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Everything Ashore

A Feasibility Study

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INNOVATION TO MARKET

Everything Ashore: A Feasibility Study

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Executive Summary

There is increasing focus on improving the utilisation of the world's resources which are under pressure due to rapid growth in the global population. The Nordic countries situated in the North Atlantic are - to varying degrees – dependent on fisheries. These fisheries resources could be utilised to a higher degree, potentially adding more value to these societies. It is often argued in public debate that this under-exploitation represents very high values. This is because in some fleets, vessels only bring to shore the most valuable part of the fish, the fillet, and discard the head, back, offal and so forth. This leaves a considerable proportion of the biomass unexploited and unavailable for processing on land. This biomass can consequently not be value added and increase the economic and social benefits for society.

The aim of this project is to explore the concept of bringing everything ashore and how this could be implemented in the Nordic countries. In doing so, this project looks at the total fisheries biomass by examining what is brought to shore, what is discarded, and calculating the economic value associated with this biomass.

The project is built on close cooperation with stakeholders. The authors have had several interactions with stakeholders in the chosen case studies in order to gather their perspectives on the various aspects of the matter and to receive their feedback on the analyses conducted in this report. Therefore, this report should hopefully be of strong relevance for industry, policymakers as well as the general public in the respective countries.

This report has three case studies: the fisheries of the Barents Sea (chapter 3), the fisheries in the Faroe Islands (chapter 4), and the fisheries in Greenland (chapter 5). It also partly looks at the Icelandic fisheries and relies heavily on data and experiences from Iceland, which arguably is the Nordic leader in improving the utilisation of fisheries resources.

Two related but different matters are examined in this report:

1. How to bring everything ashore
2. How to add the highest possible value to the biomass if brought ashore

It is difficult to estimate the exact values associated with bringing everything ashore, since there are significant uncertainties involved in time, prices, processes, etc. A complete estimation of every aspect involved is consequently outside the scope of this project. The report does however present some illustrative examples of value added products beyond the more conventional production set-ups.

Value chain analyses are conducted for the three cases for demersal fisheries. The purpose of the value chain analyses is to demonstrate the potential value of the discarded biomass if the biomass was brought ashore and processed into high-value products.

The calculations in the value chain are divided into three parts:
1. Calculating the available biomass (the currently landed and discarded biomass)
2. Calculating the value chain of the existing landings and processing of fish
3. Calculating the potential value chain of the discarded biomass

The value chain calculations and analyses measure the size of the economic activity in the value chains and compare the potential value chain from the currently discarded biomass with the existing value chain. Thus it is possible not only to get an estimate of the potential value of the discarded biomass but also to compare that with the existing value chain and thus get an idea of the relative increase in the fishery sector if everything was brought ashore.

The report uses the concept of Gross Value Added. GVA estimates the contribution of the value chain to the Gross Domestic Product (GDP) and the contribution to the economy of each individual producer, industry or sector in a country. Since a positive GVA does not indicate whether a part of the value chain operates with a surplus or a deficit, the report includes profitability calculations of three methods to bring the entire biomass ashore (silage, fish meal and oil, and frozen/sorted) for a fictional new built vessel and for redesigning an existing vessel.

Nordic Potential in Bringing Everything Ashore

The analyses indicate that the potential increase in GVA for the various cases ranges from 4 – 27 percent if all the biomass from fisheries was brought to shore (See Table 31 below). The total increase in GVA combined for all of the case studies considered here would be 14% if all the additional biomass was landed as silage and 20 percent if the biomass was sorted. This would result in an increase in GVA of 833 – 1142 million DKR for the fisheries in the case studies analysed here (See Table 1).

Overview of increase in GVA	**mill. DKR**	**Increase in GVA mill. DKR**		**Percentage increase in GVA**	
	Current GVA	Silage solution	Sorted landings	Silage solution	Sorted landings
Greenland					
Greenlandic fisheries in the Barents Sea	94	17	25	18%	27%
Demersal fisheries in Greenlandic Waters	727	116	166	16%	23%
Iceland					
Icelandic fisheries in the Barents Sea	245	33	45	13%	18%
Faroe Islands					
Faroese fisheries in the Barents Sea	290	58	69	20%	24%
Demersal fisheries in Faroese Waters	1,039	46	105	4%	10%
Norway					
Norwegian offshore fisheries	3,396	563	732	17%	22%
Total	**5,791**	**833**	**1,142**	**14%**	**20%**

Table 1: Overview of change in GVA for all the case studies if everything came to shore

The overall increase in GVA from Faroese fisheries considered here would be about 104 million DKR for the silage option, and 174 million DKR if the biomass was sorted on-board. For Greenland, the increase in GVA would be 133 million DKR for silage, and 191 million if the biomass was sorted.

Economic and Technical Feasibility of Bringing Everything Ashore

The analyses on profitability of the various methods for bringing the biomass ashore suggest that for the offshore fisheries in the Barents Sea, vessels can bring the entire catch ashore without incurring losses and that it is currently most feasible for such vessels to bring the biomass ashore using silage. This applies to both existing and newly built vessels. It also showed that on-board fishmeal and oil is the least profitable (see page 57). Therefore, perhaps the most important conclusion is that it is economically feasible for fishing vessels to bring the entire biomass ashore but the profitability is not as high as with their current activity. However, much of the value creation takes place in the latter parts of the value chain. We can therefore conclude that getting the entire biomass ashore from fisheries would enable additional value creation on land with the potential to have economic benefits on a company and societal level. The conclusions vary depending on the specifics of each case since they all face different challenges and opportunities in getting everything ashore. The major findings will be outlined in what follows.

Fisheries in the Barents Sea

Although there are many challenges, analyses show that for the fisheries in the Barents Sea, it should be economically and technically feasible to bring everything ashore (see chapter 3). To implement 'everything ashore' requires changes in on-board handling processes, equipment for storing and conservation, etc., but it is currently possible to land the entire biomass, naturally with a transition period to allow vessels to adapt. This does not necessarily mean that it is advisable to introduce or enforce a legal obligation to land everything. That depends on the priorities of policy-makers, and stakeholders were generally opposed to a legal obligation. Potential approaches to ensure that the biomass is landed will be discussed in more detail in Chapter 7.

Fisheries in Faroese Waters

The raw materials that are discarded in Faroese waters generally consist of the liver, roe and intestines. Some freezer long-liners also discard the heads, but liver, roe and intestines represent the bulk of the biomass thrown overboard. Experiences from Norway and Iceland demonstrate that it is possible for the coastal sector to land everything since it is generally done in those countries. For the small-scale fisheries, it would be useful to land the fish bled and ungutted to ensure that all by-products are or could be utilised. Based on the utilisation rate in Norway and Iceland, it should be feasible for vessels in Faroese waters to bring everything ashore. However, since many of the larger vessels fish for longer than 48 hours, a start could be that they are required to land a certain proportion of the liver and other rest raw materials, either as sorted biomass or ungutted. That way fishing vessels have time to adjust their processes on-board. At a stakeholder meeting in the Faroe Islands it was also mentioned that the increasing tendency of freezer long-liners to discard the heads was unfortunate. If the utilisation rate is to be increased in the Faroe Islands, it will be necessary to reverse this trend. One potential initiative is to make it obligatory to land fish with heads.

Fisheries in Greenland Waters
The particular conditions in Greenland mean that the overall conclusions on the project in many ways do not apply to Greenland. It is difficult to make production of rest raw materials profitable due to the geographical distances, and high transportation and production costs. The analysis suggests that there could be some potential in lumpfish, which is currently discarded after the roe are taken. One of the major obstacles for making the production of by-products economically feasible is the number of landing sites, meaning that the quantities in each area are too small to have a profitable operation. Since transport is so costly in Greenland, production is not feasible if it demands that a low value biomass is transported within the country. A necessity for getting everything ashore is that the monopoly on transportation in Greenland is revisited or that incentives are introduced to reduce the barrier that this presents in relation to getting everything ashore. This was also mentioned as the most critical challenge at the stakeholder meetings in Greenland. Getting everything ashore is an ethical, social and political choice. This is even more so in Greenland where the market is even less likely than in the other countries to ensure that everything gets landed. Reducing the number of landing sites has social costs and will result in fewer jobs in some areas so there is a trade-off involved that requires social and political deliberation. The first step is therefore to have a policy and societal debate on whether this is a path that Greenland wishes to take.

Potential Approaches for Implementing the 'Everything Ashore' Concept

First of all, it is essential to establish here that to get everything ashore is an ethical, political and societal choice. The topic of improving the utilisation of fisheries is intrinsically linked to overarching issues of sustainable use of resources. The authority which grants the exclusive fishing rights must decide whether this is a priority and the urgency with which the 'everything ashore' concept should be implemented. A stakeholder analysis has also demonstrated that there are areas of conflict between the various stakeholder groups. Some stakeholder groups, such as R&D institutions and government/civil servants seem to be more enthusiastic about getting everything ashore. Processors are also favourable towards the idea, since they need access to the raw material, whilst fishing vessels – both coastal and offshore – are more reluctant towards the implementation of the concept. At the same time, consumers are increasingly demanding more sustainable products. The challenge of implementing the idea of getting everything ashore is to get the more sceptical stakeholders to change their position from negative to positive towards the concept. There is therefore a mismatch between the interests of various stakeholders in relation to the idea of getting everything ashore. These interests need to become more aligned for the 'everything ashore' concept to be implemented successfully. Table 30 on page 88 demonstrates the action required from each of the stakeholder groups in relation to bringing everything ashore.

If the biomass is to be brought ashore, there are four potential approaches to do so with varying time scales. These options have all been touched upon at the various stakeholder meetings held in the project and will be briefly presented below. It is likely that a successful implementation of 'everything ashore' will require a combination of some of the approaches, since any single one of these might not be sufficient to reach the aim.

- **The Market Approach**

One approach would be to leave it to the market to decide when it is sufficiently profitable to bring everything ashore. In stakeholder discussions it has frequently been mentioned that it should be left to the market, and that the buyers of the biomass will need to pay a higher price if they want the raw material. However, this option could be insufficient since it is necessary to have access to the raw materials in order to set up new productions. Therefore, ensuring the raw materials are available for processors can be seen as a first step in making more value out of the resources.

- **Vertical Integration**

One of the conflicts in relation to getting everything ashore is related to the profitability of the different parts of the value chain. Since much of the value of bringing the biomass ashore occurs later in the value chain, there is limited motivation for fishing vessels to bring this ashore. It has been argued that vertical integration, which has happened in Iceland, has been a critical factor in their success in increasing the utilisation rate in Iceland (Vigfússon, 2016). One concrete step towards getting everything ashore could be to remove the barriers in place that are currently stopping vertical integration within the fishery sector, so that backward or forward integration within the value chain would be allowed to happen, where this is deemed relevant by industry.

- **Incentives**

If getting everything ashore is a societal priority, then incentives to make it more attractive to land the entire biomass is also an option. These incentives can be grouped into a) Increased quota for rights-holders, b) Tax incentives – either in form of a general tax discount in the resource fee for the exclusive fishing rights of the holder, c) Subsidy of prices for rest raw material d) Funding - improved access to financing for investing in bringing everything ashore and for demonstration projects. The incentives could be implemented individually or in combination.

- **Legal Obligation**

The fourth option for getting everything ashore is to legally oblige the fishing vessels to bring all the biomass ashore. An obligation to land everything was not recommended at any of the stakeholder meetings, although there were some voices that acknowledged that if everything was to be brought ashore, a landing obligation might be necessary.

Recommendations

The following recommendations are put forward in relation to getting everything ashore from the fisheries in the Nordic countries.

1. **Setting goals for the blue bioeconomy**

Authorities must formulate a vision for getting everything ashore, which must be seen in the wider context of the bioeconomy and value creation, since R&D institutions and innovative companies cannot create value from the biomass if it is unavailable.

2. **Remove barriers in relation to the established goals**

Depending on the goals, authorities must find ways to overcome the obstacles to allow the goals to be achieved. One of the central barriers relevant for all the cases is the share system to pay fishermen. It would be useful to examine the share pay systems in the Nordic countries and its implications for improving the utilisation of fisheries resources. Such an approach could perhaps suggest potential solutions to overcome this barrier.

3. **Establish national and Nordic funding mechanisms to improve utilisation**

One way to reach the aim of getting everything ashore is to ensure that there are opportunities for R&D institutions and industry to enter into projects on bringing everything ashore. A concrete step could be to establish flagship projects exploring various aspects related to the issue of getting everything ashore. The initial funding of these facilities could be directly or indirectly linked to the taxation of resource rent within existing fisheries.

4. **Ensure national and international co-operation between industry and research institutions**

If more value is to be created from rest raw materials, it is essential that industry and R&D institutions, such as Matís and Nofima, collaborate on creating value from the rest raw materials that are currently underutilised or unutilised. The Nordic countries considered here are all at different stages in terms of utilisation of fisheries resources. At the same time, there are many similarities between these countries, and a lot could be gained through cooperation across the Nordic countries, both within the fishing industry as well as cross-sectorally.

5. **Investing in human capital**

In order to be successful in the blue bioeconomy, you need a strong and well-educated workforce. One of the greatest threats for Nordic communities is demographic migration of young intelligent people that will undermine the ability to create a prosperous future for the next generations. It is essential that the fishing industry manages to attract young and well-educated people for the industry to develop within the blue bioeconomy. As a result, it would be useful to establish links between industry and students at higher education institutions to ensure that the industry can attract a talented and well-educated workforce.

6. **Pursue international opportunities for funding**

In order to progress within the blue bioeconomy and create further value from what currently is considered waste by many, access is needed to regional, national and international R&D funding schemes, e.g. H2020, Northern Periphery, Nordic Innovation and NORA. There are currently several opportunities within H2020. The Nordic countries are in a very good position to utilise these international funding opportunities within the context of the blue bioeconomy.

Road Map

The analysis presented in this report has highlighted several opportunities and challenges in relation to the implementation of the 'everything ashore' concept. It is clear that there are different circumstances within the different national contexts, which make the implementation of 'everything ashore' more or less feasible. To illustrate this, it is useful to look at an example. In our view, the case study where the 'everything ashore' concept is the most difficult to put into force is for the fisheries in Greenland waters. The geographical distances are simply too large, and there are too many landing sites in order for it to be economically feasible. It is clear that reducing the number of landing sites has social costs, so there is a trade-off involved in such a choice. It is therefore of fundamental importance that the issue of utilisation of fisheries is subject of public debate and that policy-makers decide whether the 'everything ashore' concept should be implemented, and if so, identify the necessary steps to reach the aim. This is because the necessary steps will naturally depend on the national context. Based on the discussions above, the following road map is presented.

Road map for the implementation of the 'Everthing Ashore' concept

Time: / To do:	Autumn 2016	Winter 2016/2017	Spring 2017	Summer 2017	Autumn 2017	Winter 2017/2018	Spring 2018	Summer 2018	Autumn 2018	Winter 2018 onwards
Develop a strategy for the Blue Bioeconomy	National and Nordic									
Identify concrete initiatives to get everything ashore			National and Nordic							
Implement inititatives to suit the developed strategy							National or Nordic			
Present project findings	National and Nordic									
Comparative study of pay system in fisheries in the Nordic countries in relation to getting everything ashore.		Nordic								
Pursue funding opportunities in relation to getting everything ashore					National, Nordic and International					
Gradually implement the concept idea of 'everything ashore'								National or Nordic		

National and Nordic **Nordic** **National, Nordic and International** **National or Nordic**

Figure 1: Road map for the implementation of the 'Everything Ashore' concept

The first step is to develop a strategy for the blue bioeconomy, which means deciding to which extent resources ought to be brought ashore. It is important for the authorities of each specific country to decide on their vision and priorities on a national level, but it is also relevant to develop such a strategy at the Nordic level, for instance under the auspices of the Nordic and West Nordic Bioeconomy Panels. In this respect, the road map for the blue bioeconomy developed under the Finnish presidency in the Nordic Council of Ministers can be useful. A lot can be gained from co-operation across the countries since there are many common challenges. In this respect, it would also be useful to conduct a comparative case study at the Nordic level into the pay systems in fisheries in the Nordic countries and their implications for getting everything ashore. Such a project could possibly be funded under the Nordic Fisheries Cooperation and would be an appropriate follow up to this project.

Based on the desired strategy for the blue bioeconomy, the next step would be to identify concrete initiatives that would make the implementation of the 'everything ashore' concept possible. It is likely that it would be beneficial to have some country-specific initiatives, whilst others should be introduced at the Nordic level. For instance, initiatives in relation to funding could be part of upcoming programmes of bodies such as NORA, Nordic Fisheries

Cooperation and Nordic Innovation. It is also important that within a year or so that the fishing industry and R&D institutions pursue funding opportunities in relation to this topic. Once the necessary initiatives have been identified and designed, the next step is to implement them in relation to the developed strategy both at the Nordic and national levels. The final step suggested here is to gradually start implementing the 'everything ashore' concept two years from now. How this is done depends on the priorities of each the respective governments in the Nordic countries.

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On behalf of Syntesa Partners & Associates

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Abbreviations and Explanations

CAPEX	A capital expenditure (Capex) is money invested by a company to acquire or upgrade fixed, physical, non-consumable assets, such as buildings and equipment or a new business.
DKR	Currency of Denmark (DKK)
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product is a monetary measure of the value of all final goods and services produced in a period (quarterly or yearly). Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons.
GVA	Gross Value Added is the value of output less the value of intermediate consumption. GVA measures the contribution to GDP by each individual producer, industry or sector. GVA is used in the estimation of Gross Domestic Product (GDP).
H&G	Headed and Gutted. Fish with heads and guts (viscera) removed.
ICES	International Council for the Exploration of the Seas
ITQ	Individual Transferable Quota
Mill.	Million
NEAFC	North East Atlantic Fisheries Commission
NGO	Non Governmental Organisation
NORA	The Nordic Atlantic Cooperation
OPEX	Operational expenditure or OPEX is an ongoing cost for producing a product.
R&D	Research & Development
Silage	Compacted biomass added formic acid, stored in airtight conditions. Can be stored for years.
TAC	Total Allowable Catch
Thousands separator	The report uses the Scandinavian method for punctuation of numerals, i.e. It uses full stops as 1000 separator instead of the common English method of the comma for this purpose (1.200 is one thousand two hundred).

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1. Introduction

There has been growing focus on improving the utilisation of the world's natural resources which are under increasing pressure due to rapid growth in the global population. The Nordic countries situated in the North Atlantic are - to varying degrees – dependent on fisheries. These fisheries resources could be utilised to a higher degree, potentially adding increased value to these societies. It is often argued in public debate that this under-exploitation represents very high values. This is because of the fact that in some fleets, vessels only bring to shore the most valuable part of the fish, the fillet, often discarding the head, back, offal and so forth. This leaves a considerable proportion of the biomass unexploited and unavailable for fish processing industry on land. This biomass can therefore not be value added.

The aim of the "Alt I Land" project (translated into English as "Everything ashore") is to explore the 'everything ashore' concept and how this could be implemented in the Nordic countries. In doing so, this project looks at the total fisheries biomass by examining what is brought to shore, what is discarded and calculating the economic value associated with this biomass. The analysis is done for three case studies: Faroese waters, Greenland waters and the Barents Sea. These case studies are presented in throughout the report.

The project is built on close cooperation with stakeholders. The project has had several interactions with stakeholders in the relevant cases, in order to gather their perspectives on the various aspects of the issue, and to receive their feedback on the analysis conducted in this report. As a result, this report should hopefully have strong relevance for the industry, policymakers as well as the general public in the respective countries. The report is organised as follows: The first section outlines the methodology and approach of the analysis. The following chapters will focus on each specific case study, before the final chapter draws some conclusions on the overall issue and the way forward.

During the open interactions, several issues and perspectives have been raised which have been taken into account to the extent possible. Throughout the report, we will use examples to illustrate issues or potential opportunities which have been raised by stakeholders.

It is important to state here, that there are two related but different issues involved in this theme.

- One is related to the bringing everything ashore and implementation of such an activity
- The other is related to the issue of adding the highest possible value to the biomass.

This project touches on both, but the key concern is how to bring the entire biomass ashore, and the immediate value associated with this. It is difficult to estimate the exact values associated with the value adding, since there are significant uncertainties involved in time, prices and processes etc. A complete estimation of every aspect involved is consequently out of the scope of this project. The report will however seek to present some illustrative examples of value added products in the respective case studies.

This report focuses on business cases in three countries: Faroe Islands, Greenland and Norway. It also considers in part Icelandic fisheries. It also relies heavily on data and experiences from Iceland, which arguably is the Nordic leader in terms of improving the utilisation of fisheries resources.

1.1 Improving the Utilisation of Fisheries in the Nordic Countries

Several of the Nordic countries in the North Atlantic are to a large degree dependent on the marine resources surrounding them. This is particularly the case for the West Nordic countries. In the Faroe Islands the direct contribution of fisheries (incl. aquaculture) is about 20 percent whilst in Greenland and Iceland the figures are 13 and 11 percent respectively. In the other Nordic countries, such as Norway, Sweden and Denmark these figures are below 1 percent, however, for some regions the fisheries have similar importance as in Iceland and Greenland (Dankel et al., 2015).

The global population is steadily increasing. In 2050, an estimate of 9.1 billion people will populate the earth, meaning that the world will need to increase its food production by 70 percent (FAO, 2009). At the same time, it is clear that 90 percent of the global fish stocks are either overexploited or exploited at a level providing maximum sustainable yield (FAO, 2014). Global capture fisheries are not expected to increase, whilst aquaculture will increase dramatically to meet the rising demand for seafood from a growing population and increased wealth in developing countries, with projections stating that aquaculture will contribute 60 percent of global seafood consumption in 2030 (World Bank, 2013). The content of marine ingredients in fish feed is already decreasing in the light of rising fish meal prices (Ytrestøyl, Aas, & Åsgård, 2014). Nevertheless,the continuous growth in aquaculture will require marine proteins to ensure that the fish contains the nutritional benefits of seafood, providing essential nutrients, vitamins and omega 3 fatty acids.

Improving the utilisation is also increasingly important in the context of the bioeconomy. According to the definition of the European Commission (2012), the bioeconomy "encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy".

At a Nordic Ministers level, increased utilisation of biomass has been addressed. At their joint meeting in May, 2014, the Prime Ministers in the Nordic countries called for strengthening co-operation within the Nordic bioeconomy. The Ministers for Food followed up on this at the meeting in June 2014 (Nordic Marine Think Tank, 2015). It is clear that the concept of the bioeconomy has received increasing attention since it was first introduced in the last decade. It has become an important component of global policies, such as at OECD and EU level (Smáradóttir et al., 2014). A report on the Arctic Bioeconomy highlighted that "the biological, social and economic challenges ahead with the scarcity of natural resources and climate changes, underline the need for new approaches and innovation" (Smáradóttir et al., 2014).

The EU introduced its bioeconomy strategy with the following rationale: "In order to cope with an increasing global population, rapid depletion of many resources, increasing environmental pressures and climate change, Europe needs to radically change its approach to production, consumption, processing, storage, recycling and disposal of biological resources" (European Commission, 2012). In 2011 the Commission adopted a Communication on Blue Growth showing how Europe's coasts, seas and oceans have the potential to be a major source of new jobs and growth, thus contributing to the Europe 2020 Strategy. It recognizes that seas, oceans and coastal areas are drivers for the European economy with great potential for innovation and growth. Blue Growth offers new and innovative ways to help steer the EU's economy and ways to tackle the scarcity and vulnerability of strategic resources while offering a wealth of technological, industrial and recreational opportunities while maintaining environmental integrity on land and sea.

Growth, welfare and values were the overall themes of the 2015 Danish presidency of the Nordic Council of Ministers under which the Faroe Islands was chairing the Nordic Fisheries and Aquaculture Cooperation. The Faroe Islands decided to focus the Nordic programme of fisheries and aquaculture cooperation in particular on blue growth and marine-based bioeconomy. In this context an international conference was held in the Faroe Islands in June 2015. At the conference the Nordic Marine Think Tank presented the synthesis report "Blue Growth in the North East Atlantic and Arctic" (Nordic Marine Think Tank, 2015). The report proposes that the coastal states in the North East Atlantic should 1) Consider introducing legislation to get all or parts of the fish, after bleeding, ashore for further processing; 2) Agree on an action plan for increased collaboration among the bio-industry in the Nordic region and multinationals controlling larger share of the value chain; and 3) Exchange information on best practices, building up bio-based value chains, including bio-refining and most importantly, securing an uninterrupted supply of biomass.

There have also been political statements in several Nordic countries on the issue of bringing everything ashore. This political intention is clearly expressed in the coalition agreement of the current Faroese government: "All catches should be landed and to the largest possible extent processed and value added in the Faroe Islands" (Føroya Landsstýri, 2015). Karl-Kristian Kruse from the Greenlandic Ministry of Fisheries, Hunting and Agriculture has also stated that "the processing of fish must be ensured to the largest possible extent, by amongst other things obligations to land all catches and requirements to process them in Greenland" (Kruse, 2015). In Norway, bringing everything ashore has also been raised as an issue in the latest report to the Norwegian Parliament on the competiveness of the Norwegian fish processing industry (Meld. st. 14 (2015-2016), 2015). After the hearing the Government was instructed to a) develop a strategy for bringing everything ashore, b) to develop an incentive system and c) to consider an introduction of an 'everything ashore' principle.

However, whilst there is significant political interest and willingness in utilising the entire biomass from the fishing industry, many challenges remain as to how this can be achieved. This report tries to shed light upon the nature of these obstacles, and suggest potential ways to overcome them.

1.2 Utilisation of Marine Resources in the Nordic Countries

This section briefly outlines the status regarding the utilisation of fishery resources in Iceland, Faroe Islands, Greenland and Norway. It gives an overview of legislative aspects in relation to this, as well as to the overall utilisation of the marine resources in the respective countries. Recently much focus has been on improving the utilisation of fishery products. In Denmark, the Trash2Cash project focused on practical demonstrations in relation to utilization and marketing of by-products from cod, Norway lobster and herring (Trash2Cash, 2015)[1]. In particular two H2020 EU projects funded in connection with the introduction of the landing obligation in the European Union are worth mentioning in this context: MINUOW (2015) and Discardless (2015) both of which examine the effects of the landing obligation for the fisheries and the ecosystem. DiscardLess also focuses specifically on handling and storage of unwanted catches on-board, processing requirements and reception facilities on land as well as bringing products to the value chain. The projects only started last year, but are likely to come up with some good solutions for Nordic stakeholders as the project progresses.

