SUCCEEDING WITHIN FLOATING OFFSHORE WIND

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Acknowledgement

This Master's thesis is our final contribution after a two-years master's program in Business Administration with specialization in innovation, at the University of Stavanger.

Our motivation for writing this thesis is the development of floating offshore wind and what we see as a major development arena for innovation and modernization of renewable energy extraction technology. We believe that this emerging market is important in order to shift into a more sustainable future. This assignment and semester have been challenging in several areas, time consuming but most of all educational accomplished through good collaboration and an exciting project. We are both happy with the cooperation and have had a good time together throughout the research.

We would like to share our thanks to our supervisor, Marte Cecilie Wilhelmsen Solheim, who always stood up during the thesis, been committed and provided good feedback. She has contributed with valuable guidance, contribution and support. We would also like to thank HHUiS and Ragnar Tveterås for their contributions and finance support for the conference in Egersund, Ocean space. A gratitude to all who had the opportunity to be interviewed in the process and finally we will would like to thank our family, friends and fellow students who have encouraged us throughout this process. Without all of you, we would have struggled completing the study and thesis.

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Summary

If the world is going to achieve the objectives of the Paris Agreement from 2015, one is dependent on a large-scale restructuring of the economy, policy and the ways we use and produce todays energy.

This thesis analyses different conditions that are needed in order for Norway to succeed producing renewable energy through floating offshore wind. Our aim is to answer the following research question: *"What measures are important when it comes to succeeding and expanding within an emerging market of floating offshore wind for Norway in order to develop a more sustainable production level within the industry?"* The capabilities, knowledge, technology and resource base that are achieved through the petroleum and maritime sectors gives Norway a competitive advantage when it comes to diversifying towards the floating offshore wind industry. It provides Norwegian firms a special position towards being able to develop concepts, adapt and to optimize them towards the floating wind technology.

The thesis is based on a combination of casual, descriptive and exploratory research designs. We made one main research question and four sub-questions. To answer these, we performed several qualitative in-depth interviews with key actors within and one actor outside the industry, we also benefitted from using previous case studies, reports, firm documents and articles.

There are measures that are essential in order to succeed and expand within the industry. We think that the Norwegian players within the industry should continue their good work towards innovating within products and processes, reduce costs and strive to succeed internationally. Our research indicates that the industry will give certain firms the technological learning that is needed to expand, but this development depends on firms' dynamic capabilities, innovation processes, knowledge, network and available resources. The Norwegian Government and firms need to develop the industry together and initiate in the improvement of a home market with a local supply chain. To utilize this opportunity, you need to include local firms and to maintain or develop comprehensive political instruments that can aid the development process before it is too late. The Government needs to develop or implement subsidiaries, tax reductions, strengthening or inventing new incentives towards investment to reduce the overall risk for firms. With these changes, there is a great chance of strengthening the Norwegian technology industry and develop a strong local supply chain within the industry that can be compared to what was done in the petroleum industry.

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1.0 Introduction

1.1 Introduction

The world is in a transition phase where the energy we produce and use should be environmentally friendly, which will help preserve nature and climate for the future. Floating offshore wind will be a game-changer and hopefully a major industry in the recovery of green energy in the long term. Nobody knows how to make a wind turbine, not alone. To truly make a wind turbine you need a technologist, that designs it, a civil engineer who evaluate the weather conditions on the structure, a biologist who investigates the eco system and the developer which programs the control system and many more.

The Paris Agreement, which the world's countries*[1] are obliged to follow, has been a political pressure tool to reduce greenhouse gas emissions and develop sustainable solutions. Floating offshore wind is in many ways seen as the solution that can supply Norway and large parts of the world with energy in the future. However, the situation as we see it today is time-consuming and expensive. The industry is at an early stage when it comes to developing technologies and solutions which will make floating offshore wind profitable, yet there is no doubt that the industry has considerable potential for creating value for Norway in the form of employment and capital, but this will require a large Norwegian investment, both from Norwegian companies and from a political point of view. The value creation potential of Norwegian-based floating offshore wind industry depends on the size of how big the market becomes. This thesis will look at how Norwegian companies, with the help of the Government, can develop to secure market shares and create value for Norwegian society by developing and innovating current and new solutions. Although several Norwegian companies that invest in floating offshore wind already have competitive advantages through technologies and experience from the petroleum and maritime industry, there will still be a great demand to develop new solutions and ideas to cut costs and be even more competitive.

[1] *All countries in the world except USA which withdrew from the agreement 1st June 2017. However, this will not take effect until November 2020 at the earliest.

This thesis focuses on areas and questions in the industry which we find important to be answered for a further development process. Our research question reads as follows:

What measures are important when it comes to succeeding and expanding within an emerging market of floating offshore wind for Norway in order to develop a more sustainable production level within the industry?

In order to better answer our research question, we have added a few sub-questions which we also want to answer:

I. What innovative solutions can be helpful or essential to succeed?
II. What are the main challenges of succeeding within the industry?
III. Is the relationship between firms and the Norwegian Government important, why?
IV. How has Covid-19 affected the overall situation towards expanding within the floating offshore wind industry?

1.2 Structure of the thesis

Our thesis is divided into six separate chapters.

1. The first chapter aims to give an introduction of our thesis and will include both motivations and thoughts behind our choice of research. We will present our research question with added sub-questions and how we aim to answer them.
2. Second chapter will include the theoretical structure and previous literature with focus on innovation, dynamic capabilities, first mover advantage and knowledge driven improvements. The relevant theories have been chosen throughout our research and interviews with experienced people within and outside the industry. The theories are helpful while answering our research and sub-questions.
3. Our third chapter will elaborate choice of method that is used for data gathering, contact persons and also to discuss potential advantages or disadvantages of the methods used.
4. Fourth chapter will include the data gathered through qualitative- and quantitative methods, as well as statistics, information collected from conversations with companies and interview objects.
5. Chapter five includes a discussion of all findings throughout the thesis and compare it towards to previous listed theory and literature. This chapter will hold the essential

information between the data collected and established theory in order to understand and answer our research and sub-questions.

6. In the closing chapter, we will present the main results obtained throughout the entire thesis and conclude on our findings. This chapter will conclude and answer the research and sub-questions, include directions of further research and finish of with limitations towards our research.

1.3 Explanation of floating offshore wind

The idea of floating offshore wind came from an employee of Hydro (formerly part of StatoilHydro, now Equinor) during a sailing trip in 2001. The thought went from an idea which were sketched on a napkin, and from sketch to reality in 2009 – Hywind Demo, the first fully scaled floating wind turbine.

"I was looking at a floating marker buoy in the ocean, and I thought – what if we had been able to make those 100 meter tall instead of four, then it would be possible to make offshore wind power" (Barstad, 2017).

After the first offshore bottom-fixed[2] wind park was installed in Denmark in 1991 the industry has become multinational, which also seems to be the case for floating offshore wind; in the long term. Floating offshore wind is at an early stage of development compared to bottom-fixed wind. However, the International Renewable Energy Agency (IRENA) (2018) mentions that the technologies which are used in floating wind are possible "game changers" for offshore wind in general.

The concept of floating offshore wind requires cooperation and interaction between companies and support from the Government to develop necessary components for a completed floating wind turbine. These components include towers with blades, floating foundations, anchors, cables, substations, etc. as well as maritime operations. Floating offshore wind power is wind power far at sea. The difference between onshore and offshore wind is the technology of the fundaments. The offshore turbines are significantly larger, have larger available areas with less

[2] Bottom-fixed turbines: Wind turbines that are attached to shallow water, down to approx. 50-60 meters. https://www.vindportalen.no/Vindportalen-informasjonssiden-om-vindkraft/Vindkraft/Offshore-vindkraft/Bunnfaste-turbiner

conflict of interest as well as it has the advantages with better and more stable wind resources as the wind quality usually increases with the distance from land. Floating platforms can in theory be used at all sea depths above a certain limit.

1.4 Case: Floating offshore wind

Floating offshore wind has come to leave its mark on the development of renewable energy for the future. Norway and the rest of the world are in a transition process where there is a great need for sustainable energy systems. Through the extraction of energy from floating turbines, the goal is to provide communities with green energy and cut fossil fuels, subsequently contributing to achieving the climate goals set in the Paris Agreement. In today's energy system, floating offshore wind is still a niche, and despite significant growth, the industry is in many ways immature where a market consists primarily of pilot projects, with some exceptions. The floating offshore wind industry is in a development process where one works hard for cost efficiency through a larger scale development and the innovation of technologies.

The industry has a global potential, but in order to achieve this potential it is important to succeed in developing cheaper and smarter solutions through innovation and face the challenges you meet under an expansion of the industry. Through this thesis we are going to seek and give answers to what we believe are the challenges occurring with expanding as well as what we believe are the right ways to go to succeed in the industry.

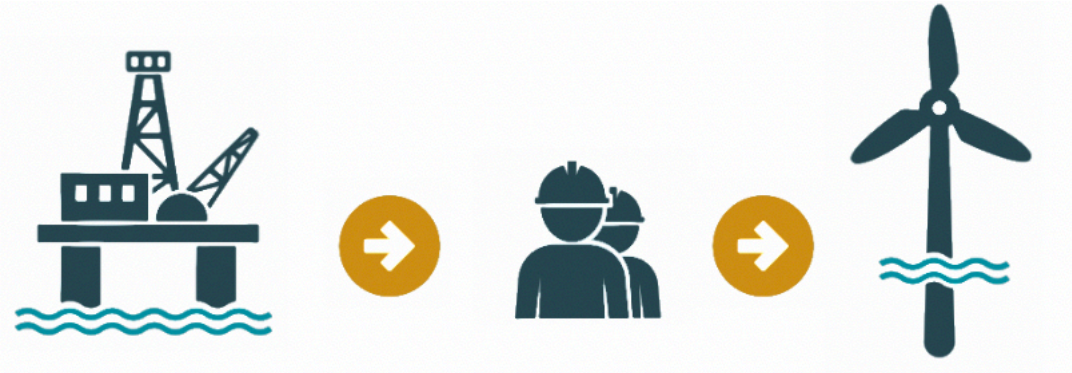

Illustration 1: Allocation of resources – from petroleum to offshore wind power. Source: NTRANS, 2019.

1.5 Refinements

Our research is about floating offshore wind that is seen as an emerging industry with huge potential of renewable energy. As of today, there are only a few companies within the industry that develop floating wind turbines. We have looked at a couple of them that are ahead of the

curve when it comes to the market, all of them are within the oil sector. Major oil companies are interested in this new industry because of previous experience and knowledge within floating offshore devices, access to capital to invest in new technology and wants to adapt towards more renewable energy sources. There has been research conducted regarding this industry that we may benefit from, though we expect to face some challenges related to limited knowledge, resources and individual trade secrets that the companies are likely to hold for themselves. The time we had to conduct research for the thesis was also limited to six months. Covid-19 has also affected us by not allowing us to meet people or interviewing them because they are more occupied towards more urgent matters. We believe that comparing previous research to our own and by talking to relevant people and companies within the industry can provide reliable answers to our research and sub-questions.

1.6 Hypothesis and expectations

Starting the discussion regarding the choice of topic, we wanted to pick an industry that forces the companies to stay motivated, encouraged and up to date towards change. During the thesis we have interviewed people, politicians and companies that are active contributors and have made significant accomplishments either to the petroleum or offshore wind industry. There are several major oil companies that are trying to emerge, which proves that this is an interesting industry for them. Through conversations, lectures and by attending a conference about offshore wind and aquaculture, some of the key factors for oil companies to invest is their previous reputation, financial status, experience and knowledge towards floating devices in tough weather conditions. Oil companies have laws and regulations from the Government when it comes to their carbon footprint, which is why renewable energy sources are becoming more of interest. Strong and competitive dynamic capabilities are important when working towards an emerging industry. They need to be able to integrate, build and reconfigure their internal and external competences in order to address the dynamic and volatile market changes. Innovation is about intentional improving a product or service and is also important for their survival or when deciding whether to pursue this industry or not. Based on this, our hypotheses before conducting any research is that innovation and dynamic capabilities have a possibility to boost their reputation, position, knowledge and economic performance.

2.0 Theory

2.1 Background for our choice of theory

In this chapter, a number of theoretical concepts and frameworks of innovation will be introduced and presented to help define this thesis. This section will be crucial for reaching a conclusion at the end of the thesis and will act as a basis for the respective chapters, data analysis and discussion. We will take a closer look at how innovation affects businesses and markets in the form of higher productivity, learning and knowledge transfer which will in turn have an impact on employment. A combination of possessive knowledge and technology mixed with new science and innovations will be crucial in the floating offshore wind industry. The background for our choice of theories and analysis tools are done with regard to what we believe is important and will be the main challenges for Norway and other key players in the development of future and sustainable offshore wind.

2.2 What is innovation

Innovation is a term that is usually seen as an economic phenomenon and is defined as an intentional change in the production of goods and/or services. Innovation comes from the Latin word "*innovare"* which has several definitions that lead to the brief concept of creating something new. Tidd and Bessant (2014) explains innovation as the process of creating value from ideas, while Schumpeter (1934) identified and distinguished between five types of innovation: new product or new product quality, opening of new markets, new production process, creation and application of a new organizational structure, and securing of a new source of raw material or other inputs. As reported by Schumpeter, innovation takes place when development between combinations of new and existing knowledge, components, resources and other factors occurs. To support his theory Lumpkin and Dess (1996) and Know (2002) interpret innovation and can be characterized procedure that provides added value and a level of novelty to the organization, customers and suppliers, developing new systems, solutions, products and services and better approaches for marketing (Popa et al., 2008).

Innovation is a process where one transfer an idea or invention into a good or service that creates value that consumers will pay for. According to Fagerberg (2005) the gap between an invention and innovation, is where the invention goes from being an idea to the first attempt to carry it into practice. In other words, innovation is not only an outcome but also a process. According

to Schumpeter (1934), innovations provide transformations which gives businesses a competitive advantage through temporary monopoly situations. The innovative business can if for a time alone offer a brand-new product, a product of new quality, or offering a known product to a significantly reduced price (Mc.Craw, 2007). Although innovation is considered to be able to generate large revenues, it involves qualitative changes which often are irreversible in practice. This leads to an unpredictability that is seen as a risk-taking behavior for both businesses and individuals who create a revolutionary product or technology that constitute a greater risk because it establishes a new market. Meanwhile, imitators take significantly lower risk because they copy the innovator's product and find more effective approaches.

2.2.1 Innovation strategy

Whereas innovation is about creating new value for society which they are willing to use and pay for, innovation strategy is a plan specified on how the company's resources and capabilities will be used to achieve the innovation goals, which mostly consist of increasing the market share or profit (Sander, 2019). The term innovation strategy could be interpreted as an explicit roadmap for desired future (Kylliäinen, 2018). To be clear, innovation strategy is not about innovation tactics but is more about mapping the organization's mission, vision and value recommendation for defined consumer markets. Without an innovation strategy, parts of business' can simply wind up pursuing conflicting priorities – even if there is a clear business strategy.

As no innovations are the same, one needs to develop a distinctive strategy for each innovation goal that you want to achieve or organize the ones who natural fits together. According to Tidd and Bessant (2014) the heart to an innovation strategy is by including three fundamental questions:

I. Analysis – what can we do?
II. Selection – what are we planning to do, and why?
III. Implementation – how are we planning to do it?

In order for a strategy to be developed you need to have an innovative organization or leadership that allows employees to work freely towards innovation.

2.2.2 Innovative organizations

The term “management” is often used in companies to describe how managers handle tasks and coordinate activities towards a set strategy, goal or purpose. Innovation management is a systematic promotion of different innovations that includes tasks of control, management, planning and organizing. Managers deals with the overall production and development of new products and services in order to differentiate from competitors. In order to succeed, they need to improve internal processes with more efficient programs, structure, or by developing a whole new business model (Hengsberg, 2018).

Managers normally has a goal to be equal to, or ahead of their competitors, and the solution is often through innovation. An innovative organization is normally strived for, however there are no universal answers to what it actually is. There are recurring traits or characteristics that organization and leadership can be seen as important components. This has been established and published multiple times in different studies where innovative- and non-innovative organizations have been linked (Tidd & Bessant, 2014). Some of the traits that leaders can benefit from are being intelligent, responsible and have an ability to be in charge of people. Different studies show that contribution from top leaders can affect throughout the entire organization. There has been a variation in numbers, but the estimated value is that leadership directly influence up to 15% of performance differences (Jacobsen & Thorsvik, 2007).

Jacobsen and Thorsvik (2007) wrote that innovative organizations often can be recognized by the fact that they are loosely organized. Authority within these organizations are often decentralized and employees are more actively taking initiative towards implementing change and improvements. Staff are also more familiar with change and have an ability towards adaptation. Communication in innovative environments is key because decision makers needs to be up to date with everything, they also need to know when improvements or change needs to happen.

2.2.3 The 4P´s of innovation

Innovation is often separated into four categories; *product-, process-, position-, and paradigm innovation,* and they are referred to as the 4 P´s of innovation (Tidd & Bessant, 2014). As shown in figure 1, they are classified as either an incremental- or radical innovation.

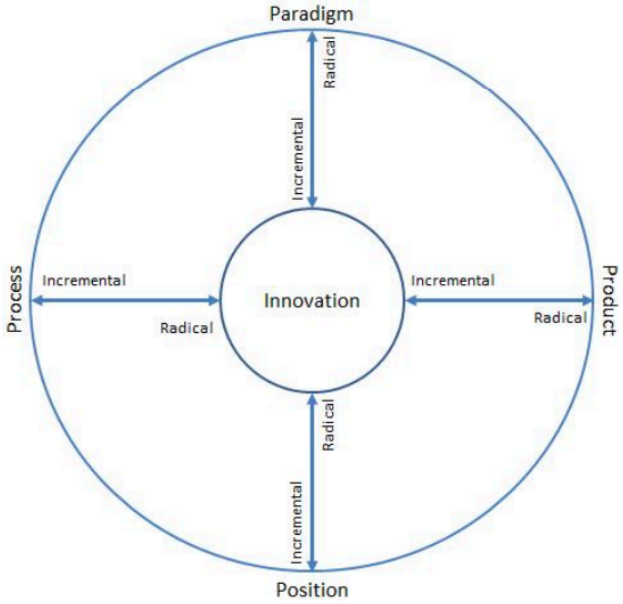

Figure 1: The 4 P´s of innovation by Tidd and Bessant, 2014.

Product innovation (What do you offer?)

Schumpeter (1934) defined product innovation as "the introduction of a new good…or a new quality of a good", while Edquist, Hommen, and McKelvey (2001) explain product innovation as a new- or better material good as well as new intangible services. New products can be seen as incremental improvements on previous goods or radical innovation which changes the product completely and makes it new to the world. For instance, an incremental innovation on a product could be small improvements on a turbine, on the other hand you got a radical innovation which makes it possible to go from bottom-fixed turbines to floating offshore turbines. Normally, product innovation significantly increases the quality and variety of the good which may help to open a new market, lead to higher production which again could have a positive- or negative impact on employment (Fagerberg et al., 2013, p.572). Product innovation often leads to a higher demand of the product as the desire for the new product rises.

