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Energy Development in the Norwegian Barents Sea – Factors influencing investment decisions

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Preface and acknowledgments

This master thesis is conducted as a part of our Master of Science in Business, Energy Management at Nord University. The thesis was written in the spring of 2021 and is a requirement for specializing in the field of Energy Management. The idea of studying investment decisions in the Norwegian Barents Sea was a result of the author's interest in the topic, combined with the relevance for Norwegian energy. We also hope that our research can help others in understanding the different factors for investment decisions in the Norwegian Barents Sea.

The thesis was written under the supervision of Professor Erlend Bullvåg. We would like to thank him for guidance and support in the process. Inputs and sharing of knowledge, which have helped us a lot in forming our thesis are greatly appreciated. We would also like to thank all our interview objects that have helped us in retrieving valuable data for our analysis.

25th of May 2021

Håkon Haus Steinshylla

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Summary

The Barents Sea is a rather new area for oil and gas explorations. It is estimated that over 60% of the undiscovered resources on the Norwegian shelf are in the Barents Sea, making it an important area for the future. Even though there are a high amount of oil and gas resources in the area, there are few energy projects established. However, the region is predicted to become important for future energy production.

In this study, we investigate factors influencing investment decisions in the Norwegian Barents Sea. We will look at what kind of factors that are identified and how they are analyzed to proceed with a project, and what criteria´s that has to be achieved. We will do this by trying to answer what the challenges are in the Barents Sea, what kind of specific context that is required especially in this area, and what the future possibilities for the Barents Sea is. To understand the different components of decision making and projects in the Barents Sea, we did a literature review to look at what previous research literature identified. There has been little research on this topic previously. We had interviews with key personnel, supported by document analysis of governmental and international law and regulation frameworks for the area. This was done to identify what kind of regulations that were applied in the Barents Sea, what factors that were especially important, and how the project process was structured.

Furthermore, we used the Johan Castberg Field as a case study. This is a field that is in the process phase as we speak and is expected to start operations by 2023. We conducted an analysis of this particular case and used it to help us answer our question throughout the study, looking at different aspects, and how and why decisions were taken, and what obstacles they had to get past.

Our findings indicated that the projects in the Norwegian Barents Sea are complex projects that must meet many criteria. The most important factors that are influencing investment decisions are economics as a baseline, based on access to infrastructure, geology, societal demands, and the environment. However, we see that due to the immaturity of the area, projects here are complicated. We assume, based on our answers, that it will be less complicated in the future as the area matures. We will also try to come up with a new model for decision making in the Arctic region.

Sammendrag

Barentshavet er et forholdsvis nytt område for olje og gass utforskning. Det er estimert at over 60% av de uoppdagede ressursene på den norske kontinentalsokkelen er i Barentshavet, noe som gjør det til et viktig område i fremtiden. Selv om det er mye olje og gassressurser i området, er det få prosjekter som er etablert der.

I denne studien vil vi undersøke faktorer som påvirker investerings beslutninger i det norske Barentshavet. Vi vil se på hvilke faktorer som er identifisert, og hvordan disse blir analysert for å fortsette med et prosjekt, og se på hvilke kriterier som må bli oppfylt. Vi vil gjøre dette ved å forsøke å finne svar på hvilke utfordringer som er i Barentshavet, hva slags spesifikk kontekst som kreves spesielt for dette området, og hvilke fremtidige muligheter finnes i Barentshavet. For å forstå de forskjellige komponentene av beslutningstaking og prosjekter i Barentshavet har vi gjort en litteraturgjennomgang for å se hva tidligere forskningslitteratur har identifisert. Det har vært lite forsket på dette temaet tidligere. Vi har også hatt intervju med nøkkelpersonell, støttet opp av dokumentanalyse av statlige og internasjonale lov - og regulerings rammeverk for området. Dette ble gjort for å identifisere hvilke reguleringer som er anvendt i Barentshavet, hvilke faktorer som er spesielt viktige, og hvordan prosjekt prosessen er strukturert.

Vi brukte Johan Castberg feltet som en casestudie. Dette er et felt som i dag er i prosess fasen, og er forventet å bli satt i drift i 2023. Vi gjennomførte en analyse av denne casen og brukte case studien for å svare på spørsmålene vi hadde gjennom studien med å se på forskjellige aspekter, hvordan beslutninger ble tatt, og hvilke hindringer de måtte komme seg forbi.

Våre funn indikerer at prosjekter i Barentshavet er komplekse prosjekter som møter mange kriterier. De viktigste faktorene som påvirker investeringsbeslutninger er grunnleggende økonomiske, basert på tilgang til infrastruktur, geologi, sosiale krav og miljø. Dessuten ser vi at på grunn av at Barentshavet er et umodent område, så blir prosjekter mer kompliserte her. Basert på våre svar antar vi at prosjekter i Barentshavet vil bli mindre kompliserte i fremtiden, ettersom området vil modnes. I vår forskning vil vi også prøve å komme opp med en ny modell for beslutningstaking i den Arktiske regionen.

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1 Introduction

The main research question in the master thesis is Energy development in the Norwegian Barents Sea - factors influencing investment decisions. In the Arctic region and the Barents Sea, one finds few invested energy projects compared to the amount of resources found. This research aims at explaining why so few investments are made and discusses how more project investment can take place in the Norwegian Barents Sea.

One might think that the offshore energy investment projects follow a fairly generic development path. Fewer investments in the Norwegian Barents Sea indicate that either specific challenges exist and/or development of energy projects in the Arctic are more complex than elsewhere. The projects in the Arctic are often large measured in investment size, and with size comes complexity and larger implications since high capital insensitivity calls for extensive risk mitigation (Norwegian petroleum directorate, 2019). In such a framework it is important that all the decisions regarding the project are rational and founded on best possible analysis.

The planning and execution of a project is important, but another factor that needs to be considered is the location. In the Arctic the distances are often very big, and the distances create a whole new set of problems. With long distances everything takes longer time, transport of resources, and preparedness to mention a few (Norwegian petroleum directorate, 2019).

The Arctic is one of the planet's most rapidly changing regions. With new regions of business opportunities, comes also new uncertainties, and given its location in a sensitive natural environment, more regulations (Norwegian petroleum directorate, 2019).

In the NBS (Norwegian Barents Sea) the regulations are very clear, and the companies operating here must follow these inside extensive rules and regulations given through licences. Licences are often given to companies forming consortiums, often with two or three companies working together on a licence, with one company leading as operator of the field (Norwegian petroleum directorate, 2019).

Even though there are huge opportunities for the Arctic, climate can be rough, geological conditions new to operators, ice can be a factor, and public focus on climate change can all influence companies' investment decisions. One also has to consider political tension between the states that operate in the Arctic (Breitenbauch et al.,2019).

The Arctic region is divided between Norway, USA, Russia, Canada, and Denmark. This makes the political aspect of business highly relevant, since one will see influence between countries. There are also a lot of other countries outside "the Arctic" that see potential profit in the Arctic. The interest in joining "the Arctic club" is growing, and Asian nations such as Japan, China and South Korea are also observing business opportunities in the region (Quaile, 2013).

Regardless of challenges, some energy project investments are made in the Norwegian Barents Sea. So far, the field centers exist, Goliat and Snøhvit, and the third center is under construction at the Johan Castberg field. The field is located 240 kilometers north of the Norwegian city Hammerfest. Compared with other fields, the Johan Castberg field is so large that it can be financially justifiable (Norwegian petroleum directorate). Since Johan Castberg represents the latest available investment done in the area, Castberg is a very relevant case for identifying factors influencing the investment process and learning how one can succeed in attracting more investments in the Area.

1.1 Motivation

Through our major Energy Management, one of the key aspects for many of the courses has been the situation in the Arctic and changes in energy development strategies due to a global green shift. We have learned about how big projects with huge revenues have succeeded in being built, and that big projects with the same prospects have failed being invested in. On background of this, we found it very interesting to see what criteria's that were needed to be able to start with a project in the Arctic region.

Because of the increasing availability of resources in the Barents Sea, the Arctic is a region that has caught the attention of the rest of the world. Both as a new oil and gas region, but also as a region where one can remove CO2 from oil and gas, produce environmentally friendly energy carriers, and reinject CO2 into the seabed by incorporating new technology from the start. However, there are not as many projects there as there could have been, and deep divides politically about what future strategies should be. We want to go deeper into this, figuring out what the main drivers behind positive investment decisions are. We believe that our research can help organizations in their future decision making of projects in the north.

1.2 Research Question

In this study we want to take a closer look at investments and decisions in the Barents Sea. Therefore, we have chosen the following research question: ***Energy development in the Norwegian Barents Sea - factors influencing investment decisions.*** We want to contribute to a deeper general knowledge to the stakeholders and the public about the factors influencing decisions in these huge projects.

To the answer the research question we have selected the following sub questions:

What are the challenges when making large energy investment decisions in the Barents Sea?

The challenges can be many during an energy development project, we will look closer at what challenges that are applied in the Barents Sea.

What decisions are applied for large projects in the Barents Sea?

In this sub question we will look at unique features in the Arctic, and what decisions that are specific to the region.

What are the future opportunities in the Barents Sea?

Here we will look at what could differentiate the Barents Sea from other fields, what are the opportunities, and eventual changes in strategies.

1.3 Structure of report

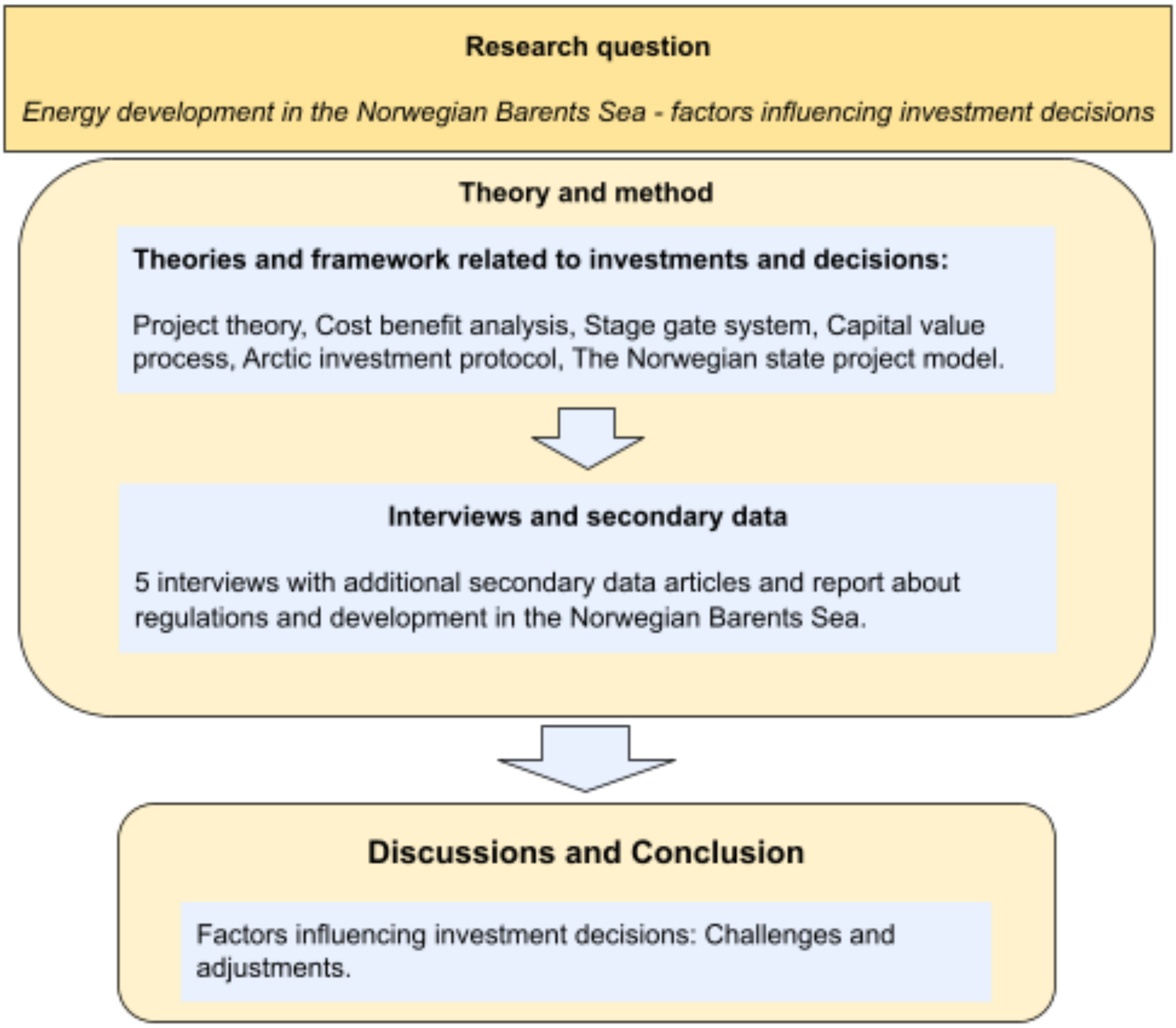

Figure 1 Structure of this study

2 Theoretical framework

2.1 Introduction

Large energy development projects are usually very large investments, typically 4 to 6 billion Euro, live over long periods (up to 15 years in development), and involve multiple professions, organizations and interest parties. Since investment decisions commit large quantities of financial, personnel and supplier resources with high return expectations, these are among the most advanced decision processes found in companies globally. To understand project investment decisions, we will draw on the project´s selection theory. Mainly using project theory, cost benefit analysis and contributions from process theory for development under high uncertainty, drawing on Cooper´s stage gate model and later adopting this type of models to energy investments.

Rational financial decisions require clear framework, principles and solid assumptions. By drawing on contributions from Cooper´s stage gate model, developed to the Capital Value Process model in the energy industry, we will discuss how internal and external factors are taken into consideration when arriving at a financial rational decision at various stages in a field development.

2.2 Large energy Investments

Large projects are identified by looking at the project duration, planning, and development of the project can take several decades. This makes the process more difficult and makes the planning and organization process more complex. The number of different activities and elements of a project, going as high as 100’000 activities for a single project which could lead to other implications. The workforce required to develop the project could range from a few thousands to many thousands. In large projects there are often huge amounts of prefabricated assemblies moved and put up, and many modules, making the assembly process more streamlined (Prieto, 2015).

Large projects often involve several stakeholders and participants from the same country but could also go international. This cooperation puts the companies and the project in a unique position that could potentially lead to a lot of problems. Problems that could occur are different work practices, morale, regulations and culture. Problems related to communication are often faced in huge projects because there are so many involved and could lead to misunderstandings and coordination problems. If these problems happen it will create time delay, and additional costs to the companies involved. These costs and risks are more presented in huge projects because there are often more companies or departments involved in the project. The practices in different countries and departments can lead to more problems, which could lead to additional delay and costs. (Aarseth, W., Rolstadås, A., & Andersen, B. 2014)

In our research we chose the Johan Castberg field as a case study because it is a new investment, and the production is estimated to start in 2023. When we look at Johan Castberg, we can easily identify the field as a large and complex project. The project scale and capital required fit the description for big projects. There are many assemblies, including the production of the production ship, the building of infrastructure on the seabed (subsea development). High promises of ripple effects in the local community are also present in this case. All these factors do identify Johan Castberg as a large complex project.

Since the project is in the last development phase, the different decisions for the field are relatively new. They give us relevant information about how the fields are facing challenges and how different decisions are affected by them. The Johan Castberg field is located far from land and high north, giving a lot of challenges to the investors and operators. Due to the size, big projects will create a lot of ripple effects, and be a driver for new investments in the Barents Sea. In large projects there is higher complexity, high risk, and higher cost, giving a higher chance of failure. What do we need to bear in mind when dealing with such large projects? With large amounts of capital invested, why are the success rates so low? According to Prieto two out of three big projects fail (Prieto, 2015).

2.2.1 Project Theory

Project theory is a common name for theories about how projects are identified, selected, developed, executed, and evaluated. A theory that is important for making decisions whether to invest in a project or not is project theory. Project theory is project management when describing the transformation from inputs to outputs (Koskela, L, 2002).

We will focus on the processes behind the investment decisions in large energy projects. To help us to do this we decided to use project theory in our thesis. This will help us to see what the different projects are like and identify project types. Selected theory describes the size of big projects will drive up the possibility for unexpected things to happen (Prieto, 2015).

In the energy industry large projects usually come simultaneously with huge, required capital. Large companies deal with these huge projects on a normal basis, but smaller businesses can try to divide it into smaller projects making it feasible. Partners to the operator are also to have in today's market, due to size and capital required. This is important because these companies are usually involved in several projects and investments at the same time (Roberto & Tiziano, 2013).

Since large projects often go across borders, or have a huge organizational level within the company, it could lead to a lot of small errors or conflicts between the different parties in a project. Table 1 below will show a few examples on what parties that could potentially be in conflict with each other during a project, some have problems in the beginning, and some during the last phases of an investment. The conflicts could be of a cost or/and quality issue, timing or delivery, but also as “simple” as miscommunication (Aarseth, W., & Sørhaug, H. 2009).

Challenges could be between different parties (between A and B)	
Party A	**Party B**
Project team	Operation team
Operator	Contractor
Contractor	Supplier(s)
Supplier A	Supplier B,C,D

Table 1 Examples of parties that could have conflict during a large project (Aarseth, W., & Sørhaug, H. (2009)).

Large projects have some major differences departing from normal projects. These projects often have a much longer lifespan. They also have a higher frequency of different services and maintenance, making the total package more difficult to deal with. When it comes to large projects the task goes from independent, to becoming more interdependent forcing the tasks to be analyzed and discussed at a deeper level. What are the different planning stages of these projects? This happens because the project process is long, and the different stages of the project need to be planned at a higher level (detail or organizational level). This results in a more complex planning and execution phase of a project (Prieto, 2015).

The assumptions of project management can be divided into two main categories, the first one is the theory of project, what is a project? When we talk about project theory there is a transformation view on operations. This is how a project is managed. This transformation can be for instance a big task is divided into smaller tasks. The second main category of project management is the management part. Planning is under the management part. Planning is the phase where it is important to show and implement creativity and implementation of the ideas and plans. The execution part comes later in the management part. This is where communication plays a huge role, both for the actual execution of the project, but also all the processes before the finalization. Including all the work that goes in to make the ideas from scrap board to a living project. The last part of the project management is called the theory of control. This part is where you can measure the outcome of the project (Koskela, L, 2002).