SINTEF in Norway continuously provides a comprehensive overview of utilisation of rest raw material of marine resources in Norway. It is estimated that in 2014, 37 percent of the rest raw materials from demersal fishers were utilised, and 41 percent of shellfish was utilised, whilst 100 percent of the pelagic rest raw materials were utilised (Richardsen, Nystøyl, Strandheim, & Viken, 2015). The utilised rest raw materials are mainly used either as feed ingredients or as products for human consumption such as canned liver, roe or as flavouring. Thus far, little of the Norwegian rest raw material is processed into high value added products, such as nutraceuticals, cosmetics and pharmaceutical market (Richardsen et al., 2015). In terms of volume of biomass, heads from whitefish fisheries constitute 80.000 tonnes, followed by entrails and liver constituting approximately 55.000 and 38.000 tonnes respectively (Richardsen et al., 2015).

In Iceland there has been relatively much focus on improving the utilisation in the whitefish industry, with particular emphasis on cod. Icelanders are frontrunners with estimations that they are currently utilising 72 percent of the cod (Smáradóttir et al., 2014). Figure 2 below demonstrates products currently derived from cod in Iceland. It demonstrates how fish skin is utilised for medical products, such as a plaster to heal chronic wounds[2], collagen[3] and well as leather. The enzymes from intestines are used in medical and cosmetic products. The liver is used for omega 3 and cod liver oil[4] or canned goods and paté. The heads and backs are typically dried and exported.

[1] Project deliverables and the final report can be downloaded from fiskeviden.dk
[2] e.g. http://www.kerecis.com/products
[3] e.g. www.zymetech.com
[4] see www.lysi.is

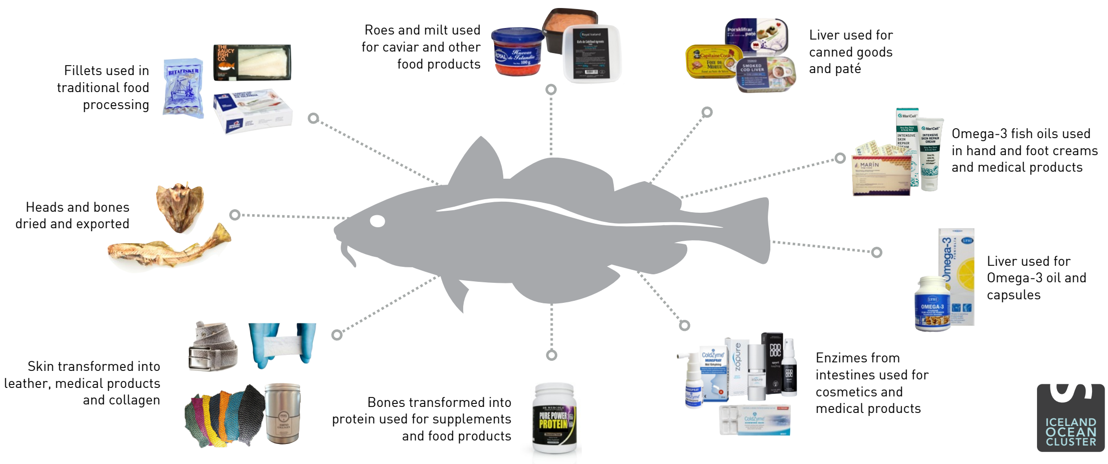


Figure 2: Products derived from Cod in Iceland © Iceland Ocean Cluster

There is a quite a substantial difference between the utilisation in Iceland and the other countries considered here in this report. Arguably, one of the reasons for the progress in this respect in Iceland, is the consolidation in the industry and the vertical integration across the value chain, meaning that vertically integrated companies can collect and handle the raw materials and make valuable products from the biomass. The vertical integration also makes it easier to incentivise fishermen to bring everything ashore (Vigfússon, 2016). Furthermore, when comparing the cod value chains of Iceland and Norway, Trondsen (2012) found that “fish quotas in Norway are greatly controlled by fishers who have no investment in land production facilities, whereas in Iceland, quotas are mainly owned by vertically integrated companies with interests in both processing plants and fishing vessels”, meaning that in Iceland there is more focus on value-adding rather than exporting raw materials to low-cost production countries.

In Greenland and the Faroe Islands, the situation regarding utilisation of demersal fish is more similar to the one for the offshore fisheries in Norway. For the pelagic fisheries, there is almost 100 percent utilisation, whilst the utilisation of whitefish, such as cod and haddock, is closer to the situation of the offshore fleet in Norway. In the Faroese coastal fisheries, the liver, roe and entrails are often discarded. For the long-distance fleet the level of rest raw material not brought to shore depends on the type of production. Most commonly filleting trawlers discard around 65 percent of the fish, whilst vessels landing headed and gutted (H&G) fish discard the head, liver and entrails, discarding approximately 35 percent. The chapters that follow will give a more complete picture of the utilisation for the various cases.

In recent decades, much research has gone into improving the utilisation, and creating value added products from the rest raw material. For more information on this, see for instance (Akse & Tobiassen, 2010; Aursand, 2015; Hansen, 2007; Henriksen, 2013; G. Johnsen, 2002; S. L. Olsen, 2000; Sandbakk, 2002; Sigurgísladóttir, 2010; Svavarsson & Margeirsson, 2010; Trash2Cash, 2015; Vigfússon, Sandholt, Gestsson, & Sigfússon, 2013).

2. Methodology and Approach

This chapter introduces the methodology and approach of the project. First the approach for interaction and co-operation with stakeholders will be introduced. This chapter also contains a general conceptual discussion on discards, before outlining the methods for the calculations on each case study, as well as the methodology for the stakeholder analysis.

2.1 Co-operation with Stakeholders

The project is built upon strong interaction with stakeholders, in particular those working in the industry. This cooperation with stakeholders is quite strongly reflected in the analysis presented. The project itself was developed in close cooperation with actors in the Faroese fishing industry. In addition to that, the project has had two rounds of stakeholder meetings in Norway, Greenland, Iceland and the Faroe Islands. Local knowledge institutions in each of the countries were responsible for organising (identifying and inviting the appropriate stakeholders), hosting and running the events. The purpose of the first round of meetings was to introduce stakeholders to the project, as well as to let them raise their perspectives on the various aspects of the issue. They were also encouraged to suggest whether there were certain aspects relevant to their respective case studies that they would like the project to consider. The second round of meetings was a round table discussion, where the preliminary findings for the relevant case studies were presented, and stakeholders were encouraged to come with their comments and corrections to ensure that the calculations and conclusions of the project were realistic. See Table 2 for an overview of the workshops and the stakeholders involved.

	PLACE AND DATE	REPRESENTATIVES FROM
OPEN DIALOGUE WORKSHOPS	**Greenland** 28.10.2015 18 participants	Sermersooq, Polar Seafood, Finansdepartementet, Dep. For Fiskeri, Fangst og Landbrug (APNN), Polar Seafood, KNAPK, Grønlands Erhverv, Royal Greenland, Grønlands Naturinstitut
	Iceland 03.11.2015 16 participants	HB Grandi, Codland, SFÚ (Association of fish processors and exporters), National Association of Small Boat Owners, Directorate of Fisheries, Skipasýn, Haustak, Margildi, Marel, Matís
	Norway 08.12.2015 19 participants	Nofima, Nergård, Kvalvik Bait, Aquarius, Nordnes, Langaas Drift AS, SINTEF, Hermes, Innovasjon Norge, AkvaRen, UiT
	Faroe Islands 14.12.2015 17 participants	Fróðskaparsetur Føroya, Vaðhorn , Fiskimálaráðið, Biotech, Hordafor, Felagið Línuskip, Meginfelag Útróðrarmanna, Framherji, Mest, Enniberg, Faroe Marine Products, Føroya Ráfiskarakeyparafelag, Syntesa
ROUND TABLE DISCUSSIONS	**Faroe Islands** 08.04.2016 17 participants	Fróðskaparsetur Føroya, Vaðhorn, Fiskimálaráðið, Biotech, Havsbrún, Felagið Línuskip, Meginfelag Útróðrarmanna, Framherji, Mest, Enniberg, JFK, Faroe Marine Products, Føroya Ráfiskarakeyparafelag, Føroya Reiðarafelag, PRG, Syntesa
	Iceland 14.04.2016 24 participants	Tempra, Codland, SFÚ, National Association of Small Boat Owners, Directorate of Fisheries, Haustak, Fisktækniskólinn, Háskóli Islands, Fisheries Iceland, Norður, Ican, Ministry of Industries and Innovation, Sjómannasamband Íslands, University of Manchester, Matís
	Greenland 18.04.2016 13 participants	Sermersooq, Polar Seafood, Finansdepartementet, Dep. For Fiskeri, Fangst og Landbrug (APNN), Polar Seafood, KNAPK, Grønlands Erhverv, Royal Greenland, Royal Arctic Line, Grønlands Naturinstitut
	Norway 21.04.2016 15 participants	Nofima, Espersen, Nergård, Kvalvik Bait, Aquarius, Hordafor, Hermes, Innovasjon Norge, AkvaRen, UiT

Table 2: Overview of open dialogue workshops and round table discussions

The outcomes from the discussions at the various workshops will be presented in relation to each case study in the forthcoming chapters. In addition to these formal stakeholder meetings, project members have also conducted key-informant interviews within the industry in the various countries in order to get a better and more in-depth understanding of various production processes, costs as well as prices. Together with relevant literature, these interviews serve as the basis for the calculations presented in the report.

2.2 Discards in the Nordic Context

Since this project focuses on bringing all the available biomass ashore, it is necessary to briefly look into the issue of discards, since the terms can have various quite different connotations and meanings.

2.2.1 *What is Discarding?*

There is some conceptual confusion around the topic of discards, which merits some clarification here. The FAO defines discards, or discarded catch, as "that portion of the total organic material of animal origin in the catch, which is thrown away, or dumped at sea for whatever reason. It does not include plant materials and post-harvest waste such as offal. The discards may be dead, or alive." (Kelleher, 2005). The Nordic workshop on discarding in Nordic fisheries defined 'discards' as the proportion of the catch that is taken on board and subsequently thrown back to sea dead or dying. Discard also includes the catch brought to the surface and is likely to die after release (i.e. slippage[5]) (Nordic Council of Ministers, 2003). Although the definitions are similar, the latter definition is clearer on that throwing offal overboard also constitutes discarding.

Despite these definitions, estimates of discarding generally tend to refer to discarding of whole fish, rather than rest raw material. For instance, in many demersal fisheries vessels frequently discard the viscera, such as liver, roe, milt and other entrails. It is also common for demersal factory vessels only to land either fillets or headed and gutted fish (H&G), discarding everything else, including heads, trimmings and cut-offs, as well as the viscera (Viðarsson, Guðjónsson, & Sigurðardóttir, 2015). This kind of discarding has been in focus in the Nordic countries, so in this project the definition of discard extends the FAO definition to the entire biomass, i.e. the whole fish. The economic calculations presented in this report are based on this definition, but further details will be provided in the chapters on case studies. Sometimes the terms discard and bycatch are used synonymously. However, this is a misconception. Bycatch is the part of the catch which is not the primary target of the fishing effort. It can consist of both fish which is retained and marketed (incidental catch) and that which is discarded or released (Clucas, 1997).

2.2.2 *Discards in Norway, Faroe Islands, Iceland and Greenland*

Discarding is prohibited in all the countries concerned here. Norway introduced a discard ban on cod and haddock in 1987, which has been expanded to more species, and in 2009 an obligation to land all catches was put in place (Nedreas, Iversen, & Kuhnle, 2015). The ban does not apply to viable fish, which can be released back into the sea. Although there are no formal exceptions from the discard ban, the Norwegian enforcement agency has a somewhat pragmatic approach in relation to damaged fish not suitable for human consumption and cut-offs. In such cases of discard, the authorities will not prosecute (Gullestad, 2013). The Faroese regulation on commercial fishing states that: "throwing catch overboard is prohibited"

[5] Slippage refers to the act of discarding fish before sorting, i.e. the catch or the proportion of the catch not brought on board for processing (Borges et al., 2008)

(Føroya Løgting, 1994). Iceland has had a landing obligation since 1977, which has been extended so that it now applies to all commercial species (Viðarsson, Guðjónsson, et al., 2015). Iceland has incorporated a significant degree of flexibility, helping address the problem of discarding. This is done via the flexible ITQ system which permits 5 percent of quota being transferred between years and fishers can also land 5 percent without deducting it from quota. A catch value of 80 percent will then go to fisheries research, whilst the fishers can keep the remaining 20 percent. In Norway, the revenues from landed illegal fish remain in the fishermen's sales organisations rather than being credited to the fishermen's account (Clucas, 1997). Additional quota can be purchased in case of larger overruns, or in case of non-target species. Catches below minimum sizes should also be landed, and will count as 50 percent of the quota (Clucas, 1997). However, an area will be closed in cases where catches of undersized fish are above the proscribed limits (Viðarsson, Guðjónsson, et al., 2015). Norway and Faroe Islands also have measures to protect juvenile fish.

2.2.3 Why Discard?

Discards on a global scale can vary significantly depending on gear type and fishing area (Kelleher, 2005). It is estimated that European fisheries as a whole discard 23 percent of total catches (Viðarsson, Guðjónsson, et al., 2015), whilst the global average according to the latest FAO estimates is 8 percent (Kelleher, 2005). The North East Atlantic has the highest discard rate on global scale, but this is mainly due to high discard rates in certain European Union fisheries (Vazquez-Rowe, Moreira, & Feijoo, 2011).

Although discarding is illegal in the countries in question here and relatively low compared to many of the other world's fisheries (Kelleher, 2005), there is still some level of discarding in the Nordic countries. The level of discarding varies significantly amongst fisheries and areas. Since discarding is considered unacceptable or illegal, it is difficult to gauge the exact degree of discarding. Not only is it difficult to obtain official figures but estimations are very much dependent on type of fisheries, for instance for Iceland discard rates for cod have not exceeded 2 percent since 2001, and were estimated as less than 1 percent in 2013 (Viðarsson, Guðjónsson, et al., 2015). Generally discarding in Norwegian fisheries ranges from 2 – 8 percent. The estimated discard rate for the Barents Sea demersal fisheries is between 1 – 5 percent. Since 90 percent of fisheries in Faroese Waters are managed with effort quotas, i.e. with ´fishing days rather than TAC, it is there is arguably little or no incentive to discard. So although there are no official discard figures, ICES (2003) estimates that discards are low or even negligent. Estimates of discarding from pelagic fisheries range from 1 – 11 percent. Discards of pelagic species from demersal fisheries range from 3 – 7 percent of total catch (Borges, Keeken, Helmond, Couperus, & Dickey-Collas, 2008).

There can be multiple reasons for fishers to discard their catch. FAO divides these reasons into five main blocks: biological causes, legislative restrictions, market demands, fishing gear and vessel characteristics (Vazquez-Rowe et al., 2011). In addition, the Nordic Council organised a workshop on discarding in Nordic fisheries where they identified potential reasons for discarding. The list can be seen in Table 3 below.

Reasons for discards in Nordic fisheries	
Undersized fish	• No market for fish • Landing legally prohibited
High-grading	• Discarding of catch to make room for more valuable catch • To save quotas for later use • Maximising profit
Lack of space	• No more space on-board • Rest raw materials thrown overboard to ensure that only the most valuable part of the fish are landed
Choke species	• Species quota reached • Capture of one species is prohibited • Mixed fisheries problem • Low-value species
Damaged or spoiled fish	• Damage by gear or fishing operation • Catch too old • Predation in gear • Fish spoiled by waste substances or marine pollution • Too long soaking time (gill-net fishery)
Overfishing	• Fish stock composed of small fish • Fishery less selective in order to ensure some catch
Gear selectivity	• Fishing methods and gears are not perfectly selective resulting in unwanted catch
Season	• A fish specimen must be discarded if caught out of season • A fishing temporarily closed for capture of one target species but open for others

Table 3: Reason for discards in Nordic Fisheries. Adapted from Nordic Council of Ministers (2003) and key-informant interviews conducted from December 2015 – February 2016.

2.3 The Methodology for the Value Chain Analysis

The purpose of the value chain analysis is to demonstrate the potential value of the discarded biomass if the biomass was brought ashore and processed into useful products.

The calculations are divided into three parts:

- Calculating the available biomass (the currently landed and discarded biomass)
- Calculating the value chain of the existing landings and processing of fish
- Calculating the potential value chain of the discarded biomass

The value chain calculations and analysis measure the size of the economic activity in the value chains and compare the potential value chain from the currently discarded biomass with the existing value chain. Thus it is possible not only to get an estimate of the potential value of the discarded biomass but also to compare that with the existing value chain and thus get an idea of the relative increase in the fishery sector if everything was brought ashore.

A value chain analysis cannot determine whether a production will be profitable or not, since some companies are able to make money out of a certain production setup while others are not. The profitability thus depends as much on designing a good production setup and good leadership as it is on availability of raw material.

Therefore, the calculations show the value chain's contribution the Gross Domestic Product (GDP). Gross Value Added (GVA) measures the contribution to the economy of each individual producer, industry or sector in a country. If you add up the GVA from each individual firm or industry in a country for a given year, you get the total production in that country for that year. When adjusted for some taxes and subsidies the GVA equals GDP. GVA in a firm or an industry can be calculated directly from the accounts as:

Sales income- intermediate expenditures[6]*= equals GVA*

GVA can be thought of as the value added by the economic activity of a producer. The value added can, after the depreciations are deducted, either go to the workforce as wages and salaries, to the foreign capital as interest payments or go to the owners of the company as profit. The advantage of GVA is that it makes the calculations comparable across industries and countries. The total value of the GVA in the value chain shows the total value created in the value chain. The disadvantage of the GVA is that it does not show the profitability of the various parts of the value chain. A positive GVA does not indicate whether a part of the value chain operates with a surplus or a deficit, it only shows the added value created in the value chain.

Data Sources Used in the Calculations

The data sources used in the calculations are:

- Catch statistics
- Conversion factors for cod
- Industry statistics
- Collected data from the industry, research institutions and authorities

The catch statistics and the conversion factors for cod are the basis for the calculations in step 1, namely calculating the available biomass. The industry statistics and other collected data from the industry, research institutions and authorities are the basis for the calculations of the existing and potential value chains.

Calculations part 1: Calculating the Available Biomass

[6] Intermediate expenditures are all normal expenditure used by a producer, e.g. raw materials, energy, packaging, rent, telephone, etc. Not included in intermediate expenditures are: wages, depreciation of fixed assets, interest payments and taxes.

The first part is to calculate the available biomass. The catch statistics only tell us what is taken ashore and disregards what is left at sea. There are no available statistics about the discarded biomass, since it is not measured before it is discarded. Therefore, the only option is to calculate the discarded biomass.

The first step in getting a good estimate of the discarded biomass is to calculate the total wet biomass taken from the sea – fresh live weight. This part of the calculations is based on the official catch statistics. The next step is to use the conversion factors for cod to estimate the available fresh biomass broken down on fillets, backbones, liver, roe, milt, skin and viscera. By subtracting the landed biomass from the estimated total biomass it is possible to get an estimate of which part of the biomass is taken ashore and which part is discarded at sea.

Calculations part 2: Calculating the Value Chain of the Existing Landings and Processing of Fish

The next part of the calculations is to calculate the existing value chain. The existing value chain serves as a reference base line for the calculations of the processing of the discarded biomass. It makes it possible to estimate the relative size of the values created when utilizing the discarded biomass relative to the existing value chain. The calculations are based on the catch statistics, the industry statistics and information gathered from the industry, research institutions and authorities.

Calculations part 3: Calculating the Potential Value Chain of the Discarded Biomass

The last part of the calculations is to calculate the potential value chain if the discarded biomass was brought ashore and processed into useful products. Building on the estimations of the potential biomass from part 1, and the industry statistics etc., the following potential value chains for the discarded biomass are calculated.

- Potential value chain 1: The discarded biomass is being brought ashore as silage
- Potential value chain 2: The biomass is frozen and sorted into heads, liver, roe, etc.

In order to keep the calculations as realistic as possible, an emphasis is put on using existing standard industry setup and not using special niche-productions that potentially could give larger value adding to the biomass. This means that even though there might exist niche-productions that could bring larger value added to the biomass, these are not included into the value chains since the bulk of the biomass is considered to go through standard industry productions, not niche productions.

2.3.1 Limitations of the Chosen Calculation Method

The chosen calculation method for the value chain has several strengths but also some weaknesses. The main strength of the method is, as already mentioned, the comparability of the calculated estimates across industries and countries. The total value of the GVA in the value chain shows the total value created. The GVA of each part of the value chain shows that part's contribution to the economy. This makes it possible to show whether the value of the discarded biomass is in the fisheries or in the processing sector. It also reveals whether most of the value is in the liver, roe, heads or other parts of the discarded biomass.

One major limitation in the calculation method is that is does not reveal whether each part of the value chain is profitable or not. This limits the possibilities for determining obstacles in the value chain. For instance, during the interviews with the industry it was claimed that it is not profitable for the fisheries sector to take everything ashore and therefore some of the biomass is discarded. The chosen calculation method for the value chains does not make it possible to verify whether this actually is true or not.

Another limitation is that the calculations are only based on existing standard industry processing methods and do not take into account the possibility that the industry could develop new and more profitable processes as the biomass is made available. At the same time, it disregards niche-productions that in most cases create a larger added value to the biomass than standard processing methods.

In order to compensate for the shortcomings of the calculations method in the value chain analysis the following analysis are included in the report. A profitability analysis is made for the long-distance vessels, estimating costs and incomes of bringing everything ashore. The analysis is divided into new and old vessels as well as three different methods of bringing everything ashore: Frozen, silage and production of fish meal and oil on board the vessels. Descriptions of various potential niche productions are included to illustrate the possibilities for increased Gross Value Added from niche productions. An extra scenario is included in the summary of the value chain analysis to illustrate the potential economic impact on the GVA of niche productions and the development of new and more profitable processes.

2.4 Methodological Approach for the Stakeholder Analysis

The classical (and most frequently cited) definition of a stakeholder is Freeman's (1984, p. 84): A stakeholder in an organization is (by its definition) any group or individual who can affect or is affected by the achievement of the organization's objective".

Although this definition is widely accepted, it has also been criticised from certain positions. While the business ethics track generally embraces a wider definition of a stakeholder, the social science track favours a narrower one. This is because a broad definition makes it possible to include even such groups as terrorists and competitors (Phillips, Freeman, & Wick, 2003) who, indeed, could affect the firm painfully. This dilemma can partly be resolved by narrowing the definition in a meaningful way. By following Clarkson's argument (Clarkson, 1994) Mitchell et al. argue that the use of risk as a second defining property for the stake in an organization helps to "narrow the stakeholder field to those with legitimate claims, regardless of their power to influence the firm or the legitimacy of their relationship to the firm" (Mitchell, Agle, & Wood, 1997). In summary, the definition of a stakeholder is not uniformly accepted. However, in most cases the differences refer to the scope of the definition. The stakeholder analysis presented in this report employs Clarkson's (1994) narrower definition where a stakeholders is defined as "a group or individual who affects or is affected by the project outcome but also finds a risk or something at stake by being connected to or influenced by the project".

3.1.1 Mapping Stakeholders

In order to recognize and act upon the various stakeholders and their claims toward the project outcome a mapping needs to be conducted. In the stakeholder analysis presented here the following mapping techniques will be applied:

- The conflict/harmony, contribution/reward stakeholder model by Johnsen (E. Johnsen, 2008)
- Three-dimensional grouping of power, interest and attitude (Murray-Webster & Simon, 2006)
- The seven stakeholder profiles based on power, legitimacy and urgency (Mitchell et al., 1997).

In order to clarify stakeholders current position, the contribution/reward and harmony/conflict issues are identified, and an estimation is made of the attitude of stakeholders towards the concept of bringing 'everything ashore'. The mapping of stakeholders in the 'Three-dimensional grouping of power' analysis will provide insight into seven different stakeholder profiles which have to be dealt with in a roadmap for future actions.

2.4.1 Steps in the 'Everything Ashore' Stakeholder Analysis

The first step in the stakeholder analysis process and in building a stakeholder map is to develop a list of the members of the stakeholder community. The potential list of stakeholders for any project will always exceed both the time available for analysis and the capability of the mapping tool to sensibly display the results, the challenge is to focus on the 'right stakeholders' who are currently important and to use the tool to visualise this critical sub-set of the total community.

In this context the stakeholder analysis will identify stakeholder groups with interests in fishing vessels, processing on-board, primary and secondary processes onshore, logistical handling, sales & distribution, related research & development, and legal framework. It will also, to a limited degree, involve community representatives, consumers and environmental Non Governmental Organisations (NGO) etc. The potential stakeholders perceive themselves as having a risk at stake to some degree that can be more or less visible or underlying.

The analysis process is based on the following procedure/steps:

1) Identify and list stakeholder groups and individuals for each case study
2) Briefly describe the characteristics of the individual stakeholder group and with respect to expected reward from and contribution to the project objective
3) Identify areas of harmony and conflict between the individual groups in relation

to the project objective

4) Estimate the level of power, legitimacy and urgency of stakeholder claims for future actions
5) Formulate recommendation for an action plan

Given the potential complexity of managing a network of stakeholders, we consider it crucial to understand: Who is part of a regional network, what role do they possess and secondly what level of power do they have and what kind of various resources they might provide.

Step 1: Identifying Stakeholders

The first step involves identifying the project's stakeholders and as a team discuss why they are critical for meeting the project objectives. It is important to focus primarily on the person and their role, not just an organisational group or a position title. This is because individuals will most likely have different levels of power or importance within an organisation, and will likely have different relationships (or none at all) with various team members. Importantly, people make up networks, not organisations.

In the selected case studies, the fleet composition can be broadly illustrated as follows:

	Barents Sea		Faroese Waters		Greenland Waters	
	Demersal	Pelagic	Demersal	Pelagic	Demersal	Pelagic
Factory trawlers	■			■	■	
Large trawlers H&G	■				■	
Pelagic trawlers		■		■		■
Smaller trawlers	■	■	■	■	■	■
Long-line	■		■		■	
Coastal	■		■		■	

Table 4: Mix of fleet in the case studies

Stakeholders representing these fleet segments were invited to the workshop and roundtable discussion carried out in Norway, Faroe Islands, Iceland and Greenland. In addition, stakeholders representing the other groups (processing, logistics, sales, science, legal & political framework) were invited. However, the list of invitees varied from country to country. It was the responsibility of the local project partners[7] to send invitations to the relevant stakeholders. The total list of stakeholder groups is in Table 5 below:

[7] The local partners are Matis in Iceland, Nofima in Norway, The Institute of Natural Resources in Greenland, and Syntesa in the Faroe Islands. Syntesa also co-ordinated the process and stakeholder meetings.