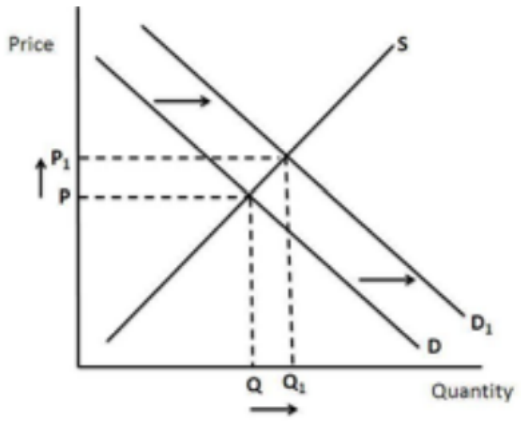

Figure 2: Product innovation results in higher demand

Process innovation (How do you create the offering?)

Schumpeter (1934) expresses *process innovation* as "the introduction of a new method of production…or a new way of handling a commodity commercially". Process innovation is a form of innovation where producing products and services are done in new ways (Ørstavik, 2017). Process innovation has a positive impact on the labor and/or capital as the efficiency becomes greater and production costs lower. A normal outcome of process innovation is higher productivity and may cause loss of employment but as an effect of higher demand as the product increase in quality or reduced price it may result in more jobs (Fagerberg et al., 2013). Comprehensive process innovation is making the processes of products and services more efficient and cheaper. When production gets cheaper, prices decrease and the supply increase.

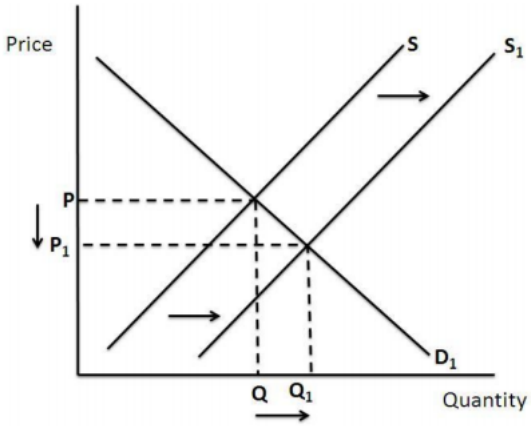

Figure 3: Process innovation results in increased supply

Position innovation (Where do we target the offering?)

Position innovation focuses on the changes of context which the products and services are framed. Tidd and Bessant (2014) represent position innovation as the way of repositioning the business to reach new segments of customers. This can be done in two ways, either marketing yourself into a new market segment or into a completely different market. For example, could business´ target specific age and gender group with different products such as female and male razors – it all falls down on the story we tell about the product.

Paradigm innovation (How do we frame what we do?)

The last of the four P´s is paradigm. Paradigm innovation, in particular, is the adjustment in the hidden mental models which outline what the organization does or on the other hand how the organization frames what they do. The separating line between these is normally blurred and innovation in one dimension frequently bring changes to the others (Tidd & Bessant, 2014). This could easily be understood by taking Ryan Air as an example and their way to change the mental model of travelling. With offering low-price tickets, Ryan Air made it possible for the normal man in the street to fly as well.

2.2.4 Incremental- and radical innovation

Incremental innovation concerns about an existing product, process, service or methods whose performance have been significantly upgraded or enhanced, which can take place in two forms; improved performance or cut in costs. The improvements usually come through use of higher performance components or materials, or that technical subsystems have been changed or improved (OECD, 2013). In other words, based on the work of Schumpeter, incremental innovation is often referred to as extended improvements (Fagerberg et al., 2006). This is a common type of innovation for all industries, as there is less risk and will often be cheaper to implement. Therefore, companies usually prefer this form for innovation.

Incremental innovation:

Improvements within a given frame of solutions (“doing better what we already do”)

Unlike incremental innovation, radical innovation is riskier and more expensive to implement. Hence, radical innovations are also seen as revolutionary innovations. Radical innovations are often inventions with added- or new useful functions. Lundgren (1995) describe the term as

“discontinuous events unattainable through incremental adjustments of the pre-existing state of affairs”. Here, as in incremental innovations takes place in products, processes, services and systems but where the differences are that we build on new technology which gives us a sensational improvement in performance, quality and/or price (Sander, 2019). Larry Keeley, President of the Dublin Group estimates that 96% of all radical innovations fail and states that successful radical innovations occurs as rarely as perhaps once every 5–10 year (Norman & Verganti, 2012).

Radical innovation:
A change of frame (“doing what we did not do before”)

2.2.5 Sustaining- and disruptive innovation

The “innovator´s dilemma” is a hard decision any business face when it needs to choose between holding onto a current market by doing likewise, yet marginally better (sustaining innovation), or conquer new markets by embracing new technologies and embrace new business models (disruptive innovation) (Christensen C. , 1997).

Like incremental innovation, sustaining innovation improves existing products. It does not create new markets but develops existing ones with a better value. Clayton Christensen (1997) explains sustaining innovation as a development which targets demanding, high-end customers by giving them significant improvements than previously available. Some sustaining innovation are breakthroughs, while others are incremental year-by-year improvements which are absolutely necessary for businesses. On the other hand, we find the term disruptive innovation. Christensen describe the term as disturbing for an existing market with an improved product or service by making the existing business model irrelevant, thereby damage successful and leading companies. Examples of this could be, Über and AirBnB.

In order to accomplish cutting-edge innovation within a business while making an abiding business advantage, one should aspire to achieve both revolution and evolution. In other words, disruptive- and sustaining innovation should not be alternative in contrast to each other, yet rather complementary measures (Deloitte, 2020).

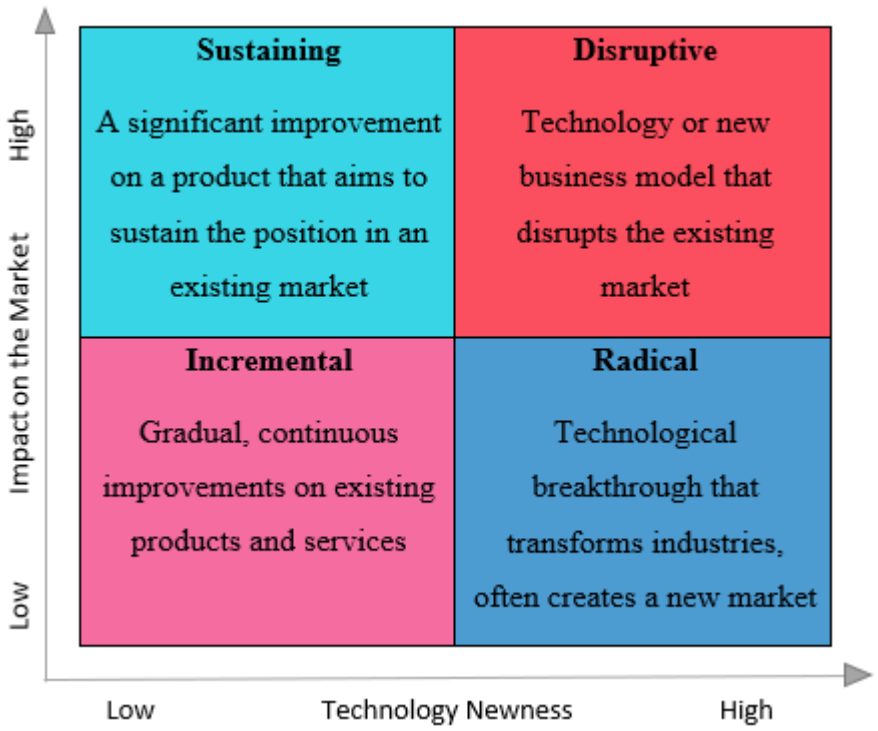

Figure 4: Short summary and differences between sustaining-, disruptive-, incremental-, and radical innovation. Source: Kylliäinen, 2018.

2.3 First movers' advantage and imitators

In an increasingly globalized world, and with great development within communication technology, new possibilities emerge. In addition to these new opportunities, changes have led to tougher competitions and pressure, for example on traditional industrial production, and in our case for this thesis in the floating offshore wind industry. *"The competitive advantage of businesses depends on their capacities to innovate and on interactive learning processes which are socially and territorially fixed"* (Asheim, 2000).

Marketing and consumer behavior theory has explained the first mover advantage of various psychological mechanisms, such as shaping how consumers learn a product's properties (Carpenter & Nakamoto, 1989), differentiated learning, memory availability (Kardes et al., 1993), decision uncertainty (Muthukrishnan, 1995) and consumer self-image (Niedrich & Swain, 2003). Common to most of these explanations is that the first movers use its conspicuous features to shape the customer's decision environment (Wanebo & Lanseng, 2007). If you are the first mover, the advantage you receive is gained by the initial significant occupant of a market segment. A market participant has first mover advantage if it is the first entrant and achieve a competitive advantage through control of resources (Grant, 2003). A process like this

can be very risky and costly but if one succeeds it can result in large revenues. Although these studies show that the first mover advantage is robust, it is important to note that the majority of brands in all product categories are imitators – not first movers.

Imitators which, according to research, can use two types of strategies to compete with first movers; improvement strategy or differentiation strategy (Carpenter & Nakamoto, 1989). Late movers to an industry or a market will have the ability to study first movers and their techniques and strategies. Through improvement strategy the imitator position can give the same traits as the first mover but at the same time is superior compared to the pioneer on at least one of the most important traits. While the differentiation strategy´s purpose is to offer new features the first mover does not have. These features are innovative and will therefore attract more consumer attention (Wanebo & Lanseng, 2007).

Firms´ ability to renew their business through innovative solutions is particularly essential in high cost countries, such as Norway, which are unable to compete under the same terms as low-cost countries, like China, due to high wages and the high costs associated with production. With this added up, first movers and innovation in high cost countries becomes increasingly important as they cannot compete on cost alone but compete through good ideas and innovations (Solheim M. , 2017).

2.4 Dynamic capabilities

Teece (1997) mentions that dynamic capability focuses on the foundation of how firms are able to integrate, build and reconfigure internal and external competences to address dynamic and volatile market changing environments. It can also be seen as the inherent capability to purposefully adapt, optimize and improve the overall resource base (Teece et al., 1997). Being able to identify and understand all factors and dimensions towards a firm's centric capabilities will provide an advantage on how to optimize capital and labor. Dynamic capabilities help create combinations of resources and employees' competencies but can also remove any unnecessary when needed. The general assumption of the framework of dynamic capabilities is that core competencies are meant to modify short-term competitive positions which may be used to strengthen or build long-term competitive advantage.

The idea behind strategic management and dynamic capabilities is to build on internal strengths of the firms such as capital and labor rather than improving external opportunities. Jay Barney (1991) featured four different methods on how management should prioritize their internal resources to gain competitive advantage, also known as VRIO:

I. **Value:** Can firms' resources and inherent capabilities result in growth opportunities and to overcome market threats.
II. **Rareness:** Firms needs to figure out what differentiates them from competitors, this is what can make a product or process unique in the industry.
III. **Imitability:** Firms needs to be aware that having a rare resource that cannot be copied, will result in competitors trying to gain access or similarities to these resource through other means.
IV. **Organization:** Being able to utilize and exploit the capability or resources in order to increase the overall value of the firm.

Dynamic capabilities can be separated into two different categories, absorptive capabilities and adaptive capabilities.

2.4.1 Adaptive capability

Adaptive capability is how well a firm can function when it comes to identifying and capitalizing on emerging market opportunities or resources (Chamyarthy, 1982). It is about bringing a balance between exploration and exploitation strategies that are connected to the resource perspective of the firm (Wang & Ahmed, 2007). The evolution of organization forms is often related by the growth of capabilities. The plan behind adaptive capability is to challenge outdated traditions through management and to encourage employees (Gibson & Brikingshaw, 2004). The firm's ability to filter out sacred cows and practices will improve the ability to adapt in a volatile business market.

2.4.2 Absorptive capability

Absorptive capability is how well a firm can recognize value of external information, how to assimilate it and how to apply it (Cohen & Levinthal, 1990). It shows prior knowledge and ability to evaluate, criticize and utilize external knowledge. Absorptive capabilities are an important factor to improve learning processes and can highlight key attributes and knowledge

in departments to fully reach their potential. In a changing environment with volatile market threats it becomes imperative to absorb and gain knowledge from other industries, partners or organizations. It is important for firms to illustrate that all of its departments have a wide specter of absorptive capabilities embedded (Wang & Ahmed, 2007). This will provide a commitment of resources through any uncertain situations, which will provide new knowledge in both skill and technology.

2.5 Knowledge driven improvements

An innovation process cannot succeed without existing knowledge and the willingness to learn. In order to implement innovation into an organization it is important to invest in your employees. You can invest in staff by educating them in their respecting fields which will boost their knowledge and responsibility of improving the company. In the next section we will compare two different methods of learning which can be important tools. First method covers science, technology and innovation (STI) and is centered on technical and codified knowledge. A basic argument about what codified knowledge represent is that it can be written down in a format of a "code book" and be interpreted by others (Johnsen et al., 2002). The second method is by doing, using and interacting (DUI) and focuses on experience-based knowledge and learning. A research conducted by Johnsen, Lorentz and Lundvall (2002) concluded that companies who are combining STI and DUI learning are the ones that excel within product innovation.

2.5.1 Codified and tacit knowledge

The distinction between STI and DUI is in general more about implicit and explicit knowledge. STI revolves around codification of knowledge and can be seen upon as a pattern, in order for others to absorb and implement for themselves. Codification of knowledge can be seen upon as explicit knowledge because there is a way to take notes and talk about it (Jensen et al., 2007). The idea of knowledge transfer or value that patterns provide can only be understood by people with prior competence or understanding in order for them to learn. The know-what and know-why methods of knowledge that can be related to the STI way of learning can often be taught by looking at data bases, attending lectures or reading books (Jensen et al., 2007).

The method of DUI towards innovation is more about an experience-based model of learning, where you are placed directly into a challenge in order to learn. This often includes getting

knowledge and experience along with the subject you want to learn of (Jensen et al., 2007). DUI can often be taught through a master and apprentice relationship. A good example of this relationship could be to succeed as a salesman. You can read articles, instructions or watch guides but the real learning experience is to be placed with customers where you actually get to challenge yourself in a real-life situation. This kind of knowledge is not something you can acquire through studies, but more stored in the individual who has learned this skill through working experience, also called implicit knowledge. Information that individual has learned through experience and is stored in their mind is called tacit knowledge. The know-how and know-who can be connected towards the DUI style of learning. Communication and information technology are used to codify tacit information that can be shared within an organization. In other words, you try to translate tacit knowledge in a more understandable way, so people can use this knowledge for their advantage.

2.5.2 "The four knows of knowledge"

Knowledge can be broken down into four different categories; Know-what, know-why, know-how and know-who (Jensen et al., 2002). The know-what and know-why are more connected to the STI and the know-how and know-who are connected to the DUI way of learning. These four different categories are meant for an individual level but can also be applied into an organization (Johnsen et al., 2007). They argue that firms that combines a strong version of both the STI and DUI modes of learning excels within product innovation. They draw results conducted from the empirical research and shows that firms that succeeds within STI and DUI have increased their innovative performance. Organizations that choose to combine both learning methods also tend to perform significantly better than organization that are not using any or just one of them. The four different knows of knowledge will be explained below:

I. **Know-what:** Is the knowledge about facts and can be easily made codifiable. Those facts can for example be cooking recipes, population of a country or information about landscapes. Information that easily can be written down and stored, can be referred to as data (Jensen et al., 2007).
II. **Know-why:** Is the knowledge of why things happened in the way they are. It refers to the human mind, society and the laws of nature. Know-what is more used as input for databases while know-why relates more towards the theorem of why things happen (Lundvall, 2004).

III. **Know-how:** As mentioned earlier it is used as master and apprentice relationship with the basics of learning by doing. This can be used towards working with things you want to learn while getting better at it (Johnsen et al., 2007). If we use the same example as earlier with the salesman. There is a fair amount of tacit knowledge that you need to learn in order to succeed because of sales methods, body language and communication skills. According to Polanyi (1962) it is something that is not taught through explanation, but through trying and failing.

IV. **Know-who:** Is about having the knowledge to seek for guidance while struggling, to ask someone who can assist you when you cannot solve it by yourself. This type of knowledge is normally learned through environments of social practice and education. While evolving your network with people it will increase individuals know-who knowledge. It can also be taught through everyday communication with colleagues, sub-contractors or customers. It is important to know who your customers are and what they want (Jensen et al., 2007).

3.0 Method, data and empirical research

This chapter aims to elaborate the method and research design that is used in this thesis. Choice of method is important when it comes to conducting research and establishing a foundation for your work. The methods used are tools to give a description of reality and how to collect empirical data (Jacobsen, 2015). The methods that are used will be helpful while collecting necessary data and function as an interpretation guide in order for us to reach a conclusion to our research.

The objective of the thesis is to answer and conclude towards developed research and sub-questions. It is therefore important to keep these questions in mind before deciding on how to proceed. After deciding on research, we moved towards the structure of the thesis itself, making sure that we included relevant topics and information below every chapter. The next phase is conducting research and collecting data from outside sources using qualitative- and/or quantitative methods. This will give us the foundation and information we need in order to answer our questions. This process is collected from and shown below in figure 5 by Jacobsen (2015):

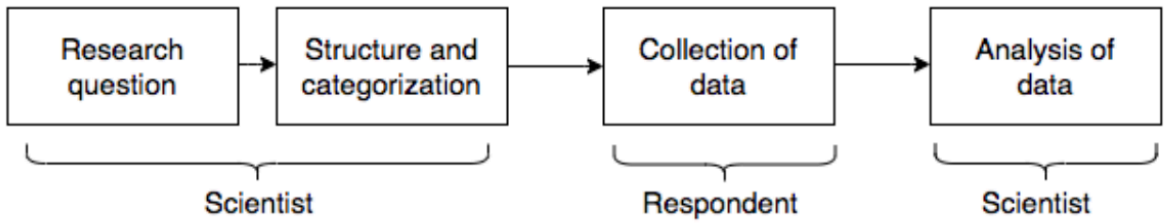

Figure 5: Collecting and evaluating data, Jacobsen, 2015.

3.1 Research design

The intention of having a research design is to provide an overall plan or an overview on how to elaborate a research question and include definitions in order to strengthen the integrity. Generally speaking, it is a step-by-step for how to conduct a research from start throughout the finish line. It also reveals how different sections of the research embrace each other and relates towards answering the research question. The research design holds the research together and without it nothing would hold the research in place (Trochim, 2002). It is key to plan the scope

and target before starting any research, even though the end result may be uncertain (Sander, 2020). The design can be seen upon as a map, guiding us towards the desired destination.