However, the traditional theories are good for projects with a limited lifespan, size and complexity, the project theory from (Prieto, 2015) will focus more on special attributes for large and complex projects, and what are important to consider. When it comes to larger and more complex projects the requirements to the projects do not only have to consider new factors, but also a new element: uncertainty over time. This is because large projects often have longer delivery times, the lifespan of the different parts in the projects but also the project itself have a longer time horizon. Precautions that are firm and set in a normal project cannot be looked at in the same way in these large projects, because they often have a longer time duration (Prieto, 2015).

With large projects comes other challenges such as the bond it creates to the local community in the form of increased activity in the region. If the focus on satisfying the primary shareholder overshadows the others it could ruin the possibility for project success. The success and value of the project will be determined through a multi stakeholder perspective. This approach gives the projects increased benefits to multiple stakeholders. (Prieto, 2015).

Large projects do often come with a longer maturing and approval process compared to classic sized projects. This process is driven by more than just the complexity of the project. Factors such as the environment are scanned to make sure that these projects do not destroy or harm the environment unnecessarily. Internal and external stakeholders need consultation before the steps are taken. An increased use of a stage gate process is also often used, before going further with the project or a possible sanction of the project. As a result of the longer process of the project, the project organization often gives a near permanent lifecycle of services and supply. The organization of this in larger projects is often quite different from traditional projects (Prieto, 2015).

During the planning and organization of the project it is important to select suppliers and partners that can deliver both fast enough and have the required quality that are expected with a large energy project. In the decision of selecting a project it could be done in various ways. A valuable analysis that can be done to ensure the selection of the correct project is the cost benefits analysis, this analysis helps create value for both the shareholder and the affected region.

2.3 How to make good decisions?

Energy projects are huge and complex as stated in the previous sub chapter. The theories described will help us see how the different decisions could be assessed and implemented. The selected theories we will draw contributions from are cost benefit analysis and the stage gate model.

2.3.1 Cost benefit analysis

When choosing a relevant investment theory, we wanted a theory that was more than just numbers. Could projects be selected even though the results are negative? This theory suits our research well, by having this we could look further on why some projects are left out, and some are chosen regardless of how the investments look (Hayes, 2021). Our research question is focused on what factors influence investment decisions. This theory can help us to identify those factors.

When setting up a cost benefit analysis, different costs/income and positives/negatives are set up as a list. The result when comparing negatives to positives, together with the financial numbers you could either decide to go for the project or not. A positive note about the CBA, is that intangible costs can be included as well, the same goes for social benefits and drawbacks. This makes the CBA a useful tool in many situations. This is also why it is called a cost benefit analysis (Hayes, 2021).

When there is a new investment planned in the Barents Sea, an operator is chosen. In our research we have Johan Castberg as a case. Equinor is the operator and has the main responsibility for the project and investments. After the CBA is made Equinor can then evaluate both the different cost posts, and the different revenue posts to see if it is a potentially profitable project. Equinor can look at which factors that are big enough to adjust the project, and which ones that are too small to bother. The CBA approach is relevant especially for huge projects, and that is why we decided to use it in our study because it is not only profitability that is considered (Prieto, 2015).

Also, intangible costs can and will likely be included in an analysis like this. A few examples of intangible costs can be employees, job culture, and the benefits or drawbacks of having the project in a certain town or location. This analysis helps the company to see if the project is worth investing in, maybe they see that a different project is better to invest in (Hayes, 2021).

Talking about the cost-benefit model, the main goal is to see if the project is worth investing in. By doing so, it is important to consider the opportunity cost. The opportunity cost is the revenue/project that you don't invest in because you choose the persisted project. If there is project A and project B, you choose A, the revenue/cost of project B is the opportunity cost. Therefore, is it better to choose the most profitable one, otherwise you lose potential revenue (Hayes, 2021).

Summarize all the different income and costs, and factoring in the opportunity cost, you will have an output that helps you make better decisions with this model. When comparing projects, it is also important to remember the life expectancy and calculate the costs in the same terms, so they are compared on equal terms (Weller, 2016). The analysis can also be used to see effects on decisions regarding morale in the company, as well as the reputation outward, such as customer satisfaction. (Hayes, 2021).

The different costs that are included in the CBA can be the following:

- Direct costs
- Indirect costs
- Opportunity cost
- Intangible costs
- Potential costs/risks

Potential risks, as the name suggests, is not a cost that is necessarily going to happen. An example of this can be, the specific cost of having the facility in a certain city or area, and risk/costs regarding the environment, and its potential impacts (Hayes, 2021).

Things to be aware of using the CBA model is that a lot of the numbers are estimates and forecasted. This means that the credibility can be questioned, even if the CBA is created with the highest morals. The forecasts can be wrong, because often a forecast is just a forecast. Not the exact future, this is important to have in mind when both creating and reading these analyses. Therefore, when making a CBA it is important that all the different costs are measured correctly and not over/underestimated. A cautious approach, and a simultaneous effort to eliminate the subjective opinions about the costs and circumstances. This includes both the income/benefits and costs in the CBA analysis (Weller, 2016).

When concluding with such analysis, it is to sum output that is looked at, and if it is positive, then the project can be accepted, if all the numbers are correct then a rational decision will be that the project will take place. The danger in this part is if the project outcome is negative and the company goes back and fixes the numbers inaccurate because they have such personal belief that this project will be a success. This means it can be wise to just reject it at once, if it is overweight of negatives, of a negative value (Weller, 2016).

A different factor that can be the tipping point is the potential risks, also known as the wildcards. How can it be like this? it is the name they are given and what they are, they are uncertainties that can occur, but not necessary. When they do happen, it is not always that the estimate of a potential risk that has occurred, it can be much more expensive, or in some cases, smaller and cheaper (Weller, 2016).

As there can be many benefits in such an analysis, there are also many limitations of a CBA. For smaller projects that have a shorter time to be completed, and projects that do not require enormous amounts of capital, the CBA can serve well as an analysis. When we have a longer time horizon, there are also other factors that should be included in. Future factors could be hard to estimate correctly in the CBA. A different factor that is important to have in mind when we have a longer time horizon is the net present value of the project. All these factors are financial measures that can have a great impact on the actual decision to invest in the project or not (Weller, 2016).

The project in our research is the Johan Castberg field where Equinor is the operator. This means that we need to look at all the different elements that should be included in a CBA and see if there is any logical mindset when the decisions are made in Equinor regarding this project.

The CBA can help to make investment decisions, to select a project, or to go with another project. The result of a CBA gives room for rational decisions. After the numbers and variables are considered correct. The analysis will help to see what is smart to do, and what is logically the best project and concept. In large energy projects we can expect to find huge revenues, and huge amounts of positive ripple effects that the region will draw benefits from (Hayes, 2021).

With large projects comes also huge costs. In the energy investments these could be standalone field developments which often make a difference between profit and loss and negative numbers. When the project is selected the operator needs to mature the project, what decisions should be made in the different stages of the project. This will be written about in the next part which is the project process.

2.3 Project Process and decision gates

The project process is a way to manage large projects in an efficient way. To plan and operate successful projects, the project process is of great importance. Companies usually have different project processes with their own requirements to the process. However, there are five generic steps that are connected for all strategies of a project process. These steps are Conception and initiation, definition and planning, launch and execution, performance and control, and project close (Mulholland, 2018).

For our thesis we are writing about large projects that require a structured project process to achieve a successful project. The project process theories that are most suitable for our thesis are Cooper's “Stage - gate” system and “The Norwegian State Project Model”. These models focus on the project process and the quality of the projects. The reason why we chose these models is that typical stage - gate models are used in the energy business, however, they´re stage gate systems are a lot more complex than Cooper´s. The Norwegian State Project Model is used to follow given requirements for methodology and quality of a project, and we find both of these theories highly important and relevant for our research. These theories are also used as a baseline in managing the process of large projects.

2.3.1 Cooper´s Stage - Gate System

Stage - gate systems is a model created by Robert Cooper as a tool for managing new products. According to Robert Cooper; “*A stage - gate system is both a conceptual and an operational model for moving a new product from idea to launch. It is a blueprint for managing the new product process to improve effectiveness and efficiency”.* Even though the model is conceptually simple, it is more complex in case of intricacies, design, and operationalization (Cooper, 1990).

The main reason for the stage - gate system is to better their management of an innovation process to gain a sustainable competitive advantage. Stage - gate systems are seen as one answer. However, there are many different versions of a stage - gate systems, and the different stage - gate systems are usually created by the companies that are using them, such as GM, which have the “four phase system” (Cooper, 1990).

Each company or industry has their own unique stage - gate system, but there are many parallels between the different stage - gate approaches. The stage - gate system recognizes that product innovation is a process, which means that the innovation for the process can be managed. This model applies process - management methodologies to this innovation process. As Cooper stated it; “*The way to improve the quality of output from the process, of course, is to focus on the process itself - to remove variances in the process”* (Cooper, 1990).

The process explained by Cooper consists of five decision gates, but the stage - gate system can consist of five to seven decision gates. Into each decision gate, there is a phase in the process. Between each decision gate, there is a quality control, which means that during the entire process there are quality controls. For each decision gate there are specified requirements that must be fulfilled and quality controlled before moving to the next decision gate. This ensures that the quality is sufficient. Usually, the next decision gate is more expensive than the last one. This is because for each decision gate, the company will get more information and then manage risk better (Cooper, 1990).

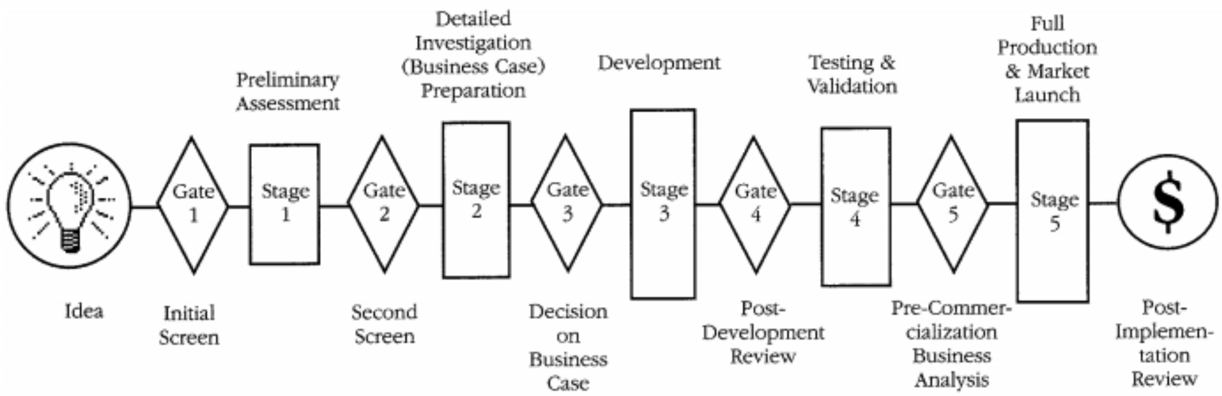

Figure 2 Stage - gate system model (Cooper, 1990)

The gates are control checkpoints for the process, and to proceed to the next gate, the characterized requirement for the previous gate must be fulfilled. These characterized requirements can be a set of deliverables or inputs, a set of exit criteria, and an output, where the inputs are what must be brought to the gate, the criteria are the items upon which the project will be judged, and the hurdles are the requirements that the project must pass to enter the next gate. The output are the decisions at the gate, typically a go/kill/hold/recycle decision, and a plan for the next gate. So, by using the stage - system model, the different gates help the company in the planning phase until the production phase with quality assurance, concept choice, cost management, etc. (Cooper, 1990).

This is a suitable model for understanding large energy projects because the use of a stage - gate system gives us the ability to parallel processing, which means that the activities are parallel rather than sequential. By using the stage - gate system, a lot of activities take place at each stage, which involves different functions of the firm. The reason why parallel processing is preferred instead of sequential is because parallel processing compresses the development cycle without sacrificing quality. The parallel process also makes the possibility of more activities taking place at once, instead of the activities happening in series, which will have longer time estimates. However, this process is more complex, and requires more careful management and planning. The parallel process is also multifunctional and gives the possibility of multidisciplinary inputs (Cooper, 1990).

Maybe the largest benefit with a stage - gate system is better project evaluations. The stage - gate system has the ability to evaluate the projects through all phases and end the project in one of the phases if the project cannot fulfill certain criteria's. With other models, projects are at the idea stage usually based on little information. When the planning of the project has started, it is very rare that the project is ended because of deficient information in the process (Cooper, 1990).

2.3.2 The Capital Value Process (CVP) Energy investment process adaptation of stage gate

In energy projects they use a special version of a stage-gate system. This is called the Capital Value Process and is the general model for energy companies. This model has the same basic features like the stage-gate system, but it is more suitable for energy projects and used as the decision process for large energy projects. We will use this in our research because it is good to use for identifying critical factors in the Barents Sea.

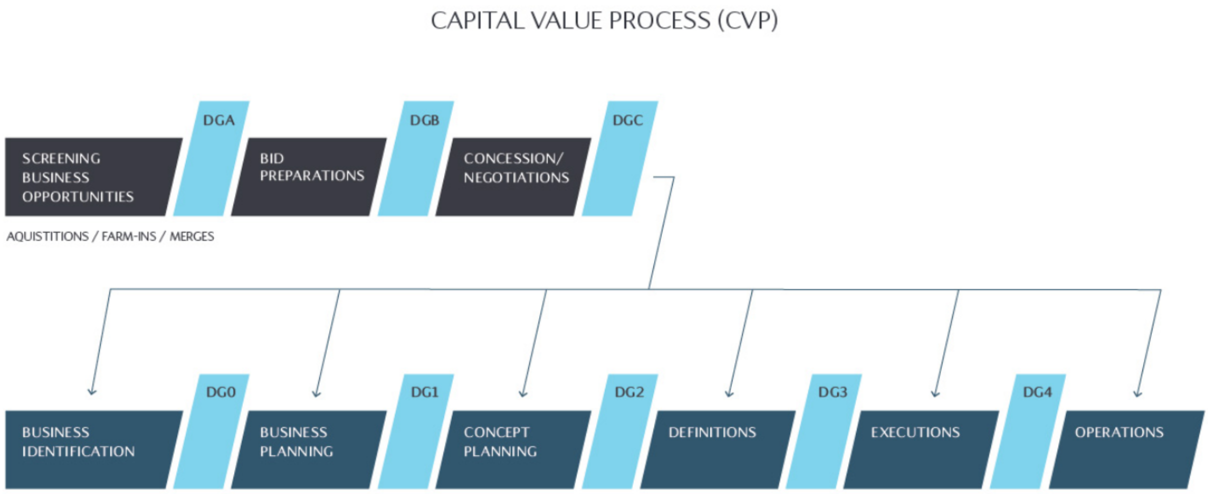

Figure 3 The Capital Value Process (Equinor, 2020).

Looking at the CVP, the model has added three gates at the start of the process, followed by five decision gates as the original stage-gate system. The requirements are the attributes that are required to be fulfilled in order to move onto the next gate. This is important for large energy investments to analyse the projects. The CVP consists of three phases, where the phases together consist of eight decision gates.

The CVP process
Business Development and Explorations access Business development and exploration access comprises the development of a business case from screening of business opportunities prior to DGA until closing of the transaction after DGC
Project Development ***Exploration discovery maturation*** Exploration discoveries are matured towards DG0 and delivered to the receiving business area. The decision of DG0 is taken by the receiving business area based on a recommendation from the business area handing over. DG0 is an approval to establish an investment project and enter the business planning phase.
Post Deal Review (PDR)/Post Investment Review (PIR) PDR or PIR is a basis for assessment of the business case based on defined key performance indicators. By using PDR or PIR, the company can also get knowledge of the case, and improve it. PIR is required for all investment projects that are approved by the chief executive or the board

Table 2 The CVP model decision gates requirements and described

The CVP will be used in our research to identify how the decision processes for large energy projects in the Barents Sea are done, and we will also use it to identify factors that are influencing decision making in the Barents Sea. In our empirical findings we will present the findings at each gate, using information from our respondents.

Environmental factors are also a big part of the processes. Due to the circumstances in the Barents Sea, the environmental factors play an even larger role here. We assume that there are strict environmental policies in this area. The external factors will be described for the next sub chapter.

2.4 External Factors

There are rather many restrictions and regulations the companies must follow in order to start projects in the Barents Sea. Some of these regulations are described in the PUD, the Arctic Investment Protocol and Management plans for Norwegian Sea areas.

2.4.1 Arctic Investment Protocol

We chose the Arctic Investment Protocol, because it is a guideline for responsible investments in the Arctic, which is needed to take into consideration when establishing a project in the region. This protocol is focusing on more socio - economic perspectives on projects in the Arctic promoting sustainability and welfare for the Arctic residents. A company cannot establish their projects if they don't follow these guidelines, which means that this is an important guideline to describe in our thesis.

The Arctic investment protocol can in many cases seem to be the major theory in this research but is not as simple as it seems. The AIP is a framework with a narrower audience, and is less known, compared to the CBA. The AIP is also more of a framework, rather than a complete theory. This makes the call for putting the AIP as a supporting theory, not the leading superior theory. The research question and the sub questions in this research is about the Barents Sea and the decisions that go within the projects. The context applied and the discussion about how important sustainability is and become even more so in the future is considered in the Arctic investment protocol. This makes the framework/theory linked strongly to the research questions.

The Arctic Investment Protocol is a guideline for responsible investments in the Arctic, through promoting sustainable and equitable economic growth in the Arctic region. The protocol is also for securing the well-being of the community and the societies in an environmentally friendly way. The protocol is led by the World Economic Forum Global Agenda Council (World Economic Forum, 2015). The principles for the foundation of responsible Arctic development are:

1. **Build resilient societies through economic development**

Through the investment, there has to be a long-term investment view where the societies and communities of the Arctic are considered. The investments have to promote sustainability and economic diversification by creating job opportunities and human capital that can diversify the regional economies. The investments also have to promote development of civil societies through economic growth.