Fishery	Fishing vessel - frozen
	Fishing Vessel - fresh
	Ship-owner association
	Fishermen Unions
Processing and sale	Processor - Fish fillet and salt fish
	Processor - other products
	Logistics and transport
	Sales - wholesale and retail
Other organisations	Research and development
	Government, civil servants
	Gear/technology provider
	Other service organisation
	Consumers and NGOs

Table 5: List of stakeholder groups used in the analysis of the three case studies

Step 2: Characteristics of Stakeholder Groups Identified in Step 1

One systematic method when characterizing the stakeholders is identifying the contribution each stakeholder group provides to getting everything ashore and the reward they expect for this contribution. It is also necessary to identify new possibilities for each stakeholder group with the implementation of 'everything ashore'.

Stakeholder	Contribution	Reward	Possibilities
Group			

Table 6: Stakeholder contribution, reward and possibilities in relation to 'everything ashore' and their contribution, reward and possibilities

The table provides a picture of the various stakeholders' expectations to the project outcome at an initial stage but should be interpreted in a broad context and not stand alone in any stakeholder analysis.

Another element to consider when characterizing stakeholders is the impact and attitude of the individual stakeholder groups on a successful implementation of initiatives to bring everything ashore. This can be done by estimating the impact it will have on the stakeholder group and by estimating the stakeholders' attitude to these initiatives.

Impact of bringing everything ashore			
Very comprehensive change			
Some change			
Insignificant change			
	Negative - Resistance	Passive	Positive - Enthusiastic
			Stakeholder's attitude to bringing everything ashore

Table 7: Project attitude and impact on stakeholders

The impact of bringing everything ashore will be very comprehensive to some stakeholders and at the same time they may express a negative attitude towards this project outcome. These stakeholders are important to interact with. There will also some passive stakeholders, for whom the impact of the project will only be insignificant and a minimum interaction is required.

Clarifying the attitudes of stakeholder groups is important when defining areas of conflict and areas of harmony in a project such as 'everything ashore'.

Step 3: Harmony and Conflict amongst Stakeholder Groups.

Different stakeholders have different interests. Sometimes these interests will conflict and sometimes interest of different stakeholders will align and be consistent. It is important to identify issues or topics that all stakeholders can agree on – e.g. is there a single or multiple topic or feature all groups agree on in relation to bringing everything ashore? At the same time, it must be recognized that stakeholders will disagree on other topics concerning bringing everything ashore and there will be conflicts among stakeholder groups in relation to the implementation of such an initiative.

	Fishery	Processing & Sale	Other Organisation
Areas of conflict			
Areas of harmony			
Opportunities			

Table 8: Harmony and conflict areas

Defining areas of harmony and conflict is helpful when organizing our communication with stakeholders at sessions and presenting project goals and approaches.

Step 4: The Level of Power, Legitimacy and Urgency

The final step in the stakeholder analysis is identifying the position of the various stakeholder groups in relation to three main groups of attributes: Power, legitimacy and urgency. The framework is developed by Mitchell, Agle and Wood (1997). By analysing stakeholders according to power, legitimacy and urgency we will systematically be able to clarify which stakeholders the project team needs to regard as salient.

The attributes:

Power: Power can be expressed as the ability to influence the behaviour of people. Weber defines power as: "The probability that one actor within a social relationship is in a position to carry out his own will despite resistance" (Weber, 1947, p. 28). Power is a crucial variable in any stakeholder–project team relation. A stakeholder possesses power if he/she can affect the project objectives, or in other words has the ability to influence the project. The stakeholder can have power over the project, the project can have power over the stakeholder or there can be mutual power dependence relationship in place. A stakeholder who possesses a claim towards the project is a stakeholder who has strong power over the project.

Legitimacy: The core of legitimacy is to be found in something “at risk” or in property rights, in moral claims or in some other construct. The notion of “legitimacy” loosely refers to socially accepted and expected structures or behaviours. Legitimacy is often coupled with power when evaluating the nature of relationships in society. Davis (1973) distinguishes legitimate from illegitimate use of power by declaring: “In the long run, those who do not use power in a manner which society considers responsible will tend to lose it”. There is a basis for legitimacy in a relationship if the stakeholder and the project are in a contractual relationship. There is a legitimacy relationship between a project and a stakeholder if the stakeholder holds a contract, has ownership or has a legitimate claim towards the project. Legitimate stakeholders are not necessarily powerful e.g. minority stockholders in a closely held company. On contrary powerful stakeholders are not necessarily legitimate e.g. corporate raiders in the eyes of current managers. A stakeholder can have an interest in the actions of the project but no legitimate claim and therefore he has a limited ability to affect the project.

Usually we analyse stakeholders on a two-dimensional scale. However, Mitchell, Agle and Wood (1997) point out that including only power and legitimacy as variables in stakeholder analysis does not capture the dynamics of stakeholder-project interactions. It is also necessary to include a third variable or attribute, ‘urgency’ which helps move the approach from static to dynamic. Urgency is related to calls for immediate or pressing attention and exists when two conditions are met: 1) when a relationship or claim is of a time-sensitive nature and 2) when that relationship or claim is important or critical to the stakeholder (Mitchell et al., 1997).

Urgency: The degree to which stakeholders claim call for immediate attention. Urgency adds a catalytic component to the analysis, urgency demands attention. If one is attempting to mobilize a public against some outside threat, one must emphasize the rapidity with which the opponent is gaining strength (Eyestone, 1978).

The link between the attributes may be stated as “power gains authority through legitimacy and it gains exercise through urgency”. The three attributes are shown in Figure 3 which also illustrates a various number of combinations of the attributes:

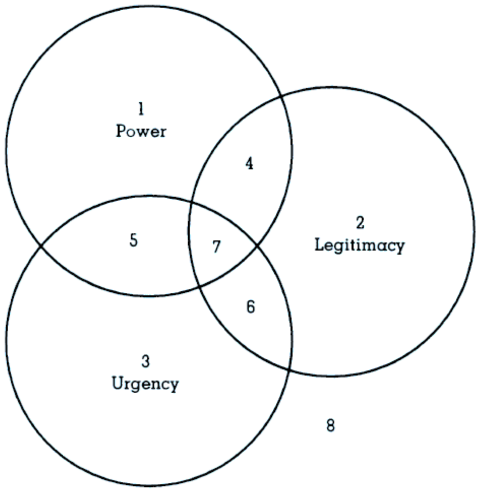


Figure 3: Qualitative classification of stakeholders

The underlying theory is that stakeholder salience – or importance - will be positively related to the cumulative number of stakeholder attributes: Power, legitimacy and urgency – perceived by managers or the project team to be present.

The low salience classes (area 1, 2 and 3) which is termed 'Latent stakeholders' are identified by their possession of only one of the attributes. The moderately salient stakeholder (areas 4, 5 and 6) are identified by their possession of two of the attributes and because they are stakeholders who 'expect something' we call them 'expectant' stakeholders. The combination of all three attributes is the defining feature of highly salient stakeholders (area 7). Area 8 are stakeholders outside the scope of the analysis.

- **Latent stakeholders** who possess only one attribute (dormant, discretionary and demanding stakeholders);
- **Expectant stakeholders** who share two attributes (dominant, dependent and dangerous stakeholders);
- **Definitive stakeholders**, who possess all of the three attributes.

The seven stakeholder profiles and their interrelation to the three attributes is demonstrated in Figure 4 below.

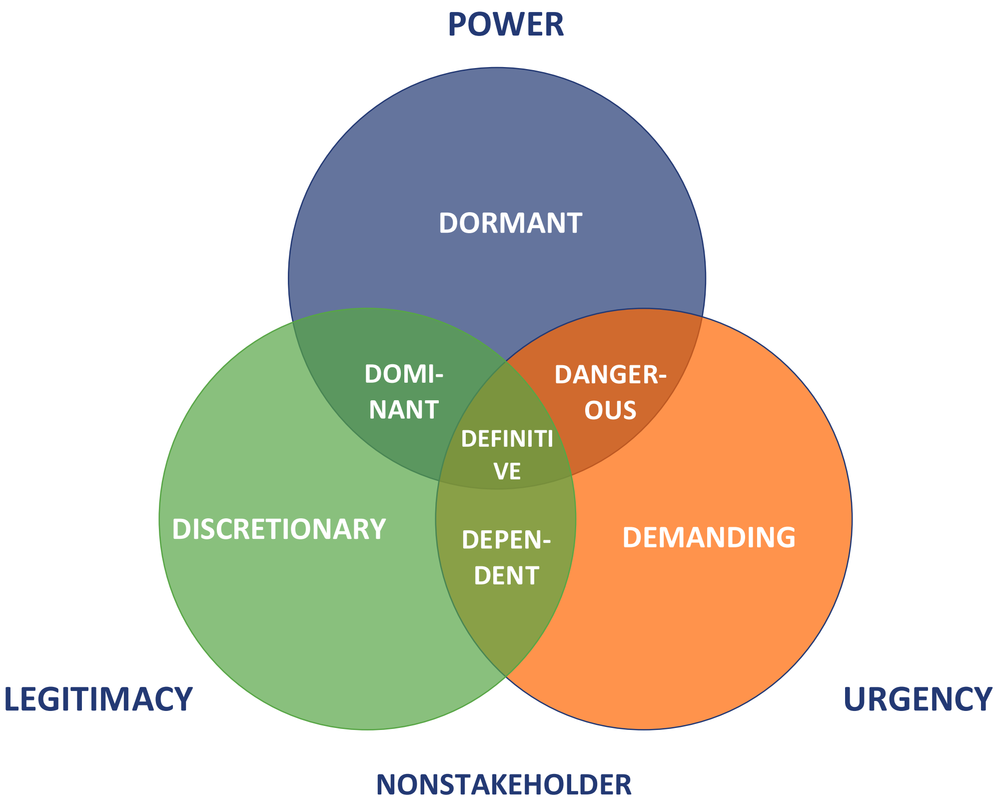


Figure 4: The stakeholder profiles. Adapted from Mitchell et al (1997)

When mapping stakeholders according to the seven profiles it is necessary to decide how much priority shall be given to the individual stakeholders analysed. The more attributes a stakeholder possesses, the more salient or important he or she is. The most salient stakeholders will require more attention from those responsible for implementing the concept idea of bringing everything ashore. For stakeholders identified as expectant and/or definitive a plan for interaction must be made. These stakeholders possess two and/or three attributes and might gain authority through a legitimate use of power. Latent stakeholders require a low degree of salience and a minimal effort from the project team but since changes in their position can occur during project lifetime they should be monitored on a regular basis.

In chapter 6 a quantitative estimate of the stakeholders' degree of power, legitimacy and urgency is presented. This evaluation is central to the process in case of implementation of the concept idea. After clarifying the stakeholder role in the mapping model, the estimation tells us *how much attention the individual stakeholder requires.*

Step 5: Action Plan

Based on the analysis conducted in step 1-4 a plan for how to interact with potential and salient stakeholders should be outlined. A stakeholder analysis table as the one demonstrated below can be helpful when preparing how to interact with stakeholders with different degrees of salience.

Name	Role	Why is stakeholder important?	Rank in map: Power, Legitimacy, Urgency	Current attitude	What would we like them to do?	Key messages	How (tactics)	When (timeplan)	Who responsible

Table 9: Stakeholder action plan

A complete stakeholder analysis will be presented in Chapter 6. The action plan will also feed into the recommendations and the subsequent road map for future actions.

3. Fisheries in the Barents Sea

The Barents Sea is a large shelf area bordering the Arctic sea in the North and Norwegian Sea in the West. The area is divided into Norwegian and Russian exclusive economic zones (EEZ). The Joint Norwegian-Russian Fisheries Commission has adopted rules for setting Total Allowable Catch (TAC), (Fisheries.no, n.d.), in cooperation with ICES For the shared fish stocks (cod, haddock and capelin). Other species are managed by the respective coastal states and some by NEAFC (ICES, 2016).

The Barents Sea is a very productive area, and contains the world's largest cod population, the North East Arctic Cod, which is the most important commercial species in the region. Over 90 percent of Norwegian cod catches come from the North-East Arctic cod stock (Norwegian Seafood Council, 2015). The Barents Sea cod spawn along the coast of mainland Norway and the larvae then drift north to the waters north and east of Svalbard, where the juvenile cod feed and grow until they in turn make their way south to spawn (Greenpeace, 2016). Other important commercial species in the area are haddock, capelin, northern shrimp, Greenland halibut, saithe, and herring (ICES, 2016; Erik Olsen et al., 2010). A multinational fishery operates in the Barents Sea using different fishing gears and targeting several species (ICES, 2016). It is estimated that about 70 percent of Northeast arctic cod catches are taken by bottom trawl, with the remaining part is caught with gillnet, long-line, Danish seine and hand-line (Institute of Marine Research, 2012). In addition to Russia and Norway, the nations that participate in the fisheries in the Barents Sea are Faroe Islands, Spain, Iceland, United Kingdom, Germany, Greenland, Portugal, France, Belarus and Poland (Institute of Marine Research, 2012).[8] The largest commercially exploited stocks (cod, haddock and capelin) are harvested at a sustainable level and have full reproductive capacity, whilst the smaller stocks, golden redfish and Norwegian coastal cod are overfished (ICES, 2016). The quota for 2015 was 894.000 tonnes for cod, 178.500 tonnes for haddock, and 122.000 tonnes for saithe (Hønneland, O'Boyle, & Hambrey, 2015). The case study presented here focuses on demersal fisheries of the long-distance fleet. In the sections that follow, more detail will be provided in relation to quantity of catches and the rest raw materials not brought to shore in the respective Nordic fleets in the area.

[8] According to the Norwegian Directorate of Fisheries a total of 189 trawlers hold licences to fish for cod and haddock in the Barents Sea in 2016: 96 Russian, 48 from EU countries, 30 Norwegian, eight Icelandic, four from the Faroe Islands and three from Greenland (Greenpeace, 2016).

3.1 Norwegian Fisheries in the Barents Sea

The Norwegian offshore fisheries consisted in 2014 of 341.000 tonnes wet white fish caught by 35 trawlers - 3 factory trawlers and 32 H&G trawlers. Most of the catch was landed as H&G fish (around 90 percent) while a smaller part was processed into fillets at sea (around 10 percent). The bulk of the catch was cod, haddock and saithe. In the calculations all of the biomass is treated as cod. This is due to several reasons. Firstly, conversion factors for cod are well known, Secondly, the scope of the work does not allow for a more detailed analysis for each single demersal species. It is in the authors' view that this approach can be justified since conversion factors for the major demersal species are relatively similar.

The table below shows the results of the calculations when the total biomass of 341.000 tonnes is converted into various parts of the fish. The calculations show that the larger part of the biomass was landed (59 percent) while the rest of the biomass was discarded (41 percent). The largest portion of the discards were the heads, where 79.139 tonnes of biomass was discarded. The table shows that of the 150.040 tonnes of the biomass that is fillets 147.789 tonnes were landed while 2.251 tonnes were discarded.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	150.040	147.789	2.251
Head	24%	81.840	2.701	79.139
Cut-offs	5%	17.050	563	16.487
Back bone	12%	40.920	38.178	2.742
Liver	5%	17.050	563	16.487
Roe	1%	3.410	824	2.586
Milt	1%	3.410	-	3.410
Viscera	5%	17.050	563	16.487
Skin	3%	10.230	9.545	685
Total		**341.000**	**200.725**	**140.275**

Table 10: Overview of landed and discarded biomass from Norwegian offshore fisheries

The discarded fillets, cut-offs, backbones and skin, were discarded in the process of filleting and beheading. The main reason for the discard of the fillets is that the filleting machines are not 100 percent effective and also that the procedure of cutting the heads of the whole fish also cuts off some of the fillets. The rest of the discards were the liver, milt and viscera. Most of the roe was landed.

3.1.2 Value Chain Analysis

The value chain analysis illustrates what potential lies in the discarded biomass. A detailed value chain analysis is in appendix 1.

Value Chain Analysis - Norwegian Offshore Fisheries

Existing value chain

	Fisheries	Processing	Total	GVA-growth
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	%
Total	**2.680**	**717**	**3.396**	

Directly to silage

	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Total	**250**	**313**	**563**	**17%**

Sorted landings

	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Heads	141	237	378	
Liver	81	61	142	
Roe	23	20	43	
Backbones and cut-offs	38			
Milt	6			
Viscera	29	94	169	
Skin	1			
Total	**320**	**412**	**732**	**22%**

Table 11: Value chain analysis for Norwegian offshore fisheries

The Existing Value Chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries is around 2680 million DKR. Adding the contribution from the processing industry of 717 million DKR brings the total up to 3396 million DKR.

Silage Value Chain

The total discarded biomass is calculated to 140.275 tonnes. If this biomass was to be landed as silage it would create a gross value added in fisheries of 250 million DKR. Furthermore, it could create an added value of 313 million DKR when processed into fish meal and oil and further into fish feed for the aquaculture industry. The total added value would be around 563 million DKR or around 17 percent of the existing value chain. It is possible to further process the silage into fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

Sorted Value Chain

Sorting the rest raw material into heads, liver, etc onboard increases the landing value compared to silage and makes it possible to process the various raw materials separately. In this scenario, the GVA in fisheries increases to 320 million DKR. By processing the material into end products the value added by the processing industry is calculated to 412 million DKR bringing the GVA up to 732 million DKR or around 22 percent of the existing value chain. Around half of the potential is in the heads with a total of 378 million DKR.

The problem with the heads is that the volume of the biomass is quite large (79.139 tonnes which is around 40 percent of the currently landed biomass) and the vessels only receive 141 million DKR in GVA for the heads compared to 2.680 million DKR for the currently landed biomass- This limits the incentive for the vessels to bring the heads ashore, whether it be frozen or as silage. The same problem concerns the backbones, cut-offs, milt, viscera and skin that in the calculations are treated as silage and processed into fish oil and meal. The total biomass is around 42.062 tonnes and the GVA is around 75 million DKR. Compared to the heads and the silage biomass the quantity of the liver and roe is much smaller (19.074 tonnes) and easier to store while they bring almost the same amount of GVA to the vessels, 104 million DKR.

Unlocking the Potential

Figure 5 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 3.396 million DKR. The following bars indicate the possible value added by various processing methods of the material, starting with three scenarios for processing of silage, namely using silage directly as animal feed, processing the silage to fish meal and oil and further processing the fish meal and oil into fish feed. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, there is included a last scenario which is labelled bio-refining indicating that bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

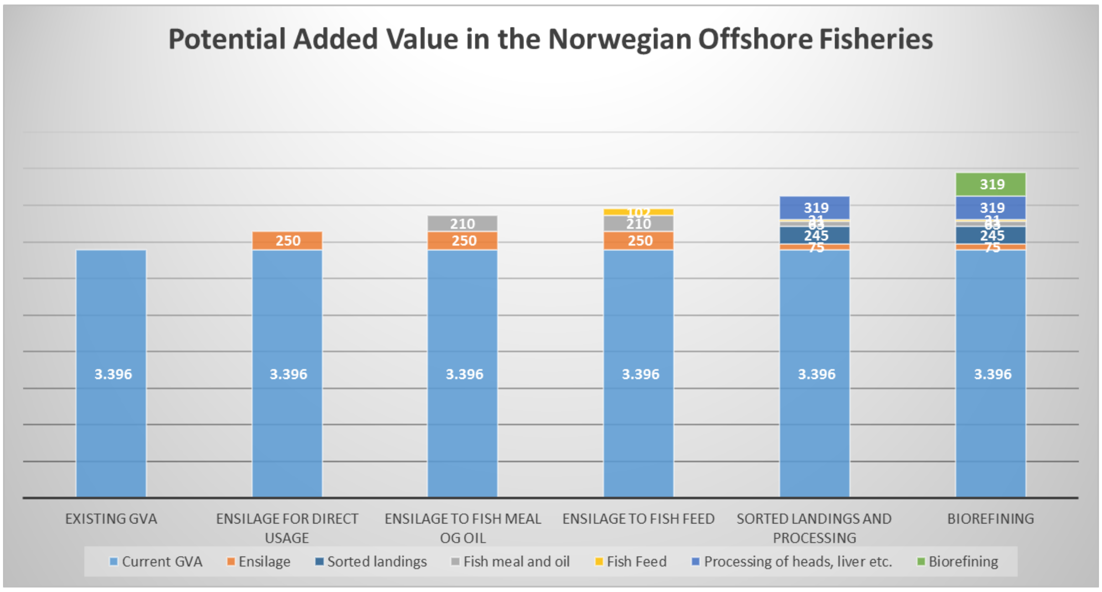


Figure 5: Potential GVA of Norwegian offshore fisheries

Concluding Remarks on the Norwegian Value Chain
The calculations on the Norwegian offshore fisheries value chain show that:

1. Bringing everything ashore will increase the value chain by about 17-22 percent relative to the existing value chain, depending on how the biomass is landed.
2. Around 75 percent of the increase in the economic activity can be obtained by bringing the rest raw material ashore as silage.
3. The last 25 percent of the gross value added can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.

3.2 Greenlandic Fisheries in the Barents Sea

The Greenlandic fisheries in the Barents Sea consisted in 2014 of 10.620 tonnes wet white fish caught by three trawlers. Around half of the catch was processed at sea into fillets while half of the catch was landed as H&G fish. The bulk of the catch was cod (83 percent), haddock (11 percent) and saithe (4 percent). In the calculations all of the biomass is treated as cod. The table below shows the results of the calculations when the total biomass of 10.620 tonnes is converted into various parts of the fish. The calculations show that half of the biomass was landed while the other half was discarded. The largest portion of the discards were the heads, where 2.549 tonnes of biomass was discarded. Half of the fish is landed as fillets produced at sea which is reflected in the calculations.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	4.673	4.392	280
Head	24%	2.549	-	2.549
Cut-offs	5%	531	-	531
Back bone	12%	1.274	765	510
Liver	5%	531	-	531
Roe and milt	2%	212	-	212
Viscera	5%	531	-	531
Skin	3%	319	191	127
Total		**10.620**	**5.348**	**5.272**

Table 12: Overview of landed and discarded biomass from Greenlandic fisheries in the Barents Sea

The table shows that of the 4.673 tonnes of the biomass that was fillets, 4.392 tonnes were landed while 280 tonnes were discarded. The discarded fillets, cut-offs, backbones and skin, were discarded in the process of filleting and beheading. The main reason for the discard of the fillets is that the filleting machines are not 100 percent effective. The procedure of cutting the heads off the whole fish also cuts of some of the fillets. The rest of the discards were the liver, roe, milt and viscera.

3.1.3 Value Chain Analysis

The value chain analysis illustrates what potential lies in the discarded biomass. A detailed value chain analysis is in appendix 2.

Value Chain Analysis - Greenlandic Fisheries in the Barents Sea

	Fisheries	Processing	Total	GVA-growth
Existing value chain				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	%
Total	**94**	**-**	**94**	
Directly to silage				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Total	**9**	**8**	**17**	**18%**
Sorted landings				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Heads	5	8	12	
Liver	3	2	5	
Roe	1	1	2	
Backbones and cut-offs	2			
Milt	0			
Viscera	1	3	7	
Skin	0			
Total	**12**	**14**	**25**	**27%**

Table 13: Value chain analysis of Greenlandic fisheries in the Barents Sea

The Existing Value Chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries is around 94 million DKR. There is no onshore processing industry therefore the total is also 94 million DKR.

Silage Value Chain

The total discarded biomass is calculated to 5.272 tonnes. If this biomass was landed as silage, it would create a gross value added in fisheries of 9 million DKR. Furthermore, it could create an added value of 8 million DKR when processed into fish meal and oil. The total added value would be around 17 million DKR or around 18 percent of the existing value chain. It is possible to further process the silage into fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

Sorted Value Chain

Sorting the rest raw material into heads, liver, etc. increases the landing value compared to silage and makes it possible to process the various raw materials separately. In this scenario, the GVA in fisheries increases to 12 million DKR. By processing the material into end products the value added by the processing industry is calculated to 14 million DKR bringing the GVA up to 25 million DKR or around 27 percent of the existing value chain.

Around half of the potential is in the heads with a total of 12 million DKR. The problem with the heads is that the volume of the biomass is quite large (2.549 tonnes) and the vessels only receive 5 million DKR in GVA for the heads which limits the incentive for vessels to bring the heads ashore, whether it be frozen or as silage. The same problem concerns the backbones, cut-offs, milt, viscera and skin that in the calculations are treated as silage and processed into fish oil and meal. The total biomass is around 2.086 tonnes and the GVA is around 4 million DKR. Compared to the heads and the silage biomass the quantity of the liver and roe is much smaller (531 and 106 tonnes respectively) and easier to store whilst they bring almost the same amount of GVA to the vessels, 4 million DKR.

Unlocking the Potential

Figure 6 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 94 million DKR. The following bars indicate the possible value added by various processing of the material, starting with two scenarios for processing of silage, namely using silage directly as animal feed and processing the silage to fish meal and oil. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, there is an additional 'biorefinery' scenario where bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

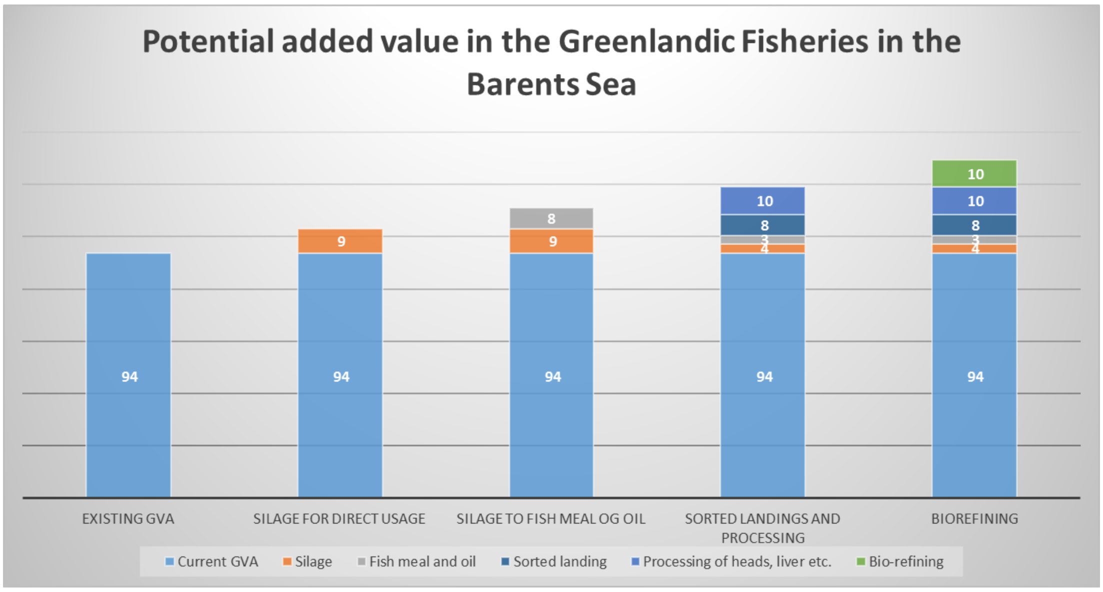


Figure 6: Potential GVA of Greenlandic fisheries in the Barents Sea

Concluding Remarks on the Greenlandic Value Chain in the Barents Sea

The calculations on the Greenlandic value chain for fisheries in the Barents Sea shows that:

1. Bringing everything ashore will increase the value chain by about 18-27 percent relative to the existing value chain, depending on how the biomass is landed.
2. Around two thirds of the increase in economic activity can be obtained by bringing the rest raw material ashore as silage.
3. The last third of the gross value added can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.