These are the three different types of research design:

I. **Casual design:** When the goal is to examine or explore quantitative variables through different relationships or effect of one independent on a dependent variable and is also known as a cause to effect relation. It is normally used as a quantitative method to perform a test of theory in order to support or reject your assumptions. This design is used when changes are made to the independent variable or the effect of each variance and its impact on the dependent one.

II. **Descriptive design:** To discover any relation or connections between different factors. This design is used to do research or to describe an ongoing situation.

III. **Exploratory design:** When the research is unfamiliar, vague or unclear. It is often used as a tool for research to get sufficient information regarding the subject before actually being able to start the research itself. You need to get familiar and have a general understanding of the subject before the main study begins.

Before starting our research, we had to do a lot of research in order to understand the aspect and background of renewable energy sources through floating offshore wind. We did not pick a clear or straight forward research question and it can therefore be considered a bit vague or unclear. This subject is regarding an ongoing evolving market and we will try to elaborate the different factors that may have a saying or affect the matter. However, it is challenging to make an econometric model due to lack of available information and individual trade secrets among companies. We will look at different aspects and try to discover similarities or connections among them in order to describe this current market. In other words, we will use a combination between all three research designs.

3.2 Methods

Methods are normally the tools used while collecting data to include throughout the research. There are two different methods that can be used when it comes to social science, these are qualitative- and quantitative methods.

3.2.1 Qualitative methods

Qualitative research relates to exploring human processes, problems in an ongoing situation or a real-life setting (Postholm, 2010, p. 9). Qualitative methods can be hard to describe but on a general level it can be argued that is a method of observing a phenomenon from the interior side (Ritchie et al., 2014). We tried to solve this by reaching out to people in relevant positions within the floating wind industry that have first-hand knowledge in the market through their employers. Qualitative research is traditionally associated with research that involves close contact between researcher/author and the object being examined, for example through interviews or observations. Information can be collected through interviews or other forms of communication among two or more individuals. It is a useful tool to obtain information that is hard to gather through surveys or statistics. By using a more qualitative method you analyze text and information rather than numbers. While working with this kind of research you need to be open to what participants do and say, and further foster the viewpoint (Postholm, 2010).

3.2.2 Quantitative methods

The intention of using quantitative research is to establish general laws of phenomenon and behavior across diverse settings or contexts (Leedy & Ormrod, 2010). It is used to collect data in order to perform a test of the theory and support or reject your assumptions. Information or data is collected in a numerical form that can be placed into categories, ranked orders, or measured as units and used in measurement. This kind of data can then be used and transferred to construct graphs, table of raw data or in statistics. Data gathered through quantitative methods can for example be through the form of a survey. These methods allow us to examine a larger number of subjects at the same time and are called extensive methods.

3.2.3 Our choice of method

We went back and forth before deciding which method or methods we wanted to use throughout our research. We decided to limit the use of quantitative methods because we saw them to be too vague and uncertain towards our topic, but also because of constant changes in an evolving market and trade secrecy. The major oil companies that are trying to expand within floating wind industry have a limited group of people or a department that specializes within the matter. A survey within a company or at our school would include too many uneducated subjects within the matter and could therefore provide us with irrelevant information, general thoughts or for them to reveal secrets by accident. A survey usually contains a standardized set of questions

which makes it less flexible and can make it easier for subjects to provide us with faulty data. Surveys may not be taken as serious but depends if it is anonymized or not. If we were writing about a more known topic, we would have used surveys because it is less time consuming and can provide us with lots of information. Written questions have the possibility to be misunderstood, not allowing us to explain or elaborate what we are asking for.

One of the key challenges that we faced was getting access to information. This is an emerging market which makes it a bit more challenging due to lack of knowledge within the industry or from the companies themselves. They tend to keep knowledge hidden and their trade secrets confidential. We had thoughts about writing a confidential thesis or to anonymize names of projects, people or companies. However, some companies are ahead of the curve and financially strong that it would be easy to see through these examples and know who or what we were writing about. Therefore, we decided to write the thesis at a general level and include the information that we managed to find and let the actors keep their trade secrets. We have no intention to ruin any competitive advantage for the people that provided us with relevant and helpful information.

We decided to base most of our research on qualitative methods. First of all, we had to acquire knowledge in order to specialize within the subject before meeting people. By attending the conference "Ocean space[3] – Offshore wind and aquaculture at sea" in Egersund that was held 28.01.2020, we got to meet several contributors that could help us in our research. This conference opened up several doors towards our research and functioned as a snowball-effect for us. Several of the lecturers at this conference has been contacted and some of them were willing to answer further questions. We will perform several in-depth interviews with different people across the industry. This method was picked because it may give us in-depth information regarding decisions or opinions from people that are in the market, observed series of relevant events or made important contributions.

We decided to use semi-structured interviews throughout our process. This means that we prepared a list of relevant questions in advance in order to support both ourselves and the interview throughout the conversation. By using this technique, you also have the possibility to adapt and adjust during the conversation itself. An advantage here is that we could get an

[3] Ocean space (Havrommet) – Havvind og Havbruk til Havs, Egersund, 28th January 2020

overview of thoughts and feelings, which is challenging to find from numbers. We customized the questions in order to provide relevant questions towards the position and occupation of the subjects. One of the many strengths of qualitative research, is that you can study phenomena's which are difficult or almost impossible to get insight into using other methods (Thagaard, 2013). Qualitative methods are our primary source of gathering information, both through previous research data and interviews. Next section will include how our interviews were prepared, conducted and further analyzed.

3.3 Interviews

Conducting interviews is a good technique to give the researcher an understanding of the opposing ends perspectives, self-understanding or point of view. The people that we interviewed are therefore allowed to share their experiences and viewpoints (Thagaard, 2013, p 12). There are several positive and negative sides using personal interviews as a data collection method (Sander, 2020). It is a good way to collect data as you can be there in person and ask questions personally, any misunderstandings or problems that occur can be solved immediately. When you want to achieve a deeper understanding of a subject, the qualitative interviews are a great tool. You can be flexible and adapt towards the conversation and ask follow-up questions based on previous answers, allowing you to get even more in-depth information. There are also some challenging sides towards conducting interviews. It is more time consuming because of preparations beforehand, it is important to ask relevant questions that the subject can relate too and provide solid answers. You can get limited information when asking personal questions because of the identity being known, the subject might hesitate to reveal any sensitive information or personal thoughts about themselves or their company. We solved this by allowing the interviewees to check our notes and the thesis itself before handing it in. Allowing them to go over all our notes gives them an extra insurance that no trade secrets or personal opinions are shared along the process.

During our thesis, one of our main sources of information was through interviews, communication with contact persons and previous research. We managed to secure some of the lecturers from the conference that were willing to function as a source of information through interviews and general communication. During the preparation period, we tried to keep our contact persons updated in order for them to know that we were actively working with our case, preparing for a conversation in near future. Prior to the interviews, we read and interpreted

different research and papers to gain a better understanding of the topic, and also to secure precise and valid questions.

Participants and contact people were reached out to because of having relevant positions or roles in the industry. We had a goal to contact both people in the private and public sector. Most of the people we reached out to works in the private sector, because there are few or none direct public sectors working within floating wind industry. The people we tried to contact from public sectors were politicians and environment activists. We wanted to get both or more sides in order for a wider variety of information, opinions and knowledge. Prior to the interviews, we did not share any information with the interview subject other than topic, because we wanted to capture their reactions and immediate responses. Before any interview we prepared different interview guides that were customized to suit the participant. We developed several guides because all interviewees have different employment positions, occupations and experience.

3.3.1 Different types of interviews

Interviews are normally separated into three different types, which is an unstructured, semi-structured and structured interview (Statistics Solution, 2018). Unstructured interviews are interviews with few or no questions during the interview at all. The interview itself functions more as a normal but structured conversation, having the research topic as an underlying model. It can be seen as a normal conversation discussing the topic itself. A structured interview is about following a particular set of predetermined questions which are prepared in advance, which removes some of the open dialogue throughout the interview. Semi-structured interview is a combination of unstructured and structured interview. It uses a prepared list of questions in order to support both the researcher and interviewee throughout the conversation. Similar to an unstructured interview, it contains the social aspect of a conversation, even though it is a guided conversation between researcher and interviewee (Statistics Solution, 2018).

We used a mix of unstructured and semi-structured interviews in our research. The circumstances with Covid-19 made it harder for us to meet people and reduced the amount of people available. We tried to maintain a semi-structured interview throughout the research by interviewing people or talking with them over phone/skype. We preferred a semi-structured interview model because we could ask follow-up questions if anything was unclear or brought us more questions than answers. We also had to use some correspondence through email, which forced us to prepare a structured type of interview due to us not having a direct conversation

with them. During any conversation or correspondence, we also allowed and encouraged interviewees to elaborate or add new and relevant information wherever they felt it could blend in.

3.3.2 Participants

As mentioned earlier most of our contact persons were gathered through attending a conference called Ocean space. We believe that these people were able to provide us with relevant and trustworthy information because of their position that can be helpful for us to answer our research and sub-questions. They are all within the same network and are working within the expansion of the floating wind industry. They have agreed to not be anonymous, so we will use references and quotes of information gathered through interviews by using their name. The participants that functioned as our contact persons and were willing to join us for interviews were:

Axel Norman	Study Manager at Aibel
Knut Vassbotn	Head of Business Development, Offshore Wind at Aker Solutions
Arvid Nesse	General Manager at Marine Energy Test Centre & Cluster Manager in Norwegian Offshore Wind Cluster
Ruth Grung	Member of Parliament. Representative from the Norwegian Labor Party. Member of The Standing Committee on Energy and the Environment
Arne Eik	Leading Business Developer Floating Offshore Wind at Equinor

3.4 Ethics

Interviews that are conducted might touch upon sensitive topics, which is why it was important for us to protect the confidentiality of the participants. We will prevent any trade secrets or personal opinions that may affect companies or individuals to leak out. This is a pure research thesis and we do not want our interviewees to feel let down or betrayed throughout or after our cooperation. Any stored recordings from the interviews was helpful throughout the research but was deleted immediately after we were done with them or they were no longer relevant. If the companies or individuals we have interviewed wants to be anonymous, they should be kept anonymous (Kvale et al., 2015). After interviews were conducted, the interviewees got access to our notes to make sure that we could use this information for further research. If any information that we gathered contained secrecy or opinions, we would respect that and remove

it from our notes and thesis. We had an open dialogue throughout the cooperation and let our interviewees or companies read our thesis if needed.

Before conducting any interviews, we prepared a paper that contained information regarding the goal of the interview, how we would use given answers, how we opened up for confidentiality. This paper was sent before any interview to make sure that the participants were aware of the different circumstances regarding the matter, this paper can be seen in the appendix. All participants agreed to the paper and no one wanted to be kept anonymous. In normal conditions we would have received a signed copy of each paper, but when not being able to conduct the interviews in person it was a bit more challenging. Therefore, we just received a confirmation through email or during the interview where they agreed to the terms listed in the paper. Further, we have done our best to render answers, thoughts and results as completely and right to the context as possible. The participants were entitled that the results are correctly rendered (Jacobsen, 2015). It was not our intention to use any results gained through the research or interviews in any way that could be favorable or harmful for someone specific or for further research.

3.5 Reliability and validity

Any research conducted has a goal to find valid and reliable data. The aim of the thesis is to provide findings that demonstrate the truth and results in credibility. It is vital in order to find a satisfactory and trustworthy answer to the research questions. Collected data needs to have a high reliability and validity (Sander, 2019). It is in our best interest of evaluating the quality of information gathered by analyzing previous listed theories and principle-based decisions that researchers made. By doing so, researchers gain several benchmarks in order to evaluate the overall quality of our study. To attain both reliability and validity through the thesis, we have had high focus on quality of literature, along with suitable techniques in order to maintain an accurate and precise research. Throughout all the conversations and interviews, we made separate question sheets which was adjusted towards the interviewees position, occupation, knowledge and experience.

3.5.1 Reliability

Reliability can be used as an illustration to what degree a research reflects the real situation and to what extent others can verify it. If a research has high reliability, you can expect it to give the same conclusion as if anyone else conducted a similar research. Reliability is associated with questioning on how reliable the research conducted is and how the data is established (Thagaard, 2013). The information needs to be accurate and consistent in order for the research to be dependable. Reliability can be used to this extent as a measurement of stability (Sander, 2019).

One of the main challenges with reliability within interviews is that it can be difficult to decide the right questions to ask before conducting the interview. It is important to stay unbiased and not let our own thoughts or opinions affect the formulations of the questions or how answers are interpreted. This includes that the researchers need to separate between collected information acquired from the fieldwork and their own opinion of the matter. In order for us to review and analyze the data it was important to transcribe information correctly by taking notes during and after the interview. This was not a challenge through email correspondence because we received written answers from the interviewees. We preferred to write down all the answers word by word during the interviews, because we could easily go back and read through them once again if needed.

3.5.2 Validity

Validity insinuates about the trustworthiness of the research conducted. It is related to the interpretation of data by looking at the credibility of the different interpretations that the researcher concludes with. The validity of a research is considered by examining whether it gives a precise picture of the reality (Thagaard, 2013). Whenever a research is seen as valid, results and conclusion are normally interpretable and generalizable. It is hard to reach a correct conclusion if the research is not valid. A case study normally focuses on three different types of validity: Construct, external and internal validity (Yin, 2013).

I. **Construct validity:** Is to what degree the research elaborates what it claims to. It is concerned by how the findings can be generalized, which is also the executive concern in the theory regarding validity.

II. **External validity:** Shows to what degree the results of the research can be transferred to other situations that is not included in our research.
III. **Internal validity:** Demonstrates the causal relationship among different conditions. It is useful while observing a cause to effect kind of relationship.

Validity will be useful for us to reach a conclusion to our chosen research. The research process is important because the more data we are able to acquire from previous studies and our research will give the thesis more statistical validity. By having a large selection of reliable sources, previous research and respondents will increase the validity of our research. We believe that we have a valid thesis by interviewing several employees from key companies that have been a part of the growth of floating wind industry. Our thesis did not have access to all individual trade secrets, but we tried to construct validity through an overall generalized finding. This will be information which are similar among the companies and people we have interviewed, but also confirmed using previous research.

4.0 Findings

In this chapter we will discuss why floating offshore wind is literally in the wind. We will take a closer look at completed, ongoing and future offshore wind projects, both domestically and abroad, as well as we will look at climate ambitions which affect the expansion of floating offshore wind. The chapter will give an insight into how Norwegian actors are positioned in the market, Norway's comparative advantages in offshore wind, and which opportunities and value creation offshore wind may create for Norwegian companies and Norway as whole. Finally, we will look at the risks an expansion of such a large industry can inflict on companies and countries' efforts on such a venture and we will give an insight into how a venture is supported public and political through various support schemes.

4.1 General information regarding floating offshore wind

From the first offshore wind park was installed in Denmark as early as in 1991, the market for this type of energy development has grown to be a multinational industry. At the moment bottom-fixed installations are the prevailing technology, as the market for floating wind power is still relatively fresh. The market for offshore floating wind exists of pilot projects with single turbines where in the end of 2018 the total capacity for floating offshore wind was at 50.3 MW[4] globally (Carbon Trust, 2018). Hywind Scotland is the only park with a certain size with five floating turbines which produce 30 MW. By comparison, bottom-fixed turbine parks are currently being built with up to 1,000 MW, and by the end of 2018 a total of 22,000 MW bottom-fixed offshore turbines were put into operation (Winje et al., 2019). Although the technology for floating turbines is at an early stage, many players are facing offshore wind and numbers of projects are under development. The majority of these project will be localized in the northern part of Europe, as well as some will be demonstrated in the US and the east coast of Japan. An overview of projects which are operative or up and running shortly can be found in the appendix. Based on reviews done by Menon Economics (2019), the expected total capacity of floating wind energy in the world is estimated to be about 300 MW by 2021. Next section will elaborate why this change towards renewable energy production is happening so suddenly and right now.

[4] Megawatt (MW) is a unit of measuring power and in this thesis is used in connection with specifying the effect wind turbines produce per hour - MWh.

4.2 Why offshore wind, why now?

During the Paris Agreement in 2015, an international climate agreement was adopted, which includes provisions for reductions in greenhouse gas emissions, climate change adaptation and support for developing countries' restructuring. The three overall objectives of the agreement are to limit global warming to “well below” 2°C, increase the countries capacity to adapt to climate change and global financial flows (Jakobsen & Kallbekken, 2020). The UN Climate Panel has estimated that we must increase the renewable share from today's 8% to about 80% in the world by 2050, and according to Professor of Renewable Energy, Torjus Bolkesjø most of the increase must come from energy sources such as solar and wind (Bjergene, 2016). However, solar and wind power only produces power when the sun shines and the wind blows. One of the biggest challenges in the climate change is therefore the transition from a heavy fossil-based energy use to an energy system based on renewable resources. Given that these ways of producing energy are variable and not controllable, we need good solutions that match production and consumption at all times.

Norway is a solar-poor country that has none, if few intuitions operating with large scaled solar power systems. On the other hand, Norway, unlike many other countries, has a long coastline towards a large and open sea. In these areas there are great opportunities for offshore wind power. Wind power is not a modern phenomenon, nor is offshore wind power, but the development of floating wind turbines is something that is new and immature. In the line with the idea from early 2000’s, development of technologies and a push from authorities have made it possible to build floating wind turbines as we know them today. However, the development has to continue. Countries have begun to realize that renewable efforts must be made to achieve the set climate goals.

4.3 Climate ambitions

The transition to a low-emission society is a major challenge but also embedded of large business economic possibilities. The world is facing a major common problem in form of man-made global warming as a consequence of greenhouse gas emissions. The largest share of greenhouse gases in form of CO_2 comes from oil and gas which are used for ignition of cars, power stations and in industries. As the world is facing global warming problems, Equinor, LO[5]

[5] Landsorganisasjonen i Norge (LO) / The National Organization of Norway: Norway’s largest employee organization

and NHO[6] have agreed on a common goal to cut emissions by 40% by 2030, measured against 2005 (Haugan & Lorentzen, 2020), while the Norwegian Government has proposed that greenhouse gas emissions should be cut by at least 40% compared to 1990 (Regjeringen, 2015). On the other hand, the European Parliament will step up its ambitions to cut emissions from 40 to 55% by 2030 (Gullberg, 2018). The UN Climate Panel argues that a two-degree temperature rise is the highest limit for what nature can resist. If we get temperature increases higher than this, climate change will be uncontrollable. During the Paris Agreement, world leaders settled on an agreement that commits them to do everything they can to keep the temperature from rising more than two degrees, and preferably not more than one and a half (FN-Sambandet, 2019). To achieve these goals, the world relies heavily on cuts in fossil energy, as well as a major rise in renewable energy. While the share of fossil energy was as much as 78% in 2018, the share of non-fossil energy is the remaining, where wind power accounted for 2% globally and in Norway respectively. Although the level of wind power was only 2% in 2018, it was a 97% increase compared to five years earlier (Øvrebø, 2020, Olje- og energidepartementet 2020).