2. **Respect and include local communities and indigenous peoples**

About 10% of the residents in the Arctic are indigenous peoples, and it is important that the investments respect their rights and don´t have any impact on their traditional practices. This can be done in a mannerly way by consulting with local authorities, indigenous governance structures and relevant community authorities. There is also a claim to develop a consultation process that seeks agreement and complies with domestic laws, and the investments have to promote capacity building in local communities.

3. **Pursue measures to protect the environment of the Arctic**

Review if the investment opportunities are feasible measuring the economic benefits with environmental and climate goals, incorporating environmental and social concerns into investments analysis. Look at the linkages between the biophysical environment and society in the Arctic. Collaborate and engage local communities to measure the Arctic environment with an ecosystem-based management approach to minimize the potential for adverse impact on the environment and health. If the project impact is unknown, the investors and developers should take measures to locate what possible impacts that may be from the project.

4. **Practice responsible and transparent business methods**

The Arctic Investment Protocol is conducting all business in a fair, legal and transparent manner to avoid corruption. They also require evaluations and reports that address the impacts on the communities and the environment. This principle also focuses on the development of a grievance process that can be used by the local community, the indigenous peoples and other Arctic stakeholders, to ensure that they have their rights in compliance with domestic laws.

5. **Consult and integrate science and traditional ecological knowledge**

This principle is about continuing the scientific research that works towards understanding the impact of investment projects and the wider effects of commercial activities in the Arctic.

Develop an overall foundation for investments that integrate a strict scientific with traditional/ local ecological knowledge to ensure environmental, social and economic impact assessment. And lastly, adhere to accepted research norms for baseline data and impact monitoring in conjunction investment.

6. **Strengthen pan-Arctic collaboration and sharing of best practices**

Encourage public - private partnerships and collaboration where appropriate. Recognize that the Arctic is a diverse environment with large geographical, demographic, seasonal and climatic variations that will determine the optimal regulatory framework and approaches across regions and situations. Promote cross-border dialogue to adopt common standards and best practices to maximize the environmental, social and financial benefits of development in accordance with relevant national and international laws.

2.5 Summary theoretical framework

The main theories we have presented in this chapter is project theory, cost benefit analysis and stage gate model. In the background of these, we assume to identify specific factors, specific behavior for the Barents Sea, rational behavior, strong external impact, many opportunities for optimization of processes in the future, and that the green transition will create more opportunities than challenges. With the use of the theoretical framework following findings are expected:

• *What are the challenges when making large energy investment decisions in the Barents Sea?* We expected that the greatest challenges when making large energy investment decisions in the Norwegian Barents Sea would be the rough climate, ice and environmental considerations. We do also have a feeling that regulations and laws can stop further exploring and investment in the region.

• *What decisions are applied for large projects in the Barents Sea?* In this sub question we are expecting to find difficulties across if investments could be done, and that political forces hold the investments back.

• *What are the future opportunities in the Barents Sea?*

We believe that movable platforms could be important for the Barents Sea, including subsea solutions as we see in the Johan Castberg field will be even more important for the future.

3 Methodology

Researching Barents Sea Energy project investments involves solving several methodological challenges. The following chapter describes in detail our research process, development of research questions, and sources of information.

3.1 The Research Process

As recommended by Johannessen, Christoffersen & Tufte. (2011), this research follows a process in four different phases:

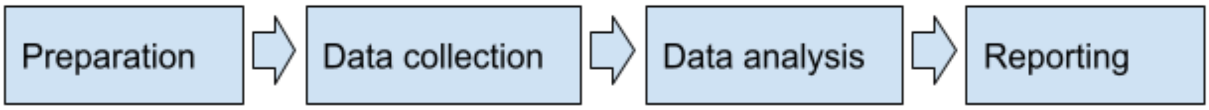

Figure 4 The research process

3.1.1 Preparation

All research starts with a phenomenon you want more knowledge about. The starting point for research is curiosity, in this case towards a gap between opportunities for energy extraction in an area, here the Barents Region, and actual projects being realized. Further on you have to formulate a research question for the topic, hence turn observation into researchable questions. Then you have to collect empirical data, in this case both from informants from energy companies involved in the Arctic and document sources. One also has to do a thorough literature review establishing a knowledge base for the problem. Based on empirical findings and theory frameworks, one then seeks to find what this research can contribute to, and what are the main answers to our research questions (Johannessen, et al. 2011).

3.1.2 Research Question

Encouraged by a lack of research on factors explaining a rather slow growth of energy investments around resources found in the Barents Sea, one important question stood mostly unanswered, which factors have influenced the decision making for this area in projects increasing investment. After analyzing previous research, we formulated a research question, and three sub questions to help us answer our research question.

Energy development in the Norwegian Barents Sea - factors influencing investment decisions.

The research question was formulated on the background of our observed knowledge gap, our own interest and our previous lectures. By focusing on the Arctic region, and especially the Norwegian part of the Barents Sea, we hope to be able to isolate those factors who influence project decision processes in an area governed by a set of national rules, and where information is openly available. Our main research question is closely linked to an observation of why there are so few successful projects in the region, but it is still expected to be one of the most resourceful and important regions in the years to come. By the end of 2020, just 2 of 90 fields in production on the Norwegian shelf were in the Barents Sea (Norwegian Petroleum, 2021). This will increase to three fields in 2022 and four fields by 2025. This is few operating fields compared to the number of uncovered resources. We wanted to research why this is the case, and why there are so few fields in production in this area.

Our main research question was divided into three sub questions:

What are the challenges when making large energy investment decisions in the Barents Sea?
We formulated our first sub question to find answers for our research question, by looking for the core of our problem, and then started to look at the challenges that could be found by making large energy investment decisions in the Barents Sea. We found out that this was a rather complex study, which had not been much studied previously. To find answers regarding this we had to perform interviews with key personnel that had experience and knowledge within this field. Based on our interviews we had some observations of the challenges which were divided into two categories: external uncontrollable challenges, and location specific challenges.

Our second sub question aims at identifying the critical decisions and decision points necessary and how they are handled by the companies. Our second sub question is: What decisions are applied for large projects in the Barents Sea?

This question will give a deeper understanding of which crucial elements influence investors, change their decisions and where in the process they occur. By researching how decisions are made, steps and parties involved, necessary quality of the project, differences specific for the Barents Sea projects and areas without prior energy extraction activity. By interviewing different companies with activity in the region, we can take a deeper dive on how these decisions are made. We also got a greater understanding on how important it is to not make wrong investment decisions.

Our third research question is based on the two previous ones. What are the opportunities in the Barents Sea?
One important aim of our interviews and document studies are to identify opportunities for reducing challenges encountered for those trying to develop energy projects in the Arctic in future investments. Both opportunities meeting external factors as emission policies, opportunities in cooperation and standardization will be investigated. When discussing this question, we want to explore the opportunities that could be realized if more of these investments happen, but also what opportunities for making investments more attractive in the Barents Seam since changes in solutions and technology towards a green transformation radically will influence interest for Barents energy projects.

3.1.3 Research Design

Several decisions regarding research design have been made. First, what to research, as described above, then who to include as informants, how the survey will be conducted, data analysed, results presented and identifying limitations. Our research falls into the broader category of case studies. Conducting surveys can be classified under different categories, such as cross-sectional surveys, longitudinal surveys, experiments, quasi-experiments, evaluation, simulation, phenomenology, ethnography, grounded theory, and case study. (Johannessen et al., 2011).

After a literature review and conversations with professionals, a case study was chosen as research design. This was based on the complexity of our research question, and the time frame of the projects in the Barents Sea. This was the best method to approach, as there has been little specific research on Arctic or Barents Sea projects compared to a large research body on energy projects in general.

3.1.4 Qualitative Research Method

The research design affects what type and how data should be obtained. A quantitative approach is used to accommodate the reflections of humans and human evaluation of processes we study. It also helps us to go deeper into special characteristics of the phenomenon (Johannessen et al., 2011).

In addition to interviews with key personnel within the industry, companies generate a huge volume of secondary data from documents produced following rules and regulations. These documents will be an important part of our investigation, especially for identification of external factors influencing investments.

3.1.5 Case Study

The case study will give us the answer which and how decisions are made as this research method is one of several in the Research study (Yin, 2018). When selecting a Case for research we can identify it by the attention focused towards a specific case, and the description is detailed. Questions as why and how are often used to give a deeper understanding over the context and phenomena. Our case will be the Johan Castberg Field, currently in the last phase of development by operator Equinor.

There are several case designs one can apply. One can use single or multiple case design. Our need for a holistic approach and Castberg being the only recent field investment, a single case design was selected. Since our case is a very large energy project planned to start operation next year, a comprehensive case description will be given when we present empirical findings.

3.2 Data collection

When gathering data, we distinguish between primary data and secondary data. Primary data is a researcher´s data gathered for the first time. It comes directly from persons or groups. The main way to collect primary data is through interviews, questionnaires, or observation. Secondary data is data that already is collected through other purposes (Johannesen et al., 2011). For our data collection we used both primary data in form of interviews, and secondary data in form of public documents.

3.2.1 Literature review

A literature review was conducted to establish a knowledge base for large energy project investments. To find relevant literature, academic search engines such as Google Scholar, ORIA and Scopus were used. To find literature, different search strings in different combinations, such as: "projects in the Barents Sea", "challenges in the Barents Sea", "large projects", "project processes" were used. This was primarily used to increase knowledge of large projects and a broader understanding of projects in the Barents Sea.

Due to lack of studies specific to the Barents Sea, the literature review was conducted to gain more understanding about large energy projects in general, large project processes, and possible Barents Sea specific challenges. To find more relevant literature regarding the research question, governmental documents and reports were used. These reports led to further relevant literature.

3.2.2 Interviews

Interviews are a common data collection strategy for the qualitative method. The qualitative interview approach selected in this study, can be categorized as a conversation with a given structure. We sought to organize interviews as a dialogue more than questions and answers, since our topic often demands more holistic explanations, understanding, context and behavior. The purpose of an interview is to understand or describe a phenomenon. The use of interviews can give us more detailed answers and help us gain knowledge of a phenomenon that we cannot find from our literature review (Johannessen et al., 2011).

All interviews were conducted on Teams, due to Covid 19 restrictions. All interviews started with asking the interview objects to describe their experiences and connection to energy projects in the Barents Sea. We then moved on to decision process challenges and characteristics, ending with future opportunities. Throughout the dialog, specified follow-up questions were asked for more in-depth clarifications. This led to a lot of useful answers and information, which became important data points for our analysis. Data from the different interview objects was compared regarding central aspects of decision processes used. We found a high degree of similarities in observations and critical steps, indication a high degree of reliability. One could use informants from only Johan Castberg operator Equinor, but we found it more reliable to acquire information from different companies active in the Barents Sea, to verify differences between companies and patterns of challenges and opportunities. Table 3 below shows our informants' roles in Barents Sea energy projects.

Company	**Position**
Equinor	Manager Northern Area Unit
Equinor	Project Manager
Petro Arctic	Director
Vår Energy	Communications Director
Wintershall Dea	Public Affairs Manager

Table 3 Interview Objects and roles. Names withheld.

3.2.2.1 Interview guide

Our interview guide varied because we had a semi structured interview, however we have included some key questions below, so it will be easier for others to understand how the objects are answering and giving information.

Guide:

- How do you look at different decisions in the Barents Sea?
    - What is more important?
    - Are there any specific differences in the Barents Sea?
- How to open a new area of investments?
    - How important is the infrastructure?
    - How much is relying on existing infrastructure?
- How are measures taken considering the green shift? Are there any adjustments?
- How are the ripple effects ensured in the region?
    - Are the expectations higher for ripple effects in the north?
- What frameworks are used for decisions?
    - Are stage gate models used? If not, what types of frameworks?
- How are the financial decisions evaluated?
- Is there a promising future for the Barents Sea?

3.2.3 Secondary data

Secondary data is data that has been collected by others, probably with a different purpose than our research question. Secondary data was chosen if the yielded process data. Multiple public reports and regulations were used as summarized in table 4 below.

Management plans for Norwegian sea areas	The government's tools for a value based and ecosystem-based management in Norwegian sea areas
OD report	The report is about the oil and gas business development in the Arctic (or as they put it in the report: northern area which is a vaguer terminology than Arctic)
Petroleum law and licensing system	Law for petroleum operations and how the licensing system in Norway works
PUD Johan Castberg	The PUD is an impact assessment, an analysis to see how the impacts are on the environment to several elements.

Table 4 List of secondary data in this study

In order to answer the research question, documents who either covered the specific Barents area were chosen in addition to generic rules and procedures for all Norwegian offshore energy activity, were chosen.

To find data that is relevant for the research, the quality of the data is very important, in terms of both validity and reliability. The most relevant assessment criteria's for assessment if the secondary data can be used is; who has gathered the data? actuality (is the data relevant to our research?), and data collection method (Hansen, 2015).

3.3 Data Analysis

Collected data must be analysed. There are different ways to analyze data. Data analysis for a quantitative method approach is enumerated with different statistical techniques, while analysis for a qualitative method approach is through text interpretation. Regardless of whether the analysis is qualitative or quantitative, an important part of the analysis is to interpret the data (Johannessen et al., 2011).

To get as detailed a picture as possible, primary and secondary data were sorted and connected. First the primary data was analyzed. This data was collected through interviews, so it had to be transcribed and then compare the data collected from the different interview objects. This was done to see if there were any similarities or differences that would have a significant impact on the research and difference across perspectives.

Then the secondary data was analyzed following processes described by the interview objects. This data came from public reports and documents, but these reports and documents consisted of a lot of information, also information that wasn´t related to this research. The information had to be separated to distinguish what information that could be used, and what information that could not be used. The reports and documents confirmed information from the interviews and deepened understanding of roles each step in the investment processes had for the end results. Because of this, it was easy to know what to use, and that it had a high reliability.

3.4 Method Criticism

It is always important to consider the quality of the research. Because this research is conceptual, a type of qualitative study, it is natural that subjective descriptions and interpretations are a part of the research. Trustworthiness is crucial for ensuring both reliability and validity. This is to understand the use of reliability and validity, commonly used in qualitative research, as concepts to test the quality of a qualitative research (Golafshani, 2003). To ensure the quality of research for our thesis, we have looked at reliability and validity, generality (transferability), and confirmability.

The Theories available give indication on what is important to focus on in energy development but lack framework implementations and are too general to be applied in an energy specific project like the Johan Castberg fields. Because of this we had to use both secondary sources like articles and reports supplemented with primary data like interviews to get answers to our research question. A general critique to existing theories about this phenomenon is that they are not complementary enough since several companies haven't even heard about them. The current theories do lack an aspect of time, and process before approval of the project resulting in a jungle of ignorance for new companies in the region but could also be the case to established companies.

3.4.1 Reliability and validity

Reliability is about whether results of the same study will be the same if they are carried out in the same way (Yin, 2018, p. 46). The reliability tells us something about how reliable the data is. Reliability is related to the accuracy of the study´s data, the data that are used, how they are retrieved, and how they are processed. There are different ways to measure data’s reliability. One way is to conduct the same study on a group over two different times. If the results are the same, it is a sign of high reliability. Another way to measure reliability is if multiple researchers study the same phenomenon. If they get the same results, it is a sign of high reliability, which can be denoted as “inter reliability”. Reliability tells us if the research is trustworthy and something to trust (Johannessen et al., 2011).

To gain a high degree of reliability in this research, we have tried to give a detailed description of the research design, and methods that have been used, so that it is easy to evaluate the process step by step. The theoretical framework of this research is based on governmental documents within regulations, laws and reports. The primary data was retrieved through interviews with key personnel in different companies within the sector that are studied. Our interview objects are directly in charge of processes relevant for the Barents Sea, over many years. We mean that the secondary data for our study has a high degree of reliability, because it is mostly governmental frameworks, made by the Norwegian government.

This is because all of the documents used are issued by the Norwegian government, and on background of that, they cannot have been manipulated or presented more positively than in reality. We consider our primary data (interviews) as a high degree of reliability as well, because our interview objects are key personnel in large and respected companies. However, some of the information we have received through the interviews may be manipulated to present their company more positively than what it really is. To ensure reliability we have been critical to the interviews and reports used. With this we consider that our research has a high degree of reliability and credibility.

3.4.2 Generality (Transferability)

Transferability can be defined as the fact that the answers from our study can be used for answering similar phenomenon's. A study´s generality is about whether it succeeds in establishing descriptions, concepts, interpretations, and explanations that can be used on other areas of what is studied (Johannessen et al., 2011). Generality is closely linked to the gathering of empirical data. The conceptual part of our study facilitates transferability. Our literature study covers different factors for decision making, and these factors can also be transferable to other areas than the Barents Sea. It can also be transferable to non - energy projects. Because most of our empirical data can be used other places than just in the Barents Sea, but also to other places in the Barents Sea, and other types of projects, we mean that there is a transferability of this thesis.

3.4.3 Confirmability

Confirmability must ensure that the answer of a study is a result of the research, and not a result of the researcher's subjective attitude. To ensure confirmability, the researcher can emphasize all decisions in the research process, so that the reader can follow the decisions, and evaluate them. Confirmability can also be ensured through similar literature and previous research (Johannessen et al., 2011).

Throughout the research we have presented the choices we made. Our findings have been from governmental documents, and we have conducted key personnel for interviews which strengthens our confirmability. However, we want to emphasize that this study is conducted independently of any third parties, and without any external incentives.

3.5 Limitations

This thesis has some limitations, we have had five different interviews, and used publicly available documents. It is important to acknowledge that if we have had documents with more specific information which are held away from the public it could have given us more specific information of some factors. This is not necessarily true and could be only limited to extraction specific details. Since the documents are public, we also have a lot of respondents to the different documents, creating a statement and reaction overview. We haven't had access to the specific discussion when these statements are being clarified.