3.3 Faroese Fisheries in the Barents Sea

The Faroese fisheries in the Barents Sea consisted in 2014 of 27.712 tonnes wet white fish caught by four trawlers. Around half of the catch was processed at sea into fillets while half of the catch was landed as H&G fish. The bulk of the catch was cod (88 percent), haddock (8 percent) and saithe (1 percent). In the calculations all of the biomass is treated as cod.

The table below shows the results of the calculations when the total biomass of 27.712 tonnes is converted into various parts of the fish. The calculations show that around half of the biomass was landed while the other half was discarded. The largest portion of the discards were the heads, where 6.651 tonnes of biomass was discarded. Half of the fish is landed as fillets produced at sea which is reflected in the calculations. The table shows that of the 12.193 tonnes of the biomass that is fillets 11.169 tonnes were landed while 1.024 tonnes were discarded. The discarded fillets, cut-offs, backbones and skin, were discarded in the process of filleting and beheading. The main reason for the discard of the fillets is that the filleting machines are not 100 percent effective and also that the procedure of cutting the heads of the whole fish also cuts of some of the fillets. The rest of the discards were the liver, milt and viscera. Most of the roe was landed.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	12.193	11.169	1.024
Head	24%	6.651	-	6.651
Cut-offs	5%	1.386	-	1.386
Back bone	12%	3.325	1.463	1.862
Liver	5%	1.386	-	1.386
Roe and milt	2%	554	277	277
Viscera	5%	1.386	-	1.386
Skin	3%	831	366	466
Total		**27.712**	**13.275**	**14.437**

Table 14: Overview of landed and discarded biomass from the Faroese fisheries in the Barents Sea

3.1.4 Value Chain Analysis

The value chain analysis illustrates what potential lies in the discarded biomass. A detailed value chain analysis is in appendix 3.

Value Chain Analysis - Faroese Fisheries in the Barents Sea

Existing value chain	Fisheries GVA mill. DKR	Processing GVA mill. DKR	Total GVA mill. DKR	GVA-growth %
Total	**241**	**49**	**290**	

Directly to silage	Fisheries GVA mill. DKR	Processing GVA mill. DKR	Total GVA mill. DKR	
Total	**26**	**32**	**58**	**20%**

Sorted landings	Fisheries GVA mill. DKR	Processing GVA mill. DKR	Total GVA mill. DKR	
Heads	12	20	32	
Liver	7	5	12	
Backbones and cut-offs	8			
Milt	0			
Viscera	2	14	26	
Skin	1			
Total	**30**	**39**	**69**	**24%**

Table 15: Value chain analysis of Faroese fisheries in the Barents Sea

The Existing Value Chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries is around 241 million DKR. Adding the contribution from the processing industry of 49 million DKR brings the total up to 290 million DKR.

Silage Value Chain

The total discarded biomass is calculated to 14.437 tonnes. If this biomass was landed as silage it would create a gross value added in fisheries of 26 million DKR. Furthermore, it could create an added value of 32 million DKR when processed into fish meal and oil and further into fish feed for the aquaculture industry. The total added value would be around 58 million DKR or around 20 percent of the existing value chain. It is possible to further process the silage into fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

Sorted Value Chain

Sorting the rest raw material into heads, liver, etc. increases the landing value compared to silage and makes it possible to process the various raw materials separately. The GVA in fisheries increases to 30 million DKR. By processing the material into end products the value added by the processing industry is calculated to 39 million DKR bringing the GVA up to 69 million DKR or around 24 percent of the existing value chain. Around half of the potential is in the heads with a total of 32 million DKR. The problem with the heads is that the volume of the biomass is quite large (6.651 tonnes) and the vessels only receive 12 million DKR in GVA for the heads which limits the incentive for the vessels to bring the heads ashore, whether it be frozen or as silage. The same problem concerns the backbones, cut-offs, milt, viscera and skin that in the calculations are treated as silage and processed into fish oil and meal. The total biomass is around 6.400 tonnes and the GVA is around 11 million DKR. Compared to the heads and the silage biomass the quantity of the liver is much smaller (1.386 tonnes) and easier to store while they bring almost the same amount of GVA to the vessels, 7 million DKR.

Unlocking the Potential

Figure 7 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 290 million DKR The following bars indicate the possible value added by various processing of the material, starting with three scenarios for processing of silage, namely using silage directly as animal feed, processing the silage to fish meal and oil and further processing the fish meal and oil into fish feed. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, there is a 'biorefinery' scenario which illustrates how bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

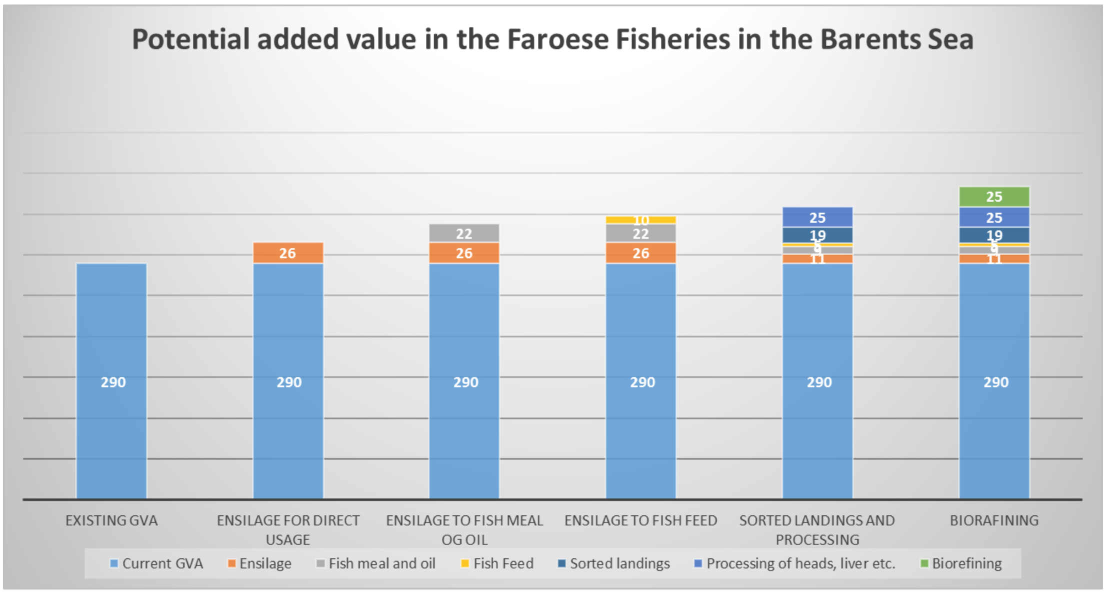


Figure 7: Potential GVA of Faroese fisheries in the Barents Sea

Concluding Remarks on the Faroese Value Chain
The calculations on the Faroese value chain for fisheries in the Barents Sea shows that:

1. Bringing everything ashore will increase the value chain by about 20-24 percent relative to the existing value chain.
2. Around 80 percent of the increase in the economic activity can be obtained by bringing the rest raw material ashore as silage.
3. The last 20 percent of the gross value added can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.

3.4 Icelandic Fisheries in the Barents Sea

The Icelandic fisheries in the Barents Sea consisted in 2014 of 21.538 tonnes wet white fish caught by nine trawlers - four factory trawlers and five H&G trawlers. The bulk of the catch was cod (85 percent), haddock (13 percent) and saithe (1 percent). In the calculations all of the biomass is treated as cod. Table 16 below shows the results of the calculations when the total biomass of 21.538 tonnes is converted into various parts of the fish. The calculations show that around half of the biomass was landed (54 percent) while the lesser half (46 percent) was discarded. The largest portion of the discards were the heads, where 4.172 tonnes of biomass was discarded. Most of the fish is landed as fillets produced at sea which is reflected in the calculations. The table shows that of the 9.477 tonnes of the biomass that was fillets, 7.560 tonnes were landed while 1.917 tonnes were discarded.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	9.477	7.560	1.917
Head	24%	5.169	997	4.172
Cut-offs	5%	1.077	851	226
Back bone	12%	2.585	1.776	809
Liver	5%	1.077	1	1.076
Roe and milt	2%	431	196	235
Viscera	5%	1.077	1	1.076
Skin	3%	646	142	504
Total		**21.538**	**11.523**	**10.015**

Table 16: Overview of landed and discarded biomass in the Icelandic fisheries in the Barents Sea

The discarded fillets, cut-offs, backbones and skin, were all discarded in the process of filleting and beheading. The main reason for the discard of the fillets is that the filleting machines are not 100 percent effective and also that the procedure of cutting the heads of the whole fish also cuts of some of the fillets. The rest of the discards were the liver, roe, milt and viscera. Most of the roe was brought to land while most of the milt was discarded.

3.4.1 Value Chain Analysis

The value chain analysis illustrates what potential lies in the discarded biomass. A more detailed value chain analysis is in appendix 4.

Value Chain Analysis - Icelandic Fisheries in the Barents Sea

Existing value chain				
	Fisheries	Processing	Total	GVA-growth
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	%
Total	**222**	**23**	**245**	
Directly to silage				
	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Total	**18**	**15**	**33**	**13%**
Sorted landings				
	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Heads	7	13	20	
Liver	5	4	9	
Roe	-			
Backbones and cut-offs	5			
Milt	0			
Viscera	2	7	16	
Skin	1			
Total	**21**	**24**	**45**	**18%**

Table 17: Value chain analysis of Icelandic fisheries in Barents Sea

The existing value chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries is around 222 million DKR. The onshore processing industry had a GVA of 19 million DKR bringing the total up to 241 million DKR.

Silage value chain

The total discarded biomass is calculated to 11.692 tonnes. Was this biomass to be landed as silage it would create a gross value added in fisheries of 18 million DKR. Furthermore, it could create an added value of 15 million DKR when processed into fish meal and oil. The total added value would be around 33 million DKR or around 13 percent of the existing value chain. It is possible to further process the silage into fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

Sorted Value Chain

Sorting the rest raw material into heads, liver, etc. increases the landing value compared to silage and makes it possible to process the various raw materials separately. In that case, the GVA in fisheries increases to 21 million DKR. By processing the material into end products the value added by the processing industry is calculated to 24 million DKR, bringing the GVA up to 45 million DKR or around 18 percent of the existing value chain. Around half of the potential is in the heads with a total of 20 million DKR. The problem with the heads is that the volume of the biomass is quite large (4.172 tonnes) and the vessels only receive 7 million DKR in GVA for the heads which limits the incentive for the vessels to bring the heads ashore, whether they are frozen or silage. The same problem concerns the backbones, cut-offs, milt, viscera and skin that in the calculations are treated as silage and processed into fish oil and meal. The total biomass is around 4.767 tonnes and the GVA is around 8 million DKR. Compared to the heads and the silage biomass the quantity of the liver is much smaller (1.076 tonnes) and easier to store while the liver brings in almost the same amount of GVA to the vessels, 5 million DKR.

Unlocking the Potential

Figure 8 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 245 million DKR. The following bars indicate the possible value added by various processing of the material, starting with two scenarios for processing of silage, namely using silage directly as animal feed and processing the silage to fish meal and oil. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, the bio-refinery scenario illustrates that bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

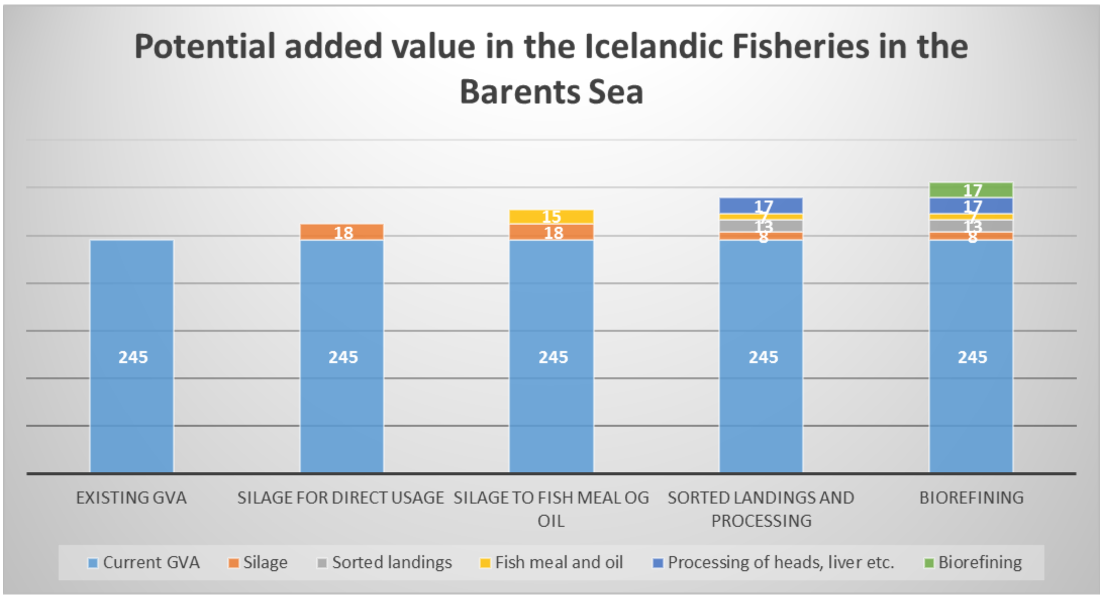


Figure 8: Potential GVA for the Icelandic fisheries in the Barents Sea

Concluding Remarks on the Icelandic Value Chain

The calculations on the Icelandic value chain for fisheries in the Barents Sea shows that:

- Bringing everything ashore will increase the value chain by about 13-18 percent relative to the existing value chain.
- More than two thirds of the increase in the economic activity can be obtained by bringing the rest raw material ashore as silage.
- The last third of the gross value added can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.

3.5 Opportunities and Challenges

In this section, an overview of the key challenges and potential opportunities for bringing everything ashore for the Barents Sea will be presented based on the stakeholder meetings that have taken place in the various countries. The section is organised around the central key themes that came up during the open dialogue workshops in the respective countries. As mentioned in the methods section, the workshops were very open, allowing participants to air their views and perspectives on any aspects of the issue they found relevant.

At all of the meetings, participants were in agreement that the countries should work more towards improving the utilisation of marine resources and bringing everything ashore. The conditions for bringing everything ashore in Greenland are more difficult than in neighbouring countries, but despite that participants did express the desire to improve the utilisation of their fishery resource. This will be discussed further in Chapter 5 which focuses on fisheries in Greenland waters. Better utilisation was recognised as an important issue, despite the many challenges to be overcome. Ethical concerns as well as an expectation about future consumer requests were the two reasons to focus on the issue. In what follows, the major challenges and viewpoints raised at the workshop relevant for the in the four countries will be presented thematically.

Economically Infeasible

The overarching reason for not bringing the entire biomass to shore was that it is not economically feasible due to several reasons. One of the central challenges for the Barents Sea fishery is the long distance to the fishing grounds. The fishing fleet for instance in the Barents Sea is at sea between 2-6 weeks. The majority of this fleet produces H&G vessels. For H&G vessels approximately 30 percent of the biomass is discarded, whilst filleting trawlers discard approximately 60 percent. It is clear that since the hold is normally full of the main product before coming ashore, then landing everything would mean additional trips. For the Norwegian ships in the Barents Sea the distance to and from the fishing grounds is around 36 – 54 hours. One participant mentioned that for his company to catch the same amount of their main product whilst landing the entire biomass, they would have to go from 5 to 7 trawlers, and each extra trip to shore would mean 4 – 5 lost days of fishing. For this fleet, it was highlighted that the costs of bringing everything ashore far exceeds the benefits with the current price level of rest raw materials.

Vessel Design

A crucial barrier in bringing everything ashore for the Barents Sea is that the current fleet structure is not geared towards taking care of rest raw materials. This was highlighted at all of the stakeholder workshops. Many of the vessels are old and do not have the necessary space to take care of the entire biomass. Good technological solutions are scarce, reconstruction and extension is therefore required, but is very expensive to implement. However, this is different for newly built vessels which can take into account a potential regulation or consumer demand for total utilisation. Therefore, it was highlighted that a fleet that brings the entire biomass to shore must be built up over time. There are currently vessels that have been redesigned to take care of rest raw materials, for instance two companies had installed silage equipment on vessels. In Iceland, a participant also mentioned that they had several trawlers in construction at the moment that were built for taking everything ashore, and would have two lines for viscera, one for liver and one for the rest of the rest raw material.

Zymetech

Zymetech is an Icelandic biotechnology company, that specialises in the development and manufacturing of marine-derived enzymes for the health and beauty industries. Zymetech which was established in 1999 is now part of the Enzymatica group after being acquired by the Swedish life science company in April 2016. Zymetech has primarily focused on product formulations for infectious diseases, dermatology and wound healing. The use of the enzymes is patent protected in 27 countries worldwide. Zymetech derives high-purity protein-cleaving enzymes (trypsin) from by-products from North Atlantic Cod. Zymetech currently has several products on the market. Two of the most popular ones are pictured here. Penzim is part of Zymetech's skincare portfolio and PreCold is a mouth spray against the common cold. Research and development work such as that undertaken at Zymetech usually takes many years before final products are launched on the market. For Zymetech, the foundations of the Penzyme technology date back to research conducted by scientists at the University of Iceland already in the 1980s and it took 15 years of research until the first product was available for customers.

Text box 1: Zymetech – High-purity enzymes from cod by-products. Photos: Zymetech

Regulatory Challenges and Required Changes

There are a range of regulatory obstacles in relation to getting everything ashore. In the stakeholder workshop in Norway, it was mentioned that there are strict regulations in relation to vessel size and tonnage. This is a barrier when building vessels to bring the entire biomass ashore. New vessels and technology collide against old regulations and this will need to be revisited if progress is to be made in this area. In several of the workshops it was also mentioned that conversion factors also need to be revised to encourage better utilisation. There is variation in the amount of fillet in relation to by-products depending on the season as well as on equipment. Another barrier mentioned in all of the countries for landing everything is the share system used to pay fishermen. Additional crew must often board to deal with new processes and technologies.

Bringing ashore a biomass with a lower landing value would also result in more work for fishermen and lower salaries. At the same time, the additional crew would also mean a lower share for each fisherman. It is likely that a change in the share system for paying fishermen is necessary to improve the utilisation. Closely connected to this, is the need to develop automatic processes and technology to make it less costly to deal with rest raw materials. For instance, in Iceland, the technological development has meant that in time fishermen will be replaced by machines such as the FlexiCut, meaning that they could attend to the rest raw materials instead. This would mean that vessels would not need additional crew. Still, with automation, the dilemma would not necessarily be completely resolved. The crew could still be earning less by bringing everything ashore if the value of the rest raw materials would not increase.

Another critical issue to keep in mind is the economy of scale. This is particularly relevant in the case for Greenland and the Faroe Islands. For instance, whilst Icelandic cod catches are approximating 250.000 tonnes, the equivalent Faroese catches are approximately 5000 tonnes in Faroese waters. This means that establishing profitable productions based on rest raw materials is challenging due to the low quantities of biomass. This must be considered when discussing the challenges involved. In this respect, the Icelandic experience with fish markets has made it possible to process species with small landing volumes, i.e. by combining catches from many vessels the total volume can become large enough to justify processing. This was also the purpose of the Icelandic 'bycatch bank' which operated in the 1990s. In this respect, collaboration across Nordic countries might be relevant. For instance, Icelandic collagen producers might want to import fish skin from neighbouring countries once they have established their production. Similarly, and more concretely a Faroese producer of fish heads is interested in sailing with its own vessels to purchase cod heads from Greenland but here the Greenlandic monopoly on transportation is a barrier.

Handling and Storage On-board

For the Barents Sea fisheries, there are also several challenges regarding both handling and storage on-board. Several potential conservation methods were mentioned, such as freezing, salting, drying, hydrolysis and silage, which have their strengths and weaknesses. Silage is relatively flexible in terms of space. However, investments need to be made into tanks and the necessary equipment, but many of the existing vessels simply do not have the necessary space for this. Silage does not require much man power in terms of handling compared to sorting and freezing the rest raw materials. In Norway and the Faroe Islands, there is a demand for silage, although in Greenland and Iceland, the demand is limited. However, provided you have space, silage can be economically feasible. In Norway, a company which had installed silage equipment had 4-5 percent increase in revenue. In Iceland, a participant mentioned that there is not much demand for silage. A participant at the workshop in Norway also mentioned that silage has been found to be a better source of peptides than fishmeal. It was also highlighted at the same workshop that price, demand and profitability of silage are increasing. Silage is currently a low value product, and the options for making higher value products from it are currently limited.

A participant at the workshop in Norway also mentioned that for frozen-at-sea vessels it is not practical or even possible to bring all catches ashore, mentioning liver as an example. It is impossible to freeze liver on the same plate freezers as other catches and it is difficult to store it in the freezing hold because only a part of it is truly frozen. It was concluded that freezing takes a lot of space, silage takes the hold and fishmeal and oil also requires additional space both for the production and storage. A Faroese fish owner mentioned in an interview that for the long-distance fleet, silage would be the most plausible option for landing the entire biomass. A presentation of the costs related to the various methods in bringing the biomass ashore from the Barents Sea will follow later in the chapter. That section will contain a discussion on the most feasible methods for bringing everything ashore.

Market Elements and Consumer Demands

As mentioned in the intro above, there was general agreement that consumers will demand more sustainable utilisation of the biomass. In Greenland, it was mentioned that consumers would most likely enquire about the utilisation of the biomass. Overall, participants in all of the four countries were in agreement that there is branding potential in bringing everything ashore, and being able to tell the story about 100 percent utilisation. It was highlighted in Norway that market drivers are necessary to increase the demand for rest raw materials. One of these drivers could perhaps come from aquaculture, which needs marine ingredients in the feed.

It might be that consumers of salmon might be willing to pay a price premium for salmon which is fed on feed with high proportion of marine and local ingredients. Participants at the Norwegian workshop, mentioned that the anticipated increase in the price of fish feed and fish meal and silage due to increasing aquaculture, might make it more profitable to bring everything ashore in future. In Norway, the question was raised whether there are enough players who have a commercial interest in purchasing the rest raw materials. As a result of this, it is important to encourage the development of innovative products from rest raw materials to encourage better utilisation. Increasing the demand for the biomass should increase the prices, meaning it could be more profitable for the fishing vessels.

Financing

Financing of new innovative methods for bringing everything ashore and for developing new products is critical for all the countries. In Norway, it was mentioned that it is of utmost importance that the big players who have the financial capabilities get involved to find solutions, since small companies cannot afford such large investments on their own. Suggestions were made that Innovation Norway should ideally be willing to take some of the costs for equipping old vessels for taking care of everything as well as for constructing new vessels for this purpose. The Research Council of Norway should also have a programme for the fishing fleet, since it is important that there is space for innovation and research in this area. For silage solutions, it was mentioned that Hordafor does finance the costs of installing the equipment provided that the vessel signs a contract with them regarding delivery of the biomass. In Faroe Islands, the need for venture capital was also mentioned and as well as the need for establishing a research fund for innovation in the fishing industry.

Ecological Consequences of not Discarding Biomass

Finally, the topic of the consequences of a regulation obligating vessels to bring everything ashore was also brought up at the workshops in all of the countries. It was highlighted that you could consider throwing overboard rest raw materials as adding to the sustainability of the fisheries and contributing to the ecosystem. This topic is out of the scope of this project, but it was mentioned that two EU projects are currently investigating the effects of the EU discard ban on the ecosystem near the seafloor (DiscardLess and MINUOW) so there will be more information available on the topic in the next three years.

3.6 Potential Solutions for Bringing Everything Ashore

Kerecis

The Icelandic medical device/biotech company Kerecis was established in 2009. The company represents an excellent example of how high-value products can be developed from fish by-products, in their case, fish skin. Kerecis aims is to become a world leader in tissue regeneration by providing products that help chronic wounds and damaged tissue to heal. The company does this by developing innovative technologies based on fish skin and the components thereof. Kerecis has already developed products for wound and skin treatment as well as products for surgical use. See picture of the Omega3 wound and skin care range with Omega3. Kerecis uses its own unique, patented Kerecis™ Omega3 fish-skin acellular dermal matrix transplantation technology, where complete acellular fish skin is used for tissue regeneration by transplantation. The Kerecis™ Omega3 transplantation technology is used to reconstruct the skin in for example chronic wounds, for

hernia repair, breast reconstruction and for dura restoration. The Kerecis™ Omega3 fish skin has improved clinical performance compared to other similar products from human and porcine origin. It also has reduced disease transfer risk and no cultural constraints on usage.

Text box 2: Kerecis - Icelandic medical device/Biotech company. Photos: Kerecis

While the value chain analysis illustrated the potential economic activity that would arise if the biomass was brought ashore, at the stakeholder meetings the vessel-owners stated that it is not profitable for them to bring everything ashore and that was the main reason why the biomass was not taken ashore. As mentioned in the methodology section the value chain analysis is limited to calculating the size of the economic activity of a production chain, but is not able to tell whether the value chain is profitable or not. This section takes a closer look at the profitability side of the fisheries in an attempt to list up the various possible solutions for taking everything ashore and to calculate whether the solutions are profitable.