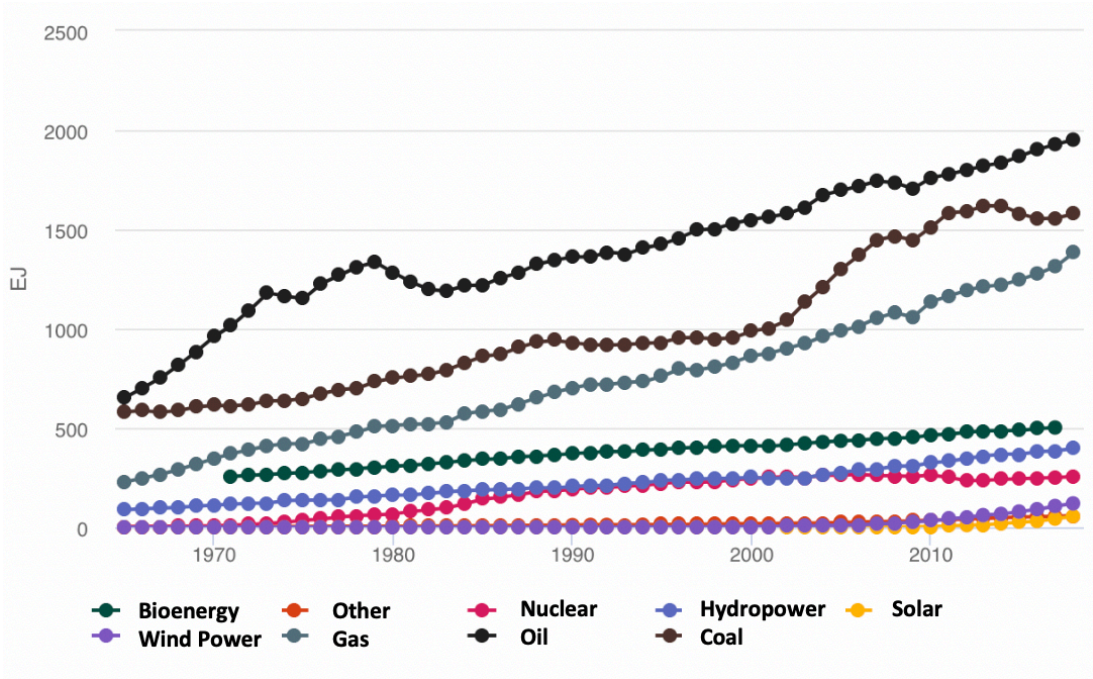

Figure 6: Global energy consumption, primary energy target in exajoule (EJ), distributed by energy sources. Source: Global Carbon Budget, 2019.

[6] Næringslivets Hovedorganisasjon (NHO) / The Confederation of Norwegian Enterprise: Is the largest main organization on the employer side in Norway

As mentioned above and as figure 6 shows, renewable energy and wind power have a long way to go to challenge fossil energy in the power markets. To achieve higher levels of renewable energy, Norway as a state, as well as Norwegian companies with follow-up of the rest of the world must dare to invest and develop new technology that will make wind power and other renewable energy more affordable and more accessible than it is today.

4.4 Development of floating offshore wind in Norway

Even though floating offshore wind is considered as an immature renewable technology source, it is a rapidly growing industry besides bottom-fixed installations. Most of the growth to date is occurring in Northern Europe but there are also emerging markets including the US, China, and Japan. As the technology develops, offshore wind parks are coming in larger scales and are being developed further from shore. In this section of the thesis there will be given knowledge of the situation in Norway today and the possibilities there are. The expansion of floating offshore wind in Norway can be driven in several ways:

- Subsidized development, either as a business economic and/or climate policy measure
- Expansion based on profitability to supply consumption points at sea or along the coast where the alternative is more expensive (e.g. large net investment on land)
- Development based on profitability in the power market (in Norway or neighboring markets)

Hywind Tampen is an example from the first point, where the project is expected to reduce CO_2 emissions from Equinors' existing oil-fields *Gullfaks* and *Snorre* with around 200,000 tons each year, which equals the same amount as 100,000 cars or about 0.4% of the total Norwegian emission (Hovland, 2019). To our observation and familiarity, there are no plans to use floating offshore wind to supply other offshore installations or coastal industry at this present, but this can be an option in a longer term.

According to the Norwegian Government (Regjeringen, 2016), development in the power market will be driven by price signals and be based on socio-economic profitability. Figure 7 shows cost projection for floating offshore wind compared with expected price developments in the power market. The price in power market is based on analyzes from NVE (2018) and Statnett (2018) and examined by Menon Economics.

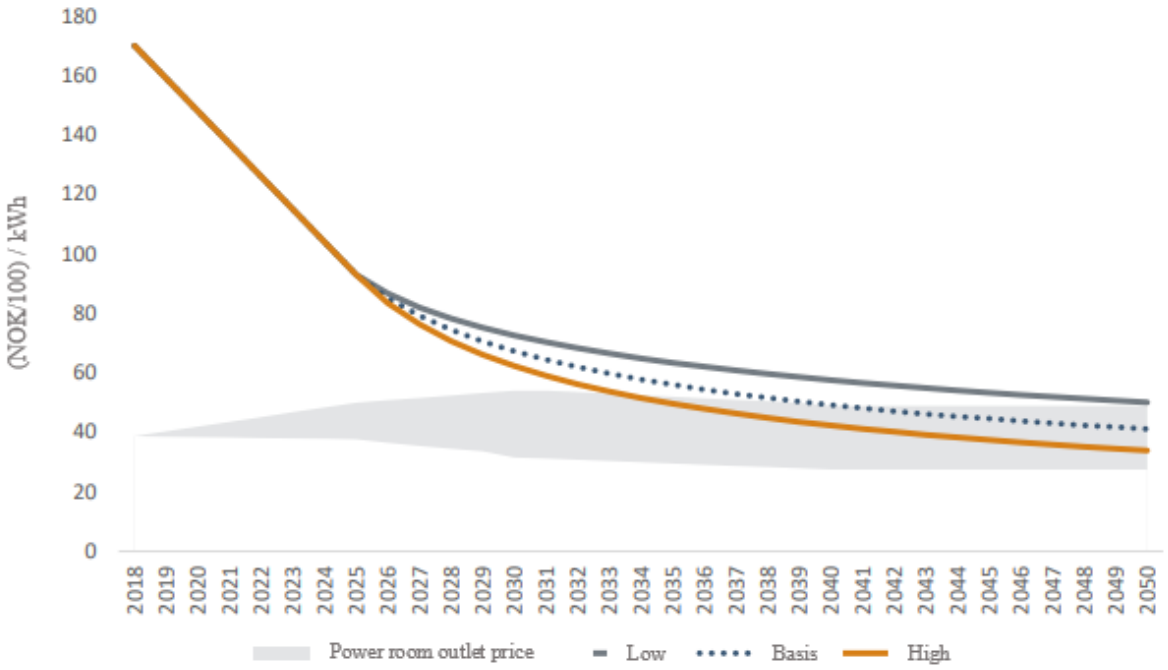

Figure 7: Showing the progression in levelized cost of energy (LCOE) towards 2050. Source: Menon Economics, 2019

As figure 7 shows, a development of floating offshore wind power will significantly reduce prices in the years to come, and an expansion will make the energy source profitable as early as the mid-2030s. However, this requires a positive price trend in the quota market, and a rapid cost reduction. By 2040, the profitability seems more robust both in terms of power price development and level of cost. It is important to point out that the analysis used is based on current trends and one cannot exclude disruptive changes related to alternative energy sources. There is also challenges with Norwegian development of floating turbines. If a development is based on profitability from the power market alone, Norwegian actors will not have the capacity to take a leading role in the industrialization of the technology. Hence, players from other countries will have a significant advantage as we see in bottom-fixed turbines today. However, the solution for this could eventually be that Norwegian authorities choose to open the Southern North Sea II for development, where possibilities for connection between offshore wind parks in Norwegian territory to power markets further south, including the UK market. This gives an opportunity to open up for a more beneficial development at an earlier stage. The purpose behind this is that the price level as of today is higher elsewhere than in Norway.

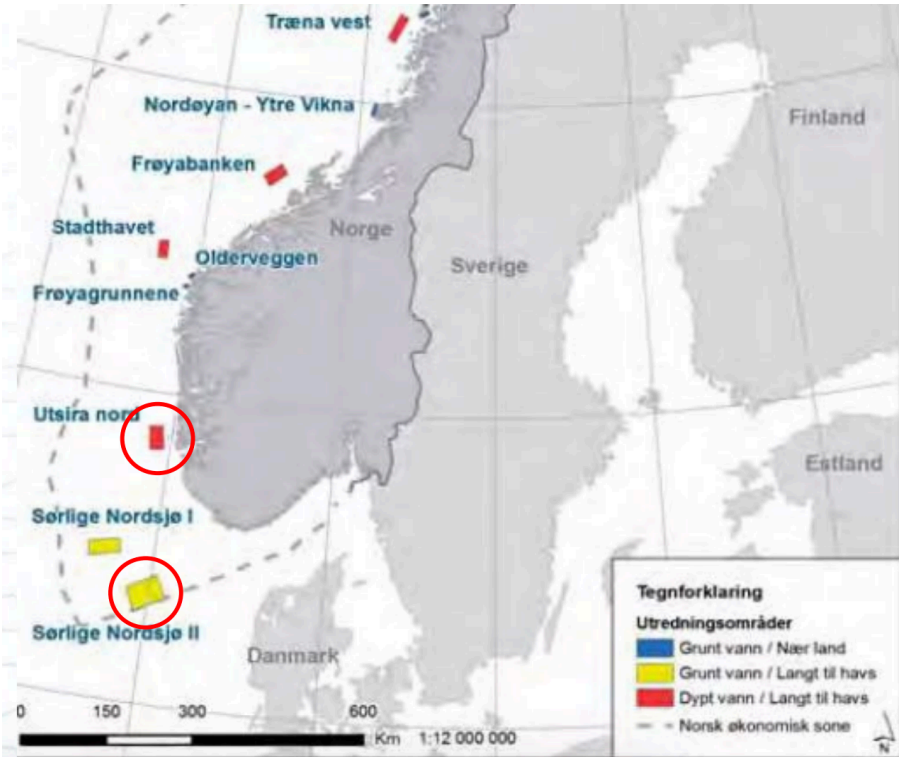

Illustration 2: Areas in the Norwegian Sea where it will be beneficial to place offshore wind parks, where among other things the Southern North Sea II has been frequently mentioned as one of the smartest areas in the initial phase of the development.
Source: Norwegian Offshore Wind Cluster, 2020

However, it is important to note that the area in and around the Southern North Sea II is not suitable for Equinor's Hywind technology. The depth of the sea here lies in a borderland between bottom-fixed and floating technologies. Utsira Nord, which is also marked on the map, is, according to NVE, designated as the most suitable area for the first floating large-scale project due to its location with deep water and lies closely to land with the capacity to receive the electricity that is extracted.

Besides, a large-scale development of sustainable power is dependent on the following decades if EU is to reach its obligations through the Paris Agreement. This increase the eagerness to pay for new renewable production capacity beyond the wholesale price for electricity, which is also reflected in the present subsidy schemes. It is important to bring up that the power market examines depends on current trends (Winje et al., 2019). However, analyzes shows that the populations willingness to pay to develop offshore- compared to onshore wind is significant in the face of increased power demand (Lindhjem et al., 2019).

4.5 Norway's opportunities in towards 2030

The expansion of the next decade will have a fair degree of dependence on each individual country's energy- and climate policy, as one is not competitive at the cost level we see today. Although there is a continuous debate about the consequences of fish and noise on spawning grounds, there are unclear and different views. It is also widely felt that most environmental organizations are of the opinion that there are greater benefits of offshore wind than disadvantages which results in offshore wind responds less conflictingly than turbines placed on shore. Our expectations will be based on projects which are in pipelines within industrial and national ambitions, and an assessment which shows probability of realization. Overall, the period over the next ten years is all about going from pilots via smaller test facilities to commercialization of large-scale parks.

Wind energy is the renewable energy source which is expected to provide the largest amount of contribution to the targets for 2020 and beyond. While EU's installed wind power capacity is about 169 giga watt (GW) at the start of 2018, only 16 GW (9.5%) were located offshore. According to the SET-Plan (2018), wind energy could reach 350 GW where close to 30% comes from offshore wind. Domestically some players point out a total expansion of 16 GW over the next 10-12 years, while others are more pessimistic. According to Carbon Trust (2018), there is a potential for up to 30 GW towards 2030 but through their analysis, levels around 12 GW in 2030 seems more realistic. This corresponds to 10% of the general offshore wind market according to International Renewable Energy Agency (IRENA) and International Energy Agency (IEA) (WindEurope, 2019).

4.6 Norway's comparative advantage in floating offshore wind

Unlike the market for bottom-fixed wind, where traditional wind power companies from countries such as Denmark and Netherlands dominates, it is expected that participants with oil and gas experience will be central in the development of a value chain for floating offshore wind (Mäkitie, 2020). This is because of the technical, operational and logistical requirements imposed in floating offshore wind that consist of solutions which are already developed in the petroleum industry. Norwegian oil and gas players have been working on technologies related to floating installations for years, which has made them world leading suppliers in the field. The expertise acquired is playing a central role to the development of Equinor's Hywind technology.

A study conducted at the Center of Sustainable Energy Studies at NTNU emphasizes that Norwegian companies involved in offshore wind reports that there is a high degree of technology transfer from the oil and gas sector (Afewerki, et al., 2019). A survey done by CenSES (2019) focuses on the known population of all Norwegian firms that target the offshore wind industry with products or services that show there are some differences. In their sample of 97 firms, a total of 68 firms had commercial sales to the offshore wind industry, while the ambitions for the other firms are to deliver to offshore wind industry sooner or later. The survey finds out that there are quite few new Norwegian firms that targets offshore wind. Most of the firms in this market are established between the years before 2000 until 2009. Further they explain that only 13 of the firms have offshore wind as their core business and the remaining 84 have diversified from other industries.

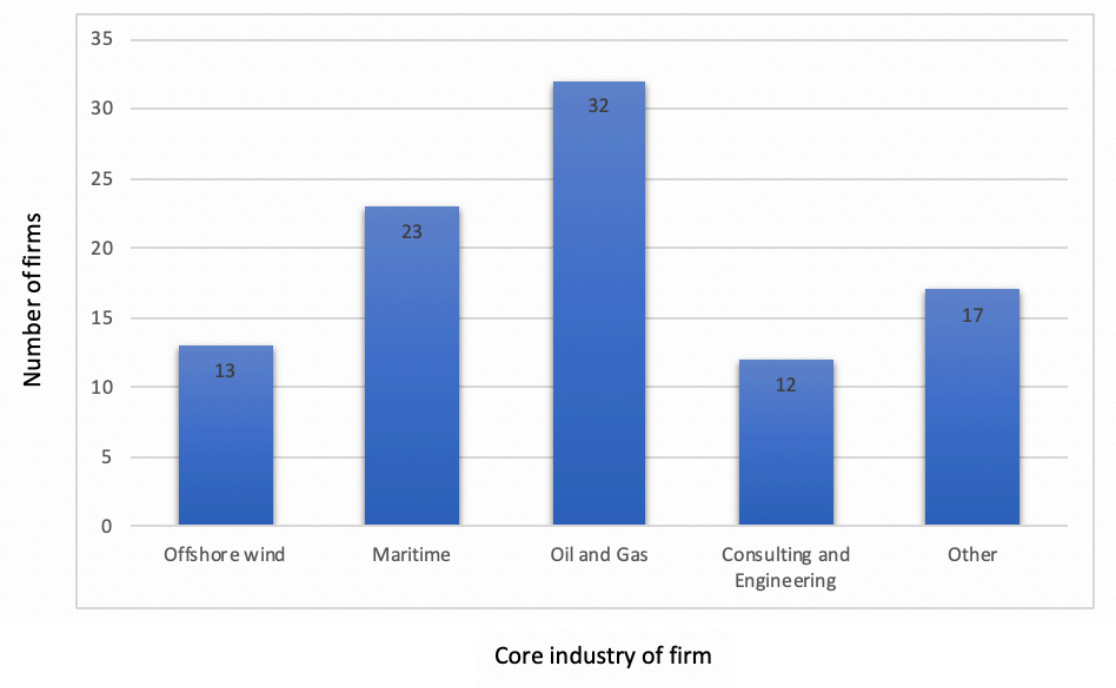

Figure 8: Primary industry of the surveyed firms. Other includes onshore wind, industry and power sectors. Source: CenSES, 2019.

Interviews done by Menon Economics (2019) also shows that actors that traditionally operate in the oil and gas sector emphasize that they are strongly competitive in offshore floating wind market, based on their technologies, qualities and delivery capabilities. Operational experience and a value chain with innovative players at all levels contribute to a significant competitive advantage in floating offshore wind. After all, floating wind turbines can be assembled ashore and towed out by tow vessels. A study conducted by NTNU and SINTEF concludes that the

industrial potential associated with offshore wind is increasing significantly next to the development of floating technology.

4.7 Norwegian players' position in floating offshore wind today

Norway has been slow developing wind power technology and therefore lost onshore and bottom-fixed projects which could have led to an expansion within this field. Floating offshore wind, on the other hand, can become a major Norwegian export commodity if one considers the industry itself. A recent Menon Economics report shows that floating offshore wind can provide value creation of NOK 117 billion and create up to 128,000 full-time equivalents (FTEs) jobs by 2050. To achieve this value creation, according to Hovland (2019) the projections require NOK 36 billion in Government subsidies, at least. The head of the state-owned company Sustainable Energy Norwegian Catapult Center, Willie Wågen points out that a composition of the Norwegian offshore supplier industry will make Norway an offshore nation. He believes that the country already is good at building robust and difficult floating structures where a combination between the knowledge within subsea and with offshore shipping companies has a competitive advantage that is hard to beat (Helgaker, 2020).

In 2009 Norwegian actors with Equinor as a pioneer build the world's first pilot project within floating offshore wind, Hywind Demo. As a result of the pilot project, Norwegian players' expertise was demanded internationally, especially in countries where the potential for bottom-fixed turbines is limited, which includes Portugal, USA and Japan. Equinor, was the main actor behind Hywind Demo and is still a key player in floating offshore wind, even though international competition is increasing. Equinor is not the only Norwegian player behind leading floating technology concepts.

The technology concept WindFloat does also have a Norwegian owner, namely Aker Solutions, which are a part of Principle Power Inc. which again is the promoter/developer of a pilot project in Portugal from 2011. Aker Solutions is a well-known company with more than 40 years' experience with designing, delivering and servicing semi-submersible drilling and production platforms (Aker Solutions, 2020). With their technical expertise and global presence, it is reasonable to believe that they will play an important role as a Norwegian player with potential to take a global position in the offshore floating wind market.