We cannot guarantee that we have covered all the relevant articles and reports regarding the Johan Castberg field and activity in the Barents Sea. The articles can be outdated in the future, but they are quite relevant today, they may also have some less described parts creating some weaknesses. We are confident that the used articles are trustworthy and reliable since we got them recommended by the operator of the field: Equinor. Since the field is new and the region is still a fairly new area of investments. The challenges and development in the region can change rapidly. What factors affect decisions could also be quite different during this maturing process of the region, making our thesis less relevant and outdated.

4 Empirical Findings

This chapter presents empirical findings from our research into factors influencing decisions to invest in energy projects in the Norwegian Barents Sea. Empirical findings were collected from primary sources through interviews with representatives from leading companies investing in Barents Sea projects, and secondary sources such as applications and governmental rules. Together, interviews and documents provide comprehensive insight into very dynamic and complex processes.

By using the Johan Castberg field investment as a case, we can look into the newest and most relevant factors for Norwegian Barents Sea investments and decipher both process strategies, how challenges have been solved and reflections for future development in the Norwegian Barents Sea. Johan Castberg as a case is a very useful framework for our investigation. The case, combined with interviews and documents will uncover information about processes, adjustments and adaptations leading to investment decisions.

4.2 Case: The Johan Castberg field

When developing such a project, challenges can come in many forms. These challenges can be related to budget, construction, suppliers, and environment related challenges. In Johan Castberg there are many good examples on how to deal with problems. One example of this is when the operator Equinor had to change the concept due to not approval of further procedure. This study uses the Johan Castberg field as an example of large energy projects in the Norwegian Barents Sea. Other examples such as Snøhvit and Goliat could also be applied. Johan Castberg was selected due to the project's planned production in 2023 and being the most recent project of the other two.

The Johan Castberg licence field consists of the three oil findings: Skrugard, Havis and Drivis. Skrugard is the oldest of these findings, which are from 2011. Havis was discovered in 2012 and Drivis was discovered in 2014. The Johan Castberg field is planned to start production in 2023, and the prediction for production is estimated to be 30 years with the current resources. Future findings could extend the lifetime of the field.

The field is located in the Barents Sea, and the field is approximately a hundred kilometers north of the Snøhvit field, and 240 km from Hammerfest. The depth of the field varies between 360 and 405 meters. The current estimated volumes of oil are equal to 450-600 million barrels of oil. (Equinor, 2021)

During the fall in the oil price in the 2014-2015 the operator Equinor needed to do adjustments to ensure profit if the oil price was going even lower. In the early development phase, several production concepts were identified and evaluated. They varied from a typical platform to a production ship solution. FPSO with bottom remotely operated wellheads connected to the FPSO. After a comprehensive subsea development with a total of thirty production wells, spread over ten bottom frames and with two satellite structures were chosen. Compared to initial estimates, this solution alone reduced the investment budget with 51 billion NOK. (Equinor, 2021), to 49 billion NOK.

The decision to use a production ship, with seabed solutions, helped to reduce the costs from the original concept (platform) from 100 billion NOK to approximately 49 billion NOK. At Equinor it is important to try to cut the costs if the oil price will be low in the future, when the project was in the planning phase, the oil price was well over 100 dollar per barrel, these days the price is around 66 dollars per barrel *(April 2021)*. Expected value recovery from Oil and Gas are estimated to be around 400-650 million barrels of oil equivalents creating an estimated gross income of at least 264 billion NOK over lifetime (500 million barrels *66 dollars each barrel *8 NOK (1$=8 NOK)).

To better illustrate the concept and constructions on the Johan Castberg field, figure 3 below from Equinor shows the field development concept seaside. Above sea level you can see the production ship, and on the seabed, we see the different bottom frames, and the satellite structures.

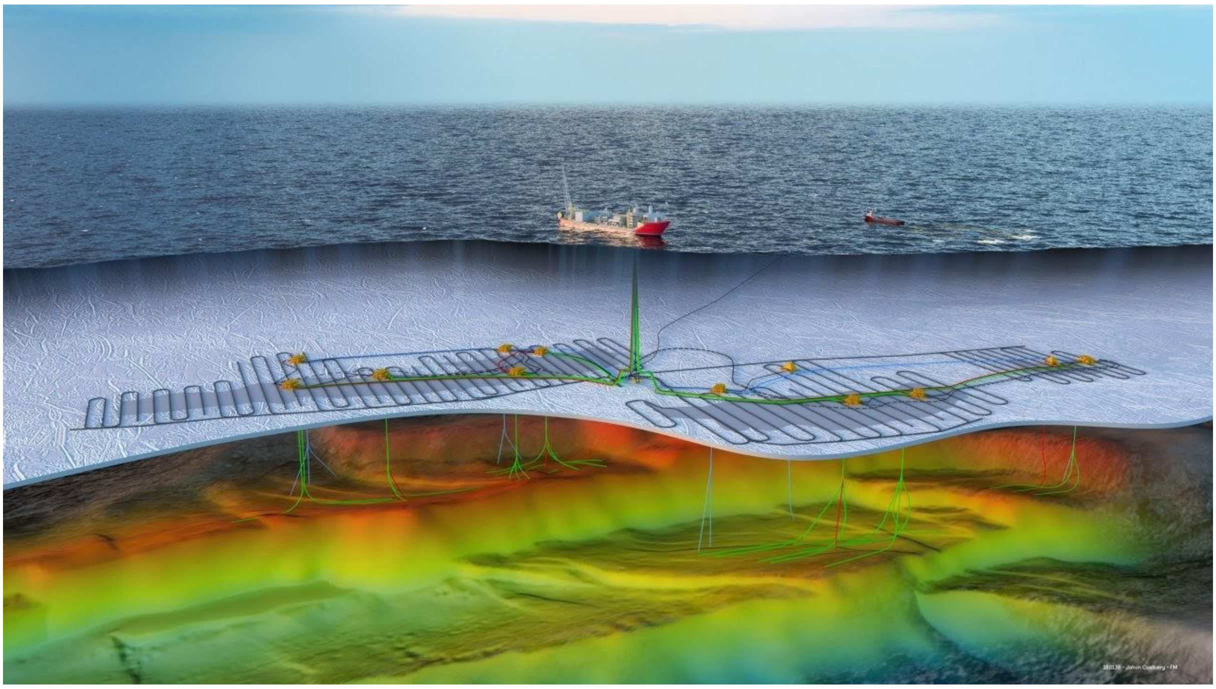

Figure 5 Johan Castberg Field: Equinor (2018)

Construction and operation require a significant number of man hours. The estimated employment effect during the building / planning period is 2000 jobs (Construction abroad as the largest part of this), and local jobs in the operation phase. Jobs in the operation phase will generate a value creation growth of two billion NOK per year in the northern part of Norway, which is a substantial positive effect for the local economy.

Since contracts on these projects are often long, it will give solid revenue long term for the selected businesses who won the different contracts. The businesses with contracts will have many benefits, but potentially drawbacks as well. The required workforce can be challenging and difficult for the businesses that have big contracts if the companies are not big enough. The operators in these projects demand the best quality on the materials and services making it difficult if the skills are not specialized (Prieto, 2015).

The Johan Castberg partnership consists of: Equinor energy AS (50%), Vår energy which have shares of 30%, and the company Petoro that have shares of 20%. The Operator is Equinor, and when a partnership is created it is important that decisions are agreed on. If the different partners disagree it's normal to sell the shares the company holds (Informant).

4.3 Johan Castberg Capital Value Process

The purpose of this subchapter is to present the findings of processes for large energy projects. We hope to get a broader knowledge of what kind of process framework they use to identify factors that are implemented in the process.

As we see, the capital value process (CVP) is the industry framework to find answers to the research question. The CVP describes each factor that takes place in the decision making of a large project and gives this research a broader understanding of the most challenging and outstanding factors. By analysing the CVP, it can also give the research a better understanding of the factors for the Barents Sea.

This process goes through eight different decision gates, where each gate decides whether the project should be continued and invested in, or if it is going to be rejected. The different phases describe the process from the start of an idea until you have a project in operation. By using this model, we will try to identify differences in decisions (gates) and can look at how Barents projects stand out from other energy projects (Equinor, 2021).

The capital value process is the baseline of how energy companies make decisions about large projects in the process. Just like a stage - gate system, the capital value process is divided into multiple decision gates, where each gate requires a set of factors to move on to the next gate. Different from the classical stage-gate system is that the gates in the CVP are related to energy projects. The CVP consists of eight gates, and they have divided the model in two phases: business development and exploration access, and project development (Equinor, 2021).

Business development and exploration access, which is Decision gate A, B and C are the first steps in the CVP. These steps are used when a company first sees a business opportunity, and these steps involve screening of opportunities, bid preparations and negotiations for a concession. The objective is to get access to business opportunities through these steps. These gates are not implemented in the general stage - gate system, but they are implemented in the CVP, which is used by energy companies, because a large part of the project planning in energy projects is to identify areas that have potential for gas or oil and get access to these through concession rounds or by buying into opportunities.

Capital Value Process
Decision gate A: Screening Business Opportunities At the start of a project, you have to screen the business opportunities. This is the identification of a business opportunity. The DGA is an approval to establish an Investment project with the purpose of maturing a Business case towards DGB. Under this phase they have to assess the opportunity (an acquisition, asset swaps, mergers, divestment, or project development). They must describe what the business opportunity are and propose a business case.
Decision Gate B: Bid preparations Based on the DGA, the business opportunity matures to establish a mandate to start negotiations or to submit a bid.
Decision Gate C: Negotiation The negotiation phase should be done according to the approved DGB mandate. If there is deviation in the mandate, a new mandate approval is required. DGC is an approval of the negotiation result and the start of the closing period for the transaction.
Decision Gate 0: Business identification Determine project feasibility and alignment with business strategy, understand project drivers, and identify viable opportunities to pursue. The objective of the business identification phase is to validate and document business ideas, and analyze to decide whether the business idea represents a technical and commercially viable business case. DG0 is an approval for establishing an investment project and entering the business planning phase.
Decision Gate 1: Business planning Perform technical definition and evaluation of prioritised project options, develop initial cost and schedule estimates for the options, compare options by focusing on uncertainties, risks, flexibility and associated economic criteria, and recommend preferred option and further develop technical definition, cost schedule and production estimates.

The objective of the business planning phase is to establish a short-list of viable development concepts, and improve the basis for the concept phase, including the criteria for choosing the concept. DG1 is an approval for maturing the investment project in the concept development phase.
Decision Gate 2: Concept planning Develop the selected option to an appropriate level of detailed technical definition and planning required to freeze the scope of the project, and confirm cost, schedule and production estimates. The concept is developed after a concept study. Looking at different factors such as capacity, level of investment, possibility for other business opportunities in the area, leading to 2 or 3 concepts. Then one concept has to be chosen based on predefined selection criteria and to mature the selected concept towards a Front-End Engineering Design (FEED). The FEED is a thorough technical and economic planning of a project before the final investment decision. DG2 is an approval to start FEED and prepare the project for the investment decision.
Decision Gate 3: Definition Produce an operating asset consistent with scope, cost and schedule, including detailed engineering, procurement, follow - on engineering, site support and project management services. This is the most important phase. The major investments start in this phase. The objective is to mature the investment project for the final investment decision. DG3 represents the sanction for investment projects and is an approval to start the execution phase.
Decision Gate 4: Execution Evaluate assets to ensure performance is to specification including feedback of facilities availability and production performance. At DG4, the decisions are made and the investments are made. In the execution phase, the investment project is realized through detailed design, construction, commissioning and preparation for operations. DG4 marks the start of the operations and is passed when hand-over is accepted by the receiving business area. For an oil or gas project, this means production start and start of the operational phase.

Benchmarking and target setting
Benchmarking shall be performed at DG1, DG2 and DG3 as a basis for target setting to secure competitive solutions and an optimal utilization of the company's resources. The benchmarking should be performed to demonstrate the competitiveness of the project at DGB.
Review process
At each DG there is a review process to ensure that the decision-makers understand expectations for the end - result, that the technical and commercial maturity meets the requirements, and that the risk exposure is adequately identified and mitigated. Before decision gates for exploration projects, development projects, acquisitions and divestments involving a major commitment, the investment arena is mandated to perform an independent technical and commercial review where there is significant risk or exposure.

Table 5 Gates in the CVP (Equinor, 2021).

Informants on the capital value process

The first part of the CVP (DGA, DGB & DGC) is about identifying an opportunity and preparing for a licensing round where you must give a bid that on the Norwegian shelf is a work program. Then you get a licence to do a screening business opportunity, and an actual permit to go through with the project.

According to our informants, the round of negotiation is important. Here, it is the negotiation of final terms between the government and the companies, which means that politics plays a role. This can be challenging as the politicians can expect more ripple effects, sustainable development etc. Especially in the Barents Sea there are high expectations for ripple effects and sustainable development.

In the business identification phase, you are mapping an opportunity and starting exploration. If a field is large enough to have an economical potential, the project will continue. Then you take a DG0, which leads to business planning. The business planning has different phases, where the most important ones are DG2 and DG3.

In Decision Gate 2, costs and opportunities are analysed, and a concept for the field is chosen. In this gate there are a lot of analyses around the field, such as possibilities for other findings nearby, number of wells, and where to go for further transport. Then a decision on DG2 is taken on a large scale, which opens the start of the detailed description of the project. This gate is of even greater importance in the Barents Sea, because of the challenges of finding fields that are large enough. Therefore, they use more time at this gate than more south.

At Decision Gate 3, an even more thorough analysis is done, including FEED (Front-end engineering design) studies, deciding more details such as material dimensions, amount of wells and other decisions until you come to a final investment decision. This is the gate where it is decided whether to start using a high amount of money on the project or not. When choosing to proceed to the next gate, the Plan for Development and operation (PUD) is delivered.

The technique for successful investment is to pass obstacles. Even a good project can be stopped by a too high break-even price, or if the total investment picture in the sector or region is already too high. Also, if there are too many projects in a short amount of time, in terms of market and capacity, one must wait out in time, because it affects the capital use in a particular year. These obstacles are identified and handled in the CVP, which makes it a suitable model for its purpose.

4.3.1 Summary Process

The project process gives a baseline to understand the process of large energy projects and how they are planned. In this research, the baseline for the project process is the CVP. The CVP gives a broad understanding of decisions in the planning phase and development stage. The CVP is made specifically for energy projects, and it is the most important tool for decision making of the projects. It takes into consideration all aspects of a project, such as the economic aspect, regulations, laws, environmental considerations, and the public perception. It is a modified Stage - gate system created to fit the energy sector.

For the Johan Castberg project, we can see the necessity of the CVP. Johan Castberg is a large project that requires a lot of planning to be profitable, but also to achieve the given requirements for activity in the Barents Sea. We can see that DG2 was an important gate for the Johan Castberg Case. In the DG2, the Johan Castberg field was stopped because of a high cost for the projects and a high break-even price of oil, which made the project slightly robust. The investment costs and the break-even price had to go down. Due to the flexibility of the CVP, they reviewed the project in DG2, and managed to choose another concept. This helped them decrease their level of investment from 80 billion NOK to 40 millions NOK. The break-even price decreased from 80 dollars to 35 dollars. This was possible because of the way the CVP is structured (Informant). The Johan Castberg project is now in the execution phase (DG4), which means that the development is finished, and they are soon starting to operate.

4.4 Johan Castberg influence from external factors

The purpose of this subchapter is to give a broader understanding of governmental factors, by presenting guidelines that are important to preserve the environment in the Barents Sea. These are important factors related to investment decisions in the Barents Sea.

The Barents Sea is more tender when it comes to preserving the environment than other places on the Norwegian continental shelf. The Barents Sea is the place where there has been the most environmental analysis (Informant). This makes the environmental factors an especially important part of the investment decisions in the Barents Sea, and an important part of this research. To cope with the perseverance of the environment, the companies have to comply with numerous guidelines in order to start with their project. These guidelines are governmental and applied for all companies operating on the Norwegian continental shelf. The guideline frameworks presented in this subchapter is Petroleum Activities in the High North, Management plans for Norwegian Sea areas and Petroleum Act and licensing system.

4.4.1 Geology of the Barents Sea

The geology of the Barents Sea is challenging due to the complex combination of large-scale tectonic processes and varying climatic and depositional conditions. The geology in the Barents Sea southeast is defined by five geographical areas: The Finnmark platform, The

Bjarmeland platform, Nordkappbassenget, Tiddlybankbassenget and Fedynskyhøgda (Oljedirektoratet, 2013, p. 13).

Geologically, a platform constitutes a relatively stable and flat area with relatively few structures that can be suitable for storage of petroleum. In the Barents Sea, there are two such large structures. One at Bjarmelandsplattformen and one at Finnmarksplattformen. If there is any petroleum in these structures, it can be of great importance for further development of petroleum activity in the Barents Sea southeast (Oljedirektoratet, 2013, p. 14).

Looking at the geology and the premise of finding oil or gas is three-part. There must be a source rock that can create oil or gas, there has to be a reservoir rock that can create a trap where the petroleum can be contained, and it has to be a sealing rock that makes sure that the petroleum doesn't leak out of the reservoir (Oljedirektoratet, 2013, p. 14).

Reservoir rocks

There are multiple factors that create reservoir rocks in the Barents Sea. The original environment is important for the reservoir attributes, and because the area is large and elongated, this will vary in the different areas. Common for all the reservoirs is that a burial depth is an important factor for the reservoir attributes. On shallow depths, the reservoirs will have good reservoir attributes, but if the reservoirs are buried to depth, the reservoir attributes will be reduced (Oljedirektoratet, 2013, p. 14).

There has been an elevation of rocks between 1000 and 1500 meters in the Barents Sea. It is specially the maximum burial depth and the temperature that steer changes in the reservoir attributes as the time goes, that calculates the reservoir attributes. For deeper levels, it is primarily the coastal area that has the potential of preserving good reservoir attributes. In the Barents Sea it is especially at Fedynsky Høgda and Bjarmelandsplattformen that have the best areas for reservoir attributes (Oljedirektoratet, 2013, p.15).

Kimmeridge

It is a high probability that it is a Kimmeridge that can give sufficient quantities of gas in the Barents Sea. In areas primarily outside the Norwegian Barents Sea, there are already large and small gas discoveries that is an indicator that there is gas in the area (Oljedirektoratet, 2013, p.15).