3.6.1 *Three Solutions for Bringing Everything Ashore*

In this section, three methods to bring the biomass to shore will be considered:

1) Silage, where the biomass is grinded into a "soup", formic acid is added and the biomass pumped into tanks where it can be stored for considerable time.
2) Fish oil and meal, where the biomass is processed into fish meal and oil. The meal is stored in dry storage while the fish oil is stored in tanks.
3) Frozen storage, where the biomass, heads, liver, roe, etc., is stored separately in a freezer.

The calculations are based on a fictional H&G-trawler of a comparable size to those fishing in Norwegian waters. The specifications are given in Table 18 below. The vessel is able to produce 50 tonnes of H&G fish per day and in total 800 tonnes per trip. The yearly quota of live weight fish assigned to the vessel is 7.500 tonnes. The assumption is that the vessel has no extra cargo hold left for storage of the rest biomass and thus it is necessary to lengthen the vessel if the biomass is to be taken ashore. Alternatively, a new vessel can be constructed and the extra space included in the ships design. Therefore, there are two sets of calculations, one for an existing lengthened vessel and one for a new vessel. The size of the vessel is 16 meters wide and 6 meters high. It is possible to utilise 14 meters of the width; therefore, one extra meter will give approx. 84 m3 of cargo hold.

Example H&G-trawler - specifications		
Ship width	16	meters
Utilised for storage (silage-tanks, dry-storage or freezers)	14	meters
Ship height	6	meters
Frozen H&G-fish	800	tonnes/trip
Heads, liver, roes and viscera	400	tonnes/trip
H&G fish	50	tonnes/day
Heads, liver, roe and viscera	25	tonnes/day
Total quota/year	7.500	tonnes
Number of trips	7	trips / year

Table 18: Specifications of example H&G trawler

3.6.2 *Calculating the Biomass*

Since the value of the biomass depends upon whether it is heads, liver, etc., and the various parts of the biomass have different storage factors, it is necessary to calculate the composition of the biomass. The calculation of the biomass is given below. Of the 7.500 tonnes of live weight biomass around 4.800 tonnes will go into the cargo hold as frozen H&G fish. The rest of the biomass, 2.700 tonnes, can be treated in one of the four different ways given above.

	Percentage	Biomass	H&G	Rest
Fillet	44%	3.300	3.300	
Head	24%	1.800		1.800
Cut-offs	5%	375	375	
Back bone	12%	900	900	
Liver	5%	375		375
Roe and milt	2%	150		150
Viscera	5%	375		375
Skin	3%	225	225	
Total	100%	7.500	4.800	2.700
			64%	*36%*

Table 19: Overview of composition of biomass of example vessel

Most of the rest raw material is heads which take up a relatively large amount of space in the cargo-hold if not compressed prior to storage or grinded into silage. The liver, roe, milt and viscera are easier than the heads to store as frozen goods than the heads. The storage factor of the silage is calculated as 1:1, meaning that 1 ton of biomass takes up 1 m^3 of storage space. The fish meal and oil conversion factors are 1:5 and 1:20 respectively, meaning that 1 ton of biomass is produced into 0,2 tonnes of fish meal and 0,05 tonnes of fish oil. The storage factor for meal is 1:1,5 and for fish oil 1:1, meaning that 1 ton of fish meal takes up 1,5 m3 of storage space in dry storage and 1 ton of the fish oil takes 1m^3 of storage space in a tank. The storage factors in the freezer are 1:1 for liver, roe, milt and viscera, while the storage factor for the heads are 1:2, meaning that 1 ton of heads take up 2 m^3 of storage space.

3.6.3 The Profitability of the Three Solutions

Table 20 shows the profitability calculations of the three solutions. See appendix 6 for a more detailed presentation of the calculations.

	Silage		Fish meal & oil		Frozen	
mill DKR / year	New vessel	Existing vessel	New vessel	Existing vessel	New vessel	Existing vessel
Revenue	5.4	5.4	6.9	6.9	8.3	8.3
Capital Expenditure (CAPEX)	2.3	2.7	2.9	3.1	3.1	3.8
Operational Expenditure (OPEX)	0.8	0.8	3.5	3.5	3.9	3.9
Surplus mill DKR/year	2.3	1.9	0.5	0.3	1.3	0.6
Surplus kr/kg rest biomass	*0.84*	*0.70*	*0.18*	*0.11*	*0.46*	*0.22*

Table 20: Profitability calculations for various solutions for bringing everything ashore

The table illustrates three solutions: silage, fish meal & oil and frozen storage. For each solution calculations are made for new vessels as well as existing vessels. The rows show the revenue, capital expenditure (CAPEX), operational expenditure (OPEX) and the surplus/deficit for each solution. The capital expenditure is quite similar for all four cases and lies around 3 million DKR annually. Most of the capital expenditure are spent on the investment cost in new equipment and to the lengthening of the vessel in order to make room for the storage hold. The difference between the solutions thus lies in the revenue and in the operational cost. In all cases it is more profitable to install the processing lines on board new vessels instead of existing vessels, but there is no major difference in profitability between new and old vessels.

The best solution for the vessel owner is silage since it creates a profit of around 1,9 – 2,3 million DKR annually. The silage solution limits the range of processing possibilities for the biomass, but both seem to be viable solutions for the vessel owners. The main reason for the attractiveness of these solution is that the operational cost is very low since the processing of the biomass is automated on board the vessels and the silage can be pumped from the tanks to storage tanks on land, thereby vastly reducing the need for manpower.

The fish meal & oil solution and the freezing solution are both inferior to the silage solution. This is mainly due to the need for extra manpower and to a smaller degree due to the extra energy usage which both increase the operational cost. It is calculated that both the fish meal & oil solution and the freezing solution require one extra man on each shift on board the vessels in order to handle the biomass and store the finished products – thus with two shifts two extra men are required on board the vessel.

The main conclusion from the profitability analysis is that it is possible to get the biomass ashore with a profit for the vessel owners, although the profit is very limited compared to the profit from the main product – the H&G fish. It is most profitable to bring the biomass ashore with as little handling at sea as possible, since the manpower is relatively expensive. For this reason, the silage solution seems to be the best option for the vessel owners. From a processing point of view, the silage solution offers good possibilities for processing of a standardized product, but it limits the range of possible processing opportunities. The freezing option offers the best range of processing possibilities on land, but leaves the vessel owners with lesser profit. From a societal perspective it makes sense to create the right incentives to get the biomass ashore in one way or another in order to secure the raw material needed for the extra possible growth in GVA. As a final remark it can be mentioned that calculations also have been made where only the liver, roe and milt is taken ashore while the heads and the viscera are discarded at sea. These calculations show that it is only profitable to choose this solution if it is possible to handle the biomass without increasing the manpower and using existing storage.

Hydrolysis: A potential alternative to silage

One promising solution for bringing everything ashore is treating the biomass with hydrolysis. Since the hydrolysis solution is relatively new and currently is being tested on board the Norwegian trawler 'Molnes', it is not possible to formally compare the solution with silage. Therefore, a qualitative description of the possibilities is included here. Compared to silage, the hydrolysis solution does not involve adding acid to the biomass and this expands the range of possible usage of the biomass. While silage mainly can be used in aquaculture and animal feed, the biomass from the hydrolysis solution can be used for human consumption and medicinal purposes which normally pay a higher price for the biomass. Another advantage of the hydrolysis solution is that it removes a lot of the water from the biomass and thereby reduces the space required for storage on-board the vessels. This in turn reduces the investment costs in the vessel. Hydrolysis thus both limits the capital investment in the vessel and expands the range of possibilities and price of the biomass which indicates that it might turn out to be a very promising solution.

Text box 3: Hydrolysis versus silage

3.7 Conclusions for the Barents Sea

A range of conclusions can be drawn from the basis of the value chains analysis and the profitability analysis. Since the fisheries activity and the discards by the various nations in the Barents Sea and offshore Norway is quite similar, the conclusions are not limited to a single case, but have a broader scope including all the fisheries in the Barents Sea by all nations – Norway, Faroe Islands, Iceland and Greenland.

These conclusions are:

1. The total increase in the Gross Added Value that can be obtained by utilising the discarded biomass from the Barents Sea and the Norwegian Waters is calculated to be around 20 percent of the existing economic activity in the fishery and land based fish processing industry. The range of the increase is from 13 percent to 27 percent of the existing economic activity.
2. The increase in the economic activity that can be obtained by bringing the rest-raw material ashore sorted instead of as silage is around 50 percent.
3. In general, there are processing industries ashore that are able to handle and process the raw material. Thus the greatest obstacle is getting the raw material ashore in a profitable manner.
4. The profitability analysis showed that the most profitable solution for the vessel owners is to bring the biomass ashore in a liquid form as silage instead of freezing the biomass or processing it into fish meal & oil at sea.
5. The analysis also revealed that in order create a demand for the rest raw material through innovation in the on-land processing, it might make sense to create the right incentives to get the biomass ashore in order to secure the raw material needed for the extra possible growth in GVA.

3.7.1 The Value of the Extra Activity

Our calculations demonstrate that the value of the extra activity from taking all the raw material ashore and processing it to products using standard processing techniques results in a 20 percent increase compared to the existing value chain. The major problem in the fisheries in the Barents Sea and offshore Norway is the long distance to the fishing grounds which makes it both difficult and expensive to bring all the catch ashore compared to the coastal fishery. Historically this has resulted in relative large discards. The filleting trawlers normally bring ashore somewhat more than one third of the biomass, since they mainly take the fillets, while the H&G trawlers bring a bit less than two thirds of the biomass, since they bring the fish without the heads and guts. The relative large discard in the offshore fishery is the main explanation behind the relative large value added by bringing the whole of the catch ashore.

3.7.2 Silage vs Sorted Landings

The calculations of the value chains also revealed that turning the discarded biomass into silage and process it to fish feed will bring about around two thirds of the potential added value. The last third requires sorted landings of heads, liver, roe, milt and viscera. The conclusion is based on existing standard processing techniques of the discarded material. As processing techniques advance the value added will most likely increase and the difference between the silage based production and the sorted landing productions will most likely increase, since niche-productions normally require sorted landings. The conclusion indicates that if the biomass is brought ashore as silage a substantial part of the potential added value could be obtained. This is thus a viable alternative to sorted landings.

3.7.3 The Barrier is at Sea

The analyses have shown that there currently exists an industry onshore that is capable of handling the currently discarded biomass. Only Greenland lacks an industry capable of handling the biomass but it is possible for the Greenlandic vessels to land the biomass in one of the other countries. Iceland, Faroe Islands and Norway all have, to a varying degree, industries that are able to handle heads, liver, roe, milt, backbones, skin etc. Some of the rest raw material is processed into fish meal and oil and further into fish fodder for the aquaculture industry, while other parts are processed into other end products. The greatest barrier for utilising the biomass of raw material is thus at sea – onboard the fishing vessels.

3.7.4 Profitable to Bring the Biomass Ashore

The main conclusion from the profitability analysis is that it is possible to get the biomass ashore with a profit for the vessel owners, although the profit is very limited compared to the profit from the main product – the H&G fish. It is most profitable to bring the biomass ashore with as little handling at sea as possible, since the manpower is relatively expensive. For this reason, the silage solution seems to be the best option for the vessel owners. From a processing point of view, the silage solution offers good possibilities for processing of a standardized product, but it limits the range of possible processing opportunities. The freezing option offers the best range of processing possibilities on land, but leaves the vessel owners with less profit.

3.7.5 Importance of Creating the Right Incentives

Since the major obstacle for unlocking the potential in the biomass is in bringing the biomass ashore, the obvious solution must be that it is necessary to create the right incentives for the vessel owners to bring the biomass to land. From a societal point of view, it makes good sense to create the right incentives to get the biomass ashore, in one way or another, in order to secure the raw material needed for the extra possible growth in GVA. Without the biomass there can be no value chain.

4. Faroese Waters

The Faroe Islands are very dependent on the fishery resources. Traditionally approximately 90 – 95 percent of Faroese exports have been fishery products, including aquaculture. Traditionally the demersal mixed fisheries targeting cod, haddock and saithe, have had the largest importance, although in recent years aquaculture and pelagic fisheries have had increased economic importance. The Faroese fisheries are regulated under the Commercial Fisheries Act from 1994. Since 1996 the mixed demersal fisheries in Faroese waters have been managed under an effort-based system, i.e. the system of fishing days (days at sea), whilst other species (pelagic) are regulated by TACs (Hegland & Hopkins, 2014). Effort is also controlled using gear and mesh restrictions and closed areas. The number of fishing days is set annually by the Parliament. There has been extensive debate on the current system, which at the time of writing is undergoing a process of reform with all fishing licenses due to expire on January 1 2018. The current system has been challenged in relation to its ability to ensure both biological and economic sustainability - for instance, ICES's North-Western Working group (ICES, 2015) concludes that "there seems to be a poor relationship between the number of fishing days and the fishing mortality because of large fluctuations in catchability". However, an analysis of the current management system is out of the scope of this project. For some further discussion on this issue, see Jákupstovu, Cruz, Maguire and Reinert (2007), Búskaparráðið (2014), Hegland and Hopkins (2014) and Grétarsson and Danielsen (2014).

The main fisheries in Faroese waters are mixed-species, demersal fisheries and single species pelagic fisheries. The demersal fisheries are mainly conducted by Faroese vessels, whereas the pelagic fisheries are conducted both by Faroese vessels and by foreign vessels licensed through bilateral and multilateral fisheries agreements (ICES, 2015). Although they are conducted by a variety of vessels, the demersal fisheries can be grouped into fleets of vessels operating in a similar manner. Some vessels change between longlining, jigging and trawling, and they therefore can appear in different fleets. The Faroese demersal stocks are in very poor condition, especially cod and haddock, with the spawning stock biomass of haddock at an historical low (Havstovan, 2015). As a result of this, ICES has every year since 2009 advised that there should be no direct fishing for Haddock (Grétarsson & Danielsen, 2014; Havstovan, 2015). The latest advice from the Faroe Marine Research Institute was to reduce number of fishing days to 50 percent of the utilised - not allocated - fishing days from 2013/2014 for those vessel groups fishing predominantly for cod and haddock (Group 3,4 and 5) (Havstovan, 2015). In the sections that follow, the catch composition and an overview of rest raw material discarded will be presented, before the value chain analysis will be presented.

4.1 Overview of Fisheries

Since there are large fluctuations in the demersal fisheries in Faroese waters the calculations are based on average catches for a longer time period. The average catches from 1993 to 2014 in the Faroese demersal fisheries in Faroese waters was around 116.000 tonnes wet white fish caught by 80-100 vessels. Almost all of the catch was brought ashore as fresh fish, iced and gutted. The bulk of the catch was saithe (37 percent), cod (19 percent) and haddock (12 percent) while the rest (32 percent) was a mixture of various species. In the calculations all of the biomass is treated as cod. The table below shows the results of the calculations when the total biomass of 116.006 tonnes is converted into various parts of the fish.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	51.043	51.043	-
Head	24%	27.842	26.842	1.000
Cut-offs	5%	5.800	5.800	-
Back bone	12%	13.921	13.921	-
Liver	5%	5.800	152	5.648
Roe and milt	2%	2.320	248	2.072
Viscera	5%	5.800	-	5.800
Skin	3%	3.480	3.480	-
Total		**116.006**	**101.487**	**14.520**

Table 21: Overview of landed and discarded biomass for demersal fisheries in Faroese waters

The calculations show that around 87 percent of the biomass was landed while the rest was discarded at sea. The largest portion of the discards was viscera (5.800 tonnes), liver (6.648 tonnes), roe and milt (2.072) and heads (1.000 tonnes). The quantity of discarded heads is estimated at 1.000 tonnes based on the catch from a few longliners with freezing capacity.

4.2 Value Chain Analysis

The value chain analysis illustrates the potential value of the discarded biomass (see Table 22).

Value Chain Analysis - Faroese Demersal Fisheries

Existing value chain

	Fisheries	Processing	Total	GVA-growth
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	%
Total	**499**	**540**	**1.039**	

Directly to silage

	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Total	**33**	**13**	**46**	**4%**

Sorted landings

	Fisheries	Processing	Total	
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Heads	2	3	5	
Liver	28	21	49	
Roe	9	8	17	
Milt	2			
Viscera	10	22	34	
Total	**51**	**54**	**105**	**10%**

Table 22: Value chain analysis of demersal fisheries in Faroese waters

This value chain will be elaborated further in the following subsections.

4.2.1 The Existing Value Chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries is around 499 million DKR. Adding the contribution from the processing industry of 540 million DKR brings the total up to 1.039 million DKR.

4.2.2 Silage Value Chain

The total discarded biomass is calculated to 14.520 tonnes. If the biomass was landed as silage, it would create a gross value added in fisheries of 33 million DKR. Furthermore, it could create an added value of 13 million DKR when processed into fish meal and oil and further into fish feed for the aquaculture industry. The total added value would be around 46 million DKR or around 4 percent of the existing value chain. It is possible to further process the silage into fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

4.2.3 Sorted Value Chain

Sorting the rest raw material into heads, liver, etc., increases the landing value compared to silage and makes it possible to process the various raw materials separately. The GVA in fisheries increases to 51 million DKR. By processing the material into end products the value added by the processing industry is calculated to 54 million DKR bringing the GVA up to 105 million DKR or around 10 percent of the existing value chain. Around half of the potential is in the liver with a total of 49 million DKR. The second largest potential is in the milt and viscera with 34 million DKR. This value might be overrated since the price of the raw material for fish meal and oil depends among other things on how much fat and water it contains and a delivery of only viscera and milt will likely not be valuable. The third largest value is in the roes with 17 million DKR. Lastly, there is the value of the heads with 5 million DKR.

4.2.4 Unlocking the Potential

Figure 9 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 1.039 million DKR. The bars indicate the possible value added by various processing of the material, starting with three scenarios for processing of silage, namely using silage directly as animal feed, processing the silage to fish meal and oil and further processing the fish meal and oil into fish feed. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, there is included a last scenario which is labelled biorefining, indicating that bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

Matís – Icelandic Food and Biotech R&D Company

Matís has played a central role in relation to improving the utilisation from fisheries and developing new innovative products from rest raw materials in Iceland. Matís works in close collaboration with established seafood companies as well as small start-up companies and equipment providers to improve processes and develop new products, with the aim of increasing value and utilisation of seafood. Matís provides access to vast variety of expertise, technology and facilities to develop and test innovative solutions and products on pilot scale.

Text box 4: Matís - Icelandic Food and Biotech Company. Photo: Matis, Iceland and Torfi Agnarsson

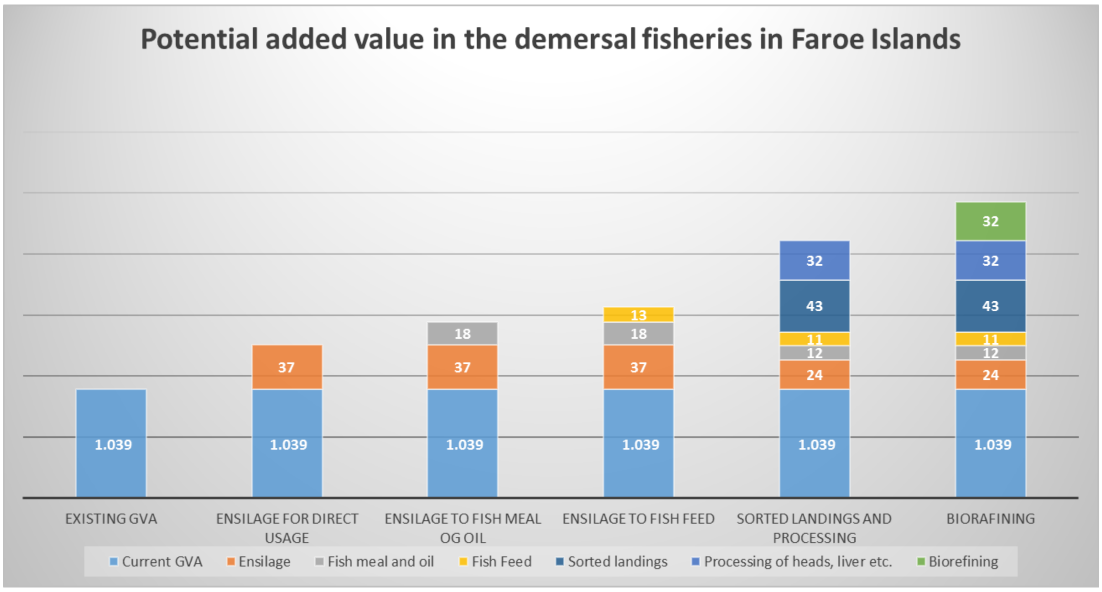


Figure 9: Potential GVA in the demersal fisheries in the Faroe Islands

According to this estimation, the potential added value in the demersal fisheries in the Faroe Islands spans from 37 million DKR in silage for direct usage to 154 million DKR in a fully integrated bio refinery scenario.

4.3 Opportunities and Challenges

This section is based on the outcome from the meetings with stakeholders in the Faroe Islands. See section 2.1 for more information on the meetings and an overview of the participants. As highlighted in section 3.5 on the Barents Sea fisheries, the participants at the meetings in the Faroe Islands also acknowledged the importance of working towards improving the utilisation of rest raw materials. Several of the obstacles are similar to those highlighted in the section on Barents Sea fisheries. However, there are also different challenges and opportunities, since here we are talking about a more diverse fleet and shorter distance to the fishing grounds. For the fisheries in the Faroe Islands, it was also mentioned that it currently is economically infeasible to take everything ashore. Participants argued that the price obtained for the biomass is not sufficiently high to make it worthwhile to bring everything ashore.

Similarly, there are also challenges in terms of the vessel design. If everything should be taken ashore, adjustments have to be made to the fleet, in terms of the necessary equipment. The biomass that does not get landed in Faroese waters, consists mainly of entrails, and for the freezer longliners, also the heads. One issue that was brought up was related to quality. Fish factories producing salt fish much prefer to buy the fish with the heads, as the area around the neck get discoloured once the head is cut off. The discoloured area is then cut off, resulting in a reduction in processing yield. For this reason, it was suggested by a representative from a fish factory that the fish should be frozen with the head on. However, this will also require some changes in terms of the freezers which are often not large enough to freeze whole fish.

As illustrated earlier in this chapter, some vessels take liver, but the majority discard the liver and other entrails in Faroese waters. In the Faroe Islands, there is currently an incentive in place where extra fishing days are given for landing liver. This has been utilised for some vessels, where the crew get all the income from the liver, rather than sharing it between vessel and crew. However, this is not much utilised, possibly due to the fact that there are many unutilised fishing days in the current system.

Utilizing fish skin for collagen

Fish skin is an attractive source for marine collagen and gelatine. Collagen from fish skin may be an alternative to animal based collagen within cosmetics, food and food supplements. Collagen is one of the strongest proteins in nature and gives the skin and bones strength and durability. Gelatine from fish skin has a lower melting point than gelatine from terrestrial animals and can advantageously be used in dry products such as micro-encapsulation, skin care products, food and food supplements. In general gelatine from cold water species has better properties as barrier to oxidation compared to terrestrial animal-based gelatine. This characteristic of marine collagen may also open up opportunities within capsules and packaging. The present global market for gelatine/collagen is around 300 000 tons – of which less than 1 percent is marine based. The price range for collagen is from €10 to €25/kg depending on the market segment. The lowest price given for collagen as a food supplement with a price range of €10-12/kg while cosmetics is the higher end price market with a price range of €20-15/kg. For a more detailed description of the potentials in collagen/gelatine, including a business case, see Rubin (2012) and Hansen (2007). For concrete examples of collagen products, see for instance seagarden.no, ankra.is or nordicbeauty.com.

Text box 5: Utilizing fish skin for collagen. Photos: Matís

The economy of scale is also very relevant for the Faroese fisheries. The total amount of biomass means that establishing profitable productions based on rest raw materials is challenging due to the low quantities of biomass. However, if all the liver would come to shore from the major demersal species, such as cod, haddock and saithe, it should be possible to establish a profitable production of fish oil. It was highlighted at the meeting with Faroese stakeholders that the quality of landed fish is not adequate, and that we should focus more on ensuring that the fish is handled and stored appropriately.

The share system to pay fishermen has also been highlighted as an issue for the fisheries in Faroese waters. Taking the entire biomass does not add much to the crew, and in some cases additional crew must board to deal with new processes, meaning that there is even less pay per member. Related to this issue, there is currently a project on developing automated equipment for taking liver, which would result in less work for the crew. A prototype is currently in operation on-board a vessel and the feedback has been positive.

One concrete suggestion from the stakeholder meetings was that the catch from the small-scale fisheries should be landed ungutted. The fish should only be bled at sea, and then gutted on land. Not only would this make it possible to utilise all parts of the fish, but if the fish is bled quickly, and then cooled to the optimal temperature, the quality of the fish will improve. This is common practice both in Norway and Iceland. It was mentioned at the meeting that this should be a priority for the fisheries in Faroese waters. Faroese fish factories have recently been gutting fish for coastal fishers in return for the rest raw materials, such as heads, entrails, etc. The lessons are that not only does this reduce the workload of fishers, but it also results in bigger catches; and fishermen can be longer out on the fishing field as they do not have to gut whilst sailing home. However, this has only been done in the roe season.

An advantage of the Faroe Islands is that the country is very small, which makes the logistics relatively simple. In the Faroe Islands, the necessary infrastructure is already in place. There is a fish feed factory, which could take care of the biomass and there are also facilities for drying fish heads and backs, although at the time of writing, the main market for these dried fish heads is in a very bad shape. There is also available equipment for making fish liver oil which can be set up within a relatively short notice.

Financing was also brought up as an important issue. It was mentioned that there need to be funding mechanisms for innovations in the fishing industry. It was also suggested that perhaps a good way forward would be to fund projects on small scale, for instance with one vessel, and then make the results available to the rest of the fleet as appropriate. In the meetings in the Faroe Islands, the ecological consequences of not discarding rest raw materials were mentioned, but to assess this effect is out of the scope of this project. However, as mentioned earlier, this topic is currently being investigated in other projects. See for instance DiscardLess (2015) for more information on this.

4.4 Conclusions for Faroese Waters

The calculations on the value chain for the Faroese Demersal Fisheries in Faroese Waters have shown that:

a) The total increase in the GVA, that can be obtained by utilising the discarded biomass from the fisheries in Faroese Waters is calculated to be from 4 percent to 10 percent of the existing economic activity.
b) Around 40 percent of the increase in the economic activity can be obtained by bringing the rest raw material ashore as silage. The last 60 percent of the GVA can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.
c) The most valuable raw material to bring ashore is the liver and the roe.

