) invites to annual meeting 2017 and seminar:

Small-scale fisheries; knowledge-based sustainable management

Kystens Hus, Tromsø

1 - 2 november 2017

Background:

Globally, small-scale fisheries is the most common fishery, and an important source for work, food security and income in developing countries. In the Norwegian government´s White paper (No. 22; 2016-2017) "The place of the oceans in Norway's foreign and development policy" it is indicated that the Government will continue the support for small scale fisheries in relation to food security and poverty reduction. In the Norwegian forum for development cooperation in fisheries, aquaculture and aquatic environment (FFF), it has been underlined that future cooperation projects within fisheries and aquaculture should have a comprehensive approach and that the whole competence chain; education, research, surveillance, management advising, should be included. At the 2017 FFF Seminar, sustainable management of small scale fisheries will be the main focus. The seminar will touch upon different aspects connected to management of small-scale fisheries, including research and education, management and business development and the relation between environmental sustainability, social/economic sustainability and poverty reduction.

Fiskerifaglig Forum
Norwegian forum for development cooperation in fisheries, aquaculture and aquatic environment

Program

1 november (12:00 – 17:00), Moderator: Jens Revold, University of Tromsø
12:00 – 12:45 Lunch
12:45 – 13:00 Welcome
13:00 – 13:30 Nicole Franz (The Food and Agricultural Organization of the United Nations): FAO Guidelines for Small-Scale Fisheries
13:30 – 14:00 Svein Jentoft (The University of Tromsø): The Norwegian example; how relevant for the global south?
14:00 – 14:30 Coffee Break
14:30 – 15:00 Ratana Chuuenpagdee (Too Big To Ignore): Research and Governance for Small-Scale Fisheries: Global visions
15:00 – 15:30 Matthias Kaiser (The University of Bergen): Thinking horizontally!
15:30 – 16:00 Edel Elvevoll (The University of Tromsø): Knowledge-based Development cooperation for global food production
16:00 – 16:30 Elvar Hallfredsson (The Institute of Marine Research): Data collection in data poor areas
16:30 – 17:00 Elizabeth Selig (The Norwegian Institute for Water Research): Using lessons learned to catalyze management effectiveness in small-scale fisheries
17:00 Sum-up, day 1

19:00 FFF Dinner Restaurant Skirri, Kystens Hus

2 november (09:00-15:00) – Case studies, Moderator: Åsmund Bjordal, Institute of Marine Research
09:00 – 09:30 Trond Almendingen (The Directorate of Fisheries): Sri Lanka
09:30 – 10:00 Even Moland (The Institute of Marine Research): Sudan
10:00 – 10:30 Coffee Break
10:30 – 11:00 Ragnhild Overå (The University of Bergen): From canoe to table: A value-chain perspective on small-scale fisheries and food security
11:00 – 11:30 Kari Strande (The Ministry of Local Government and Modernisation): Possibilities with the Norwegian Peace Corps
11:30 – 12:30 Lunch
12:30 – 13:00 Brit Fisknes (The Norwegian Agency for Development Cooperation): Experiences
13:00 – 13:30 Evert Flier (Norwegian Mapping Authority): Knowledge on the ocean soil in support of the UN 2030 Sustainable Development Goal 14
13:30 – 14:00 Sylvia Frantzen (National Institute for Nutrition and Seafood Research): Food safety; Documentation and surveillance of contaminants in seafood
14:30 – 15:00 Discussions and sum-up

Appendix 5 – Income statement

		2019	
INCOME STATEMENT Alga from the Arctic		**Kroner**	**%**
Sales revenue	+	30 000 000	######
Cost of goods sold	-	3 000 001	10,0 %
Gross profit	(A =	26 999 999	90,0 %
Operating expenses (per. year):			
Wages - employees, monthly salary x 11		5 000 000	16,7 %
Wages - owner, monthly salary x 11			0,0 %
Employers' national insurance contributions (not including vacation pay)		395 000	1,3 %
Vacation pay		510 000	1,7 %
Employers' national insurance contributions (vacation pay)		40 290	
Rent			0,0 %
Electricity		1 000 000	3,3 %
Telephone, mobile, fax, internet		24 000	0,1 %
Car expenses, leasing, gas, etc.			0,0 %
Other travel costs		400 000	1,3 %
Office supplies			0,0 %
Other consumer goods			0,0 %
Insurances		1 000 000	3,3 %
Marketing (advertising, etc.)		500 000	1,7 %
Accounting		50 000	0,2 %
Depreciation			0,0 %
Other (please specify): Distribution		2 000 000	6,7 %
Other (please specify):			0,0 %
Other (please specify):			0,0 %
Sum operating costs	(B)	10 919 290	36,4 %
Operating results (operating net profit)	(C = A-B)	16 080 709	53,6 %
Interest costs - loan		81 000	0,3 %
Interest costs - other (bank overdraft etc.)			0,0 %
Interest income			0,0 %
Sum financing costs/(revenue)	(D)	81 000	0,3 %
Earnings before tax (= Res. for pers. selskap)	(E = C-D)	15 999 709	53,3 %
Tax - 25 % of earnings before tax	(F)	3 999 927	13,3 %
Net income (for companies organized as AS)	(G = E-F)	11 999 782	40,0 %
Private withdrawal (if sole proprietorship)			

Appendix 6 – Calculations revenue

	1725	USD per ton average (1800+1650)
	2725	USD per ton from alga (DHA)
120 %	3270	USD per ton alga EPA + DHA
140 %	4578	USD per ton from alga (EPA + DHA) with lice efficiency

	Million NOK			Million NOK	
Average capacity/year with	16,6	16 560 000	Average capacity at	336	335 795 400
5 million litre	26,2	26 160 000	at Finnfjord full scale	530	530 459 400
1 200	31,4	31 392 000	100.000.000 litre/year	637	636 551 280
	43,9	43 948 800	24 333	891	891 171 792

Revenue model				
	Fish oil	Algae oil DHA	Alga DHA + EPA	Efficient on lice
5 million litre	17	26	31	44
Mid scale	168	265	318	446
Full scale	336	530	637	891

Revenue 5 million litre tank	31 392 000
USD NOK	8
Revenue NOK total	251 136 000
Monthly revenue	20 928 000

Appendix 7 – Gowth scenario explained

The estimations used to create the growth scenario shown in table Table 3 and Table 5 are derived from primary and secondary data. Some numbers are found online, such as Polarfeed and Skretting. The other where presented as estimations during data collection. Stating that "the three major players are close to equal in production". Using Skrettings public number, the other two were given similar and approximated values.

	Fish feed production in Norway (tons)	**Fish oil in feed tons (average 9 %) 2017**	**Fish oil in feed tons (average 9 %) 2050**
Skretting	543.000	48.870	244.350
BioMar	approx. 540.000	48.600	243.000
Cargill (EWOS)	approx. 540.000	48.600	243.000
Marine Harvest	approx.340.000	30.600	153.010
Polarfeed	35.000	3.150	15.750
Total	1.998.000	179.820	899.110