There is also a new giant project on the stairs for several Norwegian actors. The project called *Flagship* has been awarded NOK 290 million from the EU's Horizon 2020, but the total investment will, however, be much higher. The project involves testing and designing what will become the world's largest floating offshore wind turbine, with a height of 308 meters and blades of 108 meters making the size unrealistic to be on shore. The turbine will initially have a capacity of 10 MW but can allow up to 20 MW. By comparison, Equinor's turbines at Hywind Tampen will have a capacity of 8 MW per. turbine. The energy company Iberdrola from Spain is the client for the Flagship project, but as much as 70% of the project's suppliers are Norwegian (Dr.techn. Olav Olsen, Kværner, Unitech Offshore, MetCentre, DNV GL), respectively the other players are companies and institutions from Spain, France and Denmark. We find several Norwegian actors involved within this project, the construction and tests will take place in Rogaland, Norway (Buljan 2020, Helgaker 2020). The main goal of the Flagship project is according to Norwegian Offshore Wind Cluster to demonstrate a cost-effective floating wind turbine to ensure that costs reduces to €40-60 / MWh by 2030 (Norwegian Offshore Wind Cluster, 2020).

"The Norwegian industry is world class in two areas— renewable energy and complex offshore projects. Offshore wind is an industry where these capabilities combine and where we really should be internationally competitive" – Anonymous actor from Afewerki, et al., 2019.

With several leading technological concepts and operational competences which Norwegian players possess, CenSES considers the players to have bigger opportunities to get parts of global projects, given that it is invested facilitating industrial development in Norway, which will also help create value opportunities for Norway.

4.8 Value creation opportunities

Floating wind turbines are still a niche in today's energy system and despite significant growth, the industry is in many ways immature. Offshore wind is a growing industry and an important part of a future sustainable energy system. A study by CenSES (2019) shows that the Norwegian continental shelf has considerable potential for offshore wind and that, in a European perspective, it is worthwhile to develop Norwegian offshore wind power. The market for bottom-fixed wind is already dominated by international players, while floating offshore wind have few, if any, dominant players. The market is growing rapidly, and if Norway is to

realize value creation, it will be important to preserve its competitive advantages and to be early; Norwegian industry must develop smarter and better solutions, which requires a good interplay between industries, research and innovation. If Norway acts fast enough, according to the Menon Economics report (2019), floating wind turbines can be worth a fortune for the country, with up to 128,400 FTEs and value creation up to NOK 117 billion over a 30-year period; but the effort is required. To realize this, Norway need to create an active domestic market, be early in the development of technologies and processes in the offshore wind, the authorities must have a clear vision and help companies with different forms of subsidies, and appropriate measures must be in place to realize floating offshore wind developments (Export Credit Norway, 2019).

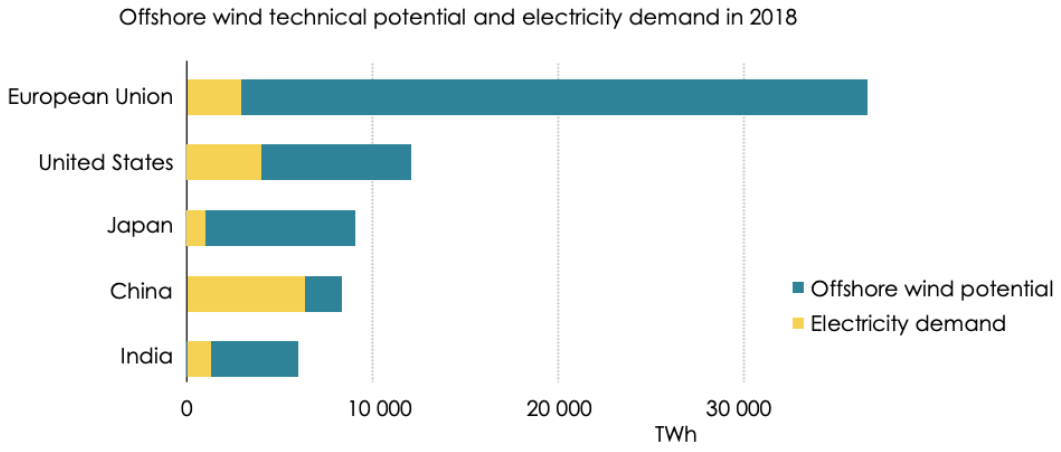

Figure 9:Offshore wind has huge untapped potential. Source: IEA, 2019.

There are technological areas where Norwegian R&D environment has strong expertise and where Norwegian industry has the opportunity to obtain significant benefits through new and more efficient processes, as well as new solutions in production that are more affordable and cost-saving than it is today. These areas are among other things the materials, power supply, digitalization, marine operations and so on (Karstad, et al., 2019).

An analysis done by CO_2 Capture and Storage (CCS) (2013) states that technology development plays an increasing role in the development of offshore wind from 2020. They calculate that with today's price level, offshore wind will produce only 5.3% of energy in Europe in 2050, but with a reduction of 30%, the production share will increase to 21.3% (CCS, 2013). This clearly shows that the potential for offshore wind is highly dependent on the success of industrialization and associated cost reductions.

4.9 Cost development

One of the most important assumptions that influence how attractive offshore wind is in the technology mix is how the cost will evolve. The cost of bottom-fixed wind has fallen substantial in recent years, which also has been the case for floating turbines. Since the establishment of the North Seas Countries' Offshore Grid Initiative (NSCOGI) in 2009, the cost of offshore wind energy has dropped following the developing maturity of these technologies (SET-Plan, 2018).

Illustration 3: Equinor's Hywind Demo about 10 km west of Karmøy, Norway. Source: Google Maps

For instance, Equinor managed to cut costs on Hywind Scotland by about 70% compared to the pilot project outside Karmøy (Undrum, 2019). The cheapest development projects are already planned to be realized without subsidies (Karstad, et al., 2019), although most offshore wind developments require forms of support to minimize risk of the investment. If you compare the prices of bottom-fixed and floating wind today, bottom-fixed wind is cheaper, but this can change with the development of both market and technology in the future. One of the strategic objectives for offshore wind in the EU's SET-Plan in the long term is that offshore wind should be able to be built and operated entirely without subsidies (SET-Plan, 2018). In the line with the technological development the recent years, WindPowerOffshore (2019) indicates that the price per MW between 2013 and 2018 fell by 44.5%, from €4.41 to 2.45 million / MW. This is

due to a number of combinations of various factors, such as the development of larger- and more robust wind turbines, technology development, scale advantages, cheaper financing and increased competition both for production licenses and in the value chain.

4.10 Risk related to the industry

The start-up of new industries and businesses is crucial for the development of value creation and competitiveness. Starting a new business in a new industry involves risk. This is due to many factors, such as great uncertainty regarding whether the market will value the new that is being offered (Ottesen & Grønhaug, 2004). The market for floating wind is very applicable in today's society but it would be naive to believe that there is no great risk of a large-scale development of this industry which hopefully will feed us with renewable- and sustainable energy in the years to come.

"Offshore wind projects carry great risk, which imply that one has to focus on risk assessment in every step." – Anonymous actor from Afewerki, et al., 2019.

There are major reasons to believe that high levels of uncertainty and risk are due to a lack of experience-based knowledge. This means that it is difficult to extract risk profiles for the industry because the likelihood of incidents and their consequences are unknown; something banks and investors use when investing in projects. The disadvantage of immature and untested products and services are that new markets can only deal with new solutions on a limited scale, which in turn affects competitiveness compared to established industries. In a study conducted by CenSES (2019), two strategies were recurring for companies related to reduction in uncertainty and risk. One of the most common was only to postpone entry into the industry until the risk level had become acceptable, while the other strategy was to limit investments in floating offshore wind to internal resources and expose the firm to market risk slowly and incrementally. In order to reduce risk, some must take part of the "burden" to consider contributing to new and cost-reduced technology, this does not arise by itself but often in an interaction between different actors (business, education, R&D, authorities) in an innovation system. Different forms of support and predictable framework conditions contribute positively to reducing risk and increased willingness to invest (Karstad, et al., 2019).

4.11 Policy and R&D

Public policy is an important factor for new industries to achieve growth. Today, there are several different policy instruments that help support the growth of Norwegian offshore wind. The purpose of this chapter is to present different areas that Norwegian firms identify policy needs by elaborating and evaluating already existing policy within floating offshore wind. The chapter also aims to present findings based on the view from Norwegian offshore wind related firms´ on the importance of different policy instruments.

The CenSES (2019) survey asked 69 different Norwegian firms about their satisfaction with the current Norwegian policy instruments and their current contribution or connection towards offshore wind. Some results from the survey is shown below in figure 10. It shows that over half the respondents are not satisfied (26%) or only somewhat satisfied (27.5%) with the existing Norwegian policy instruments. We aim to explore the diversity among firms when it comes to the different policy needs and the most critical areas where they face weaknesses or strengths in the current policy environment. Further in this chapter we will elaborate three areas of policy which can help Norwegian firms succeed in the offshore wind market if it is addressed correctly. These three areas are:

I. Creation, pilots and demonstration of a home market for offshore wind
II. Supporting R&D and supplementary mechanisms
III. Access to capital and investments

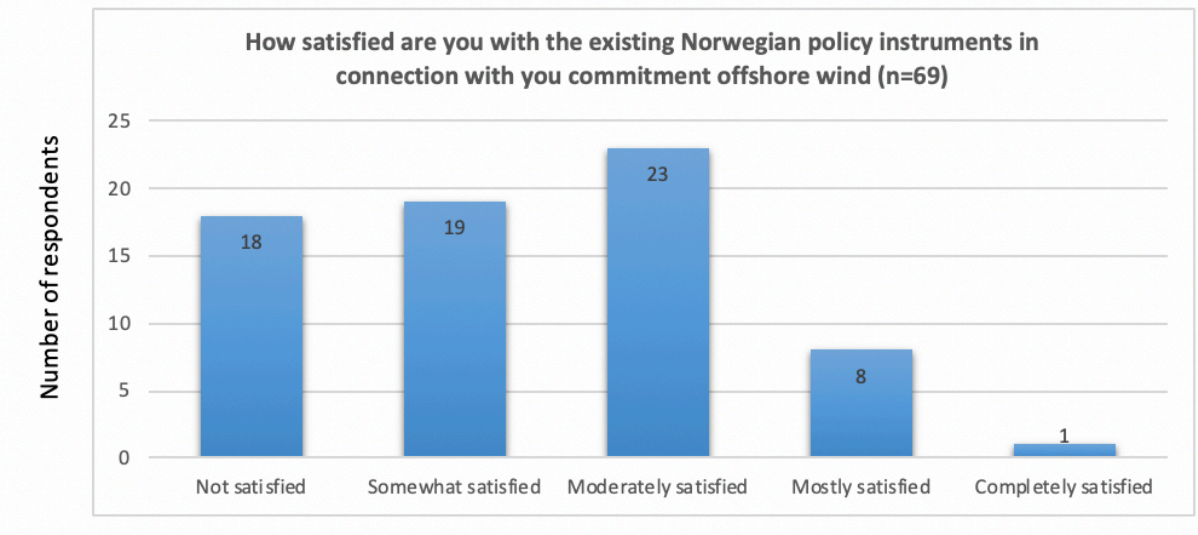

Figure 10: Satisfaction with current Norwegian policy instruments. Retrieved from NTNU study. Source: CenSES, 2019.

4.11.1 Securing a home market for offshore wind

The survey by CenSES (2019) shows that some firms suggested that various forms of policies are related to piloting and demonstrating products, services, or technology represent the most useful tool that the Norwegian policy makers should introduce. Additionally, some firms called out that market creation policies are needed. Working together within the industry can lead to opportunities for other firms in order for them to enter the market themselves. Opening up possibilities for others can allow more entrants like suppliers, distributors, partners and so on can lead to securing a home market. The lack of having a home market that could allow the qualification of technology creates an additional barrier for firms that need to provide references of their products or services (Hansen & Steen, 2011).

Norway has an economy that is related to the oil and gas industry. In the industry there are many Norwegian suppliers that are developing technology within large floating constructions and anchoring for platforms. There are several large and small firms that represent the supply chain. Throughout the interview process we have learned that suppliers and sub-contractors are essential in order to promote expansion or development within new fields. Knut Vassbotn states that it is important to have a good and stable home market in order to promote the Norwegian supply chain. Developing a good home market means that you practice by delivering products and services domestic in order to expand internationally. Arne Eik mentions that time is of the essence when it comes to developing a home market. Norway needs to have consecutive improvements within the field in order to succeed as a country with a strong and solid home market. He believes that the market will be quite established by 2030, which means that Norway and its firms needs to act accordingly.

Despite Norwegian firms have been on and off the public agenda for several years now, they are still needed to demonstrate and qualify their technology which is crucial for firms. Most of the firms do not have the capital or resources to invest in R&D and take the risk by themselves. Which is why they need to demonstrate new and capital-intensive products that has not yet established a foothold in the existing international markets that could benefit and establish a Norwegian pilot and different demonstration projects. According to CenSES (2019), having a home market has varied on the public agenda for several years. Particularly, the first wave of interest was between 2008-2011 and there were several calls for publicly funded projects. These projects could have secured the industry a foothold in the international market. It did not go well due to a combination of a lack of political commitment and an oil and gas crisis between

2011-2014. Throughout the interviews, we found that there are several small and large firms that emphasizes the need of a home market for offshore wind and has their core activities within the oil and gas industry. There are several benefits mentioned of having access to a domestic market for demonstration and piloting in the CenSES-survey and is also confirmed throughout our interview process. Some of these are:

I. Gaining valuable knowledge and experience
II. Demonstrate your capabilities and competence
III. Assist the development of a local supply chain
IV. Collect references and information from real-world projects

4.11.2 The current R&D support is an important cause, but it is not enough

The same survey that was conducted by the various authors from NTNU also included an open question section, regarding which policy change that could support the most efforts in offshore wind. In this section there were less firms that answered, however they managed to get answers from 57 different firms. In figure 11 which is shown below presents the findings from this survey. It shows that only five firms points towards improved R&D support as the most critical change when it comes to policy changes to support the firms offshore wind efforts. Considering that the Norwegian authorities prioritize public R&D programs and not private. As mentioned earlier in the thesis most of the firms are within the oil and gas sector or from private sectors, which is why this outcome is not surprising.

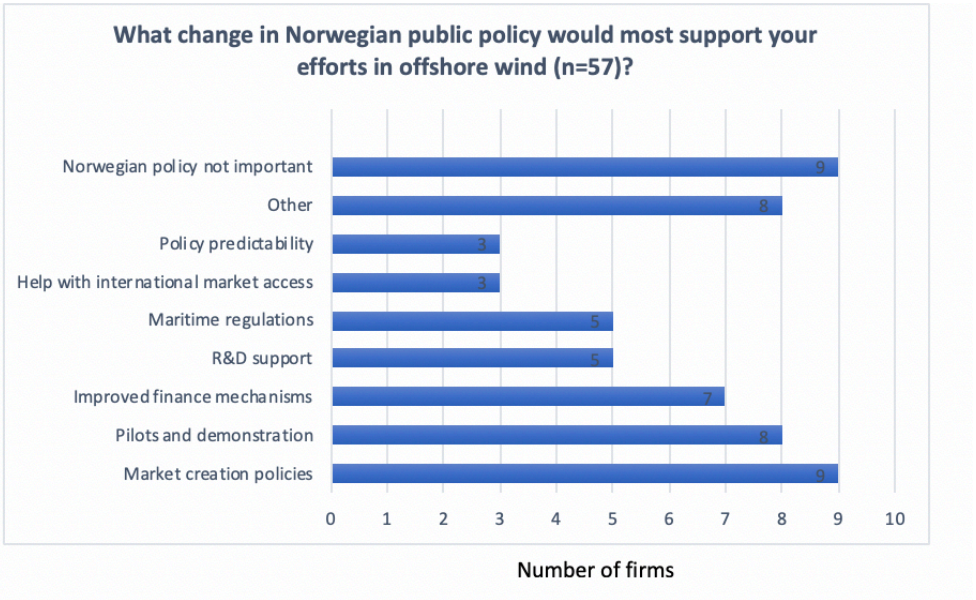

Figure 11: Which policy change would most support efforts in offshore wind. Source: CenSES, 2019.

The open question section of the survey shows that the different policy instruments that are essential for expansion are Norway´s Environmental Technology Enterprises Financing Scheme (Miljøteknologiordningen), Skatte-FUNN, Nysnø and Enova. A large technology firm said in one of the open questions that they are lucky to have a support system through the research council, Innovation Norway and Enova. The support from these three agencies should be valued and is considered to be very important. Equinor received NOK 2.3 Billion from Enova to further their Hywind Tampen project in 2019 (Lorentzen 2019, NTB 2019). This is the largest amount of funding that Enova has ever done, which shows that they believe in this project and new industry. However, the public R&D support is often not sufficient in order to secure access to international markets. Arne Eik from Equinor says that receiving funding is a requirement in order to succeed. They have made significant reductions when it comes to costs when comparing Hywind Demo and Hywind Tampen, but they are still in need of assistance from the Norwegian Government. He states that as of today, floating wind will not be profitable, which means that firms will not take all the risk by themselves without any support. The different firms normally have the technological capabilities needed in order to transfer it towards the offshore wind industry. The process of acquiring jobs, contracts and getting sales are an existing challenge due to weak relation towards the market. The efforts to deal with the market situation can be resource demanding. Several of the firms from the CenSES-survey and our interviews have mentioned that it is important to establish specialized sales teams, set up local offices and hiring local sales representatives in the offshore wind markets wherever they can see it being relevant.

One of the key findings from the study done by CenSES (2019) is that while companies report a general satisfaction with the current policies concerned with the development of technology, they still report challenges and a lack of support towards marketing products and services. It may provide barriers towards market entry, even in situation were technologies from oil and gas can easily be transferred to floating offshore wind. This has also been confirmed throughout our interview process, because several of the conversations we have had states that it is challenging for newcomers to enter this industry. In order to successfully diversified your business from petroleum towards offshore wind can require large investments both in marketing and sales processes. The allocation of resources needed for this change often needs to be sustained for a longer period of time before firms are actually able to capitalize off of those investments. Research from the CenSES (2019) report indicates that public support for

marketing would be useful because the process of marketing itself can be resource demanding. The findings indicate that having an increased support for market access could have a potential of boosting the effects of already existing policy support for research and the development technology. However, the industrial development should also include different important non-technical factors, like customer relations, creating legitimacy and securing market access.

4.11.3 Access to capital and investments

A large technology firm mentioned in one of the open questions that during the oil crisis between 2011-2014 it was challenging for the petroleum industry to focus on anything else than their core business and the renewable business got delayed while securing their survival through the crisis. This can be linked towards the crisis of today with Covid-19, and the challenges it may bring towards the financials and survival of firms. A challenge that has been stated through previous and our own study talking with Aibel, Aker Solutions and Equinor is securing access to capital, in particular capital-intensive ventures like building larger structures or new vessels. Firms mention challenges towards their size and lacking financial strength. The report done by CenSES (2019) shows that companies struggle getting financing through public support because they are lacking private investments and linkage towards commercial partners that are able to fulfil the different criteria needed to achieve public funding. Some of the companies highlight the importance of having foreign owners that are willing to provide equity, qualified human resources and investments towards the venture for success within offshore wind or technology development.