4.4.1 The Value of the Extra Activity

Measured in the Gross Value Added the value of the extra activity from taking all the raw material ashore and processing it to products in a standard manner is calculated to around 4-10 percent of the existing value chain. The relatively small increase in GVA compared to the Barents Sea fisheries illustrates the advantage of the coastal fisheries. While the long distance to the fishing grounds in the Barents Sea makes it both difficult and expensive to bring all the catch ashore, this is not a problem in the coastal fisheries in Faroese Waters. Historically this has resulted in relative small discards where the heads are brought ashore and the most valuable discards are the liver, roe and milt.

4.4.2 Silage vs Sorted Landings

The calculations of the value chains also revealed that turning the discarded biomass into silage and to process it into fish fodder will bring about around 40 percent of the potential added value. The last 60 percent require sorted landings of liver, roe, milt and viscera. The conclusion is based on existing standard processing techniques of the discarded material. As the processing techniques advance the value added will most likely increase and the difference between the silage based production and the sorted landing productions will most likely increase, since niche-productions normally require sorted landings. The 40 percent for the silage solution is relatively less than for the Barents Sea scenario where silage could bring 50 percent of the GVA. Also a silage solution in the coastal fisheries would require installing silage equipment on board around 80 vessels in the current fisheries in addition to installations onshore. This could prove to be an expensive solution compared to bringing the biomass ashore iced.

4.4.3 Landing of the Liver and Roe

Most of the value in the discarded biomass is in the liver and roe. Landing the liver and roe ashore would thus bring the most valuable biomass ashore and vastly reduce the value of the discards. The discard would then mostly consist of viscera. However, such a solution would not unlock the potential for any new industry based on extracting values from the viscera and would not unlock the possibility for marketing the Faroe Islands as a country where everything is brought ashore.

5. Greenland Waters

Fishing is the primary industry of the Greenlandic economy with approximately 88 percent of export coming from fish and shellfish (Grønlands Statistik, n.d.). Cold water shrimp represents just under half of the country's exports, whilst halibut represents a quarter of exports. The other species exported are mainly cod and crabs. Fishing is regulated through the Fisheries Act no. 18 from 1996 (Government of Greenland, 1996) by licence and quota regulations. The total TAC is set in accordance with advice from the Greenland Institute of Natural Resources as well as NAFO, NEAFC and ICES (Government of Greenland, n.d.). The fishery is divided into coastal and offshore fleets, for instance for the shrimp fishery west of Greenland, the coastal vessels get 43 percent of the total TAC, whilst the offshore fleets gets 57 percent (Viðarsson, Þórðarson, et al., 2015). The fishing fleet is around 850 vessels of various sizes, whilst there is an estimate of 5000 small boats (Berthelsen, 2014; Government of Greenland, n.d.).

Two large companies account for approximately 77 percent of the total fish production from fishing, processing to export (Jervelund & Fredslund, 2013). Royal Greenland is owned by the Government and Polar Seafood is the largest private owned company in Greenland. The two companies' activities coincide with small-scale coastal fishing (using small fiberglass boats and dinghies) that remain vital for livelihoods in rural coastal communities in (West) Greenland (Holm, Raakjær, Becker Jacobsen, & Henriksen, 2015). For the coastal fisheries there is an obligation to land all the catch locally. For the offshore prawn fishery the obligation was 10 percent, which has been changed to 25 percent in order to support onshore employment and income generation (Holm et al., 2015). Each fishery has a different set of rules and regulations. For more specific details on the rules for each fishery, see Viðarsson et al (2015) and Berthelsen (2014).

5.1 Overview of Fisheries

The Greenlandic demersal fisheries consisted in 2014 of 86.677 tonnes wet white fish caught by trawlers and smaller fishing boats. The catch can be divided into four categories:

1. Greenland halibut constituted 42 percent of the total demersal catch and 69 percent of the export value of demersal fish. It is exported as H&G fish without processing.
2. Cod, haddock, saithe and redfish constituted 30 percent of the catch and 22 percent of the export value. It was processed into fish fillets.
3. Lump fish was 17 percent of the catch but only the caviar is exported at 4 percent of the export value of demersal fish.
4. Other fish species were 10 percent of the catch and 5 percent of the export value.

The table below shows the results of the calculations when the total biomass of 86.677

tonnes is converted into various parts of the fish. The calculations show that 59 percent of the biomass was landed while 41 percent was discarded. Around 40 percent of the total discard of 35.374 tonnes were lump fish where the roes were extracted and exported while the rest of the biomass was discarded. The main part of the rest of the discards are cut-offs, liver, roe, milt and viscera from the filleting and liver, roe, milt and viscera from the Greenland Halibut.

Tons	Conversion factors	Total catch	Landed	Discarded
Fillet	44%	37.763	31.636	6.127
Head	24%	20.598	8.808	11.790
Cut-offs	5%	4.291	-	4.291
Back bone	12%	10.299	8.628	1.671
Liver	5%	4.291	-	4.291
Roe and milt	2%	2.568	1.130	1.438
Viscera	5%	4.291	-	4.291
Skin	3%	2.575	1.101	1.474
Total		**86.677**	**51.303**	**35.374**

Table 23: Overview of discarded and landed biomass from demersal fisheries in Greenland

5.2 Value Chain Analysis

The value chain analysis illustrates what potential lies in the discarded biomass. See appendix 5 for a more detailed value chain analysis.

Value Chain Analysis - Greenlandic Demersal Fisheries

	Fisheries	Processing	Total	GVA-growth
Existing value chain				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	%
Total	**727**		**727**	
Directly to silage				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Total	**63**	**53**	**116**	**16%**
Sorted landings				
	GVA mill. DKR	GVA mill. DKR	GVA mill. DKR	
Heads	21	35	56	
Liver	21	16	37	
Roe	6	5	12	
Backbones and cut-offs	22			
Milt	1			
Viscera	8	28	61	
Skin	3			
Total	**82**	**85**	**166**	**23%**

Table 24: Value chain analysis of demersal fisheries in Greenland

5.2.1 The Existing Value Chain

The existing value chain illustrates the value created from the biomass that currently is taken from the sea and processed at sea or on land. The gross value added in the fisheries and processing is around 727 million DKR. It has not been possible to split the GVA into separate groups of fisheries and processing.

5.2.2 Silage Value Chain

The total discarded biomass is calculated to 35.374 tonnes. If this had been landed as silage, it would have created a gross value added in fisheries of 63 million DKR. Furthermore, it could create an added value of 53 million DKR when processed into fish meal and oil. The total added value would be around 116 million DKR or around 16 percent of the existing value chain. It is possible to further process the silage into fish feed or fish oil and proteins for human consumption, which would further increase the value – this is not shown in the value chain.

5.2.3 Sorted Value Chain

Sorting the rest raw material into heads, liver, etc. increases the landing value compared to silage and makes it possible to process the various raw materials separately. The GVA in fisheries increases to 82 million DKR. By processing the material into end products the value added by the processing industry is calculated to 85 million DKR bringing the GVA up to 166 million DKR or around 23 percent of the existing value chain. Around one third of the potential is in the heads with a total of 56 million DKR. One third is in the liver and roe with a total of 49 million DKR. The last third is in the biomass that is going to fish meal and oil in the calculations, with a total of 61 million DKR.

5.2.4 Unlocking the Potential

Figure 10 below illustrates the adding up of the added value in the value chain. The bar furthest to the left shows the existing value added of 727 million DKR. The following bars indicate the possible value added by various processing of the material, starting with two scenarios for processing of silage, namely using silage directly as animal feed and processing the silage to fish meal and oil. The sorted landings and processing bar indicates the potential of sorted landings which is relatively higher than the silage scenarios. Finally, the 'biorefinery' scenario illustrates that bringing the raw material sorted ashore can unlock some new processing possibilities and/or create high value niche-productions.

Biotep: Norwegian Facility for Marine Bioprocessing

In order to develop more high-value products from the marine rest raw materials, facilities and infrastructure are needed to research and test how to obtain high-value compounds from the biomass. One example of such a facility is Nofima's Biotep – The national centre for marine bioprocessing. The plant was opened in 2013, fully operational from 2014 and new infrastructure is constantly being added. The plant is a mini-factory where high technology companies or researchers can test and optimize their processes to extract all desired components from marine- and plant-based biomass. At Biotep, companies can perform test productions based on their own processes and technology, Nofima can also assist in the development of the processes. Smaller companies can rent the facility to perform periodical or regular production. From the test production, a cost estimate can be made and a product prototype can be tested in the market. Biotep is located close to the laboratories and scale-up hall at the Nofima headquarters in Tromsø. Nofima can offer extensive experience in the development and scale-up of bioprocessing methods and has all the necessary equipment for bioprocessing a large variety of biomass.

Text Box 6: Biotep - Norwegian facility for marine bioprocessing. Photo: Lars Åke Andersen/Nofima

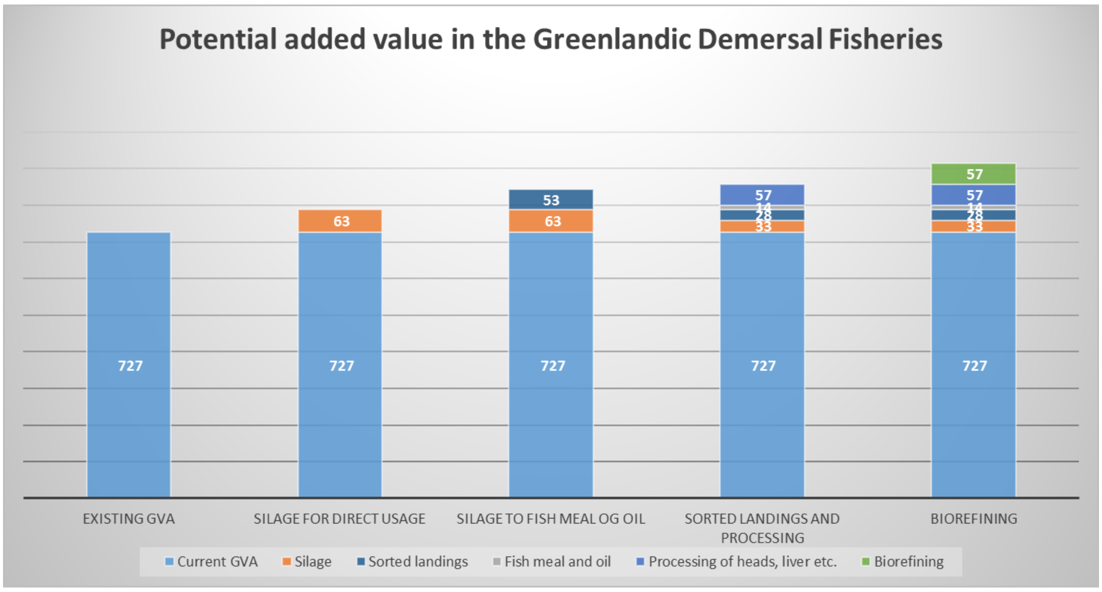


Figure 10: Potential GVA in the Greenlandic demersal fisheries

According to this estimation, the potential added value in the demersal fisheries in Greenland spans from 63 million DKR in silage for direct usage to 191 million DKR in a fully integrated bio refinery scenario.

5.3 Opportunities and Challenges

This section is based on the outcome from the meetings with stakeholders in Greenland. See section 2.1 for more information on the meetings and an overview of the participants. Overall, and as highlighted in section 3.5 on the Barents Sea fisheries, the participants at the meetings in Greenland acknowledged the importance of working towards improving the utilisation of rest raw materials. Many of the obstacles are similar to those highlighted in the section on Barents Sea fisheries, although Greenland has some specific features that make it more challenging to bring everything ashore. At the meetings in Greenland, participants highlighted that although Greenland could bring more ashore, it is impossible to bring all the biomass ashore. From the stakeholder meetings, it was clear that Greenland faces larger challenges in terms to bringing everything ashore.

It was argued at the meetings in Greenland that the most important barrier to improving the utilisation are the high transportation prices. Geographical distances in Greenland are vast, and the monopoly on transportation is a barrier. Stakeholders expressed a desire for the project to illustrate the costs of bringing more ashore. See section 3.6 for a presentation of the costs in relation to the various methods for bringing raw materials ashore.

Related to the issue of vast geographical distances, there are a lot of landing stations in Greenland. This means that the quantities that would be landed would be too small to set up new productions, for instance for fish oil. At the same time, the transportation costs associated with transporting all of the raw material to one central facility is likely to make the production economically infeasible. Another issue brought up was related to the work force.

Some villages already have challenges with the work force. If new productions are established, it is possible that additional labour would need to be brought in from other areas and the costs related to this would most likely also reduce profitability.

Processing Possibilities for Shrimp Shells

Shrimp shells can be processed in various ways. One way is to dry the shells and process them into shrimp meal. Shrimp meal can be used as an ingredient in animal feed. Lately the price of shrimp meal has not been high which is one of the reasons why the producers in Greenland have not been fully utilising the shrimp shells for shrimp meal. Shrimp shells can also be processed into Chitin which has a range of utilization possibilities. Chitin can be further processed into the high value product Chitosan or used as an ingredient in the production of Glucosamine, which is a rheumatic agent. A company in Iceland is currently in the process of starting up a production plant for Chitin and Chitosan. One way of utilising the shrimp shells in Greenland could be to export the shells to the production plant in Iceland and later on start a plant in Greenland. See Nielsen et al (2006) for a more detailed description of the potentials in shrimp shells.

Text box 7: Processing possibilities for shrimp shells. Photo: Primex

A participant also mentioned that the storage capacity of the various villages also needs to be considered if the entire biomass will be landed. In terms of the Greenland halibut coastal fishery, the fish is landed gutted with head, so most of the fish is already landed today. The entrails, which potentially could be utilised, are discarded. However, since landing facilities are scattered in villages across the coast, the quantity of raw material in each area is relatively low. If this had to be transported to a central facility, it would unlikely be profitable.

When it comes to the fish factories, a potential option could be to have silage tanks at each factory to avoid the factory having to dump the rest raw materials from the factory at sea. This could perhaps be used as feed in the local area to avoid transportation of a low value product. Some factories currently also freeze rest raw materials from the production to mix with dog food locally (Nielsen et al., 2006).

One of the options mentioned in relation to the shrimp fishery, is to make shrimp meal from the shells, and potentially also to value add this further with productions of chitin or chitosan. The Royal Greenland factory in Ilulissat produces shrimp meal instead of emitting the shells back into the ocean (Nielsen et al., 2006). A report on options for utilisation of organic industrial waste in Greenland identified several opportunities as 'realistic' in terms of economic feasibility (Nielsen et al., 2006). These were: production of fish meal and fish oil, fish silage for dog feed, or for export for other feed production as well as export of rest raw materials to Asian markets. See Nielsen et al (2006) for a more information.

All in all, based on the interactions we have had with stakeholders in Greenland, the challenges for Greenland are substantially bigger than in the neighbouring countries. This is particularly due to the large geographical distances and associated transportation costs, the price of electricity and water, as well as relatively small productions units and limited quantities of raw material. A profitable utilisation of rest raw materials will require that the monopoly of Royal Greenland or the transportation prices are revisited, as this was identified as the critical point of the discussions at the meetings. As opposed to the Faroe Islands, Norway and Iceland, utilising all of the biomass in Greenland will require additional production set-ups. However, as discussed in the section above, stakeholders have also identified some concrete opportunities to improve the utilisation.

5.4 Conclusions on Greenlandic Case Study

The calculations on the Greenlandic Demersal Fisheries value chain show that:

a) Bringing everything ashore will increase the value chain by about 16-23 percent relative to the existing value chain.
b) Around 70 percent of the increase in the economic activity can be obtained by bringing the rest raw material ashore as silage while the last 30 percent of the gross value added can be obtained by bringing the raw material ashore as sorted landings, which also might unlock new potential processing possibilities.
c) It is unclear whether the lump fish, which is a substantial part of the discarded biomass, can be exported directly. Currently the roe from the lump fish is exported while the fish itself is discarded. Other countries, e.g. Iceland, have succeeded in exporting the lump fish as well as the roes. Exporting the lump fish would reduce the discarded biomass by around 40 percent.

5.4.1 The value of the Extra Activity

Measured in GVA, the value of the extra activity from taking all the raw material ashore and processing it to products in a standard manner is calculated to around 16-23 percent of the existing value chain. One major problem in extracting the value of the discarded biomass is that there are many and small fish trading stations along the cost, which limits the quantity of biomass in each location, which again limits the potential processing of the biomass.

5.4.2 Silage vs Sorted Landings

The calculations of the value chains also revealed that turning the discarded biomass into silage and processing it into fish fodder will bring about around two thirds of the potential added value. The last third requires sorted landings of heads, liver, roe, milt and viscera. The conclusion indicates that if the biomass is brought ashore as silage, a substantial part of the potential added value could be obtained. This is thus a viable alternative to sorted landings. Since silage can be stored in tanks for a long time, easily pumped from one tank to another and transported, this might be a viable solution that could help gather larger quantities of the biomass in fewer locations for processing.

5.4.3 Exporting the Lumpfish

The lumpfish is caught for the sake of the roe while the rest of the biomass is discarded. Normally the value of the lumpfish is regarded close to zero and only the roes have a value. But in other countries it is possible to export the lumpfish for a reasonable price. Icelandic export statistics reveal that Icelandic lumpfish is exported at 10 DKR/kg for frozen lumpfish and around 50 DKR/kg for salted lumpfish. It seems likely that it should also be profitable to export the lumpfish from Greenland instead of discarding it.

6. Stakeholder Analysis

In this chapter the stakeholder analysis will identify stakeholder groups with interests in fishing vessels, processing on-board, primary and secondary processes onshore, logistical handling, sales & distribution, related research & development, and legal framework. It will only to a limited degree also involve community representatives, consumer and environmental NGOs etc.

The analysis is based on the following procedure/steps:

1) Identify and list stakeholder groups and individuals for each case study
2) Briefly describe the characteristics of the individual stakeholder group and with respect to expected reward from and contribution to the project objective
3) Identify areas of harmony and conflict between the individual groups in relation to the project objective
4) Estimate the level of power, legitimacy and urgency of stakeholder claims for future actions
5) Formulate recommendation for an action plan

Given the potential complexity of managing a network of stakeholders, we consider it crucial to understand: firstly, who is part of a regional network and what role do they possess? and secondly what level of power do they have and what kind of various resources might they provide?

6.1 Identification of Stakeholder Groups

Representatives from 14 stakeholder groups were invited to the stakeholder work shops and round table discussions. The events were held in Norway, Iceland, Faroe Islands and Greenland. In each country a local scientific partner decided on the relevant stakeholders to be invited. These were Nofima (NO), Matís (IS), Syntesa (FO) and Greenland Institute of Natural Resources (GR).

In total more than 100 stakeholders were invited, and of these approximately 50 percent attended the events.

	Session	Open dialogue workshop								Total Show	Roundtable discussion								Total show	Total invited
	Turn-out	Invited				Show					Invited				Show					
	Country	NO	IS	FO	GR	NO	IS	FO	GR		NO	IS	FO	GR	NO	IS	FO	GR		
Fishery	Fishing vessel, frozen	4	1	5	2	2	1	2	2	7	4	1	5	2	2		5	2	9	12
	Fishing vessel, fresh	3	1	3	1			1		1	3	1	3	1		1	2		3	8
	Shipowner association		1	1	1		1	1		2		1	1	1		1	2	1	4	3
	Fishermen unions		1	2	1			1	1	2		1	2	1		1	1	1	3	4
Processing & sale	Processer, fish fillet & salt fish	2	3	7	2	1	1	1	2	5	2	3	7	2	2		1	2	5	14
	Processer, other products	8	8	8	1	4	3	2		9	8	8	8	1	3	4	5		12	25
	Industry association		1	2			1	1	1	3		1	2			1		1	2	3
	Logistics and transport			1	1				1	1			1	1					0	2
	Sales, wholesale & retail	2	1	3	1					0	1	1	3	1					0	7
Other organisations	Research and development	3	2	2	1	4	2	1	1	8	3	2	2	1	2	3	1	1	7	8
	Government, civil servants	2	3	2	2	1	2	1	4	8	2	3	2	2	1	1	1	2	5	9
	Gear/technology provider		2	1		1	1	1		3		2	1			1			1	3
	Other service organisation	3	1	1						0	3	1	1						0	5
	Consumer & NGOs	1		0		1				1	1		0						0	1
	Total	28	25	38	13	14	12	12	12	50	27	25	38	13	10	13	18	10	51	104

Table 25: List of stakeholders

If the stakeholders are analysed with respect to the three major groups: ‘Fishery’, Processing & sale’, and ‘Other organisations’, the split of attendance compared to invited can be illustrated as follows:

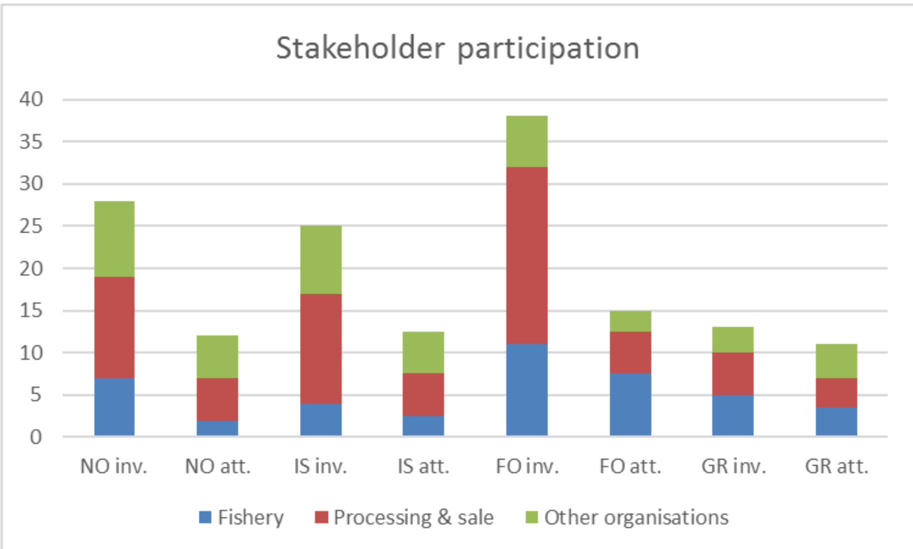


Figure 11: Stakeholder participation. Explanation: inv.=invited; att = attended

In general, 25 percent of the invited stakeholders were from fisheries, 50 percent from processing and sale, and 25 percent from other organisations. This split was also to a large degree reflected in the attendance at the stakeholder events, however, in the Faroe Islands significantly more representatives from the fishery group participated compared to the processing and sale stakeholder group.

6.2 The Attitude of Participants

The attitudes and behaviours of each participant group in terms of contribution, rewards and possibilities (CRP) to implementing the concept idea of bringing everything ashore are summarised in Table 26. In the first column from the left the stakeholder group is listed. In the 'contribution' column we list the main aspects or elements the stakeholder can contribute with in order to obtain the main objective in questions – in this case implementing the concept idea of bringing everything ashore. In the 'reward' column we describe the reward the stakeholder expects to get for the listed contribution. In the column 'possibilities' we list additional actions or activities that have been mentioned during the stakeholder interactions. These are not directly or currently a contribution or reward in relation to the stakeholder group, but can become either a contribution or reward if certain conditions are fulfilled. As such the table gives a simplified picture of the various stakeholder interests and obviously can be elaborated further.

Stakeholder	Contribution	Reward	Possibilities
Fishing vessel, frozen	Bringing biomass ashore, investing in sorting and storage facilities	Income from sale of biomass	Due to relatively low profitability the fishing license authority could provide further incentives related to license terms, and investment incentives for new vessels if designed for bringing everything ashore
Fishing vessel, fresh	Change current practice regarding handling biomass	Income from sale of biomass	
Ship-owner association	Profession stakeholder representation	Key interests of members are addressed	
Fishermen unions	Change salary system so it is more feasible to bring everything ashore	Improved conditions for fishermen in terms of salaries and/or working condition	Fishermen can receive payment for new biomass if vessel gets increased fishing rights in value/volume
Processer, fish fillet & salt fish	Increased purchase price for fish with heads	Improved quality and price for further sale	
Processer, other products	Purchase biomass of a variety of production processes	Improved availability of biomass and return of investments	Investments in innovative knowledge based bio-products
Industry association	Profession stakeholder representation	Key interests of members are addressed	
Logistic and transport	Provide suitable transport solutions	Increase market revenue	
Sales, wholesale & retail	Conduct market innovation for new marine bio products	New market segments and increased revenue of fishmeal/oil	Potential branding effect of bringing everything ashore
Research and development	Continue research of sustainable utilisation of the marine biomass	Increased knowledge generation and funding for further work	
Government, civil servants	Provide acceptable legal framework for bringing everything ashore	Impact in terms of increased marine bio-economy	Promote implementation of 'everything ashore' through fishing license terms
Gear/technology provider	Conduct process innovation in vessel design, equipment and storage	Increased sales to new markets	
Other service organisation	Facilitate general innovation related to bringing everything ashore	Match to strategic mission of the organizations	
Consumer & NGOs	Recognition of the effort of the fishing industry to implement zero discard. Demand for products from sustainable fisheries with 100 percent utilisation	Assurance of the North East Atlantic fisheries as biological sustainable and ethical in terms of resource utilisation.	Creating a good standard for bringing everything ashore based on NE Atlantic. Create a supportive environment for bringing everything ashore in the region

Table 26: Stakeholder groups and their contribution, reward and possibilities in relation to 'everything ashore'

Table 26 above gives an overview of the interest the different stakeholder groups have in relation to bringing everything ashore, and also indicates what can be done to promote the idea, if that is deemed to be desirable.

Another element to consider when characterizing stakeholders is the impact and attitude of the individual stakeholder groups on a successful implementation of the concept idea of bringing everything ashore. This can be done by estimating the impact it will have on the stakeholder group and by estimating the stakeholder's attitude to these initiatives (see Table 27).

Impact of bringing everything ashore			
Very comprehensive change	• Fishing vessel, frozen • Fishermen unions		• Processer, other products. • Government, civil servants
Some change		• Fishing vessel, fresh • Sales, wholesale & retail • Processer, fish fillet & salt fish	• Research and development • Gear/technology provider
Insignificant change		• Ship-owner association • Industry association • Logistic and transport	• Other service organisation • Consumer & NGOs
	Negative, Resistance	**Passive**	**Positive, Enthusiastic**
	Stakeholder's attitude to bringing everything ashore		

Table 27: Impact of 'everything ashore' on stakeholder groups

The impact of bringing everything ashore will be very comprehensive to the fishing vessels (especially frozen), and at the same time they have been negative or expressed most resistance to the idea. On the other hand, 'Processer, other products' together with 'Government, civil servants' seem to be very positive and enthusiastic towards the concept idea of bringing everything ashore, and this will also be a comprehensive change for them. Furthermore, we estimate that this is the same with research and development institutions and gear technology providers, other service organisation; and consumers and NGOs. However, for the latter stakeholder groups the change is not very comprehensive, but still they must be regarded as key stakeholders.