However, the challenge for oil with Kimmeridge is greater. The traditional Kimmeridge that has formed 98% of the oil on the Norwegian Continental Shelf is not buried deep enough to form oil or gas. Because these Kimmeridges are buried only at 1100 - 1200 meters depth, this is not sufficient to have started the formation of oil and gas. Everything is at ease of formation of oil and gas, the organically content is high and has a composition that is favorable for formation of oil, but due to the lack of depth, the temperatures are not low enough to form oil. Due to this, there is a need to find other Kimmeridges that may have formed oil (Oljedirektoratet, 2013, p.15).

Cap rocks

One of the biggest challenges in the Barents Sea is the sealing potential. The lifting in the Barents Sea and gathering of salt in the core of the structures have led to cracking and development of small faults in and over the structures. Seismic shows us that there are leaks in some of the structures. This also shows us that it has formed gas in the area, but they cannot estimate how much gas is left in the reservoirs or whether there is any oil or not (Oljedirektoratet, 2013, p. 17).

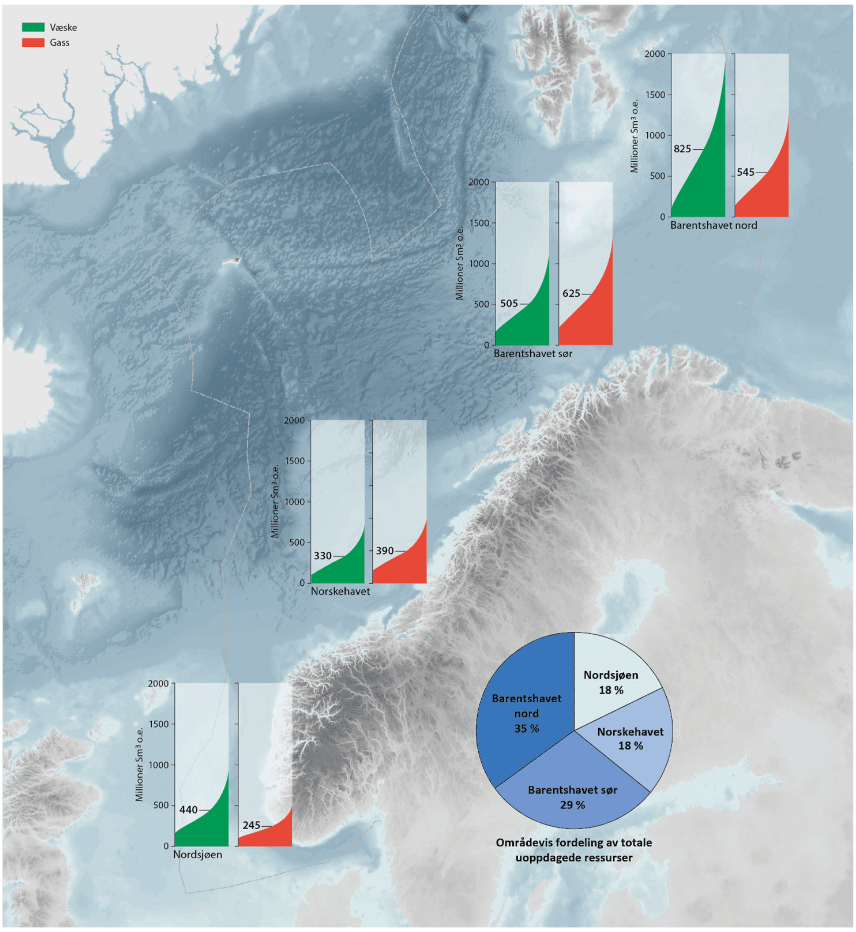

Figure 6 Undiscovered resources by region, Norwegian petroleum directorate (2021)

In figure 6 we can see with the green color the amount of oil, and in the red color we see the amount of gas. The pie-chart shows us that 64% of the predicted undiscovered resources are in the Barents Sea, this is a good indicator that there should be increased activity and more investment should be made.

Summary geology

The probability of forming oil is greatest in areas tied to the salt pools (saltbassengene). In the Bjarmeland Platform, there is a big probability of gas. For oil it is uncertain whether there are any Kimmeridges to form it, and whether the Kimmeridges have enough volume to be interesting. From the resource analysis for Barents Sea southeast, the probabilities of finding oil and gas in the areas is considered. The results are that the Bjarmeland Platform and Fedynskyhøgda is pure gas provinces, while Nordkappbassenget, Tiddlybankbassenget and the Finnmark Platform is combined oil - and gas provinces (Oljedirektoratet, 2013, p. 17).

4.4.2 Arctic offshore oil and gas guidelines

These guidelines are written due to concern regarding the potential impacts related to future increases in offshore petroleum and gas activity in the Arctic, and what impact it will have on the environment. The first guidelines were written in 1996 while the latest, and the one we are using in this research was written in 2009, and it is those who are applied today. The guidelines are intended to be of use to the Arctic nations for offshore oil and gas activities during planning, exploration, development, production, and decommissioning (Arctic Council, 2009, p. 3).

The guidelines cover all operation related activities, such as Arctic communities, indigenous peoples, sustainability and conservation of flora and fauna, environmental impact assessment, environmental monitoring, safety and environmental management, operating practices, emergencies, and decommissioning and site clearance. The content is especially focusing on the environment and how to operate in an environmentally friendly way.

The general principle for the guidelines is that Arctic offshore oil and gas activities should be based on the following principles: principle of the precautionary approach, polluter pays principle, continuous improvement and sustainable development (Arctic Council, 2009, p. 6).

The goals for environmental protection during oil and gas activities in the Arctic area is that these activities should be planned and conducted so as to avoid:
Adverse effects on air and water quality that exceed national or applicable international standards or regulations
Changes in the atmospheric, terrestrial (including aquatic), glacial or marine environments that exceed national or applicable international standards or regulations
Detrimental changes in the distribution, abundance or productivity of species or populations of species
Further jeopardy to endangered or threatened species or populations of such species

Degradation of, or substantial risk to, areas of biological, cultural, scientific, historic, aesthetic or wilderness significance
Adverse effects on livelihoods, societies, cultures and traditional lifestyles for northern and indigenous peoples
Adverse effects to subsistence hunting, fishing and gathering

Table 6 What to avoid during oil and gas activities in the Arctic: Arctic Council (2009)

4.4.3 PUD Johan Castberg

The PUD is an impact assessment. This helps different stakeholders see how the impacts are on the environment and several elements. This paper does also consist of statements from the different industries such as maritime environment, environment risk, fishery interests, society impact and infrastructure. We include a small summary of the PUD in the empirical chapter after the case study to show the structure of such an assessment application. The operator with partners needs to look at what the different groups have to say, should they do adjustment or do they have an argument for not following up on the input. The PUD for Johan Castberg was approved back in June 2018.

The PUD application consists of thematic grouping of consultation statements. The consultation consists of the different departments/ministries in the governments and institutes. It also includes the different municipalities that are nearby the facility. And some political parties are also included in this consultation as well as some other industries, for example fisheries. The consultation is built up with a hearing including comments and statements from the different shareholders and interest groups. The PUD report gives us a picture on how the different stakeholders can affect the operator to do adjustments and changes. This could lead to changes in the production phase. When the PUD has been made, most of the things have been settled. The operators are not obligated to do the adjustments, but if the adjustments are made it can help the operator to maintain trust from stakeholders. It could also be important for the long-term relationship and development of the region. The most relevant parts of the PUD are included in table 7 below. The parts included are A, B, D, E, G, H and K.

PUD: Johan Castberg		
Part	**Stakeholder**	**Statements/Remarks**
Part A: General remarks on the impact assessment and process.	The ministry of climate and the environment	States that Equinor needs to gather all the necessary approvals before the production can start, and to always have a close and open dialogue with the environment agency. This is good because the necessary measures can be coped with early on.
	The Norwegian environment agency	Mention that Equinor has done solid work on the general but lacks information regarding the area around the Johan Castberg field. The information presented does not give a good enough view on the environmental impact at the Johan Castberg field.
	National institute for nutrition and seafood research	The importance of a clean and healthy ocean is the foundation for safe seafood. They also mention that the precautions that are done, have not considered the new types of sea resources like: shells, snow crab, sea sausage, macroalgae and jellyfish.
	Alta municipality	Mentions that the Government's processing of the application for the Johan Castberg field have clarifications on what areas that are important for Finnmark (north in Norway). The important elements are clarified regarding location of different operating and logistics solutions/infrastructure.

Part B: Environmental values and knowledge	Norwegian polar institute (NPI)	The impact assessment gives a good view from existing programs regarding occurrences of seabird, using the programs: SEAPOP and SEATRACK. On the other hand, the assessment lacks information of available data regarding an overview of the potential consequences for sea mammals if an oil spill occurs. All year around the Barents Sea has a rich sea life with a lot of birds. The seabirds are especially vulnerable when it comes to pollution in the ocean. This is because they are dependent on the insulating capabilities of the feathers. On the Norwegian list of threatened birds in Norway, six of these are located in or around the area of the Johan Castberg field. Sea mammals will be in the Barents Sea for a large part of the year, this includes several types of whales which are using the Barents Sea as graze grounds. The evaporation of toxic gasses just above the ocean surface, making it dangerous for whales. The first meters from the surface will also contain these chemicals.

	The Norwegian coastal administration	The coastal administration points out that seabirds are the most vulnerable species if an oil spill occurs. The tracking programs used, have only data which is collected over a short time period. The different areas the birds are located will depend on the winds and other weather conditions, as well as the access to food and nutrition. Remarks the importance of using updated data on the tracking programs.
Part D: Climate, emissions, and powersolution	Climate and environment directorate	Points out that electrification with the selected solution for development is not possible, they also say that they are depending on Equinor to take an active role in future development of an eventual merge with other oil and gas fields in the region/area.
Part E: Consequences for the maritime environment	Climate and environment directorate	The plans include traditional seismic collection and permanent reservoir monitoring where seismic is fired once or twice a year. The general knowledge on the aftermath on sea mammals after being exposed to seismic, is low. The plans include ways that will try to reduce this to a minimum.
	The Norwegian Environment Agency	Remarks that reinjection is an important factor to reduce emissions and will be important for the Barents Sea. Equinor plans a reinjection rate of 95%. This rate of reinjection is high and is a good measure to reduce emissions.

Part G: Fisheries and other business interests	Directory of fisheries	The uneven seabed will force the cables and pipes to be exposed and in a free span. The directorate will point out that it is important that free spans are held at a minimum. Digging down cables and pipes are recommended. This will reduce exposure and the need for stone fills and reduce the possibility for things getting stuck in the cables and pipes.
	The coastal administration	The Coastal administration refers to the direct impact on the ship traffic is small. The monitoring will be the same as other platforms in the region. Established routines need to be in place. This will be made in contact with the coastal administration traffic center in Vardø. They are monitoring all the ship traffic in the region as well.
	Finnmark county municipal	Requesting Equinor for measures that can contribute to the fishery industry as a compensation for the risk the fishery industry takes because of the development of the Johan Castberg field.
	Harstad municipality	Requesting for the operation on the field to be adjusted when the fishing season is active to minimize the disadvantages to the fishery industry.

Part H: Social consequences / location of operating organization & basic services	The Norwegian environment agency	Mention that the assessment should include a transparent view of the socio-economic consequences of the development. It is also pointed out that some elements are explained poorly in the assessment. The agency also points out it should be included in a more detailed scenario if several central factors turn negative.
	Finnmark county municipality	Look at the development as particularly positive. The reason for this is that the development of the Johan Castberg field will contribute to further development of base structures in Hammerfest.
	Hammerfest municipality	The expectations for Equinor are high. The choices they do will lay the foundations for all the local ripple effects in the future. Hammerfest is happy to be the chosen location for the helicopter and supply base.
	Harstad municipality	Remarks that there are still many years of production of oil ahead of us, but the general skepticism to the industry is rising. With this in mind, it is important that all activity that can be developed in the north, should be developed in the north. Supports the decision for location of a helicopter base in Hammerfest. The choice suits the plan for Equinor with future ripple effects in the region.

Part K: Landing	The Norwegian environment agency	Points out that if a common oil terminal will be built in Veidnes, it will require a separate government approval, including an impact assessment.
	Nordkapp municipality	Remarks that Equinor has created big expectations on building a new terminal on Veidnes.

Table 7 PUD, Equinor (2017)

The most important topics for the PUD are the environmental factors mentioned, and the expectations of Equinor. Since the companies operating in the southern part of Norway have done such a great job with ripple effects, the expectations in the north are very high. A higher pressure on the operator since the ripple effects and infrastructure haven't been equally efficient in northern Norway yet. The seabed is less explored in the Barents Sea and discoveries of coral reefs have been made, resulting in awareness and protection of these reefs. During our conversations we have learned that if companies had not scanned the seabed the knowledge of existing coral reefs in the north would not probably have existed at all (Informant).

4.4.4 Management plans for Norwegian Sea Areas

The management plans for Norwegian Sea areas are guidelines that have to be followed in all of the Norwegian seas. However, it is also specified for each area in the Norwegian Sea Areas, which makes these guidelines extremely important to follow in order to be allowed to do operations in the area. Therefore, these guidelines are relevant to our research.

The management plans for Norwegian Sea areas are the government's tools for a value based and ecosystem-based management in Norwegian sea areas. The goal for these plans is to create value and operate in sustainable ways. It is the Ministry of Climate and Environment that is responsible for the management plans (Regjeringen, 2020).

According to (Klima - og miljødepartementet, 2020, p. 6), the climate changes in the Barents Sea have contributed to increased temperatures in the ocean, reduced ice and ecological changes. These factors have contributed to changes in production and the eco - system. Because of the increase of ecological changes, the stock of krill in the area have increased, which have led to higher stock of cod.

Operational emissions from activities shall not entail damage to the environment or contribute to increases in the background levels of petroleum or other environment damaging substances over time. The emissions in the Barents Sea are low, and it is expected that they won´t influence the background level of petroleum or other damaging substances (Klima - og miljødepartementet, 2020, p. 18).

The petroleum activities are the most important nutrition for Norway, measured in value creation, government revenue, investment, and exportation value. The business is very important for Norway, and it both employs and contributes to activity all over the country and is important for nutrition - technology and society development. According to numbers from the government, half of the petroleum reserves are produced. Most of the remaining resources are expected to be in the Barents Sea (Klima - og miljødepartementet, 2020, p. 84).

Regulation of the petroleum activity

The activities must be in areas that are opened by the government, and they have to follow given area specific frameworks that follow the management plans for petroleum activities. Areas for petroleum activity are allocated every second year for immature areas, while in more mature areas they are awarded yearly. The allocation is done by "the Allocation of predefined areas" (TFO). However, the allocation of areas for petroleum activity is a complex process, where the government has the final word (Klima - og miljødepartementet, 2020, p. 87). Most of the area in the Barents Sea is immature areas, which means that they are allocated every second year.

The most environmental emissions connected to the petroleum industry is acute emissions. This is emissions that come from adverse events, like oil spills, dangerous chemicals, etc. Based on data, the probability for acute emissions is very low, but as there is expected a higher activity in the future, it is something that can happen (Klima - og miljødepartementet, 2020, p. 89). This is a big problem in the Barents Sea, as it is a rather bad preparation to cope with these situations.

The emissions from the petroleum industry can affect marine wildlife, such as corals, bottom fauna, and fish. The petroleum industry is obligated to map corals, fish areas, etc. They may be touched by the petroleum industry to ensure that such deposits are not affected by the petroleum activities. In areas with petroleum operations, there are specific species with corals that are important for the marine wilderness. Some of these species are slow - growing and will take a long time to re - establish itself. It is important to protect areas with these kinds of species. The regulations and terms of preserving marine life is given in the concession rounds, through claims in the Health, Environment and Safety regulations and terms in the permissions to the industry in the Pollution Control Act (Klima - og miljødepartementet, 2020, p. 92). There are some area specific regulations for the Barents Sea which have an impact on the activity. Those are specified in table 8.

The coastal zone along Troms and Finnmark to the border with Russia	35 km from the baseline along the coast from Troms to the border with Russia, there will be no petroleum activity. In the area between 35 km and 100 km from the baseline there will be no exploration drilling in the period of March 1st to August 31st.
Tromsøflaket	On the Tromsøflaket, the same regulations as on the coastal zone along Troms and Finnmark to the border with Russia are applied. On Tromsøflaket, there will not be legal exploration drilling in the period of March 1st to August 31st.

Eggakanten	Have to follow up on the general requirement that new production licenses will map possible coral reefs and other valuable bottom communities that may be affected by petroleum activity in the blocks and ensure that these are not damaged by the activity. In vulnerable areas there may be separate requirements to avoid damage.
The ice edge zone	Do not initiate new petroleum activity in areas where there is sea ice more than 15 percent of the days in April, based on a basis of data for the 30 years period 1988 - 2017. This regulation is applied until the data eventually will be updated in a later update of the management plans, earliest in 2024.
Bjørnøya	Do not initiate new petroleum activity closer than 65 km from the coastline of Bjørnøya. There will not be legal exploration drilling in a belt of 65 and 100 km around Bjørnøya in the period of April 1st to August 15th.
Nordland IV (unopened part), Nordland V (unopened part), Nordland VI (opened part), Nordland VI (unopened part), Nordland VII and Troms II	Do not open for petroleum activity, or impact assessment according to the Petroleum Act, in the sea areas outside Lofoten, Vesteraalen and Senja in the period of 2017 - 2021.
Other terms	In an area closer than 50 km where sea ice has been observed, there will not be legal exploration drilling in the period December 15th to June 15th.

Table 8 Regulations for the Barents Sea, The Ministry of Climate and the Environment (2020)

4.4.5 Petroleum Act and licensing system

The Petroleum Act is important for our research because it specifies laws for petroleum activity, which is an important part of being able to start a project. The petroleum act requires industry to take care of all important societal considerations and make sure to maintain the value creation that benefits Norway (Oljedirektoratet, 2021).

The Petroleum Act (Act 29 November 1996 No. 72 relating to petroleum activities) provides the overall legal basis for good resource management, including the licensing system that gives the companies rights to petroleum activities. The Petroleum Act states that the state has the property rights for the subsea petroleum resources at the continental shelf.