A benefit of having access to capital is that they can make early phase investments into new business areas and hopefully end up ahead of the curve. Interviews conducted elaborates that firms that do not have access to capital from owners can be a significant barrier, especially towards the development of new technology. According to Axel Norman from Aibel, it can be challenging to get hesitant customers to pay in advance for an unknown product or project, which can lead to the supplier taking the financial risk themselves. This can be particularly challenging if the firm does not succeed securing loans, public financing or financials from owners.

Offshore wind is a new and emerging industry, which is why most actors in this industry have their main business activity in a different industry. Throughout the interview process it seems like having main activities in different segments can count as both a benefit and challenge.

Firms that are able to use their existing infrastructure, knowledge, experience, capital or technical solutions report of having less need of investments or capital to enter the offshore wind industry. Revenues generated from oil and gas has the possibility of providing the needed capital in order to invest in offshore wind, though the revenue generation can be reduced if the oil and gas prices has a downturn. If the oil prices have an upturn, it may reduce the incentives for other firms to invest in offshore wind.

4.12 Environmental considerations

The development of the industry is not solely about building the best and cheapest wind turbine; it is equally important to think about and preserve the nature and the environment around the wind parks. Although floating wind parks will be far away from land, it is important that companies do not take for granted that they will not meet comprehensive environmental documentation requirements. Environmental impacts that the parks will create are greater proportion of bird deaths, as a result of seabirds flying into the turbines. A study published in the journal Renewable Energy in 2012 indicates that wind power kills 0.27 birds per GWh they produce. Corresponding figures for nuclear power plants are 0.42 and for coal power stations it is 5.18 per GWh, i.e. close to 20 times higher than for wind power (Kalogirou, 2012). It is also important to think about what is happening underwater, how the anchors and cables will affect the seabed. Several of the people we have been in contact with said that there is also a continuous discussion about the impact on fish, which is unclear, as well as noise in the spawning areas where there are different perceptions. Companies and industry spend a lot of time avoiding conflict with other industries and environmental activists. While onshore wind turbines are met with several major demonstrations, there are few, if any, demonstrations against turbines far at sea.

5.0 Discussion

This section of the thesis will review our empirical findings that has been found throughout the research and interview process. Previous research and interviews that we conducted were our main source of information. The questions that we prepared throughout the interviews were adjusted to fit the interview object while having a clear structure for them to answer our questions related to previous listed theory and towards our research and sub-questions. The findings will be discussed in conjunction with previous literature and listed theory, we will also summarize the most important discoveries that we found.

5.1 Innovation strategy

Having a clear innovation strategy is essential when it comes to expanding or succeeding in a new emerging market. It is important to have a well-organized and complete plan on how a company should allocate their resources and capabilities in order to achieve their innovation goals. Firms wants to have a strong, stable and specified plan in order to increase their market share and profits. An innovation strategy is about mapping firms' mission, vision and values in order to define consumer markets. It is important to decide on what you want to do, decide what you are planning to do and why, and how you are planning to implement it.

Throughout our interview process we have seen clear relations between information collected and previous listed theory. Wind Europe has released research and outlined the massive potential there is for floating wind around the world. This is related to adapting towards the United Nations sustainable development goals regarding the production of a lower carbon footprint. This has shown firms the importance of digging into this source of renewable energy. A similar action that is conducted among the firms are that they analyze the overall situation in order to evaluate their potential and contributions that can be achieved. The firms have different types of innovation strategies, but they are all about how to succeed and gain competitive advantage. Not everyone we interviewed were necessarily deep into investments within the business yet. However, they all said that it is important to establish a foundation early to secure a market position in order to be a part of the growth and learning process. Axel Norman from Aibel states in the interview that they have conducted several internal studies regarding floating offshore wind. They want to evaluate the overall situation, and hopefully be able to position themselves towards the industry early, at a low-cost expense.

It is important to make up your mind whether you want to pursue this opportunity or not. All the firms we have been in contact with are well known because of their significant contributions in the petroleum sector. Due to previous success, experience within floating vessels, different relations and the need of renewable energy sources is the reason why they have selected to invest within the matter. Most of them have selected their main operation or products within the field and decided why they are pursuing this opportunity. They are all commercial firms that are thinking of long-term solutions and mentions that renewable energy is the way to go. It is therefore important to have a plan that is made for the years to come. If we take Aker Solutions current plan that is called 20/25/30 as an example. The company has a goal to "derive 20% of their revenue through renewable energy and 25% from distinct low-carbon solutions by the year 2030" (Aker Solutions, 2019). This can be used as an indication or proof over their ambitions toward the industry within the next ten years. According to our interview with Knut Vassbotn, most of the renewable energy collected to achieve this plan will come from offshore wind.

5.2 Innovative organizations in collaboration

We believe that for ideas to develop and being successful it is important to get confirmations and acknowledgement that the idea can make a difference, to a greater or lesser extent. To achieve this, it is important that you are in an environment that gives you the opportunity to explore and/or study to find new ways or solutions to the product you are delivering, which can happen through innovation methods that improve or disrupt existing ones. This can happen in-house or together in a cluster. Working on development and innovation within the company is a good idea but in a new and large industry it will be resource-consuming and risky. On the other hand, when one is working in a cluster there will be greater access to resources, knowledge spillovers and to a lesser extent, risk. New technologies do not arise by itself but often in an interaction between different players in an innovative environment. Cluster manager in the Norwegian Offshore Wind Cluster, Arvid Nesse, says that working together is important to create a comprehensive value chain but also to develop new innovative and good solutions. This is supported by Knut Vassbotn who points out that clusters play a crucial role as a catalyst for commercial players in the value chain, both large and small. However, as with everything else, there are both advantages and disadvantages to work in clusters - everyone has their own way of working. While some are very open-minded and share thoughts and ideas, some are more cautious and only seek information for their own good. It is important to mention that is

normal to not share everything with each other during these meetings, therefore closed forums for confidential matters also arise. It is not uncommon for companies to meet separately and share information among themselves in a more closed forum. This is done on the basis of security for their own competitive advantages that one will not lose through an open division and to succeed alongside your partners.

In this process of upheaval that we are in with this new industry, as well as the climate ambitions Norway and large parts of the world have agreed to, it becomes important that we work together on a common overall goal – to keep the earth sustainable.

5.3 Targeted development using innovative solutions

In order for offshore wind to develop into a profitable industry that is worth investing in, at this present and in the future, it is important that development takes place in the right direction regarding several things. The main challenge today is the costs associated with production and processes. Here, great development is required in terms of how to cost-efficiently recover the power produced. This requires good interaction between actors in the industry and the willingness to invest in order to achieve results. The main purpose of this industry is to reduce greenhouse gas emissions by producing environmentally friendly energy that will take over the need of fossil fuels, among other things. However, from a business perspective, one will always think of profits. In these times, there is a great focus on climate, which is why the society we live in demands that companies operate through the triple bottom line (TBL) framework. The framework recommends that companies commit to focus as much on the social (people) and the environment (planet) as the financial gain (profit).

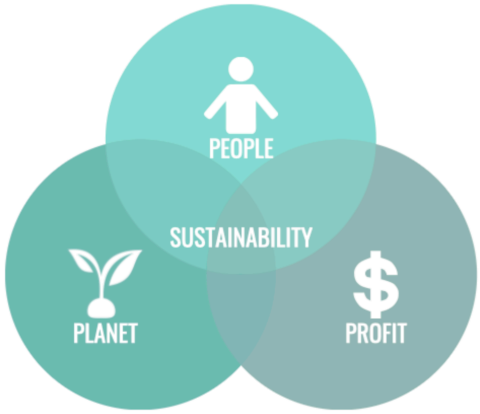

Illustration 4: Triple bottom line – people, planet & profit

It has been clear that Norwegian businesses have achieved leading roles within the petroleum and maritime industry along with renewable energy, and that floating offshore wind is an area where all these competences meet to some extent. Although Norway and Norwegian companies have good prospects of succeeding in this industry, it will cost, but will eventually be able to deliver great value if one succeeds. To succeed, one must dare, either through small incremental and sustainable changes or through more extensive and radical changes that can be disruptive to the industry. Common to these innovation types is the risk that is linked to high costs.

The technology for modern and energy efficient wind turbines exists but it is important to note that this is for turbines that are land-based and bottom-fixed. Most of this knowledge can be linked to and is transferable to floating wind turbines; to a certain extent. Floating wind turbines will face more weather and greater forces, which will cause other forms of wear and tear than what, for example, bottom-fixed turbines do. Thus, it will be important for the components that are developed for the turbine itself as well as the blades to withstand severe weather. It will therefore be important to produce material that is stainless, durable and can last for a minimum of 20 years. Here, there may and will be room to further development of components that already exist with small changes through incremental innovation, or to develop the product significantly where the goal is to maintain its position in the existing market. The turbines being moved out to sea provide the opportunity to build larger, taller and more robust turbines, which in turn provides the basis for a development potential for, among other things, larger and longer rotor blades and towers.

The development of floating offshore wind turbines is not solely about finding the best solutions for the turbine itself. The energy created must be transported to land, and it will therefore be equally important to develop good solutions to transport the produced power to land. This will be done through substations and cables respectively. For sea depths less than 100-120 meters it will be natural to have a bottom-fixed station, while at deeper depths it will be natural with floating substations or a subsea station; here you will need dynamic high voltage cables. There are currently few players who have established solutions for floating substations but Aibel, Kværner and Aker Solutions all have solutions here, where for example so far, Aibel has delivered a station and has another contract waiting. Foreign players own large parts of the market share with the production of the turbine itself, there are great opportunities here to secure the market on floating substations. According to Knut Vassbotn, nobody has supplied large

floating substations or subsea stations, which provides opportunities for companies such as the aforementioned companies with experience in this field. This can happen through incremental improvements or radical changes. In the same way as substations, it is important to manufacture and install export cables[7], which are dominated by a few established players but where floating installations require dynamic cables, the global expertise is limited. In other words, there is potential for development and opportunities to secure market shares in this field as well, but then it is required that you are early on with good solutions.

In the period since the first floating offshore wind turbine at Karmøy was commissioned in 2009, there has been a period of pilot installations, and now a number of pre-commercial projects that are under development. The next step further is commercial floating wind parks. The potential for growth is present, provided that we succeed in extracting economies of scale and industrializing the manufacturing and production processes so that costs fall rapidly. To date, the turbines are completed on land before being towed to the respective area. There is considerable potential here to extract economies of scale in the manufacturing and installation process. Other cost-effective solutions may include new disruptive solutions such as setting up turbines in their respective areas. When Statoil's (now Equinor) first floating wind turbine was installed, it was assembled at land and towed vertically. This method costs a lot and requires good weather and not least great depths of sea all the way out. Installation and completion of the turbines constitute a significant part of the costs. Therefore, we believe that players in the market must find new and more cost-effective solutions that make transport and installation easier. This will require a completely new technology than is currently used, more advanced tugs and barges and better weather measurements because the work requires longer periods of good weather.

During the conference Ocean space in Egersund, a telescopic solution was mentioned several times – where the turbine is towed out and installed on site through such a solution. This solution will make it easier and cheaper to install offshore wind turbines without the use of large cranes and vessels with high load capacity (Ryvik, 2016) and will potentially destroy today's way of completing the turbines. This solution can also make it easier to maintain turbines, where you can do this on site instead of towing the turbine back and forth to land. The wind turbines must be maintained and repaired from time to time. For floating wind turbines,

[7] Export cables: includes sea and land cables

the process will be more extensive. The money rolls when the wind turbines have to be disconnected from the mains, transported for repair, and towed out for new installation. Here we also believe that new methods will be required to make the operation more efficient. Operations and maintenance will be geographically contingent, as local players will require local presence. Norwegian players today have a competitive advantage in supply vessels and marine operations with local subsidiaries or with a global presence, but this can require adjustments if today's ways of deploying completed turbines change. It is very important that these companies keep up with the innovation and develop in line with it. It is imperative to point out that industrial development should not only be viewed as a technology development process alone but should also include important non-technical factors, such as establishing customer relationships, creating legitimacy for new technical concepts and gaining market access.

Norwegian technology concepts[8] currently have a central position in the market for floating offshore wind, and previous expertise paves the way for Norwegian players to gain significant market shares when the global market is commercialized. Those who are willing to invest in floating offshore wind point out that an active domestic market will be decisive for whether Norway will take a leading position in the floating offshore wind market as this will provide them with reference projects. It is important that this happens at an early stage of the market as it will reinforce a potentially advantageous position in securing new contracts as the market grows. Experience counts, and for floating offshore wind there are few projects to show experience for. It will therefore be important that as many Norwegian companies as possible get involved in the first projects and thus gain experience at an early stage. If the Norwegian industry is early and takes a central position in the commercialization of the technology, it will increase market share internationally as well. Increasing market shares has a self-reinforcing effect by helping to further and strengthen competence and competitiveness. Historically, from bottom-fixed wind power, it shows that players and countries that secured market shares early, are still those with a dominant market position today. It will therefore be important for Norwegian players who already have a leading role in their respective fields to continue with sustaining innovation and/or radical or disruptive innovation.

[8] Hywind, Windfloat

A well-developed floating offshore wind industry will be able to supply large parts of the population with renewable energy and if there is anything the world needs in the years to come, it is energy. This energy should preferably be renewable and recovered sustainably to achieve the climate goals. Through paradigm innovation, it is important to change the mindset of both businesses and consumers to choose a sustainable path when it comes to extracting energy but also using this environmentally friendly energy even if the price level may vary. The bottom line for all companies is that it is driven economically and provides profit. More than ever, there has been a greater focus on the environment, and therefore companies are required to use the framework within TBL. Although the industry is not profitable to date, figure 7 shows that if the industry continues with the mentality, they have today to create a new, environmentally friendly and robust energy extraction industry, this will be achieved in the 2030s. This requires facilitation and adequate support from the state as well as a market access that companies experience as more demanding than technological requirements.

5.4 Competitive position

There is no doubt that Norwegian companies possess a high level of expertise in large parts of the value chain related to floating offshore wind and that Norway's current advantage is knowledge-based, even though the industry is an "open playing field" with a large lack of information. To preserve this advantage, Norwegian industry must develop smarter and better solutions, which requires good interplay between industry, Government, R&D and innovation. Actors that are early on with good solutions can position themselves in the market, gain competitive advantage and secure market shares.

From a Norwegian industrial perspective, an emerging floating offshore wind market can offer greater potential than a bottom-fixed wind market, because the technological, operational and logistical requirements bear many similarities to the petroleum and maritime solutions.

The Menon Economics report describes potential areas where Norwegian companies have strong expertise and where Norwegian industry has the opportunity to obtain significant benefits which are considered areas in the value chain that are not yet dominated by other foreign players. Through our research and interviews, we partly agree on some of the points they provide and have therefore chosen to look more closely at the areas we think are most relevant. Here we will highlight the following:

- Manufacture and installation of (dynamic) array cables
- Manufacture and installation of substations
- Operation and maintenance
- Marine operations

The markets for array-cables[9] are dominated by established players where, among others, Norwegian players such as Aker Solutions, Nexans and Unitech are significant suppliers. Unlike bottom-fixed installations, dynamic cables for floating offshore wind will be more needed as the turbines and substations will be in motion as a result of sea and wind. The depth of the sea will affect whether substations and export cables also need dynamic cables. If the depth of the sea is less than 100-120 meters, it will be natural for bottom-fixed substations – where no dynamic cables are needed. If the depth is deeper than 120 meters, the substation will be floating, hence parts of the export cables (closest to the substation) must also be dynamic. Although many have developed dynamic cables according to Arvid Nesse, the global expertise, is stated in the Menon Economics (2019) report as limited, which provides a potential for high market share for those who come with good technological solutions.

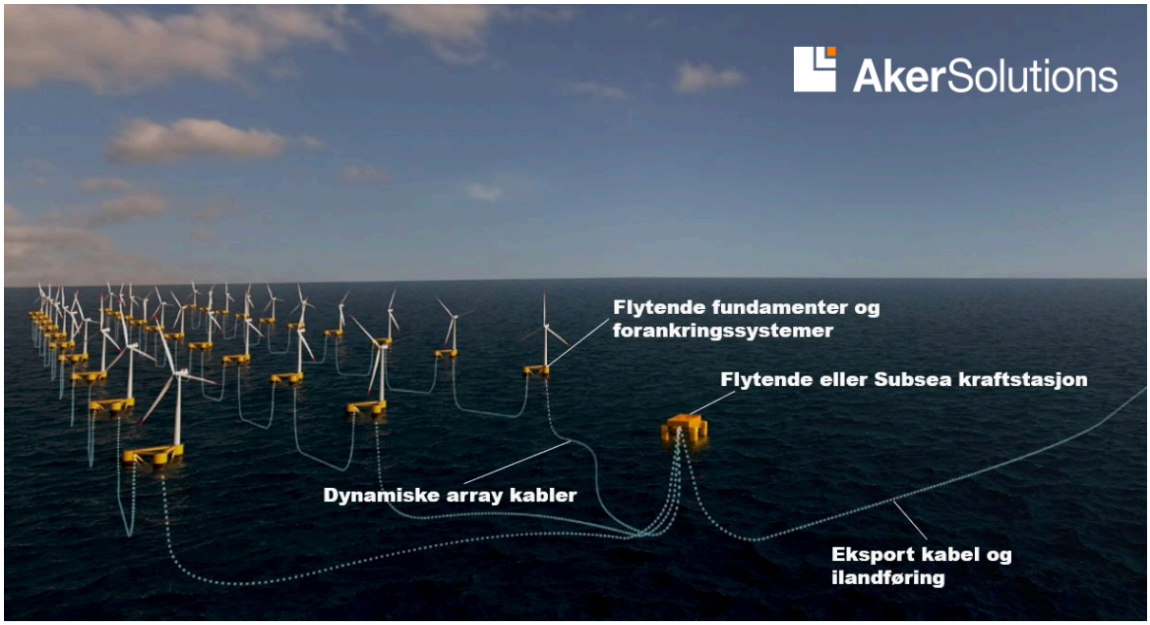

Illustration 5: Illustration of the technological building blocks in a floating offshore wind park. Source: Presentation of Einar Bjarnason, Ocean space – Offshore wind and aquaculture at sea

[9] Array-cables: Flexible cables between turbines and the substation.

As the industry is in its initial phase, there are few standards for maintenance processes related to floating offshore wind and one must work on processes that are more affordable today and this may change as technology advances. Operation and maintenance will be geographically dependent, as local presence of ships and local operators is required. Today, Norwegian players in supply vessels and marine operations possesses competitive advantage. The trend is that the industry players use larger service boats in maintenance longer distances from shore and Norwegian supply companies have already won competitions with large service boats for maintenance. The potential in this part of the value chain will depend a great deal on geographical proximity, as it will be cost-effective to use local infrastructure, but the export of expertise and presence will contribute to increased potential internationally. Here, there are great opportunities to gain market share through subsidiaries or global presence.