The stakeholder analysis also estimates several stakeholder groups as being passive, even if the impact of bringing everything ashore represents some or a comprehensive change. These stakeholder groups are, 'Fishing vessel, fresh', 'Sales, wholesale & retail', and 'Processer, fish fillet & salt fish'. Finally, there are three stakeholder groups of which the change is deemed to be insignificant and they are also passive, and thus a minimum interaction is required in future action with respect to implement the concept idea of bringing everything ashore.

6.3 Harmony and Conflict amongst Stakeholder Groups.

Different stakeholders have different interests. Sometimes these interests will conflict and sometimes the interests of different stakeholders will align and be consistent. Based on the stakeholder interaction and the analysis above an attempt is made in the table below to identify conflicts, harmonies and opportunities among the main stakeholder groups: Fishery (fishing vessels, ship-owners association and fishermen unions), Processing and sale (all processors, sales and logistics) and Other Organisations (research & development, government, gear providers, other service organisations and consumers/NGOs). The analysis serves the purpose to identify issues or topics that all stakeholders can agree on - e.g. is there a single or multiple topic or feature all groups agree on in relation to the implementation of the concept idea of bringing everything ashore? At the same time stakeholders will disagree on other topics concerning bringing everything ashore and there will be conflicts among stakeholder groups in relation to the implementation of such an initiative. These conflicts have to addressed with the aim to get an acceptable solution for the stakeholders involved. Otherwise these stakeholders will have a negative influence on the likelihood of a successful fulfilment of the project goals.

	Fishery	Processing & Sale	Other Org.
Areas of conflicts	Profitability of bringing everything ashore. Existing salary system	Accessibility to biomass	License terms for fishing. Perceived waste of resources – or an important part of the marine ecosystem
Areas of harmony	Potential for increased value. Improved reputation	Potential for increased value. Process and product innovation	Sustainability and ethical approach to utilisation of marine biomass
Opportunities	Incentives via licensing terms	Develop further into the bio-economy value chain	Increased value creation through research and development

Table 28: Areas of harmony and conflict

Defining areas of harmony and conflict is helpful when organizing communication with stakeholders at sessions and presenting project goals and scientific approaches. Based on the above table the main conflict area relates to accessibility of the biomass: The fishing vessels are not interested in bringing everything ashore due to lack of profitability, and furthermore the existing salary system (at least in the Faroes and Norway) has to change in order to make it attractive from a fisherman's income point of view to participate in bringing everything ashore. However, in Iceland these conflicts are not as dominant as in Norway and Faroes, and this is explained by the higher degree of vertical integration among the operators in the fishing industry. In Greenland the conflict is further complicated by the large geographical distances and cost of logistical handling.

The processors experience this conflict in terms of lack of access to the biomass, and they are 'unwilling' or unable to get the access through normal market mechanisms, e.g. to offer a price high enough to make it profitable for the fishing vessels to bring everything ashore. This 'unwillingness' is a function of the global market conditions and competition of the processers' end-products. Furthermore, in the value chain analyses presented in the previous chapter, it is clear that a large part of the value creation in relation to bringing everything ashore is based on the land based processing functions – and especially if the chain spans into refined products of the biomass.

The ‘Other organisation’ – and here we especially consider governmental functions – seem to have a deliberate interest in bringing everything ashore. This is partly due to a desire to pursue a strategy of ‘growth in the blue bio-economy’, and partly because there is a perception among the general population – and thereby consumers – that not bringing everything ashore is a waste of marine resources. However, there is also scientific evidence suggesting that a sudden decrease in discarded rest raw materials could influence the marine food web with negative consequences for benthic animals, predator species and seabirds (Fondo, Chaloupka, Heymans, & Skilleter, 2015).

The stakeholder groups are in harmony in relation to their interest of realising value creation. Furthermore, the fishing vessels do accept the potential branding effect in terms of improved reputation of their business. All stakeholders have an interest in continued innovation within processes and products related to the marine area, and all stakeholders do recognise the importance of having a sustainable and ethical approach in utilising the marine resources.

When analysing the opportunities, it becomes clear that one way of implementing the everything ashore concept idea is to create incentives in relation to the exclusive fishing rights the fishing vessels are enjoying. The structure and content of these incentives will vary from country to country - depending on the fishing license system. In the Faroese stakeholder events, several examples of such incentives were mentioned, one already in place in the form of increased fishing days if liver is taken ashore, and a potential one, related to the current fishery system reform, where an increased duration of fishing rights could be linked to the obligation to bring everything ashore. However, in most of the stakeholder events representatives from fishing vessels did also emphasize, that a legal obligation to bring everything ashore is a worst case scenario.

The processors see an opportunity in developing new bio-based products and thereby participate in the expected growth potential within the bio-economy, including market segments beyond food and feed such as cosmetics and health. This also counts for the main group ‘Other organisations’ such as the Government, research & development, gear providers and other service organisations. These stakeholders see a potential in increased value creation through research and development based on the accessibility to biomass that currently is not brought to shore.

6.4 The Level of Power, Legitimacy and Urgency

The final step of the analysis is to analyse the position of the various stakeholder groups in relation to three main groups of attributes: Power, legitimacy and urgency. The method is briefly described in Chapter 2 and will be elaborated in this subsection. By analysing stakeholders according to power, legitimacy and urgency we will systematically be able to clarify which stakeholders are important for a successful implementation of the concept idea of bringing everything ashore.

The stakeholders have been scored subjectively by the project team at Syntesa based on their interaction in the stakeholder events held in this project and based on a general estimates of the specific attributes used in order to determine the level of power, legitimacy and urgency of the individual stakeholder. The attributes are listed below[9]:

Definition of attribute constructs:

Power constructs:

- C = Coercive (force or threat)
- U = Utilitarian (material or incentives)
- N = Normative (symbolic influences)

where C, U & N can have a scoring value between 0-3

Legitimacy construct:

A generalized perception of actions as being desirable, proper or appropriate within some socially constructed norms, values, beliefs or definitions. Perceptions on three levels:

- I = Individual
- O = Organizational
- S = Societal

where I, O & S can have a scoring value between 0-3

Urgency constructs:

- T = Time sensitivity (the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder)
- CR = Criticality (the importance of the claim or the relationship to the stakeholder)

where T, & CR can have a scoring value between 0-3

Such a scoring process is by nature subjective and depends on the perceptions of those who conduct it. As such, it should not be seen a definitive, but rather as indicative. They can hopefully serve as a useful starting point for a structured debate on the issue. The scoring results for the stakeholders in the project is listed in Table 29 below:

Stakeholder group:		Power				Legitimacy				Urgency			Total Score
		Coercive	Utilitarian	Normative	Weighted Score	Individual	Organiza-tional	Societal	Weighted Score	Timesens.	Criticality	Weighted Score	
A	Fishing vessel, frozen	1	3	2	2.0	2	3	2	2.3	1	1	1.0	5.3
B	Fishing vessel, fresh	1	2	3	2.0	3	3	3	3.0	2	1	1.5	6.5
C	Shipowner association	1	0	3	1.3	1	3	2	2.0	1	1	1.0	4.3
D	Fishermen unions	3	1	3	2.3	2	3	2	2.3	1	1	1.0	5.7
E	Processer, fish fillet & salt fish	1	1	1	1.0	1	3	2	2.0	2	1	1.5	4.5
F	Processer, other products	0	1	3	1.3	3	3	3	3.0	3	2	2.5	6.8
G	Industry association	1	0	3	1.3	1	3	3	2.3	1	1	1.0	4.7
H	Logistics and transport	2	3	2	2.3	1	2	2	1.7	1	1	1.0	5.0
I	Sales, wholesale & retail	1	1	3	1.7	1	3	1	1.7	2	1	1.5	4.8
J	Research and development	1	1	2	1.3	2	3	3	2.7	2	2	2.0	6.0
K	Government, civil servants	3	3	3	3.0	1	3	3	2.3	2	2	2.0	7.3
L	Gear/technology provider	1	2	2	1.7	3	2	2	2.3	1	1	1.0	5.0
M	Other service organisation	1	1	3	1.7	2	2	3	2.3	2	1	1.5	5.5
N	Consumer & NGOs	3	2	3	2.7	1	2	2	1.7	1	2	1.5	5.8

Table 29: Stakeholder groups and their level of power, legitimacy and urgency in relation to getting everything ashore.

[9] Score: Ranking is made up by scoring each attribute (see below) with numbers from 0-3 where 0 = none ; 1 = small; 2 = medium; 3 = high

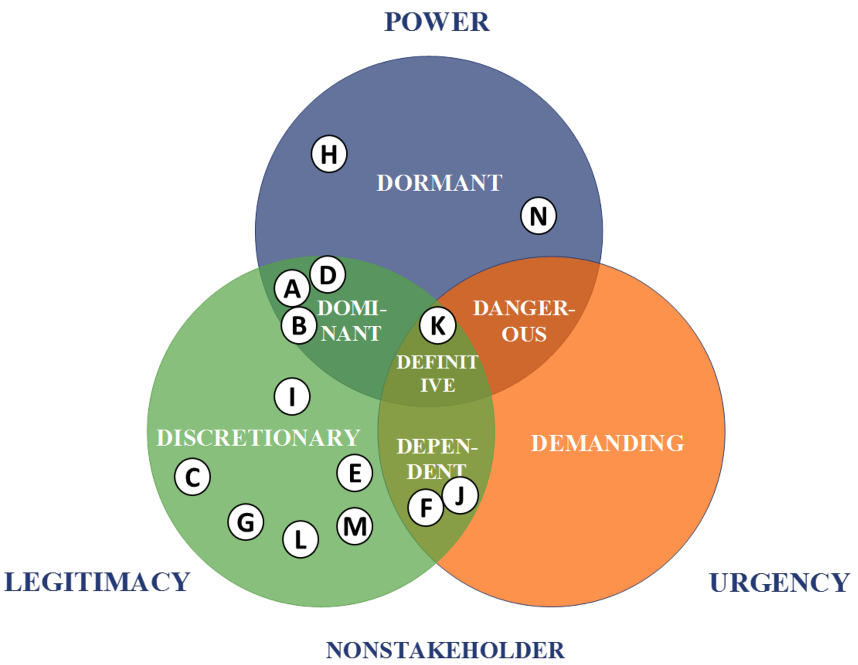
Stakeholder importance will be low where only one of the stakeholder attributes - power, legitimacy, and urgency - is perceived by those who score to be present. These are labled as ‘Latent stakeholders’.

Stakeholder importance will be moderate where two of the stakeholder attributes are percieved to be present. These stakeholders will be labled as Expectant stakeholders.

Stakeholder importance will be high where all three of the stakeholder attributes - power, legitimacy, and urgency - are perceived to be present. These are Salient, or ‘Important, stakeholders’. If none of the stakeholder attributes is perceived to be present they are regarded as ‘Non-stakeholders’.

We consider a stakeholder attribute to be present when the weighted score is 2 or more. The total sum of the weighted scores indicates the level of importance of the stakeholder: <3 = Low importance, 3-6 moderate importance, >6 high importance. Based on these result, the most important stakeholders are Government/civil servants; Processors, other products; Fishing vessels, fresh; and Research & Development. All the other stakeholder groups are of moderate salience or importance.

The stakeholders can also be mapped in seven different profiles (as described in Chapter 2) and these profiles are listed in the figure below based on the scoring in the table above (see Figure 12)



Source: Mitchell, Agle. 1997

Figure 12: Profile map of stakeholders

6.4.1 *Latent Stakeholders*

The profile mapping reveals a number of latent stakeholders.

- Dormant: The stakeholder groups "logistics & transport" and "Consumers & NGOs" are regarded as dormant, as they possess power to impose their will on implementing the concept idea of bringing everything ashore. However, by not having a legitimate relationship or an urgent claim, their power remains unused. Due to their potential to acquire a second attribute, they will become more important for the idea if they acquire either urgency or legitimacy.
- Discretionary: There are six stakeholder groups profiled as Discretionary stakeholders. These possess the attribute of legitimacy, but they have no power to influence the implementation of the concept idea of bringing everything ashore and do not have any urgent claims. The key point regarding discretionary stakeholders is that without absent power and urgent claims, there is no immediate pressure on the 'Everything ashore' project to engage in an active relationship with such a stakeholder, although the project management can choose to do so.

6.4.2 *Expectant Stakeholders*

As we consider the potential relationship between the project 'Everything ashore' and the group of stakeholders with two of the three identifying stakeholder attributes, we observe a qualitatively different zone of importance. In analysing the situations in which any two of the three attributes - power, legitimacy, and urgency - are present, we cannot help but notice the change in momentum that characterizes this condition. Whereas one attribute – stakeholders with low importance - are anticipated to have a latent relationship with the project, two-attribute moderate-salience stakeholders are seen as "expecting something," because the combination of two attributes leads the stakeholder to an active versus a passive stance, with a corresponding increase in the project's responsiveness to the stakeholder's interests. Thus, the level of engagement between the 'everything ashore' project and these expectant stakeholders is likely to be higher. Accordingly: *Stakeholder salience will be moderate where two of the stakeholder attributes -power, legitimacy, and urgency - are perceived by managers to be present.*

We describe the three expectant stakeholder classes (dominant, dependent, and dangerous) in the following paragraphs.

- **Dominant stakeholders**. In the situation where stakeholders are both powerful and legitimate, their influence on the implementation of the concept idea of bringing everything ashore is assured, since by possessing power with legitimacy, they form a "dominant coalition". In this mapping the dominant stakeholder groups are 'Fishing vessels, frozen'; 'Fishing vessels, fresh'; and 'Fishermen Unions'. We characterize these stakeholders as "dominant," in deference to the legitimate claims they have upon the 'everything ashore' project and their ability to act on these claims (rather than as a forecast of their intentions with respect to the project - they may or may not ever choose to act on their claims). Some scholars would argue that the "dominant" stakeholders are the only stakeholders worth taking into consideration. In our typology dominant stakeholders expect and receive much attention, but they are by no means the only set of stakeholders to whom project managers of 'everything ashore' should or do relate to.

- **Dependent stakeholders**. There are two stakeholder groups with this profile: 'Processors, other products'; and 'Research & Development'. We characterize stakeholders who lack power but who have urgent legitimate claims as 'dependent', because these stakeholders depend upon others stakeholders for the power necessary to carry out their will. Because power in this relationship is not reciprocal, its exercise is governed either through the advocacy or guardianship of other stakeholders. To satisfy their claims, these stakeholders have to rely on the advocacy of other, powerful stakeholders.
- **Dangerous stakeholders**. The stakeholders who will be coercive and possibly violent, making the stakeholder 'dangerous' literally, to the firm. 'Coercion' is suggested as a descriptor because the use of coercive power often accompanies illegitimate status. Examples of unlawful, yet common, attempts at using coercive means to advance stakeholder claims (which may or may not be legitimate) is the campaign agains pilot whaling and seal killing that the Nordic countries have experienced in several decades. No stakeholder group has at this stage been mapped as dangeous, but if 'Consumers & NGOs' get an increased sense of urgency towards implementation of the concept idea of bringing everything ashore, they could be in a position to be labelled as 'dangerous'.

6.4.3 Definitive Stakeholders.

Previously, we defined 'Important' as the degree to which managers give priority to competing stakeholder claims. Therefore, *stakeholder importance will be high where all three of the stakeholder attributes - power, legitimacy, and urgency - are perceived by managers to be present.* By definition, a stakeholder exhibiting both power and legitimacy will be a dominant factor. In the profile mapping conducted here, this is the case with the 'Government, civil servants' stakeholder group. It could also be argued that this is the case for the fishing industry operators in Iceland, based on their practices and attitude towards bringing everything ashore. When such a stakeholder's claim is urgent, the project 'Everything Ashore' has a clear and immediate mandate to attend to and give priority to that stakeholders' claim. Any expectant stakeholder can become a definitive stakeholder by acquiring the missing attribute. The most common occurrence is likely to be the movement of a dominant stakeholder into the 'definitive' category, by increasing their perception of urgency in relation to implement the concept idea of bringing everything ashore. If the biomass is brought ashore, the dependant stakeholders will become definitive, as they will be able to gain power within their field of operation in the value chain.

6.5 Action Plan

Based on the analysis conducted in step 1-4 a plan for how to interact with expectant and important stakeholders can be outlined. A stakeholder analysis such as Table 30 below can be helpful when preparing how to interact with stakeholders with various degrees of importance.

Name	Role	Why is stakeholder important?	Rank in map:	Current attitude	What would we like them to do?	Key messages	How (tactics)	When (time-plan)	Who is responsible?
Government	Authority	Provides legal framework	1 Definitive	Positive, Enthusiastic	Take action	Kick off the process	Formulate goals and implement	fall 2016- fall 2017	Politicians
Fishing Vessels	Operator	Catches the biomass	3 & 8 Dominant	Negative, Resistant	Commit themselves	Make biomass available	Incentives	2017-2018	Fishery Authority
Fishermen Unions	Employee	Contractual relationship	6 Dominant	Negative, Resistant	Show flexibility	Innovate salary system	Share of added value	2017-2018	Ship-owner organisations & unions
Processors, other products	Operator	Purchase the new biomass	2 Dependent	Positive, Enthusiastic	Develop value chain	Increase the value	Product and market innovation	2016 - 2018	Processors & entrepreneur s
Research & development	Science	Provide new knowledge	4 Dependent	Positive, Enthusiastic	Identify valuable functionalities	Make an impact	Applicable solutions	2016	R&D organisations

Table 30: Stakeholder action plan

The suggestions for how, when and responsibility will be used further in the elaboration in the recommendations presented in the following chapter.

7. Conclusions and Recommendations

This final chapter will start by highlighting some of the major conclusions from the analyses conducted in the study, before it will discuss what these findings could mean for the way forward in relation to getting everything ashore. The chapter will offer concrete recommendations, and present a road map for moving forward with the issue.

7.1 Nordic Potential in Bringing Everything Ashore

The analysis conducted indicates that the potential increase in GVA for the various cases ranges from 4 – 27 percent if all the biomass from fisheries was brought to shore (See Table 31 below). The total increase in the GVA combined for all of the case studies considered here, would be 14 percent if all the additional biomass was landed as silage and 20 percent if the biomass was sorted. This would result in an increase in an annual GVA of 833 – 1142 million DKR for the fisheries in the case studies analysed here.

Overview of increase in GVA	**mill. DKR** Current GVA	**Increase in GVA mill. DKR** Silage solution	Sorted landings	**Percentage increase in GVA** Silage solution	Sorted landings
Greenland					
Greenlandic Fisheries in the Barents Sea	94	17	25	18%	27%
Demersal Fisheries in Greenlandic Waters	727	116	166	16%	23%
Iceland					
Icelandic Fisheries in the Barents Sea	245	33	45	13%	18%
Faroe Islands					
Faroese Fisheries in the Barents Sea	290	58	69	20%	24%
Demersal Fisheries in Faroese Waters	1,039	46	105	4%	10%
Norway					
Norwegian Offshore Fisheries	3,396	563	732	17%	22%
Total	**5,791**	**833**	**1,142**	**14%**	**20%**

Table 31: Overview of change in GVA for all the case studies if everything came to shore

Fisheries from Greenland and the Faroe Islands were represented in two cases, making it interesting to examine it at a national level. The overall increase in GVA from Faroese fisheries considered here would be about 104 Million DKR for the silage option, and 174 million DKR if biomass was sorted. For Greenland, the increase in GVA would be 133 million DKR for silage, and 191 million if the biomass was landed sorted. However, it is important to note that GVA can not determine whether an activity is profitable or not (See section 2.3 for a description of the methodology).

7.2 Economic and Technical Feasibility of Bringing Everything Ashore

The analysis on profitability of the various methods for bringing the biomass ashore suggests that for the offshore fisheries like in the Barents Sea, vessels can bring the entire catch ashore without incurring losses. The profitability analysis illustrates that it currently is most feasible for such vessels to bring the biomass ashore using silage. This was the case for both existing and new built vessels. It also showed that on-board fishmeal and oil is the least profitable (See , page 57). Therefore, perhaps the most important conclusion is that it is economically feasible for the fishing vessels to bring the entire biomass ashore, but the profitability associated with such an activity is not as high as with their current activity. However, much of the value creation takes place in the latter parts of the value chain. It therefore can be concluded that getting the entire biomass ashore from fisheries would enable additional value creation on land with the potential to have economic benefits on company and societal level.

In order to discuss the analysis further and recommend ways forward, it is important to distinguish between the various cases which all have presented different challenges and opportunities in relation to bringing everything ashore. In what follows, there will be a short discussion on the central conclusions for each case, before concrete recommendations for the way forward are presented.

Fisheries in the Barents Sea

The conclusions for the various fisheries in the Barents Sea are actually relatively similar. There are many challenges as presented in chapter 3, but the analysis has shown that bringing everything ashore should be economically and technically feasible. Vessels will naturally need to ensure that they get the highest possible values from the rest raw materials. One dilemma that they are presented with is whether to freeze the most valuable rest raw materials such as liver and roe, and then put the rest in silage tanks. The liver and roe have the most value and do not take much space, whilst the heads are a bulky and low value product. The heads represent by far the biggest biomass of rest raw materials, over 30 percent of a codfish. They will present a challenge in terms of storage, so it is useful to put them in silage, but it makes little sense to have silage if you do not add the liver, since the selling price will be substantially lower. Therefore, one conclusion from the project is that if vessels choose to have silage, then they are better off adding all of the biomass into it to make it a worthwhile investment. However, this balance can naturally change in favour of one approach to another with changes in prices of the respective products.

The implementation of 'everything ashore' would need changes in processes on-board for handling, equipment for storing and conservation etc. but it is currently possible to bring everything ashore, naturally with period of notification to allow vessels to adapt. This does not necessarily mean that it is advisable to introduce or enforce a legal obligation to land everything. This depends on the priorities of policy-makers as stakeholders were generally opposed to a legal obligation. Potential approaches to ensure that the biomass is landed will be discussed in more detail later in this chapter.

Fisheries in Faroese Waters

The rest raw materials that are discarded in Faroese waters generally consist of the liver, roe and intestines. A few freezer long-liners also discard the heads, but all in all, liver, roe and intestines represent the bulk of the biomass thrown overboard. Experience from Norway and Iceland demonstrates that it is possible for the coastal sector to land everything since that is generally done in those countries. For the small-scale fisheries, it would be useful to land the fish bled, and ungutted, to ensure that all the by-products could be utilised. Results from elsewhere show that if cooled immediately and to the right temperature, the cod can keep at least 48 hours before being gutted (Akse & Tobiassen, 2010; Egil Olsen & Dalsá, 2003). However, the maximum time before fish will reduce in quality also varies with season. Not only does this ensure that all the biomass gets landed but the gutting on land also results in a better quality.

At the stakeholder meeting in the Faroe Islands it was also mentioned that the increasing tendency of freezer long-liners to discard the heads was unfortunate. If the utilisation rate is to increase, then it will be necessary to reverse this trend. Especially when considering that the processors prefer to buy the fish with head on, since fish without head gets a discolouration of the neck, which has to be cut off when producing salt fish. This reduces the processing yield.

Based on the utilisation rate in Norway and Iceland, it should be feasible for vessels in Faroese waters to bring everything ashore. However, since many of the larger vessels are out longer than those 48 hours, a start could be that they are required to land a certain proportion of the liver and other rest raw materials, either as sorted biomass or ungutted. That way fishing vessels have time to adjust their processes on-board. One potential initiative is to make it obligatory to land fish with heads. There is currently an incentive in place where you get additional fishing days for landing liver. Despite this, not much liver is landed in the Faroe Islands. Perhaps the incentive is less attractive because there are too many unused fishing days in the system in the first place. However, this incentive is utilised with success on some vessels, where the crew get the total income from the liver and the vessel gets the additional days.

Fisheries in Greenland Waters

The particular conditions in Greenland mean that the overall conclusions on the project in many ways do not apply to Greenland. As already mentioned in chapter 5, it is difficult to make production related to rest raw materials profitable due to the geographical distances, high transportation as well as production costs. The analysis above suggests that perhaps there could be some potential in lumpfish, which is currently discarded after the roe are taken. Other countries, such as Iceland, exported whole, frozen lumpfish, so there might be an opportunity for Greenland in that respect. One of the major obstacles for making the production of by-products economically feasible is the number of landing sites, meaning that the quantities in each area are too small to have a profitable operation. Since transport is so costly in Greenland, productions are not feasible if they demand that a low value biomass is transported within the country. A necessity for getting everything ashore is that the monopoly on transportation is revisited or that incentives are introduced to reduce the barrier that this presents in relation to getting everything ashore. This was also mentioned as the most critical challenge at the stakeholder meetings in Greenland.

As mentioned earlier, implementing 'everything ashore' is also a social and political choice. This is even more so in Greenland where the market is even less likely than in the other countries to ensure that everything gets landed. Reducing the number of landing sites has social costs and will result in reduction of jobs in some areas. There is a trade-off involved which requires social and political deliberation. The first step is therefore to have a policy and societal debate on whether this is a path that Greenland wishes to take.

7.3 Potential Approaches for Implementing the 'Everything Ashore' Concept

First of all, it is essential to establish here that to get everything ashore is an ethical, political and societal choice. The topic of improving the utilisation of fisheries is also intrinsically linked to overarching issues of sustainable use of resources. The authority which grants the exclusive fishing rights must decide whether this is a priority and the urgency with which the 'everything ashore' concept should be implemented. The stakeholder analysis has also demonstrated that there are areas of conflict between various stakeholder groups. Some stakeholder groups, such as R&D institutions as well as government/civil servants seem to be more enthusiastic about getting everything ashore. Processors are also favourable towards the idea, since they need access to the raw material, whilst fishing vessels both coastal and offshore are more reluctant towards the implementation of the concept. At the same time, consumers are increasingly demanding more sustainable products. The challenge of implementing the idea of getting everything ashore is to get the more sceptical stakeholders to change their position from negative to positive towards the concept. Currently there is a conflict of interests of various stakeholders in relation to implementing the idea of getting everything ashore. These interests need to become more aligned for the 'everything ashore' concept to be implemented successfully. Table 30 on page 88 demonstrates the action required from each of the stakeholder groups in relation to bringing everything ashore.