Laws most relevant influence specific for Johan Castberg development

Opening of new areas for petroleum business

The change of law can be a risk if the license is given a long time ago. Before permits can be granted for petroleum activity, the area where the activity is supposed to be open for petroleum business. For opening areas, the Ministry of Petroleum and Energy must prepare an impact assessment that assesses what kind of economic, social and environmental impacts the business may have. Through an opening process, it is secured with an overview of positive and negative sides for and against petroleum industry in the given area.

The process of opening new areas for petroleum business also let the public and stakeholders come forward with their views on the matter. There is also a resource mapping of the area. However, it is the Norwegian government that decides if a new area will be opened for the petroleum industry. The laws of opening new areas are described in the Petroleum Act, chapter 3 (Oljedirektoratet, 2021).

Award of production license

The production license gives a company exclusive rights for examination, exploration drilling and production of petroleum within the given geographical area for the license. The licenses are regulating what rights and duties a licensee has above the state. Law and regulations for the industry are stated in the licenses.

The production licenses are awarded through licensing rounds. The licensing rounds are managed by the department, as they announce certain areas that can be applied for. The specific requirements for whom that can search for the licenses is regulated in the Petroleum Act chapter 3. According to (Petroleumloven, 1996, §3-3); "*A production license can be granted to a legal entity that has been established in accordance with Norwegian legislation and is registered in the Register of Business Enterprises, unless otherwise provided by international agreements. A production license can also be granted to a natural person domiciled in an EEA state".* The licenses are normally awarded to multiple companies, on background of factual, objective, non-discriminatory and predefined criteria's (Oljedirektoratet, 2021).

Licensing rounds

It established two equal licensing rounds to get an exploration of both mature and immature areas on the Norwegian shelf. All areas that are open for the petroleum industry can be announced in numbered licensing rounds or be included in the predefined area. Petroleum professionals are managing which areas are in the different rounds based on their assessments of the area's maturity, and the necessity for step by step exploration and time critical resources. The two licensing rounds are numbered licensing rounds in immature areas, and TFO - Licensing rounds. These rounds are similar after the announcement, but different before the announcement.

Numbered licensing rounds in immature areas

Immature areas are areas that are little explored, and there is a lower knowledge of the geology and greater technical challenges, and a lack of infrastructure. The strategy behind the licensing rounds in immature areas is step by step exploration where the result of wells in chosen blocks of an area should be evaluated before new blocks are announced in the same area. This is to ensure that big areas can be mapped with few exploration wells. Before the announcement of a licensing round, there is a nomination process.

4.5 General Considerations in the Barents Sea

In Addition to the external factors in the Barents Sea, there are also some general considerations which are more location specific, and therefore important to implement in this research. The general considerations in the Barents Sea are something that can´t be handled by one company alone, but rather through cooperation and with help from the government.

4.5.1 Energy Transition in the Barents Sea

The World Energy Council has predicted economic growth in the future. With economic growth, the demand for global energy will also increase. The demand for global energy is predicted for 2 scenarios. The pessimistic scenario is that the demand for global energy will increase by 35%, while the optimistic scenario predicts that the demand will increase by 45% - 60% by 2030. To cope with the increase of demand, more energy - efficient technologies must be implemented, and new energy sources have to be produced, such as renewable energy sources (Tvaronaviciene, Baublys, Raudeliuniene & Jatautaite, 2020).

Increasing energy efficiency is the most important direction for sustainable economic development in all states, economic and social structures. There will also be limited resources in the future, which will cause a problem of energy security. Energy security is important for every nation, as each nation depends on energy. To cope with the threat of energy security, there will as mentioned be necessary diversity of fossil fuels and renewable energy sources, and the production of renewable energy sources need to increase through an energy transition (Tvaronaviciene, et al., 2020).

In the Barents Sea, the energy transition is very important. The most important factors for the energy transition are the effectiveness of use of energy by the end users, an increased amount of renewable energy, and carbon capture - and storage. These factors will both be environmentally friendly, contribute to the energy transition, and create more workplaces (Johansson, 2012).

In the Barents Sea, there are good opportunities for development of renewable energy sources. Oil and gas will be produced where economics, environmental and societal interest align. The development of oil and gas will facilitate additional investments in renewable energy sources in the Barents Sea, as they are working toward a green transition. Investments in renewable energy projects are also increasing the sustainable development in the Barents Sea. For the decision of the energy transition, local communities and Indigenous peoples are key stakeholders, right - holders, and energy partners with the project owners and governments must engage (Andreassen, 2018).

There are multiple reasons why the Barents Sea energy systems have to look for other alternatives than fossil fuels. Because of volatile fuels costs, energy security and climate change, the Arctic communities need an energy transition towards renewable energy. Because of the rapid cost - reductions and technological development, renewable energy sources can be their solution. The renewable energy sources that most commonly are described are wind and solar power (Andreassen, 2018).

One of the greatest challenges for the energy transition is that the economically developed countries will invest in the transition and focus more on renewable energy, while the developing countries will increase their use of cheap fossil fuels for their economic growth. The greatest challenges won´t be political, but rather technological and economic (Kireeva, 2020).

4.5.2 Infrastructure

The greatest challenge for large energy projects in the Barents Sea is the infrastructure (Informant). Much infrastructure is required to meet the demands of the energy industry. This type of infrastructure can be everything from preparedness, gas pipelines, infrastructure between the wells, transport, etc. The infrastructure is crucial for establishing a profitable energy industry area.

Today there are 3 important harbors that are connected to the petroleum activity in the Norwegian Barents Sea. These harbors are located in Hammerfest, Honningsvåg and

Kirkenes. However, these harbors are a great distance from the fields, so there is a need for required infrastructure. This is not a problem in the more southern fields, where there already is established a good infrastructure.

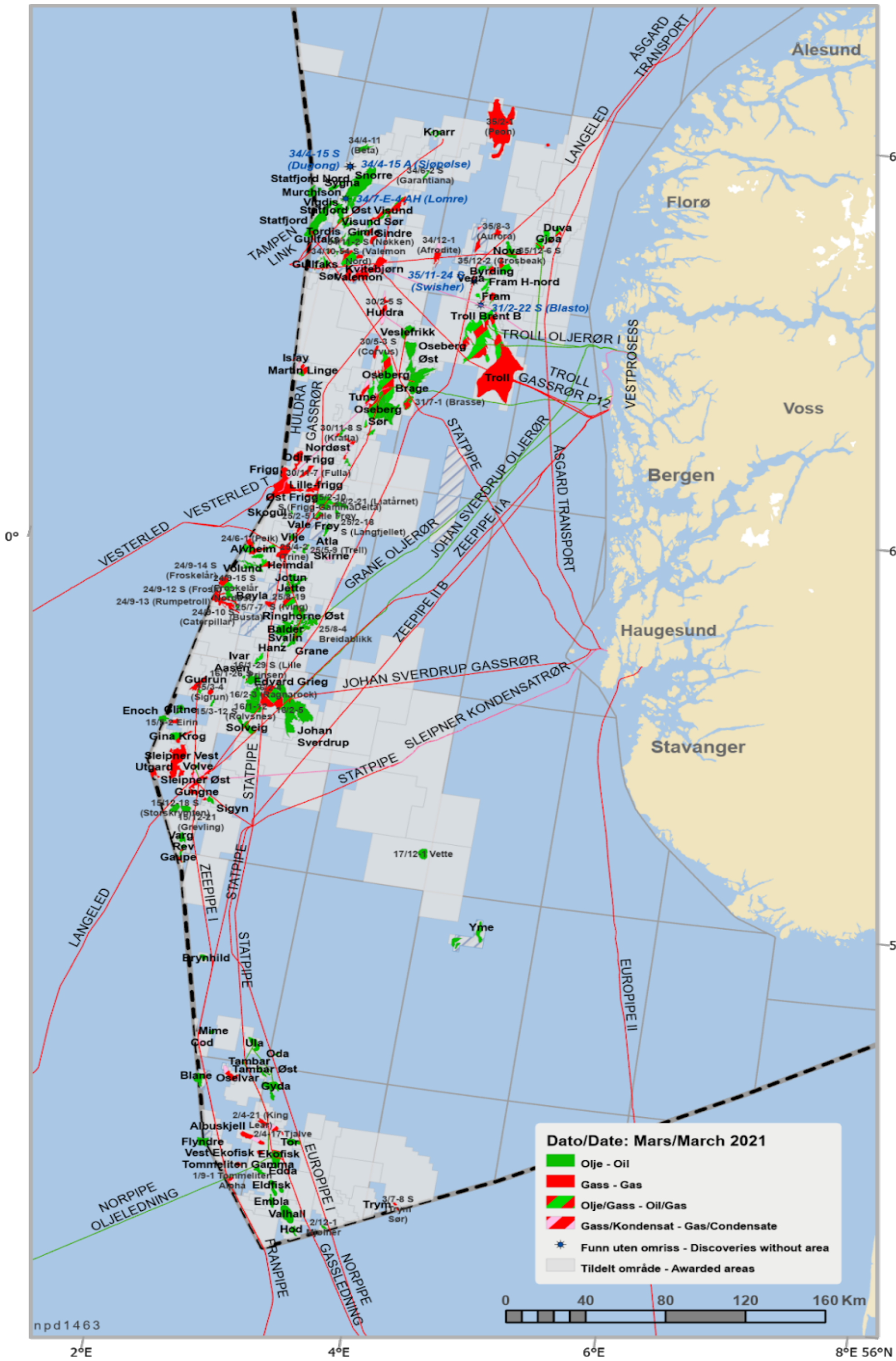

Figure 7 Fields with infrastructure in the North Sea (Multiconsult 2012)

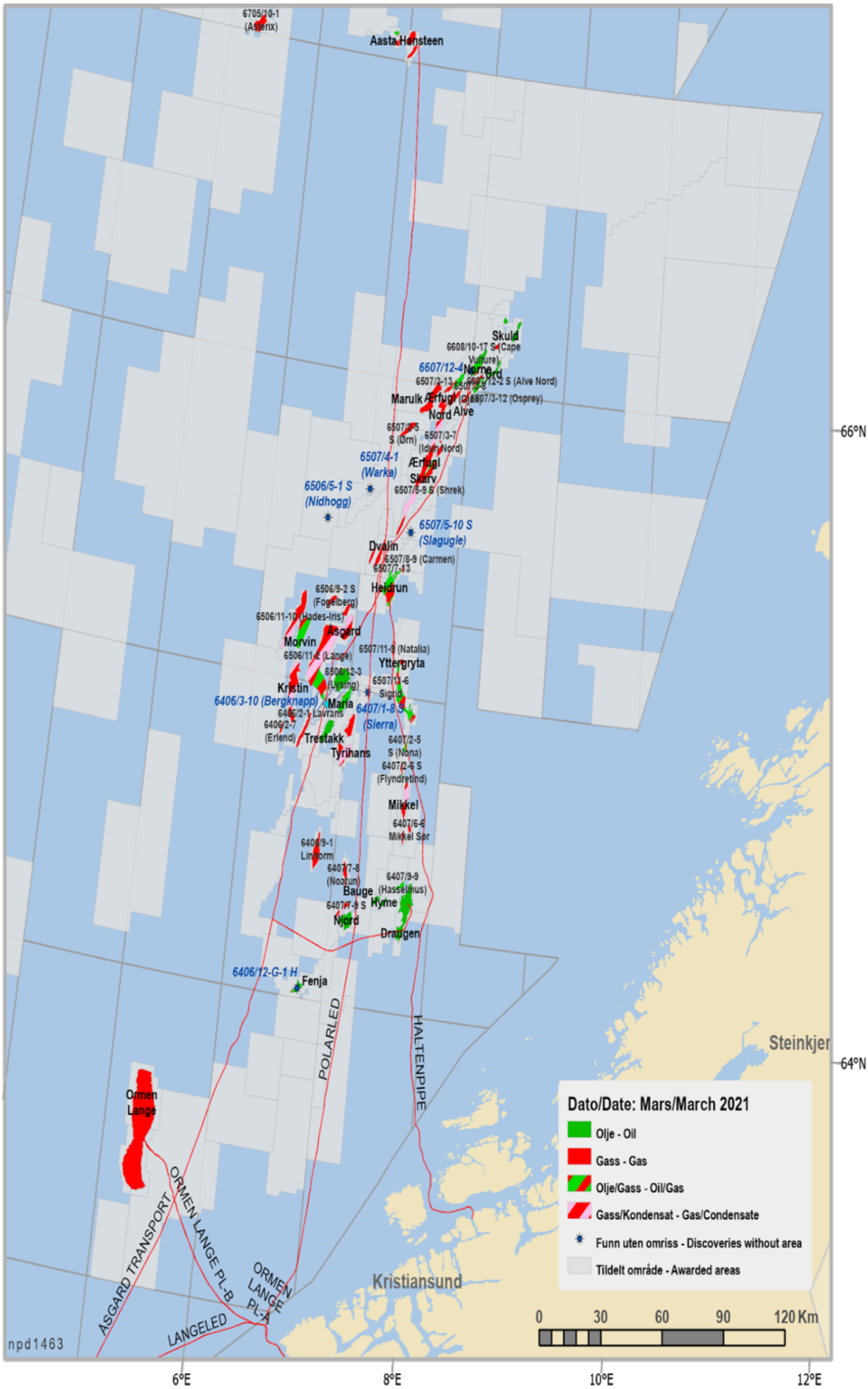

Figure 8 Fields with infrastructure in the Norwegian Sea (Multiconsult 2012)

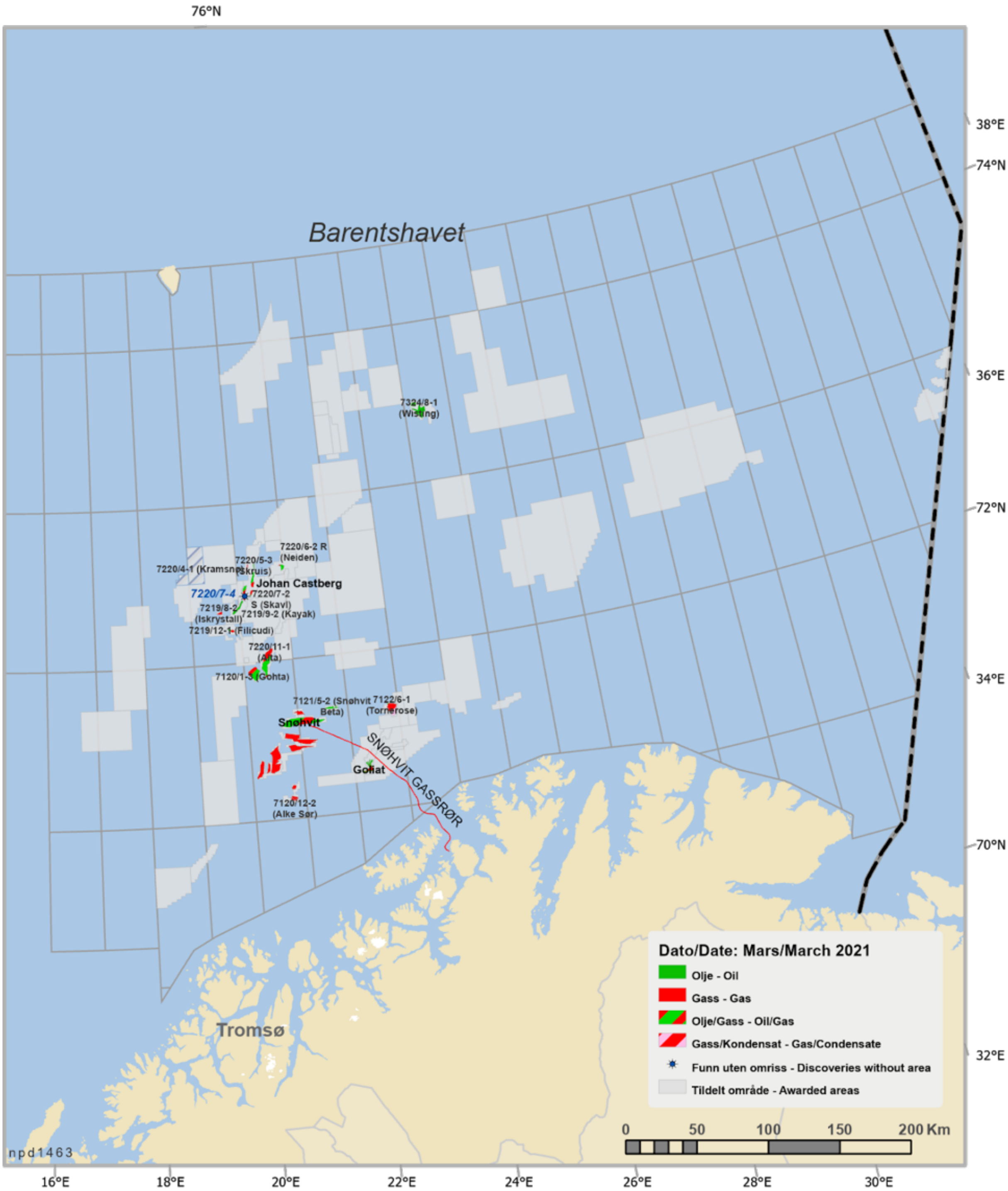

Figure 9 Fields with infrastructure in the Barents Sea (Multiconsult 2012)

Looking at these three figures, we can see that there is substantially more activity in both the North Sea and the Norwegian Sea, than the Barents Sea. Oil fields are marked as green, gas fields are marked as red, while gas pipelines are marked as red lines, and oil pipes are marked as green lines. We can see from the pictures that there is much more activity in the North Sea and the Norwegian Sea than in the Barents Sea. However, maybe the biggest differences are the size of the fields and infrastructure (Eger et al., 2012).

In the Barents Sea there is only one big gas pipeline that is connected to Snøhvit and has full capacity, while there are no oil pipes. In the North Sea and the Norwegian Sea, there are multiple gas pipelines, and more importantly, they are connected to each other, creating a network of gas pipelines covering a large area. This makes it easier and more cost effective to open new fields without new infrastructure. We can also see that because of this, the fields in the North Sea and the Norwegian Sea are much more overall than in the Barents Sea. Opening new fields without any existing infrastructure is expensive, and it is one of the most important reasons why there are so few investments in the Barents Sea (Eger et al., 2012).