In order for Norway and the Norwegian industry to accomplish the goals of securing 10-20% of the global market, it is important that we use the competitive advantages we have, taking a leading role in the first projects to ensure that we retain our position as a first mover. For this to be feasible, it is important to strengthen your dynamic capabilities.

5.5 Dynamic capabilities

Dynamic capabilities are the capabilities of firms to purposefully adapt, optimize and improve the overall organizations resource base. They are individual and often earned through years of being in business. The capabilities are about being able to integrate, build and reconfigure your internal and external competencies in order to address changes in the market, both dynamic and volatile (Teece et al., 1997). It is important to be able to identify and understand all relations and dimensions towards your centric capabilities because it will provide an advantage on how you optimize labor and capital.

Developing or improving your capabilities can secure a short-term market position and result in a long-term competitive advantage. It is important to do an evaluation over the circumstances before starting investing or pursuing opportunities. Both Axel Normann and Knut Vassbotn said that they have conducted individual confidential market evaluations within the company to evaluate the overall circumstances. This means evaluating the firm's capabilities in order to achieve competitive advantage within the field. It is important for them to do a proper

background check and overall evaluation before deciding whether to pursue this opportunity or not. They need to figure out if this is a respective field that reflects on their experience, knowledge, resource base and dynamic capabilities that they may benefit from. It is important to see if this can give value to the company and result in growth opportunities in order to overcome potential market threats.

It is challenging for firms to figure out what differentiates them from competitors, but this is what can make their product or process unique in order to succeed in the floating wind industry. All the firms we interviewed believe that they are in a strong position when it comes to expanding within offshore wind. They have previous experience and a large specter of knowledge within the oil and gas industry and also bottom-fixed wind turbines. Floating wind turbines can be an addition to their already existing portfolio of business. The evolution of an organization form is often related to the growth of individual capabilities. Firms related to the oil and gas sector already possess knowledge, experience and resources that are hard to gain access to or copy and are essential for them while securing a competitive advantage. It might be common to try to imitate brilliant ideas or concepts, however, this is an emerging industry and several of the firms are trying to collaborate towards a common goal. They are interested of securing Norwegian firms' advantage over others. There are trade secrets among them, but also open discussion through alliances, partners, clusters and so on. Arvid Nesse mentions that there are open debates where members of the cluster can participate and share their knowledge. There are also meetings behind closed doors, where firms actually reveal their trade secrets in order to solve them together as a team.

It is challenging to succeed in an emerging industry but being able to utilize and exploit the capabilities or resources one might have can result in an overall value increase of the firm. It is important to have knowledge and experience, but also be compatible with changes. When deciding to enter a new industry, can demand a whole new structure for firms. Normally firms have to make investments within products, processes, people and so on in order to adapt towards new circumstances. They might have to allocate important and qualified personnel from an existing project over to the new one. This is why the firms do proper background checks, evaluations and so on to figure out if this is a correct move or opportunity for them. Knut Vassbotn says that Aker Solutions can and have already delivered most of the equipment needed to succeed within floating wind turbines which is why it is a natural transition for them to expand within this industry.

Covid-19 is an active and ongoing virus these days and affects everyday life. All the firms have noticed more uncertainty and changes regarding their work situation. When it comes to offshore wind they have barely seen or made any changes towards their expansion due to the virus. They still have qualified personnel within emerging markets working within technology, research, development, investment etc. They are trying to keep their progression stable without any setbacks while trying to expand and succeed to secure their competitive advantage. The hard work, commitment and dedication towards this new emerging field can function as a proof of their credibility towards the floating offshore wind industry.

5.5.1 Adaptive and absorptive capability

When it comes to succeeding in an emerging industry it is vital to be able to identify and capitalize on market opportunities and resources. Firms need to find a balance between exploration and exploitation strategies that can be connected to the resource perspective and goal. This can also be connected and related to previous listed information regarding conducting a proper evaluation and having a well-planned innovation strategy.

The overall plan behind adaptive capability is to challenge outdated traditions through management and by encouraging employees. It is clear throughout the interview process that investing in staff is a common tool to adapt towards the circumstances. In several occasions' firms have mentioned that there are held meetings or educational gatherings among themselves, partners or in clusters. It clearly has a high priority to be able to work together in order to increase the overall knowledge and strengthen their position. In some situations, they try to share ideas and help one another in order to achieve growth for themselves and their partners so the Norwegian industry can grow all together. A common way is by giving the staff a more open playing field and flexible workspace which can encourage and promote individual learning and innovative ideas. Having good absorptive capabilities are an important factor to improve learning processes and can highlight key attributes and knowledge so firms can fully reach their potential. We believe that the firm's ability to filter out sacred cows and practices will improve the ability to adapt into a volatile business market.

Within a constant changing industry with volatile market threats it becomes imperative to absorb and gain knowledge from other industries, partners or organizations. The capability that firms possess show prior knowledge and their overall ability to evaluate, criticize and utilize external knowledge and potential. It is important for all firms analyzed to illustrate their abilities

as a firm and its departments to have a wide specter of absorptive capabilities embedded. This will result in providing a commitment of resources through uncertain circumstances, which can provide them with new knowledge driven improvements in both skill and technology.

5.6 Knowledge driven improvements

We believe that existing knowledge and the willingness to learn is an important part of a successful innovation process. Having access to large sources of knowledge, capital and experience can reward firms with a good reputation, financials, competitive advantage and new business partners. As mentioned in an earlier section, we have divided knowledge into two methods which are science, technology and innovation (STI) and doing, using and interacting (DUI). One should be combining both STI and DUI learning techniques because study show that firms who are combining those methods are the ones that excel within product innovation (Johnsen et al., 2002).

STI revolves around the codification of knowledge and can be seen upon as a pattern, in order for others to absorb and implement for themselves (Jensen et al., 2007). The general idea behind knowledge transfer or value that patterns provide can only be understood by people with prior competence or understanding in order for them to benefit and learn from. We think that the STI way of learning can be a bit challenging when it comes to an emerging market. There is a lack of knowledge, experience, competence and unknown factors within the field, which makes it difficult to codify complete information into patterns or "code books". However, the obtained knowledge can be codified and used as general guidelines of data for further research by collaborating with others in order for them to join in on the results and interpretation. Typical sources of learning from STI methods in this case can be looking through previous data or attending meeting/lectures with other relevant groups or clusters.

DUI is more about an experience-based model of learning, where you are placed directly into a challenge or a real-life situation in order to learn. It includes getting first-hand experience alongside the project or object you want to learn from (Jensen et al., 2007). We think that it is challenging to obtain all information regarding floating wind turbines through data and studies, you also need to perform tests and experiments to figure out different results or outcomes and where you can make improvements. By conducting tests, you will acquire real learning experience that may not be obtained through theoretical research. We think that having a

practical way of testing your ideas and equipment is as important as the science, technologies and innovation. While interviewing the general manager of Metcentre, Arvid Nesse we have learned more about his test center that provides facility and assistance that can be used for testing new marine renewable energy technologies.

The Marine Energy Test Center in Karmøy allows you to perform real life simulations on your product or constructions. Using this environment can expose your product to different temperatures, waves, wind and so on to figure out the overall effect and movement patterns on your construction. The information gathered through these tests cannot necessarily be collected or as accurate through general research. It can result in participants gaining implicit knowledge that may provide a more trustworthy and accurate product for the firm. The experience earned through these types of projects is not taught through explanation but through trying and failing. The firms that has proceeded with a test can also develop tacit knowledge through the confidential results and information. Communication and information technology can then be used to codify this tacit knowledge and shared within the organization for everyone to benefit and learn from. We have noticed that is not unusual to have open discussions or forums related to the Norwegian wind industry within firms, clusters or among competitors. We have noticed that there are firms who want to achieve mutual success alongside their partners and in some circumstances, their competitors. We think that it is important to be able to know when to seek for assistance, by asking colleagues, partners or competitors when you are struggling to find an answer on your own. This type of knowledge is normally learned through environments where social practice and education are essential.

5.7 Developing and promoting a home market

Norway has an economy that is related to the oil and gas industry. We know that Norway has a wide and resourceful knowledge base when it comes to floating constructions, underwater technology, platforms and promoting a strong local supply chain. There are both large and small firms that represent the supply chain and they are contributing towards the development of technology concerning the different floating constructions and are providing anchoring for platforms. We believe that this knowledge can directly be transferred towards the floating wind industry. There are good chances that the Norwegian industry can become the leader with the help of knowledge transfer from the oil and gas industry. Implementing incentives that

promotes interaction between firms working with floating wind and the petroleum industry can result in new technology being implemented.

Axel Normann states in the interview that having partners, suppliers and sub-contractors are essential when it comes to promoting expansion or development in an emerging industry. Through experience we have seen that it is important to have long-term partners when it comes to having a successful growth while developing or working with projects. Knut Vassbotn mentions that it is a natural process for Aker Solutions to include previous suppliers or partners when it comes to new projects, especially firms that has a solid ground in the potential location or country where it is supposed to be implemented. However, previous relations do not necessarily mean that you are automatically chosen for the job. Firms are dependent on securing a strong market position in order to grow or expand into new market. According to Knut Vassbotn and Arne Eik it is important while discussing with the Government to promote and strive for having a good and stable home market in order to promote the Norwegian supply chain. By having a strong home market means that you practice by delivering products and services domestic in order to expand internationally. It is central to include as many firms as possible and to maintain or develop comprehensive political instruments to aid in the development. We believe that if this can be sorted out, there is a great chance of strengthening the Norwegian technology industry in order to develop a strong local supply chain within floating wind that can be similar to what was done in the petroleum industry.

5.8 Other prerequisites that can help if Norway wants to succeed within the floating wind industry

In order for Norwegian firms within offshore wind to succeed on a global scale, there are several prerequisites that we think should be strived to achieve. These prerequisites have been developed throughout our research and the interview process. We will list and discuss these requirements below.

5.8.1 Develop incentives for firms to engage within innovative work

Having a supportive Government will be central towards the development of new radical innovations such as floating wind turbines. Entrepreneurs are important to perform experiments and to achieve technological learning. Throughout the interview process, the firms said that it is normally up to the individuals within the industry to succeed within innovative processes. A

solution here to engage firms to innovate is that the Government should adapt towards each step of the innovation process in order to further individual success. It is therefore important that the Government has a long-term goal and vision towards improving the technological learning and reduce costs involved in the process. The representative from the Norwegian Labor Party, Ruth Grung says in our interview that there are barely any incentives to affect and shift the mindset of firms towards offshore wind as of today. It is not enough to leave the future of the industry to the market forces like the Government does and there should be developed incentives in order to engage the industry towards innovative work.

5.8.2 Sharing resources like capital and knowledge

Developing knowledge and skills are critical for Norwegian firms in order to succeed within the floating wind industry. Knowledge can be achieved within existing firms or through the creation of new. In this case, it is necessary to have a good cooperation between the industry itself and research institutions. It can be a helpful tool to have institutions researching on relevant and real-life research questions within floating wind to achieve common growth. We think that one of the most important processes when it comes to innovation is learning and sharing of knowledge. Learning in this matter can be achieved through experiments, projects and real-life experience. In order to achieve this proposition, Norwegian firms could invest or educate to promote the research and development process while helping to improve the overall learning and innovation process as a country.

5.8.3 Affect how firms spend their resources

Having access to capital tends to be a scarce resource when it comes to research and development. Many firms want to evolve and grow alongside the industry, but without taking a high risk. It is therefore important to have a clear strategy before deciding whether to invest or not. We have three different suggestions on business models that firms can use to collect the economic value from the technological potential. You can try to further your technology within the company, outsource the development process or create a new company to use this technology within new fields. When it comes to the floating wind industry, most of the firms have their main operation within different industries. Both public and private firms tend therefore not to prioritize new industries in form of investments and staff. If the Norwegian Government wants floating wind to be the next oil and gas industry, this is a topic of debate. How firms choose to allocate their resources may be essential for the future success of the

industry and can be dependent on the politicians to participate. Most of the firms do not have the capital or resources needed to invest in research and development or they cannot take all the risk by themselves, which is why measures from the Government and different policies are necessary.

5.8.4 Recognize the growth potential to identify opportunities within technology and economy

Through research and development projects it is possible to identify different technological and economic opportunities. In order for the Norwegian floating wind industry to reduce costs, it can either become more efficient or in larger scales according to Knut Vassbotn. Firms wants to be a part of the growth opportunity that this new industry can provide. It can therefore be challenging if the industry evolves to fast, which can result in Norwegian firms not being able to keep up with the growth and therefore lose the benefits of the situation. The Norwegian industry as a whole wants different suppliers within technology, products and so to be included in the market to grow the overall potential for the country. It is therefore necessary to build more full-scale wind parks that Norwegian firms can deliver their knowledge, capabilities and products to, which will automatically increase the potential benefits for the Norwegian economy.

5.8.5 Open up for discussion and exchanging ideas among firms and institutions

It is important that there are changes that allow universities and research institutions to become a part of the solution. We believe that collaborating and opening up for discussion among the oil and gas companies can come in handy due to their experience and knowledge towards offshore wind. To aid research institutions to conduct research and development it is useful to let them have access to different data that firms might have. Having a broad network and being a part of clusters is essential to create and spread new knowledge and information. The firms that are a part of a cluster will have a competitive advantage because of all the knowledge potential that are shared within these meetings. Several of the firms we have interviewed mention that network and clusters are essential to succeed on a global scale. The representative from the Norwegian Labor Party mentions that they are actively communicating with the industry, research institutions and other stakeholders in order to get more understanding and assist them in their progression. It is essential to receive knowledge and first-hand information from the firms working within the industry, but also to guide and influence them in the right direction.

5.9 Why is the relation between the industry and the Government important in order to succeed within an emerging industry?

The information provided will be a composition of information gathered through all of our interviews and findings. There are some direct examples below which are collected through the interview with the representative of the Labor Party, Ruth Grung. We do not have a goal to promote any political opinions or direction in this thesis, the information gathered will only be used as a guideline to understand the relation between the industry and the Government. The section below will be presented in different topics and asked as questions, followed by us trying to answer them. These questions were developed before interviewing Grung because it was essential information for us to figure out and learn in order to fully understand the circumstances towards the Government while answering our research and sub-questions.

5.9.1 What does the Government mean for firms when it comes to promoting development?

The Norwegian Government plays an important role when it comes to handling the direction for economic activity. They need to create a direction if the potential to develop an industry within floating wind is to be exploited. Floating offshore wind can be seen as a second chance, where bottom-fixed wind was an important first lesson. The Government did not create or show any signals, neither did they promote a direction that Norwegian firms should try to strive towards international competitive success within the industry. Norway did not have a home market that could have been used for experimenting and to gain market experience from. Some firms did evaluate the situation and assessed the international markets but waited to see the approach, which led to the international market to mature without Norwegian firms being a part of it.

We believe that a stronger setting can be achieved through an approach where there are policies supporting market access and incentives to promote diversification and innovation. Increasing the support towards marketing activities could be helpful because firms are satisfied with the technological relatedness but not towards the market relatedness. There should be created a policy that opens up for domestic market creation that can be used for verification, demonstration and piloting technology. Norwegian firms have challenges when it comes to verifying and proving any relevance connected to their concepts towards the international market. There are many Norwegian firms that vary in size and by strengthening the support towards access to capital could also prove to be a significant implementation towards growth

of the local supply chain. However, any policy measures that may be introduced should be seen in relation to the potential synergies that can be achieved while combining different policy instruments.

The Government is important because most projects that are in the planning or start-up phase are normally not profitable according to Axel Normann. Firms are dependent on sharing costs and risk in order to build prototypes that can be used for further research or progression. Having a close relation with the Government can provide firms with a helping hand consisting of incentives, funds and so on. We think that having assistance both in the form of capital and knowledge let people and firms focus more on the progression itself, rather than the risk and limitation of resources. Cooperation is an important measure to achieve success, which is why a close relation with Government, clusters, competitors and research institutions are key to optimize projects. It is possible to divide costs among them in order to reach a mutual success and develop the business together where information can be shared among the contributors. Like any industries it is important to have large firms in order to influence others and start with various projects, however, the leading companies also need assistance to be willing to invest their time and resources.

5.9.2 Does the Government have any plans on how to succeed within offshore floating wind?

Ruth Grung mentions that the Government has made a strategy towards offshore wind and are currently debating about two out of three areas that can be used for testing technology in the matter. Norway is the only country around the North Sea that does not have a set goal or guidelines when it comes to expanding within the field towards 2030. Individual companies have a goal, but the Government itself does not have a clear or structured plan that can function as a general guideline for the industry as of today. The Labor Party believes that a reasonable goal is to have five GW and strive to achieve 10% of the global market.

5.9.3 How can the Government contribute towards floating wind?

We believe that there are several ways that the Government can make contributions that will lead to changes in the industry. As of today, there are not enough contributions available towards the industry. The measures that has been presented and promoted so far has not been significant enough to get things in the right direction. The obvious measures that could assist or further research and development are through funds and by strengthening or inventing new

incentives or tax reductions for those firms willing to invest. The Norwegian Labor Party thinks that offshore wind should have similar or the same tax rules as oil and gas. They believe that an increased amount of funds given to Norwegian Government enterprises like Enova, Nysnø and so on could have made a change. Ruth Grung believes that both the Government and Enova should develop different support mechanisms or rules that are custom made for the floating wind industry.

5.9.4 What is emphasized when subsidies are assigned?

According to Ruth Grung it is important that any projects presented can create profitable jobs, and that it can give revenue to the society, both directly but also through selling technology, electricity and solutions. The projects are often preferred if they can help reduce the carbon footprint as well. We think that there should be equal treatment no matter the size, if they have a game changing idea, they should be rewarded for it in form of support of resources and capital. The Government wants to maintain comprehensive value chains, this means that they do not want to create a monopoly but a good market where competitors strive for success, both individually and together. By having a strong market where competition occurs will help promote innovation and the Norwegian international competitive advantage. The overall society are dependent on large firms to contribute and further the growth but also needs help from creative small businesses.

5.9.5 How can the industry influence and affect the Government towards changes?

Ruth Grung answers this question by saying that the firms within the industry can work towards active political challenges or take own initiatives towards the development of the industry itself. In the future the globe should be maintained through sustainable energy, where offshore wind can be one of the main contributors. There needs to be developed different business models and a distribution map over the consumers of the energy produced. There are currently several products developing, active test pilots and relevant projects to improve the offshore wind industry. Having an open dialogue and communication is essential in order to influence the Government. It can promote the projects itself but also increase the trustworthiness of the ongoing projects, as well as showing the value potential. The Norwegian Government are dependent of the industry showing interest and credibility, Hywind Tampen is an example of a project that changed and affected the overall view towards the industry.