If the biomass is to be brought ashore, there are four potential approaches to do so with varying time scales. These options have all been touched upon at the various stakeholder meetings held in the project.

1. The Market Approach
2. Vertical integration
3. Incentives
4. Legal obligation

It is likely that a successful implementation of 'everything ashore' will require a combination of some of the approaches, since one of these alone might not be sufficient to reach the aim.

In what follows, aspects of the various options will be briefly discussed.

The Market Approach

One approach could be to leave it to the market to decide when it will become sufficiently profitable to bring everything ashore. In stakeholder discussions about the subject of bringing everything ashore, it has frequently been mentioned that it should be left to the market, and that the buyers of the biomass will need to pay a higher price if they want the raw material. However, this option could be insufficient since it is necessary to have access to the raw materials in order to set up new productions. Therefore, ensuring the raw materials are available for processors can be seen as a first step in making more value out of the resources.

Vertical Integration

One of the conflicts in relation to getting everything ashore is related to the profitability of the different parts of the value chain. There is a conflict between the interests of the fishing vessel, which currently does not bring ashore all of biomass due to the low prices obtained for this biomass and the processor who wants access to the raw material. Since much of the value of bringing the biomass ashore occurs later in the value chain, there is no incitement for the fishing vessel to bring this ashore. This conflict between the different parts of the value chain can be resolved where companies are vertically integrated, since it can be in the overall interest of the company to focus on creating value from rest raw materials despite that it is not profitable for the vessel. It is argued one of the determining factors why Iceland is more successful in improving the utilisation of their fisheries resources is the increasing vertical integration across the value chain (Vigfússon, 2016). It is not in the power or role of policy-makers to force companies to become vertically integrated, but one concrete step towards getting everything ashore could be to remove the barriers in place that are currently hindering vertical integration, so that backward or forward integration within the value chain can be allowed to happen, where this is deemed to be relevant by the industry.

Incentives

If getting everything ashore is a societal priority, then incentives to make it more attractive to land the entire biomass is also an option. These incentives can be grouped into a) Increased quota for rights-holders, b) Tax incentives – either in form of a general tax discount in the resource fee for the exclusive fishing rights of the holder, c) Subsidy of prices for rest raw material d) Funding - improved access to financing for investing in bringing everything ashore and for demonstration projects. Exactly which incentives will be most appropriate depends on the fishing industry and the particular circumstances in each context. For instance, in Norway, it was clear that the fishing industry did not recommend granting additional quota for bringing everything ashore, since this would just result in either extra pressure on stocks or less for each quota holder, neither of which were attractive options. Improved access to funding for demonstration and pilot projects focused on testing new equipment or processes for getting everything ashore could also be useful to help vessels bring everything ashore. Financing mechanisms for redesigning of vessels and/or building new vessels that are equipped for bringing the entire biomass ashore are also necessary. These needs have been explicitly mentioned at the stakeholder meetings in the different countries.

Legal Obligation

The fourth option for getting everything ashore is to legally oblige the fishing vessels to bring all the biomass ashore. An obligation to land everything was not recommended at any of the stakeholder meetings, although there were some voices who acknowledged that if everything was to be brought ashore, then a legal obligation might be necessary. Representatives of offshore fishing vessels in the Faroe Islands mentioned that they would accept a legal requirement to bring everything ashore in turn for exclusive fishing rights that would last over 15 years at the time. This perspective has to be seen in the light of the upcoming reform of the Faroese fisheries to be implemented in 2018. The option to obligate fishing vessels to bring a proportion of the catch ashore was also mentioned. A participant at the meetings mentioned that the obligation to bring 30 percent of cod heads to shore in Iceland had been helpful in forcing them to design processes to bring them ashore, and that now they took all the heads with some rare exceptions. If a legal obligation was to be introduced, the industry should be given time to adapt their fleet to such a requirement. It would also be recommendable to introduce such a legislative requirement in steps, with gradual increments in the proportion of for instance heads and liver that had to be landed.

7.4 Recommendations

Based on the research conducted in the project, the following recommendations are put forward in relation to implementing the 'everything ashore' concept for the fisheries in the Nordic countries.

7.4.1 Setting goals for the blue bioeconomy

The authorities must formulate a vision in relation to getting everything ashore. It is important that the authorities decide what the goals are for the blue bioeconomy in the respective countries for the next 10 – 15 years. In that respect, it is necessary to develop a strategy for growth in the blue bioeconomy. The newly establish West Nordic Bioeconomy Panel could have an important role in this process. It is clear that getting everything ashore is very much a political and social choice so policy-makers in each of the countries need to decide whether it is a national priority. The 'everything ashore' concept must be seen in the wider context of the bioeconomy and value creation, since R&D institutions and innovative companies cannot create value from the biomass if it is unavailable.

7.4.2 Remove barriers in relation to the established goals

Depending on the goals, authorities must find ways to overcome the obstacles to allow the goals to be achieved. For instance, should they decide that in 10 years the 'everything ashore' concept should be implemented, then concrete initiatives must be put in place to allow that to happen within the timescale. This project has identified several barriers which all must be overcome in order to implement the 'everything ashore' concept. One of the central ones which is relevant for all the cases, is the share system to pay fishermen. It would be useful to examine the share pay systems in the Nordic countries and its implications for the improving the utilisation of the fisheries resources. Such an approach could perhaps suggest potential solutions to overcome this barrier. Another critical barrier relevant only for Greenland is the monopoly on transport. This issue should be explored further to identify how it can be overcome if there is a political desire to implement 'everything ashore'.

7.4.3 Establish national and Nordic funding mechanisms to improve utilisation

One of the means to reach the aim of getting everything ashore, is to ensure that there are opportunities for research & development institutions and the industry to enter into projects related to the issue. A concrete step could be to establish flagship project exploring various aspects related to the issue of bringing everything ashore. These could be on pilot scale to allow these actors to test processes and concepts in relation to getting everything ashore. National governments should investigate the possibility to enable loan or grant facilities to regional entrepreneurship within the area. The initial funding of these facilities could be directly or indirectly linked to the taxation of resource rent within existing fisheries.

7.4.4 Ensure national and international co-operation between industry and research institutions

If more value is to be created from rest raw materials, it is essential that industry and research and development institutions, such as Matís and Nofima collaborate on creating value from the rest raw materials that are currently underutilised or unutilised. In Iceland, they have had great success from collaborating within the ocean industries[10]. Matís has also played a central role in improving the utilisation of fisheries from Iceland via their collaboration with many of the most innovative companies in Iceland. The Nordic countries considered here are all at different stages in terms of utilisation of fisheries resources. At the same time, there are many similarities between these countries, and a lot could be gained through cooperation across the Nordic countries, both within the fishing industry as well as cross sectorally.

7.4.5 Investing in human capital

The competitive advantages of the Nordic countries considered here are generally related to natural resources, being fisheries, aquaculture, tourism, shipping etc. It is a competitive advantage, because the resources are in the region, and they have to be exploited in the region. The markets in Europe, North America and Asia need the products (seafood or marine extracts) and services (tourism and shipping) of the region. The countries are often selling commodities, and their direct market involvement is often limited. A bio-based economy with high knowledge content is very different. In such an economy the competitive advantage is the ability to provide flexible solutions for the customers' needs and demands. The focus has to be on the market, and thus terms such as 'user driven innovation' come into play for the business situated far away from the user.

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[10] See oceancluster.is

The North West Atlantic migration patterns are closely linked to the situation of the local economies in neighbouring countries or regions. International emigration is especially frequent among the highly educated, young adults and women. Many of those who leave remain abroad. Job opportunities are often better, particularly for those working in fields unrelated to fisheries, hunting or forestry. As a result, the communities of origin lose some of their more qualified people. Moreover, this situation creates disincentives for economic diversification (NORA, 2011).

It requires a global mind set in order to compete and win in the knowledge based bio-economy. It is important to ensure that the countries have the human resources that possess the necessary educations, skills and know-how to provide solutions with value for the global customers. This is one reason why it is so challenging to think of knowledge as a new business area in the rural regions of the world. But the greatest threat for rural communities is demographic migration of the young intelligent people that will undermine the ability to create a prosperous future for the next generations. It is essential that the fishing industry manages to attract young and well-educated people for the industry to develop within the blue bioeconomy. As a result, it would be useful to establish links between industry and students at higher education institutions to ensure that the industry can attract a talented and well-educated workforce.

7.4.6 Pursue international opportunities for funding

In order to develop within the blue bioeconomy and create further value from what currently is considered waste by many, access is needed to regional, national and international R&D funding schemes, e.g. H2020, Northern Periphery, Nordic Innovation and NORA. There are currently several opportunities within H2020. The new 3.7 billion partnership between the EU and the Bio-based industries consortium (see http://www.bbi-europe.eu/) is considering a project call within the theme of marine based value chains in 2017. The Nordic countries are in a very good position to utilise these international funding opportunities within the context of the blue bioeconomy.

7.5 Road Map

The analysis presented in this report, has highlighted several opportunities and challenges in relation to the implementation of the 'everything ashore' concept. It is clear that there are different circumstances within the different national contexts, which make the implementation of 'everything ashore' more or less feasible. To illustrate this, it is useful to look at an example. In our view, the case study where the 'everything ashore' concept is the most difficult to put into force is for the fisheries in Greenland waters. The geographical distances are too large and there are too many landing sites in order for it to be economically feasible. It is clear that reducing the number of landing sites has social costs, so there is a trade-off involved in such a choice. It is therefore of fundamental importance that the issue of utilisation of fisheries is subject of public debate, and that policy-makers decide whether the ‘everything ashore’ concept should be implemented, and if so, identify the necessary steps to reach the aim. This is because the necessary steps will naturally depend on the national context. Based on the discussions above, the following road map is presented (see Figure 13 below).

Road map for the implementation of the 'Everthing Ashore' concept

To do: / Time:	Autumn 2016	Winter 2016/2017	Spring 2017	Summer 2017	Autumn 2017	Winter 2017/2018	Spring 2018	Summer 2018	Autumn 2018	Winter 2018 onwards
Develop a strategy for the Blue Bioeconomy	National and Nordic									
Identify concrete initiatives to get everything ashore			National and Nordic							
Implement inititatives to suit the developed strategy							National or Nordic			
Present project findings	National and Nordic									
Comparative study of pay system in fisheries in the Nordic countries in relation to getting everything ashore.		Nordic								
Pursue funding opportunities in relation to getting everything ashore					National, Nordic and International					
Gradually implement the concept idea of 'everything ashore'									National or Nordic	

National and Nordic | **Nordic** | **National, Nordic and International** | **National or Nordic**

Figure 13: Road map for the implementation of the 'Everything Ashore' concept

The first step is to develop a strategy for the blue bioeconomy, which includes deciding how to get access to the available resources. It is important for the authorities of each individual country to decide on their vision and priorities on a national level, but it is also relevant to develop such a strategy at the Nordic level, for instance under the auspices of the Nordic and West Nordic Bioeconomy Panels. The Nordic Road Map for Blue Bioeconomy which is currently being developed under the Finnish presidency in the Nordic Council of Ministers will also be useful in this respect. A lot can be gained from co-operation across the countries since there are many common challenges. In this respect, it would also be useful to conduct a comparative case study at the Nordic level into the pay systems in fisheries in the Nordic countries and their implications for getting everything ashore. Such a project could possibly be funded under the Nordic Fisheries Cooperation and would be an appropriate follow up to this project.

Based on the desired strategy for Blue Bioeconomy, the next steps would be to identify concrete initiatives that would make the implementation of the ‘everything ashore’ concept possible. It is likely that it would be beneficial to have some country-specific initiatives, whilst others should be introduced at the Nordic level. For instance, initiatives in relation to funding could be part of upcoming programmes of bodies such as NORA, Nordic Fisheries Cooperation and Nordic Innovation. It is also important that within a year or so that the fishing industry and R&D institutions pursue funding opportunities in relation to this topic.

Once the necessary initiatives have been identified and designed, the next step is to implement them in relation to the developed strategy both at the Nordic and National levels. The final step suggested here is to gradually start implementing the 'everything ashore' concept in two years from now. The way this should be done would depend on the priorities of each the respective governments in the Nordic countries.

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Appendices

Appendix 1: Detailed Value Chain Analysis for Norwegian Offshore Fisheries

Detailed Value Chain Analysis - Norwegian Offshore Fisheries

Fishery – Landed biomass

Total biomass: 341.000 tons

H&G - trawlers: 306.900 tons

Factory trawlers: 34.100 tons

H&G - trawlers

	Landing tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
H&G fish	181.071	17,00	3.078	12,83	2.324
Roes	767	11,00	8	8	6
Total	181.838		3.087		2.330

Factory trawlers

	Landing tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Fillets	12.753	34,00	434	25,23	322
Roes	56	11,00	1	8	0
Heads	2.701	4,00	11	3,28	9
Cut-offs	2.813	4,00	11	3,28	9
Back bone	1.350	4,00	5	3,28	4
Liver	563	4,00	2	3,28	2
Milt	-	4,00	-	3,28	-
Viscera	563	4,00	2	3,28	2
Skin	338	4,00	1	3,28	1
Total	21.137		468		350

Processing

	tons	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Salt Fish	72.428	9,25	670
Fish feed	18.107	2,23	40
Canned roes	824	7,60	6

End products

	tons	Gross Value Added mill.dkr.
Saltfish	72.428	1.832
Fishfeed	18.107	40
H&G fish	90.536	1.162
Canned roes	824	13
Fillets	12.753	322
Fish oil and meal	8.327	27

	Landing Value	Gross Value Added	Gross Value Added (Processing)	Gross Value Added (End products)
Total value	3.554	2.680	717	3.396

Fishery – Discarded biomass

H&G - trawlers

	Landing tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	73.656	2,00	147	1,78	131
Liver	15.345	6,00	92	4,91	75
Roe	2.302	11,00	25	9,00	21
Cut-offs	15.345	2,00	31	1,78	27
Milt	3.069	2,00	6	1,78	5
Viscera	15.345	2,00	31	1,78	27
Total	125.062		332		287

Factory trawlers

	Landing tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	5.483	2,00	11	1,78	10
Liver	1.142	6,00	7	4,91	6
Roe	285	11,00	3	9,00	3
Backbones and cut	6.135	2,00	12	1,78	11
Milt	341	2,00	1	1,78	1
Viscera	1.142	2,00	2	1,78	2
Skin	685	2,00	1	1,78	1
Total	15.214		38		33

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Dried fish heads	79.139	3,00	237
Fish Oil	16.487	3,73	61
Canned roes	2.586	7,60	20
Fish feed	42.062	2,23	94

End products

	tons	Gross Value Added mill.dkr.
Dried heads	79.139	378
Fish oil	16.487	142
Canned roes	2.586	43
Fish feed	42.062	169

	Landing Value	Gross Value Added	Gross Value Added (Processing)	Gross Value Added (End products)	
Total value	370	320	412	732	22%

Fishery – Directly to ensilage

	Landing tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Biomass to ensilag	140.275	2,00	281	1,78	250

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Fish Oil and meal	140.275	1,50	210
Fish feed	140.275	0,73	102

End products

	tons	Gross Value Added mill.dkr.	
Fish feed	140.275	563	17%

Appendix 2: Detailed Value Chain Analysis for Greenlandic Fisheries in the Barents Sea

Detailed Value Chain Analysis - Greenlandic fisheries in the Barents Sea

Total biomass

Filleting trawlers 10.620 tons

Fishery — Landed biomass

Filleting trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Fillets	1.589	37,00	59	28,23	45
Whole fish	3.759	17,00	64	13	49
Total	5.348		123		94
Total value			**123**		**94**

End products

	tons	Gross Value Added mill.dkr.
Fillets	1.589	45
Whole fish	3.759	49
		94

Fishery — Discarded biomass

Filleting trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	2.549	2,00	5	1,78	5
Liver	531	6,00	3	4,91	3
Roe	106	11,00	1	9,00	1
Backbones and cut-offs	1.321	2,00	3	1,78	2
Milt	106	2,00	0	1,78	0
Viscera	531	2,00	1	1,78	1
Skin	127	2,00	0	1,78	0
Total	5.272		14		12
Total value			**14**		**12**

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Dried fish heads	2.549	3,00	8
Fish Oil	531	3,73	2
Canned roes	106	7,60	1
Fish feed	2.086	1,50	3
			14

End products

	tons	Gross Value Added mill.dkr.	
Dried heads	2.549	12	
Fish oil	531	5	
Fish oil	106	2	
Fish feed	2.086	7	
		25	**27%**

Directly to ensilage

	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Biomass to ensilage	5.272	2,00	11	1,78	9

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Fish Oil and meal	5.272	1,50	8

End products

	tons	Gross Value Added mill.dkr.	
Fish feed	5.272	17	**18%**

Appendix 3: Detailed Value Chain Analysis for Faroese Fisheries in the Barents Sea

Detailed Value Chain Analysis - Faroese fisheries in the Barents Sea

Fishery

Total biomass

27.712 tons

Landed biomass

H&G - trawlers 12.130 tons

H&G - trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
H&G fish	7.194	17,00	122	12,83	92
Roes	122	11,00	1	8	1
Total	7.316		124		93

Factory trawlers 15.583 tons

Factory trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Fillets	5.804	34,00	197	25,23	146
Roes	155	11,00	2	8	1
Total	5.959		199		148

Processing

	tons	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Salt Fish	4.955	9,25	46
Fish feed	1.239	2,23	3

End products

	tons	Gross Value Added mill.dkr.
Saltfish	4.955	125
Fishfeed	1.239	3
H&G fish	1.000	13
Roes	122	1
Fillets	5.804	146
Roes	155	1

	Fishery Landing Value	Fishery Gross Value Added	Processing Gross Value Added	End products Gross Value Added
Total value	323	241	49	290

Fishery

Soreted landings

H&G - trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	2.926	2,00	6	1,78	5
Liver	610	6,00	4	4,91	3
Cut-offs	610	2,00	1	1,78	1
Milt	122	2,00	0	1,78	0
Viscera	610	2,00	1	1,78	1
Total	4.877		11		11

Factory trawlers	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	3.725	2,00	7	1,78	7
Liver	776	6,00	5	4,91	4
Backbones and cut-offs	3.662	2,00	7	1,78	7
Milt	155	2,00	0	1,78	0
Viscera	776	2,00	2	1,78	1
Skin	466	2,00	1	1,78	1
Total	9.560		22		19

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Dried fish heads	6.651	3,00	20
Fish Oil	1.386	3,73	5
Fish feed	6.400	2,23	14

End products

	tons	Gross Value Added mill.dkr.
Dried heads	6.651	32
Fish oil	1.386	12
Fish feed	6.400	26

	Fishery Landing Value	Fishery Gross Value Added	Processing Gross Value Added	End products Gross Value Added	
Total value	33	30	39	69	24%

Fishery

Directly to ensilage

	tons	Landing kr/kg	Landing Value mill.dkr	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Biomass to ensilage	14.437	2,00	29	1,78	26

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Fish feed	14.437	2,23	32

End products

	tons	Gross Value Added mill.dkr.	
Fish feed	14.437	58	20%

Appendix 4: Detailed Value Chain Analysis for Icelandic Fisheries in the Barents Sea

Detailed Value Chain Analysis - Icelandic fisheries in the Barents Sea

Total biomass

Biomass available: 21.538 tons

Fisheries – Landed biomass

Landed biomass

	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Roes	196	11,00	2	8	2
Heads	997	2,00	2	1,78	2
Cut-offs	851	2,00	2	1,78	2
Backbones	1.776	2,00	4	1,78	3
Viscera and liver	1	2,00	0	1,78	0
Skin	142	2,00	0	1,78	0
Fillets	7.560	37,00	280	28,23	213
Total	11.523		289		222
Total value			**289**		**222**

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Canned roes	196	7,60	1
Dried fish heads	997	3,00	3
Fish meal and oil	2.770	1,50	4
Salt Fish	1.560	9,25	14
Total value			**23**

End products

	tons	Gross Value Added mill.dkr.
Roes	196	3
Dried heads	997	5
Fish meal and oil	2.770	9
Saltfish	1.560	58
Fillets	6.000	169
Total value		**245**

Fisheries – Discarded biomass - sorted landings

	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	4.172	2,00	8	1,78	7
Liver	1.076	6,00	6	4,91	5
Roe	-	11,00	-	9,00	-
Backbones and cut	2.951	2,00	6	1,78	5
Milt	235	2,00	0	1,78	0
Viscera	1.076	2,00	2	1,78	2
Skin	504	2,00	1	1,78	1
Total	10.015		24		21
Total value			**24**		**21**

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Dried fish heads	4.172	3,00	13
Fish Oil	1.076	3,73	4
Fish meal and oil	4.767	1,50	7
Total value			**24**

End products

	tons	Gross Value Added mill.dkr.	
Dried heads	4.172	20	
Fish oil	1.076	9	
Fish meal and oil	4.767	16	
Total value		**45**	18%

Fisheries – Directly to ensilage

	tons	Landing kr/kg	Landing Value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Biomass to ensilag	10.015	2,00	20	1,78	18

Processing

	tons	GVA kr/kg	Gross Value Added mill.dkr.
Fish Oil and meal	10.015	1,50	15

End products

	tons	Gross Value Added mill.dkr.	
Fish meal and oil	10.015	33	13%

Appendix 5: Detailed Value Chain Analysis for Greenlandic Demersal Fisheries

Detailed Value Chain Analysis - Greenlandic Demersal Fisheries

Total Biomass

Total catch 86.677 tonnes

Fisheries – Landed biomass

	tonnes	Exportprice kr/kg	Export value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Greenland Halibut	30.461	35,00	1.066	16,45	501
Cod, Haddock, Saithe, Redfi	14.672	23,50	345	11,05	162
Lumpfish caviar	1.130	53,00	60	24,91	28
Other	5.040	15,00	76	7,05	36
Total	**51.303**		**1.546**		**727**

Processing

tonnes	Gross Value Added kr/kg	Gross Value Added mill.dkr.

End products

	tonnes	Gross Value Added mill.dkr.
Greenland Halibut	30.461	501
Cod, etc.	14.672	162
Lumpfish caviar	1.130	28
Other	5.040	36
		727

Fisheries – Discarded biomass

	tonnes	Landingprice kr/kg	Landing-value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Heads	11.790	2,00	24	1,78	21
Liver	4.291	6,00	26	4,91	21
Roe	719	11,00	8	9,00	6
Backbones and cut-offs	12.090	2,00	24	1,78	22
Milt	719	2,00	1	1,78	1
Viscera	4.291	2,00	9	1,78	8
Skin	1.474	2,00	3	1,78	3
Total	35.374		94		82
Total værdi			**94**		**82**

Processing

	tonnes	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Dried fish heads	11.790	3,00	35
Fish Oil	4.291	3,73	16
Canned roes	719	7,60	5
Fish Oil and meal	18.574	1,50	28
			85

End products

	tonnes	Gross Value Added mill.dkr.	
Dried heads	11.790	56	
Fish oil	4.291	37	
Canned roes	719	87	
Fish oil and meal	18.574	61	
		166	**23%**

Fisheries – Directly to silage

	tonnes	Landingprice kr/kg	Landing-value mill.dkr.	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Biomass to silage	35.374	2,00	71	1,78	63

Processing

	tonnes	Gross Value Added kr/kg	Gross Value Added mill.dkr.
Fish Oil and meal	35.374	1,50	53

End products

	tonnes	Gross Value Added mill.dkr.	
Fish oil and meal	35.374	116	**16%**

Appendix 6: Profitability Calculations for Various Solutions for Bringing Everything Ashore

	Silage		Fish meal&oil		Frozen	
	New vessel	Existing vessel	New vessel	Existing vessel	New vessel	Existing vessel
Required storage space, tonnes	400	400	100	100	400	400
Required storage space, m3	400	400	150	150	700	700
Required equipment space, m3	negligible	negligible	80	80	80	80
Required extra length of vessel, meter	6	6	3	3	10	10
Cost pr. m extra length, mill DKR	2	2	2	2	2	2
Total cost of extra length, mill DKR	12	12	6	6	20	20
Equipment cost, mill. DKR	5	5	10	10	5	5
Depreciation period - vessel, years	15	10	15	10	15	10
Depreciation period - equipment, years	5	5	5	5	5	5
Interest rate, percentage	3%	3%	3%	3%	3%	3%
CAPEX, mill DKR						
Depreciation vessel	0,8	1,2	0,4	0,6	1,3	2,0
Depreciation equipment	1,0	1,0	2,0	2,0	1,0	1,0
Interest payment	0,51	0,51	0,48	0,48	0,75	0,75
total CAPEX/year	**2,31**	**2,71**	**2,88**	**3,08**	**3,08**	**3,75**
CAPEX (kr/kg rest biomass)	0,86	1,00	1,07	1,14	1,14	1,39
OPEX (kr/kg rest biomass/raw material)						
Formic acid	0,17	0,17				
Maintenance etc.	0,08	0,08	0,15	0,15	0,10	0,10
Fuel/energy and handling	0,05	0,05	0,20	0,20	0,15	0,15
Wrapping			0,05	0,05	0,30	0,30
Manpower			0,90	0,90	0,90	0,90
OPEX - total	**0,30**	**0,30**	**1,30**	**1,30**	**1,45**	**1,45**
Quantity of products, tonnes						
Silage	2.700	2.700				
Hydrolysis						
Fish meal			540	540		
Fish Oil			135	135		
Heads					1.800	1.800
Liver					375	375
Roe and milt					150	150
Viscera					375	375
Total	**2.700**	**2.700**	**675**	**675**	**2.700**	**2.700**
Sales price, kr/kg						
Silage	2,00	2,00				
Hydrolysis						
Fish meal			10,00	10,00		
Fish Oil			11,00	11,00		
Heads					2,00	2,00
Liver					6,00	6,00
Roe and milt					11,00	11,00
Viscera					2,00	2,00
Concluding calculations, mill DKR/year						
Revenue	5,4	5,4	6,9	6,9	8,3	8,3
Capital Expenditure (CAPEX)	2,3	2,7	2,9	3,1	3,1	3,8
Operational Expenditure (OPEX)	0,8	0,8	3,5	3,5	3,9	3,9
Surplus mill DKR/year	**2,3**	**1,9**	**0,5**	**0,3**	**1,3**	**0,6**
Surplus kr/kg rest biomass	*0,84*	*0,70*	*0,18*	*0,11*	*0,46*	*0,22*