Infrastructure has been one of the greatest challenges for further investments in the Barents Sea. Some of the fields are so far away from each other, which means that they cannot connect it to existing infrastructure. That requires entirely new infrastructure which is very expensive and won't be profitable due to the small sized fields in the Barents Sea.

4.5.3 Ripple effects

In the PUD, there are stated a lot of expectations and comments on whether the different stakeholders are satisfied with the selection of different bases, or landing. The reason why this is discussed is because it will help create ripple effects where the location of the helicopter base or service station is located. The estimates of ripple effects created by Johan Castberg are estimated to be above 3 billion NOK. These numbers are estimates from the development and construction phase, numbers from the operation phase are not included, which could be a disadvantage. (Informant)

A lot of the operating companies are stating that ripple effects will be greater in the operations phase. This is met with skepticism by other stakeholders affected by the development of the fields. When the PUD is accepted the different stakeholders have agreed on the terms in the application. In reality, often the same people that have accepted the terms are not happy afterwards. When maximizing ripple effects, they need to stand forward and negotiate in the discussion of the PUD (Informant).

The reality could have been quite different if the active work to ensure ripple effects in the north hadn't been made. The required measures that are done in order to move the services and suppliers to the north are more expensive and aren't necessarily financially wise. The costs are much higher in the north and the economic benefits from doing this are zero to none. There are not many if any rational good business decisions to move this kind of maintenance and supplies to the north. This indicates that the work for ensuring the ripple effects is even more in the north. The ripple effects can be divided into three different categories:

Ripple Effect: 1	Ripple Effect: 2	Ripple Effect: 3
With 78% tax in the petroleum industry, it will create a lot of value and income from operations. Petoro (partner in JC field) is 100% state owned, making the dividend greater to the state. Equinor is also partly state-owned giving additional dividend.	Suppliers, employment, supplier industry. In Norway the oil/gas industry will contribute around 150 billion NOK annually among suppliers nationally. This is approximately 50% more than the seafood exports annually. The export of providing services in the oil/gas industry also has exports of around 150 billion as well (annually). Which generates a lot of revenue to the state.	In the local community, how the community develops and operates. Examples of this could be airports, harbors, roads. The LNG pipe in Hammerfest is a good example of this which generates 200 million in property tax.

Table 9 Different types of ripple effects (Informant)

The first category is tax money, and can't be changed too much anyway. The taxes of the income are regulated by the government. The second category is affecting the region by a lot. If you have a good and secure job, why move at all? This is one of the effects the category 2 provides, because the local suppliers will be prioritized. Jobs and a growing population are some of the main fundamentals for a municipality or small town to get better infrastructure and growth in general. (Informant)

The ripple effects in the second category are the effects that could be changed the most. This category includes what businesses will do the maintenance and other services. Therefore, there are organizations working to ensure the commitment the companies make. So, the growth in the local industries/business is maximized. For the development of the fields, this work starts already at the beginning of the projects. The organizations are working on making contracts and assignments to specific fields to ensure this, a list of selected businesses is sent out, and the operator needs to choose what company they want to work with. (Informant)

It is often difficult to land these contracts, due to high competition and high requirements. The Contracts are often very long, and the expected delivery is high, both time pressure and the size of the contracts plays a role. The different contracts and expectations are mentioned in the PUD, as well, where the different stakeholders can express their opinions on the ripple effects. (Informant)

4.6 Summary

In this chapter, the most central findings were presented as a case study. The case we used was Johan Castberg. We have presented the most important phases of large energy projects in the Barents Sea. This includes the process phase, which in this case is the Capital Value Process, further we presented the projects influence from external factors, which are geology, Arctic Offshore Oil and Gas Guidelines, the PUD for Johan Castberg, Management plans for Norwegian Sea Areas, and the Petroleum Act and licensing system. At the end, we presented general considerations in the Norwegian Barents Sea. These general considerations were presented as Johan Castberg's role in the energy transition based on Barents Sea fields, infrastructure, and the expectations for ripple effects. By looking at these factors, we have tried to find the data that are most relevant to answer our research question, which is discussed in the next chapter.

5 Discussion

Our investigation reveals that Energy project developers in the Barents Sea conduct very elaborate geological and project analysis in all steps towards completion. Optimize concepts through rework and revisions numerous times must comply with one of the most complex and strict regulations found globally for offshore energy projects. Because it is a new area to operate in and high capital extensive, more complex surveys and project analysis is required. Even so, since Barents Sea is mostly about opening new areas, projects reaching completion need to be very large deposits with resources at least 300 million barrels in order to be attractive and trigger investment (Informant). The fields creating increasing challenges, and companies need to handle before one reaches operational activity. Below we discuss our empirical findings more in detail, first identifying challenges specific to this type of energy investments in the Arctic, identifying critical points in the project's development phases in projects leading to investment, and finally discussing how external factors influence both process and project content.

5.1 What are the specific challenges when making investment decisions in the Norwegian Barents Sea?

To answer the question "What are the specific challenges when making investment decisions in the Norwegian Barents Sea", challenges can be divided in two groups; project external challenges and location specific challenges more often found in the Barents Sea than other areas. The most important influencing factors are external defined environmental factors, geographical factors defined by geology and remote location, regulation and laws defined by area specific rules and code conduct among operators, politics defined by public political opinion of oil and gas activity in Arctic areas, and local ripple effect expectations defined by development plans and local actors.

5.1.1 External uncontrollable challenges

The external uncontrollable challenges highlighted by our respondents can be political, legal, regulations of authority approvals, social/cultural, external environment regulations, commercial viability, business cycles and long-term market considerations during project execution and after Arctic weather. The companies must be aware of these challenges, and plan for them in the planning phase (Hasle, Kjellén and Haugerud, 2008).

Guidelines/regulations

Like all other areas where there is petroleum activity, the areas are in most cases regulated by a set of strict laws and regulations. Because the Barents Sea is a part of the Arctic, both national and international regulations are applied in the area. Because the environment is particularly vulnerable in the Arctic, specific frameworks are made to regulate the industry in the area (Flynn, Ford, Pearce & Harper, 2017). Further on in this sub question, we will go through the most frequently used laws and regulations for the Barents Sea, and try to explain how they can be challenging for the energy companies in the Norwegian Barents Sea.

International regulations

Due to the situation in the Arctic, there are also some international regulations that the companies have to follow. Two of those which are specified for the Arctic, and therefore applied in the Barents Sea are the "Arctic Investment Protocol" and "Arctic Offshore Oil and Gas Guidelines". Both of these guidelines are created in order to ensure sustainability in the region, avoid environmentally damaging activity and ensure economic profit or ripple effects in the Arctic region.

According to (Informant), many of the area specific regulations are already implemented in the Norwegian governmental regulations that have to be followed on the Norwegian continental shelf, with further specified requirements in the Arctic region. Our respondents highlighted Norwegian oil and gas administration as responsible to implement international rules into Norwegian rules and regulations, a task well performed seen from the respondents side. From interviews, we know that the Norwegian government is trying to keep the Barents Sea as sustainable as possible, so our assumption is that the regulations in these frameworks are already implemented in the Norwegian government´s regulation frameworks. There are some parts of the Arctic which are influenced by more comprehensive natural impact studies, requirements for area plans, and commonly accepted rules for ripple effects.

The Petroleum Act and Licensing system

The petroleum act regulates planning requirements for new energy projects in the Barents Sea. These laws are governmental and have to be followed. All respondents described the law as a major tool creating a stable framework for energy investments. These laws are applied for all petroleum operations on the Norwegian continental shelf. The petroleum act consists of laws through the entire phase from planning to end and the law is also covering themes such as pollution, safety, fisheries, etc., which is a topic that is more vulnerable in the Arctic, and therefore must get increased attention in areas further north.

However, as our informants point out, the petroleum act can be more challenging for fields in the Barents Sea, because it imposes strict regulations for activities possible consequences for fisheries there, and since there are a lot of fisheries, it can be a complex challenge finding solutions in the Barents Sea, compared to the Norwegian Sea and the North Sea. Requirements considering safety are also more complex in the Barents Sea, due to large distances from land and other infrastructure and lack of preparedness systems with necessary capacity.

Management plan for Norwegian sea areas

The management plans for Norwegian sea areas are a tool for value based and ecosystem-based management in Norwegian sea areas. The management plan is a set of guidelines (deposit report) that describes which factors that must be followed when doing operations in the Barents Sea. The management plan also gives a picture of environmental impacts, possible value creation and employment, and regulation of the petroleum activity. In general, the management plan is for all the Norwegian sea areas, but there are also area specific frames for each of the seas (Klima - og miljødepartementet, 2020).

The management plan divides the Barents Sea into multiple areas, each with specific environmental values that can be harmed when exposed to oil and in new areas where no activity has taken place before and there is little knowledge of the vulnerability of ecosystems (Klim - og miljødepartementet, 2020). The lack of knowledge means additional planning and knowledge base requirements for the companies seeing opportunities in new areas. This is special compared to mature areas in south and middle Norway. This can lead to more companies getting denied, less interest to explore new areas, increased cost and longer development time.

International Climate Focus and weather in the Arctic

Over the last years, the focus on climate changes has been an important factor for energy development everywhere and especially in the Arctic areas. There are numerous treaties to cope with climate change. Our respondents all mention that it seems like the Arctic region has engaged more people in the question of oil and gas activity, than other areas. Because the Barents Sea is located along the main pathway of entering the Arctic, the climate focus is strong with increased attention to temperatures growing. The Arctic environment is particularly sensitive to changes in climatic conditions and impacts of climate change are expected to become more significant in the future (Smedsrud. et al., 2013).

Several of our informants argue that the management plan has resulted in new and innovative solutions for reducing environmental damage and pollution in the Barents Sea. Examples are cooperation with the fishing fleet on oil spill response, regulation in exploration drilling in given seasons and periods to ensure that coral reefs and other valuable bottom communities will not be affected by petroleum activities, and also definition of entire areas that are not open for petroleum activity. These regulations can be found in table 4.5 above. These regulations can be challenging, because when there are periods the companies are not allowed to explorate, there may be a loss of revenue, which will lead to a lower profit for a given project. This means that the companies have to do more thorough investigations and monitoring in the Barents Sea, which is expensive.

The reason why the region has got increased focus globally on the climate is because the Barents Sea contains one of Europe's last large, clean and undisrupted marine ecosystems. The Barents Sea has a high primary production, which supports a rich biological diversity. The Barents Sea is the location of numerous colonies of seabirds, rich seafloor communities with coral reefs, and marine mammals such as walrus, bowhead, whales and polar bears. These values are threatened by oil and gas development. Due to the harsh climatic conditions, the marine ecosystem is particularly sensitive to pollution or a potential oil spill. This has led to numerous petroleum-free zones in the Barents Sea (Barentsinfo, u.y.).

There are many societies that are dependent on fishery, and interest parties outside the country that want to stop energy projects. This has made it a challenge to initiate energy projects in the area due to strong opinions against influencing political frameworks, regardless of good commercial prospects. It has also started a political game between opposing interests and those in favor, influencing elections, which makes the situation in the area more uncertain for planning of further opportunities. (Barentsinfo, u.y.).

5.1.2 Location specific challenges

Location specific challenges are challenges associated with the location of the project. These challenges are natural and may be wind conditions, currents, high waves, temperature, visibility, seabed conditions, external environment, deep water and distance to land or other installations (Hasle et al., 2008).

In unison, our respondents say location specific challenges are not so different in the Barents Sea compared to southern areas on the Norwegian continental shelf. However, it is significantly different in operational distance from land and geology. The location specific challenges in the Barents Sea are infrastructure, unusual geology, climate and climate change, size of the fields necessary for economically viable projects, and distance from land.

Size of the fields
All of our respondents mention the size of the fields as very important. There have been identified a lot of fields in the Barents Sea. However, these fields are varying in size, and most of them are rather small fields and not economically profitable. This is challenging as the companies have to either abandon fields found or try to invest more money in new technology improving profitability. In many cases this leads to postponements of development and pauses while waiting for development of infrastructure or new technology.

Often one lacks the needed infrastructure that is required. Since petroleum operation infrastructure is very expensive, lack of infrastructure in the Barents Sea hinders development of small oil and gas fields that would have been developed in the North Sea or the Norwegian Sea if found there. A kind of lock-in exists, where new infrastructure is needed, there have been no findings that have been big enough to cover the cost for the new infrastructure, and the only position to take is to wait until other fields in the area are found(Henderson & Loe, 2014).

Infrastructure

All respondents mention lack of infrastructure in the Barents Sea as a situation unique for the area. This create a challenge for the energy companies stronger in the Barents Sea than in other regions. Lack of infrastructure is mainly explained by the Barents Sea being an immature area, and by its share size, with fields spread out over large areas. The development of infrastructure is happening gradually as the area becomes more mature. However, in order to get the area more mature, more activity is needed, creating a lock-in. If the infrastructure had been in place, these fields may have been profitable, so due to the lack of infrastructure, a lot of potential profit may be lost for both companies and from taxes (Informant).

Both the North Sea and the Norwegian sea, which are mature areas, have a well-developed infrastructure. This means that they can start operations at small fields, and still be profitable. Instead of building entire new infrastructure, they can connect to the existing one which makes them save a lot of money. Based on our interviews, better cooperation between the companies is required in order to develop the infrastructure in the Barents Sea. It seems like Equinor must take the lead to make it a reality. With better infrastructure, it is likely that there will be more activity in the area, and that small fields can be developed. The lack of infrastructure is one of the greatest challenges of the Barents Sea, However, it is worth mentioning that when new fields, such as Johan Castberg, are developed, the infrastructure will open for nearby field development, creating a win win situation for Castberg and for field owner getting the opportunity to develop their resources (Informant).

Geology of the Barents Sea

The geology of the Barents Sea is tricky. Even though the great futures are the same as in the North Sea and the Norwegian sea, the complex geology in the Barents Sea creates many challenges. It is the same process as in the rest of the Norwegian shelf, and the same type of deposits, but in the Barents Sea, the entire shelf has elevated late geological time, so the layers one hits oil and gas have been 1000 to 2000 meters deeper and lather top level is honored away so that the reservoirs are shallower. These reservoirs have the same attributes as when they were buried deeper. The deeper a reservoir is, the worse it is to extract oil from (Informant).

Due to the geology, it is only parts of the Barents Sea that are conducive to offer well-developed reservoirs. This contributes to technical challenges when recovering resources, increasing costs and reducing economic results. Challenges with this may be that companies don't see any profit in the Barents Sea, and withdraw from the area. However, the companies are cooperating in order to understand the geology, and be able to maximize the resources. But, the companies have not given up the area yet, since difficult geology can be favorable for carbon storage, innovation in drilling methods and subsea processing.

Distance

Respondents rate distance as the greatest challenge for project development concern in the Barents Sea. Distance creates challenges in multiple areas, not only cost of operation. It is a challenge when it comes to preparedness, which is required when establishing a project in the petroleum industry. The distance can also give challenges regarding transportation and for the exploration phase, which makes all parts of the operation more complex.

Helicopters are a means of transport that are used a lot in the Barents Sea. It is used in all of the phases, and is used for exploration, transporting, preparedness, safety, and more. The maximum distance the helicopters are flying today is 200 nautical miles. For the new areas in the Barents Sea, the helicopters have to increase their flying distance to 243 nautical miles. There are many challenges for helicopter operations in the Barents Sea. The most important of those are search and rescue service, air traffic control service, weather forecast service, opportunities for emergency landing, and refueling. The increase of fly range can be improved with the existing technology, but then required to drop weight and replace it with fuel (Dalløkken & Andersen, 2015).

Climate

The low temperatures during wintertime is challenging on multiple levels of the industry. Firstly, it is challenging regarding the operations, but it is also challenging for the preparedness planning, and it has to get increased attention in the planning stage. However, one of the findings we did was that the climate in the Barents Sea is not that different from the climate in other parts of the Norwegian petroleum industry, such as the North Sea and the Norwegian Sea, but there are some factors like local polar low-pressure, and possibility of sea ice, that make operations in the Barents Sea more demanding than other areas.

Sea ice in the most northern parts of the area can occur during the winter months in some years, though not often. Regardless of a small chance, the companies have to prepare their operations and create plans if this happens. This means that the companies have to choose their technical solutions and design according to the possibility of sea ice. The required technology is more expensive than the technology used more south, which means that the profitability will decrease (Henderson & Loe, 2014).

Almost as the sea ice, icing in general is also a climate challenge in the Barents Sea. The icing can make the facilities heavier, requiring more expensive materials. The icing may also affect vessels, and they´re abilities to complete tasks. This requires newer vessels that have the ability to operate in icy areas and as the sea ice, better and more expensive technology (Henderson & Loe, 2014).

5.1.3 Summary

As expected, we find large energy projects with long development processes, huge pre-investment by companies and a rather complex planning phase. We see that there are a lot of challenges to consider when starting a project in the Barents Sea, and that it requires even more attention than in fields further south. Some of the greatest challenges in the Barents Sea is the time frame of the project planning. While it may take 5 years from discovery to finished field, this takes an average of 15 years in the Barents Sea (Informant). This gives us a picture of how complex the process of projects in the Barents Sea is.

Looking at the two groups of challenges in the Barents Sea, we see that the activity is most affected by location specific challenges, and those who are the main challenges are lack of infrastructure due to large distances, small fields and an immature area. The geology is also challenging as it makes part of the Barents Sea unavailable for activities. We assumed that the climate would have a great impact on the activity in the Barents Sea as well, but according to our data, it seems like the climate challenges are the same in the North Sea and the Norwegian Sea.

The challenges are an important part of the decision for the projects. The challenges have to be handled and evaluated in order to make the project as profitable as possible. Risks have to be evaluated and planned. A bad decision can have huge consequences for the project. The challenges are handled in the CVP, where they are challenged, and concepts are made in order to cope with the challenges in the best way possible. This also shows the complexity of the CVP, as there are a lot of challenges to be handled.

5.2 What decisions are applied for large projects in the Barents Sea?

In this sub question we will discuss what decisions companies need to take in the Barents Sea, if they want to maintain the licence to operate and public trust. Our answers are based on our interviews, dividing the decisions in two types, the first part which is *environmental concern driven decisions*. This part will show which adjustments are made and which decisions are driven by the environmental outcome. Some of the decisions come from requirements, others come because companies get regulations by law.

The second part is *increased value generating decisions*. The decisions in this part are from an economical point of view, the decisions we are discussing in this part either help create value, or they could help the companies to create social benefits in the region where the project is developed.

5.2.1 Environmentally driven decisions

Coral reefs

In the Arctic in general there are a lot of coral reefs. These are protected by the law, so the companies that are searching for oil need to be aware of any occurrences of coral reefs.

Luckily for the Johan Castberg field there is no coral reef at the field, but all the pre-work has cost a lot of money and is pushing the costs of the project. (Informant)

Wildlife, grazing area.

Tracking the impacts of the wildlife in the region is important, this is important because it makes it easier to make decisions regarding certain activities and operations (Equinor, 2017). The companies are using tracking programs which are mentioned in the PUD as well. The programs that are used are SEAPOP and SEATRACK. The importance of mapping the behavior of the birds is high. This is due to the fact that there are several species of threatened birds located in the region near the Johan Castberg field. There is a list of 18 different threatened birds in Norway, six of these birds are in the Barents Sea region. (Equinor, 2017)

The wildlife in general is threatened if oil spills occur. This will affect the birds as well as other sea mammals. The bird feathers will lose the insulation capabilities, and the whales will get oil and toxic evaporation gas in their blowholes causing irritation. Because an accident could be a possible reality, the companies in the Barents Sea need to take precaution and make the possibilities for oil spills less. Companies can take different measures to ensure this, one example is to have ice monitoring. If the icebergs collide with the production ship or other elements of the field it would lead to spillage. (Equinor, 2018)

Reinjection of produced water

An environmentally friendly action that has been implemented is the decision for reinjection of produced water in the extraction process. As a result of extraction the field produces water, this water contains a lot of chemicals. When the produced water is reinjected, it is considered to be the most environmentally friendly way, when it comes to the usage of produced water. This will be the best possible cleansing of the water as well. This is important and in particular in the Barents Sea. Equinor is planning a reinjection rate of 95% which is pretty high, resulting in a good environmental move for the project. (Equinor, 2017)

When the Johan Castberg field is operating with such a high percentage of reinjected produced water, it will decrease the amount of hazardous and radioactive chemicals in the ocean which is a benefit for fish and other creatures in the ocean. (Equinor, 2017)

5.2.2 Value generating decisions

Ripple effects in the region

Informats emphasize ripple effects of high importance in the decision process. The expectations for ripple effects in the north of Norway are much higher compared to the expectations in the south. This is confirmed both in documents and interviews we had. We have come to know that the expectations are in fact so high, that it has created a kind of expectancy gap, especially in the construction phase. This is a source of distrust between parties, says the informants, because the expectations are almost never completely fulfilled, even if targets from the planning phase are met and over fulfilled as a rule.

Due to this state, a cooperation instance has been created to make sure there is a detailed plan and strategy to make sure that the ripple effects will maximize the benefits in the north of Norway. Of a total of three ripple effect organizations in Norway, the North group is the only one that has its own team of people that are making sure that the strategy is followed and creating as high ripple effects as possible.

Most active are the county level. Troms-Finnmark wants bigger activity in their region, and wants Equinor to establish further land activity in Hammerfest to increase the ripple effects. They also want Equinor to make sure that maintenance work is done in the region as well. They also address how this can be done, by making it easy for companies to be used, or even easier for them to build new service stations in Hammerfest.

In recent years, there have been several projects (projects in general) that have taken place in the north of Norway, where the benefits should have come to the region. This was not the result in the end. Promised benefits to the region did not happen. This distrust is difficult to build up again. When having the value of the resources in mind, the situation can be understandable. Regional authorities argue that when the region provides such large resources, it is only normal to expect to have a bigger percentage of the value generated back to the local community. This could be workplaces, infrastructure, or more culture and leisure activities offered for the children in the local community.

This negotiation is in fact highly complex, which makes it difficult to cope with. The municipality demands more ripple effects, the locals feel they are left out and the growth is happening in the south. The solution to this is not a simple answer. If the locals are not aware of how much ripple effects affect the local community, it is difficult to obtain trust and cooperation. If the locals are ignorant of the effects, it will be hard for them to be satisfied with a small increase in ripple effects.

New fields need to fill out an application in order to apply for the licences. At the bottom of this application there is a list of local suppliers, the company can choose which one of them, but the supplier needs to be on that list, this is done prior to the decision on which oil/gas company that get the license, so there will be less doubt on whether they choose a local Norwegian supplier, or they unexpected go for a foreign supplier. These lists of the local suppliers are made by an organization that is working on to maximize the ripple effects by choosing local suppliers/services in the region.

When the application is made, the selected local suppliers are decided, and the list of the ripple effects in the construction and building phase have key performance indicators (KPI) set. The KPI helps to measure the growth and benefits of the Johan Castberg field. One weak point of the applications is that they lack KPI in the operating phase. The operators are calming the locals/municipality by pointing out that the ripple effects will be greatest in the operating phase of the projects. This is met with skepticism by (Informant), who does not believe the ripple effects will be greater in the operating phase.

This is an interesting find and result we have discovered, and it is important to acknowledge that certain situations in the past have created skepticism among local stakeholders. The operators in the Barents Sea are working hard to regain the trust and become a good partner for the region. But will it be enough? or have the situations created such distance and resistance that it will be forever difficult to expand and create new opportunities in this region?

Technology

The areas in southern Norway the infrastructure as well as a lot of specialized competence are already established. This is due to early investments which created the infrastructure and helped speed up the total numbers of investments. This makes the region in the south far more mature compared to the fields in the Barents Sea, which are usually dependent on stand alone field developments. (Informant)

Today the fields of the Barents Sea need to be quite big to trigger an investment. Without existing infrastructure the requirements for oil equivalents are so high as 300 millions barrels before a field trigger a investment. In the Barents Sea there are few fields of this size making it difficult to have many investments in the region. If the infrastructure is in place the requirement for oil equivalents can go as low as 5 million barrels in some cases for new oil finds. This gives us an indication that if infrastructure is established the Barents Sea could be a blooming future investment area, especially if new technology makes it possible to capture co2 from oil and gas and reinject the emissions/fill into fields. With infrastructure in place, the maturing process will increase rapidly in the region (Informant).

Investments in the Barents Sea for now are concentrated around oil and gas investments. For the future it could be different investments as well, this will be discussed more in our sub question 3: *What are the opportunities in the Barents Sea?* The investments being made are usually large, the technology is in constant change and the budgets are also important to keep. Since the pressure is on, the project won't be profitable if they are not over a certain size. Because the investments are usually stand-alone field developments the requirements for triggering an investment are much higher in the Barents Sea compared to the investments in the South (Informant).

5.3 What are the future opportunities in the Barents Sea?

In the first part of sub question 3 we will discuss the opportunities that could be utilized now, and create immediate growth and benefits to the region. The second part looks at how different opportunities for future developments look. What is necessary to utilize opportunities in the region? When making decisions regarding energy investments it is important to know that the consequences, both positives and negatives, will have an impact on the local community and the region. This is because the activity will be increased so much that it will affect the community for the better or worse. Because of these factors it is important to make the correct decision.

The opportunities for near future

The opportunities for the present time are a combination of several elements. Opportunities for the industry through new technology and organization, and opportunities for the region, from new activity made possible because of energy investments in the region. To become an important part of the industry, one of the most important factors is to acquire specialized skills to the local region. The reason is because specialized skills ensure many good jobs for a long time in the region (Informant).

With today's numbers there is a lot of unfilled potential in the Barents Sea. If we take a look at the predicted undiscovered resources, we can see that there is a higher percentage of gas in the Barents Sea compared to the rest of the coast of Norway. This could lead to further screening and exploring in the region. The amount of oil is higher in the south, and with existing infrastructure like pipelines and multiple platforms, they can get huge profits from the gas in the reserves. (Norwegian petroleum directorate, 2021)

With the amount of resources and the need for development it is crucial for the northern region to take this chance to become a central and important part of the industry in Norway. If the investors and developers are willing to take a risk, there could be a great chance of success. On the Norwegian continental shelf there are around 1100 appraisal wells. In the Barents Sea there are only around 130. With the amount of estimated undiscovered resources in the region the potential is high, and the profit can be huge.

Future opportunities

A traditional oil industry in the Barents Sea won't probably give much activity long term. The operators with partners need to look at different possibilities in the Barents Sea for the future. The stakeholder’s requirements are important to take seriously to maintain the right to operate, this could be public pressure or regulations from authorities. However, new technology could make it possible to extract and utilize the resources without emissions in the future. This could be achieved by capturing the released Co2 and returning it back in the reseroirvars, making the oil industry emission free.

We could potentially see an end to the traditional oil industry. The industry could evolve into an environmentally friendly industry with new low/zero emission products. This could be important to be more competitive in the future. An emission friendly product that could be necessary to continue the activity in the Barents Sea is blue hydrogen. This type of hydrogen differs from the regular, because the release of Co2 is captured during the production of the hydrogen. Normally this process releases a lot of Co2 in the air. With the amount of hydrogen that is estimated is required in the future, blue hydrogen is necessary to meet the demand. Another new product is green hydrogen (made from renewables) and has the most environmentally friendly approach, but it requires a lot of energy, and won't produce enough hydrogen to meet the demand on its own (Informant).

If the oil industry reaches near zero emissions, there won't be many reasons to shut down the projects and development in the region. To make this change happen, the industry needs to continue to invest in technologies. The opportunities in the Barents Sea are many and will be an important region for future solutions in the oil and gas industry. Since the region is still under development and in its maturing process it is important that the entire value chain have the same mindset and work together for the best possible outcome. If these products and production solutions reach acceptable standards it could give the Barents Sea investments for many years (Informant).

The changes and pursuit for new solutions and products could be connected with the Paris agreement. Norway is a part of this agreement resulting in adjustments and adaptations. Which are necessary in order to fulfill the terms of the agreement.

6 Conclusion and implications

6.1 Conclusion

In this research we have studied which factors influence investment decisions in Barents Sea energy projects. Our aim is to identify reasons why the Barents Sea has fewer investments than identified valuable resources should imply. This indicates challenges exist, both specific for the area and general. By studying the latest project with positive investment decisions. The Johan Castberg field, combined with interviews and extensive document studies, several critical factors are identified. We have also found several suggestions for mitigating challenges, making more profitable investments possible, especially by producing energy carriers without CO2 emissions and reinjection into the fields.

Our research question: *Energy development in the Norwegian Barents Sea - Factors influencing decision making*. We have structured the findings, both internal and external. We have organized the conclusion to first cover some challenges that are identified, then the CVP are evaluated. Future investments should include new products and have a more focus towards a world with less emissions.

Firstly, we find that the most challenging factors overall that influence the investment decisions in the Barents Sea are the distances, infrastructure, complicated geology, and societal requirements such as ripple effects and sustainability. The projects in the Barents Sea are large projects, usually with a development cost of several billion. The distance is challenging due to development of infrastructure, connecting fields, the exploration phase and preparedness. The infrastructure is an important factor to consider in order to start production, transportation, preparedness and execution. It is involved in all parts of the activity, and it is expensive to establish infrastructure. The infrastructure in the Barents Sea is rather poor, which means that the companies and stakeholders have to consider this when they are making investment decisions. The geology is complicated in the Barents Sea. It is not equal in all the parts of the Barents Sea, meaning that in some areas it is quite good, while it is rather poor in other areas. This is an insecurity for the companies when they are in the exploration phase. It also makes it more complicated to find profitable large fields, which is required to develop new infrastructure.

The framework that is used by energy companies is the Capital Value Process. The capital value process framework seeks to maximize project value. However, this framework is not specified for the Arctic region, even though several factors identified indicated a higher rate of complexity and calls for a revised CVP model in the area. The revised CVP model will be suggested in the next section.

Secondly, decisions we recommended to strengthen efforts towards in future investment analysis can be divided into environmentally driven decisions and value generating decisions. The environmentally driven decisions focus on sustainability, such as preserving cold water coral reefs, and wildlife (birds and fish). For the environmentally driven decisions, a much larger focus on implementing new technologies for removing CO2 from the oil and gas produced and reinjection of produced water. Such considerations could, if made a mandatory decision point in the CVP model, turn oil and gas from a problem for the Paris agreement to an enormously important part of the solution to future carbon-less energy forms.

The value generating decisions unique to the Barents Sea, focus especially on fulfilling expectations of ripple effects in the region. The development and infrastructure are less present in the Barents Sea resulting in fewer ripple effects. Many more activities take place in the south of Norway and being a less developed area. Since the region is less mature, the entire investment process will get affected by strong ripple expectations. The public can see and compare the ripple effects the investments are generating in the south, resulting in high expectations in the north. We recommend reducing the negative gap in infrastructure by including the in the CVP decision process, and by this create a higher volume of ripple effects and make it cheaper and more efficient for the companies to operate since more infrastructure becomes available in the North. A new pattern will by our opinion create a win-win situation, since more specific knowledge will be spearheaded into Barents Sea projects.

We asked our respondents to look forward. There are many future opportunities in the Barents Sea. From interviews, we expect that new technology and specialized skills will make large energy projects very attractive investments in the future. By for example implementing opportunities/technologies for emission free products from a field, one will radically change both public opinion and place the Barents Sea as a central solution for fulfilling the Paris agreement. With improved infrastructure and new technology, new fields may open. This will help the region to be an important part of the global energy market and help the image of the industry. To maintain the licence to operate, it is important to focus on new products with small amounts of emissions, ideally products with zero emissions. This is best achieved with further investments on technology leading to new product folios including such as blue hydrogen and production of ammonia. This will in our opinion mature the region and open for a longer period of extraction and higher value generation despite investment in new technology. Since the Barents Area still is maturing, the earlier this happens the earlier the entire value chain can be established in the region. A change like this will help the industry to take part in the green transformation which very likely will be necessary to operate in the future.

6.2 Recommendations

Based on our findings, we have identified recommendations for succeeding reaching positive investment decisions in large energy projects in the Barents Sea.

First, the decision process used for large energy projects in the Barents Sea today, is the Capital Value Process. This is a suitable framework, but it is general, and not specific for the Arctic region. The Arctic region is much more complex regarding extraction, but more demanding in terms of environmental challenges, focus on sustainability and green transition, ripple effects, etc. A framework specific for the Arctic region would in our opinion help to realize more energy projects in the Barents Sea. Our recommendation is to conduct further research in order to define and make an extension of the CVP, making it a true **Arctic Capital Value Process** (ACVP), that effectively mitigates specified challenges in the area.

One suggestion is to include a new Decision Gate D into the process of a **ACVP**, which focuses on the opportunities for transition of resources to green energy, more sustainable projects through closed systems with little or no emission to water or air from activity. This contributes to green value creation, and the green transformation is used as a tool in the development of the fields.

Secondly, we recommend carefully seeking new principles of cooperation in the Barents Sea. Both between government and companies, and between companies. It is a cooperation there today, but it is a competition driven by partnerships developing one by one projects. By forming a wider cooperation opening for longer value chains, more projects in the region may be realized. One example is a long term cooperation between energy field owners, industrial partners transforming oil and gas environmentally friendly products and subsea transport systems, one can develop many more of the medium to small size fields found, but not developed yet. Also more cooperation with the local business community is recommended.

Further, we recommend these points as well:

- Investing more in technology relevant for the Barents Sea. Subsea development could help to attract specialized skills to the region.
- Focus on new products during the entire development and decision making, when developing the Barents Sea region
- As soon as possible, market the possibility for a "new" oil industry with less emissions, creating new trust to the industry and extending the industry's lifetime.
- Continue to have lists of possible local suppliers to be chosen in early stages, and also reach out to the companies not on the list located in the north and give them insight into the requirements for becoming a supplier company. We know this already takes place, but more motivation might be necessary.
- Create a cooperation between different stakeholders, to help share and learn about the importance of ripple effects. This will help the stakeholders to be more aware of the realistically outcome. The terms in the PUD are agreed, but does not make everyone happy in the operation phase afterall.

6.3 Practical implications

In this research our findings are connected to the case we have chosen, which is the Johan Castberg field. We have identified some of the decisions which are important to trigger investment, and what decisions that are making the operators in the region to adjust the decision they are taking. These factors we have identified can be related and used in other fields in the region, but some of them could also be specific to only the Johan Castberg field. It is also important to acknowledge that several identified factors could also be applied outside the Barents Sea. The differences between regions can be quite different in some factors. There is also a possibility that some factors are fairly similar across regions.

6.4 Political implications

Because the Barents Sea is a part of the Arctic, there are political implications for the area. The Arctic is a strategically important area, with increasing attention to developments in the area. Due to strategic interests, it is also a place for political power struggle between states, making it a politically tense increasing activity in the area. This may have a negative impact on companies' activity in the area (Østhagen, 2020).

Political decisions may also have a more direct impact on energy extraction. Political decisions imposing new restrictions may impact the activity if sanctioned broadly. Recently, US president Biden sanctioned the Arctic National Wildlife Refuge by imposing a “temporary moratorium” on all oil and gas leasing activities in Alaska (Jonassen, 2021). This may have a domino effect, and other countries follow the US, but it is not very likely. However, this shows how politics are influencing activities in the Arctic, and that the Arctic is an important part of the political game.

6.5 Recommended future research

In future research related to factors influencing investment decisions it would be interesting to look at:

- Develop further temporary movable infrastructure for the Barents Sea. *Could trigger investment for small fields.*
- A study comparing and developing the reservoir's ability to store CO2. *The geology of the Barents Sea may have better capabilities.*
- Study the possibility for achieving a green industry with zero emission products, which will remove the possibility of peak oil. *Future oil will be used in zero emission products, not cars.*
- Adjustments for theories, and a need for Arctic specific theories. *Stakeholder theory and general theory about projects do not cover the requirements for the Arctic.*

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