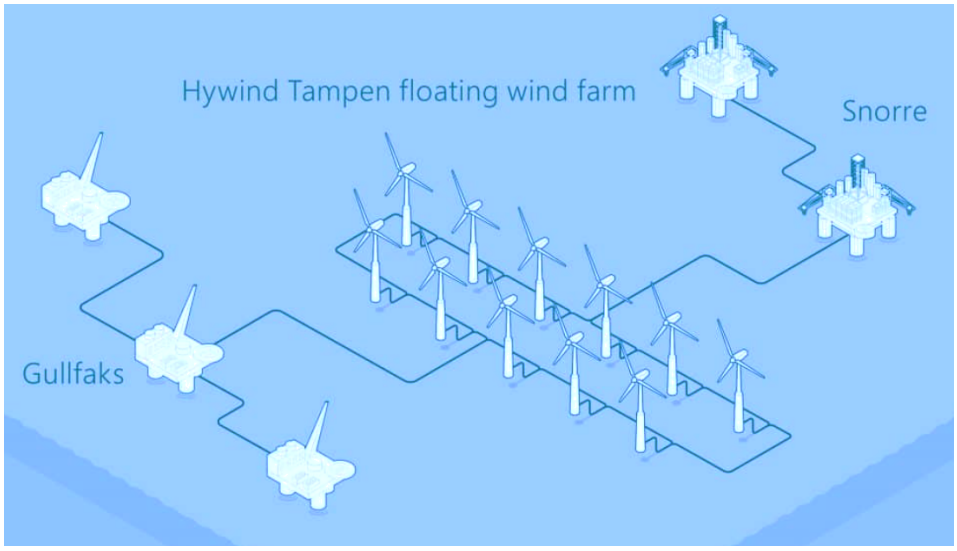

Illustration 6: An illustration of Hywind Tampen which shows how the floating turbines will give power to the oil fields Gullfaks and Snorre. Source: Oljedirektoratet, 2019.

Having a successful new industry can create value for the country in form of capital and labor. All our interview objects mentioned that they believe offshore wind will create a lot of value for the country and employment in the future. The Labor Party wants to set requirements towards employing local workforce when public funding is handed out to firms or projects. The Government did not set any requirements towards employment when Enova funded Hywind Tampen with over two billion NOK. The Labor Party wants all firms to have a chance to demonstrate their capabilities, competence, ideas and technology, especially when it has the potential of bringing valuable knowledge, experience and labor to Norway. We believe that it is therefore important to create a balance and having an open discussion back and forth between the industry and Government. Active collaboration can assist one another to develop the local supply chain. It also has to possibility to collect references and information from real-life projects.

5.10 How has Covid-19 affected the expansion within floating wind?

When it comes to Covid-19, it is important to see it from two perspectives, both from the industry but also from the Government. For the companies within the offshore wind industry it looks like it does not affect the ongoing projects that much, yet. Arne Eik mentions that Equinor is trying to work towards their ambitions when it comes to renewable energy, but the development can be affected due to lower revenue as an effect of reduced oil prices. They are still trying to stay competitive and wants to develop their projects and technology further. Many of the ongoing projects are large, and the costs associated with pausing them and then restarting

at a later occasion can be quite significant for firms. Both in the form of capital lost but also a reduction in chance of gaining competitive advantage compared to competitors. Although the firms have made some changes in the aspect of having their employees work from home, there are still held meetings and active communication to maintain stability within the projects. However, if the virus cannot be maintained or stopped there is a lot of insecurity also among the active projects within offshore wind.

The Government have had significant changes to their everyday work life since Covid-19 affected the country. The ongoing virus has led to a significant drop in oil prices which has led to several challenges for Norway. It shows how sensitive and vulnerable the overall economy in the country actually is. This have affected firms in a way of having to deal with more critical challenges, which means that the expansion of a new industry can be placed on hold from their side. According to the representative from the Labor Party they have more time to read upon the matter, attend meetings online, though they prefer and believe more in open discussions in-person. The changes in oil prices can make firms more accessible towards a new industry. A sudden drop in oil prices can make the decisions towards investing easier. If the prices raise it can reduce the willingness to transition towards the industry. Ruth Grung believes that the sudden drop in oil prices and when Covid-19 is under control can make people more welcoming towards a new industry. It can open up for more commitment towards the matter while simultaneously securing the Norwegian core competences in all parts of the value chain.

5.11 Environmental footprint

Forecasts indicate that large-scale expansion of floating offshore wind will in the long run contribute to the sustainable extraction of energy, which will help achieve the climate targets set during the Paris Agreement. According to IEA (2019) the European Union believes that offshore wind is set to become the largest source of electricity by 2040 and as figure 12 shows offshore wind will generate about 25% of the energy in Europe in 2050. As commercial players, companies themselves do not set global goals for how much they should reduce their emissions but look at how the industry can deliver on the goals that are politically agreed upon. The companies we have been in contact with are of the utmost importance to focus on sustainability in order to have a long-term business. The companies work to not affect fishing activities and are in dialogue with bird associations to see typical migratory routes and so on. They spend a lot of time avoiding conflicts with environmental activists, in addition to society in general, and

record that most environmental organizations are of the opinion that there are greater benefits of offshore wind rather than disadvantages. We are also of the opinion that most people have become more environmentally conscious and look positively at developing environmentally friendly production sources.

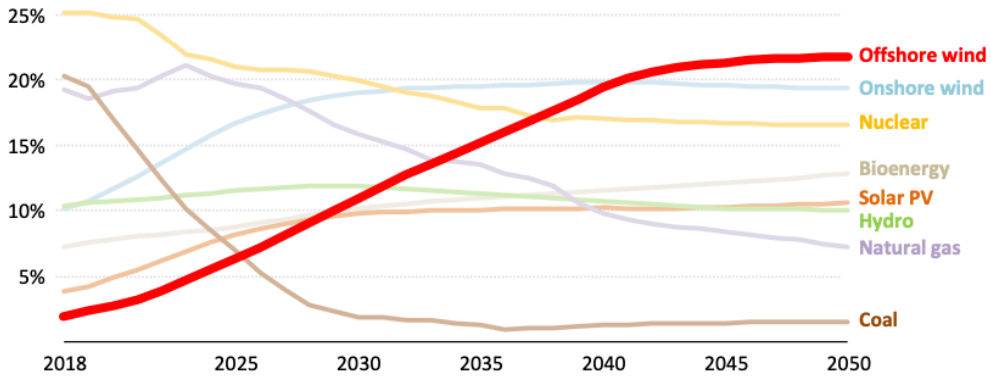

Figure 12: Share of electricity generation by technology in Europe by the years to come. Source: IEA, 2019.

6.0 Conclusion

The aim of this thesis is to answer the following research question: **What measures are important when it comes to succeeding and expanding within an emerging market of floating offshore wind for Norway in order to develop a more sustainable production level within the industry?** So far, we have discussed our empirical findings and compared it with established literature on innovation frameworks. Conducting research on an emerging industry has been challenging because there has been released new information regarding the industry and projects throughout our research in both media and from research institutions. Although, we still managed to reach a conclusion and answer our research and supplementary questions through our findings and discussion.

Floating offshore wind is considered an immature renewable energy source, it is a rapidly growing industry that in many ways will characterize the recovery of renewable energy in the future. Norwegian industry and companies are currently possessing world-leading technologies in the petroleum industry, maritime industry and renewable energy – where offshore wind is an area where all these competences meet to some degree. It is based on knowledge-based expertise in these areas that makes the similarity easier to transfer between industries. Having a fluctuating oil price and decreasing investment levels in Norwegian oil and gas has led to an increase in the motivation towards diversification into offshore wind. Firms that are able to use already existing infrastructures or different technical solutions seems to be in less need of high capital investment in order to enter the industry. Equinor's Hywind technology is considered as one of the leading technologies to this date, but there are a number of new technologies under development where several Norwegian players are involved in projects such as WindFloat and Flagship. To preserve the advantages, Norwegian industry must continue to develop smarter and better solutions, which requires good interplay between the industry, Government, education, research institutions and innovation. The Menon Economics report reveals that Norwegian industry has the potential to create close to 128,400 jobs and a value creation of up to NOK 117 billion over a 30-year period, but then Norwegian companies must be willing to risk and invest in the development of technologies and market access at an early stage. Here, there are national ambitions to produce 30GW by the year 2050 and secure up to 20% of market share globally. This will be characterized by the extent to which you can develop good enough solutions when it comes to the development and installation of the turbines as well as having it performed on larger scales.

The first supplementary question is about what innovative solutions that can be helpful or essential when it comes to succeeding within the floating wind industry. It is important to have a clear, strong and specified innovation strategy towards how they should allocate their capabilities and resources in order to achieve their goal while promoting an innovative organization. The firm's dynamic capabilities, knowledge and resources that are achieved through oil and gas gives Norway a competitive advantage towards floating wind. It provides firms with a special position towards being able to develop concepts, adapt and to optimize them towards floating wind technology. We believe that existing knowledge and being willing to learn is an important part of a successful innovation process. A good way to share and learn new knowledge can be meeting up with actors in the industry. The Norwegian Offshore Wind Cluster function as a network where actors in the industry can exchange ideas and discuss amongst themselves. Although Norwegian companies have a great deal of expertise related to floating offshore wind, there will still be a need to develop their products or services to varying degrees of innovation where we recommend that Norwegian companies focus on marine operations, grid connection and operation and maintenance. Having access to large sources of knowledge, capital and experience can reward firms with a good reputation, financials, competitive advantage and new business partners.

The second supplementary question is about the main challenges of succeeding within offshore wind. The industry has specific characteristics that can be different compared to those industries that firms have previous experience or knowledge. Examples of such differences can be sales processes, customer relations or contract designs. The dedication of firms is linked to the overall dynamics within the sector that firms are diversifying from. Firms may not have strong incentives to commit to a new industry if the main policy aim is to create a framework towards producing profitable oil and gas in the long term. The dedication by diversifying depends on the long-term expectations for the current business and the prospects for new industrial opportunities. Most firms that diversify towards offshore wind may only have to make minor changes when it comes to technology, however, they normally need to make substantial changes and investments when it comes to marketing capabilities and in terms of sales. Different market risks and uncertainties can result in firms delaying their entry towards the industry. The existing market characteristics, resources and capabilities that are necessary in order to enter the international offshore market can function as barriers or challenges for the Norwegian suppliers. We noticed that these challenges can be reflected upon when it comes to

policy. The current policy support is more pointed towards research and development of technology, rather than other support mechanisms that firms actually express the need for.

The third supplementary question is about the importance and relation between firms and the Government. We believe that they are dependent on one another in order to strengthen the Norwegian economy and position towards floating offshore wind. The Government plays an important role for firms when it comes to handling the direction they want to achieve towards economic activity. It is important for firms to demonstrate their capabilities and competences, share resources like capital and knowledge with one another and to influence the Government towards changes. Strengthening the home market will allow Norway to collect references and information from real-life projects that can be used for experimenting and to gain experience within the industry. Although Norwegian (and international) companies have many good solutions for how a development is to take place, there are still major uncertainties that create risk as there is a lack of data. The industry requires a lot of time for testing, many resources, collaboration between several actors and costs billions of NOK to develop.

The obvious measures that could assist or further R&D are through funds and by strengthening or inventing new incentives or tax reductions for those firms willing to invest. We believe that a stronger setting can be achieved through an approach where there are policies supporting market access and incentives to promote diversification and innovation. Increasing the support towards marketing activities could be helpful because firms are satisfied with the technological relatedness but not towards the market relatedness. There should be created a policy that opens up for domestic market creation that can be used for verification, demonstration and piloting technology in order to succeed in the international market. There are many Norwegian firms that vary in size and by strengthening the support towards access to capital could also prove to be a significant implementation towards growth of the local supply chain. However, any policy measures that may be introduced should be seen in relation to the potential synergies that can be achieved while combining different policy instruments.

The final supplementary question is about the ongoing virus, Covid-19 and how it has affected the industry and Government when it comes to growth. For the companies within the offshore wind industry it looks like it does not affect the ongoing projects that much, yet. They still have qualified personnel working within technology, research, development, investment etc. They are trying to keep their progression stable without any setbacks while trying to expand

and succeed to secure competitive advantage. The Government have had significant changes to their everyday work life since Covid-19 affected the country. The ongoing virus has resulted to a significant drop in oil prices which has led to new challenges for Norway. This have affected them in a way of having to deal with more critical encounters, which means that the expansion of a new industry can be placed on hold from their side. We believe that the reduction in oil prices and when Covid-19 is under control can make people more welcoming towards a new industry. It can open up for more commitment towards the matter while simultaneously securing the Norwegian core competences in all parts of the value chain. If the virus cannot be maintained or stopped there is a lot of insecurity also among the active projects within offshore wind and only time will tell if it will affect the development or not.

When it comes to answering the **research question** itself, we believe that a few measures are essential in order to succeed and expand within the industry. First of all, we think that the Norwegian players within the industry should continue their good work towards simplifying products and processes, reduce costs and strive to succeed internationally. They need to be willing to develop the industry together and initiate in the improvement of a home market with several local actors. If Norway wants to be a part of the potential of the industry, we need to develop a home market before it is too late. This will contribute to developing competence, experience and market knowledge. The Government is needed to help out in the form of subsidiaries, tax reductions, strengthening or inventing new incentives towards investment in order to reduce the overall risk for firms. Prognosis and calculations conducted give believes that this emerging industry will create great value in the future, in the form of capital, employment and renewable energy. If everything is put right from the Government, we think that combining the two methods of learning, STI (science, technology and innovation) and DUI (doing, using and interacting) is the way to go in order to excel within the industry.

6.1 Further research

In order to further research on how to succeed and expand within an emerging industry, it would be interesting to write a confidential thesis instead. By doing so, we would get more access to valuable information and knowledge through interview objects because they could be more open in our conversations. Not everything would be shared throughout the interview processes, but we could have gained access to some trade secrets that could make our study more reliable. There are large uncertainties around the subject because it is such a new energy source that is

not cost efficient yet. Further research is needed in order to achieve a more overall overview about the industry in the future when it comes to the renewable energy production.

It would also be interesting to dig into how different existing policies are in different emerging markets, in order to see relations or differences between offshore wind and other potential markets.

The floating offshore wind industry is an emerging market that are constantly changing, which makes it difficult to find strong and solid conclusions because new technology or processes are developed frequently. Throughout our research there has been released new information regarding projects or firms within the industry in both media and from research institutions. It would have been helpful if we could have known about this information before it is confirmed and open to the public. If we had more time we would have reached out to more firms, additional politicians and people that are working towards the expansion and development in order to find even more information about the subject.

6.2 Limitations

We have now finished our research and it is therefore important to look back and identify areas that we could have done differently or improved. As mentioned above, information could have been more available and reliable if we could have gotten access to trade secrets and so on through a confidential thesis. Even though, we still managed to get trustworthy information through our interviews and previous research in order to reach a conclusion. However, if it was not for Covid-19 we could have had the chance to conduct more interviews to support our work because the virus made it significantly harder to obtain interview objects. We would also have preferred to get more people alongside the thesis from the Norwegian Government, besides one representative from the Labor Party to get a more overall assessment.

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8.0 Appendices:

8.1 Appendix I: Interviews

Forespørsel om deltakelse i forskningsprosjekt

What measures are important when it comes to succeeding and expanding within an emerging market of floating offshore wind for Norway in order to develop a more sustainable production level within the industry?

Bakgrunn og formål med forskningsprosjektet
Formålet med vår forskning er å få innsikt i hvordan man kan lykkes når det kommer til ett nytt fremragende og voksende marked, som i dette tilfelle omhandler flytende vindkraft. Oppgaven handler om hvilke innovative løsninger som kan være med på og prege fremgang og suksess. Den skal også inneholde ulike avgjørende faktorer fra for eksempel leverandører, myndigheter, regelverk, skattelette, investorer osv.

Prosjektet er en masteroppgave og gjennomføres av to studenter ved Handelshøyskolen ved Universitet i Stavanger. Du er forespurt om å dela på bakgrunn av din rolle som x-x-x-x-x-x

Hva innebærer deltakelse i vår masteroppgave?
Deltakere kan velge om de vil gjennomføre intervju skriftlig eller muntlig over telefon. Intervjuet vil være tilpasset dine erfaringer om emnet og vil være tilpasset din posisjon/yrke. Det vil være åpent for dine innspill rundt temaet. Dersom intervjuet gjennomføres over telefon ønsker vi gjerne og ta opptak over selve samtalen for eget bruk.

Hva skjer med innsamlet informasjon og informasjon om deltaker?
Vi ønsker svært gjerne å bruke innsamlet informasjon til vår masteroppgave, samt knytte ditt navn og din rolle til denne informasjonen. Dersom det er ønskelig og bli anonymisert skal dette selvsagt etterkomme ditt ønske.
Prosjektet skal etter planen være innlevert og avsluttet 15.06.2020. All data som er innsamlet vil selvsagt slettes når sensur er mottatt på oppgaven.

Frivillig deltakelse
Det er frivillig om du ønsker å delta på vår studie, og du kan når som helst trekke ditt samtykke uten og oppgi en grunn for dette. Dersom du trekker deg, vill alle dine personopplysninger bli anonymisert.

Dersom du har noen spørsmål, kan du kontakte:
Erik Aske Malmin, epost: erik.malmin@gmail.com, telefon: 93234696
Thomas Winnem Jørgensen, epost: th-winn@hotmail.com, telefon: 99364955.
Veileder er Marte Solheim, epost: marte.solheim@uis.no.

Samtykke til deltakelse
Jeg har mottatt informasjon og er villig til å delta

_____
(Signatur av deltaker, dato)

Interview I: Aibel

Navn på selskap, ditt navn og rolle?
Axel Norman, Study Manager i Aibel.
Går det fint at vi bruker ditt navn i oppgaven og at vi tar opp samtalen til eget bruk?
Ja så lenge jeg får lese igjennom hvor mitt navn eller Aibel nevnes.
Hva er målet til Aibel når det kommer til flytende vindkraft?
• Vi er og ønsker å forbli store på substasjoner • Disse stasjonene opererer med å samle inn strøm og sender det inn til land • Sub-stasjoner er vår hovedsatsing • Når det kommer til flytende vind ønsker vi i tidlig fase å være med på å posisjonere firmaet mot potensielle nye bransjer, være med på læringen men vi investerer ikke tungt innenfor flytende vind enda.
Hvilke prosjekter har dere innen flytende vindkraft?
• Vi har ikke noen større prosjekter slik ståstedet er i dag, men vi har en del studier som har og blir foretatt.
Hvor stort anslår dere potensialet for norsk offshore vind er?
• Offshore vind har ett stort potensial til å bli avgjørende og stort. • Vi har ikke gjort noen markedsmessige vurderinger, så det betyr at vi ikke direkte har noen tall eller statistikker på hvordan vi anslår dette. • Businessen vår slik det står i dag er hovedsakelig innen offshore bunnfast vind • Flytende vind er noe vi ønsker å posisjonere oss innenfor • Det har ikke blitt gjort noe stort fra vår side i Norge enda, men det er ett stort fokus på verdensbasis som vi fokuserer på.
Har dere et godt utgangspunkt for å drive flytende vindkraft, hvorfor?
• Vi føler at vi har ett godt utgangspunkt når det kommer til flytende vindkraft grunnet tidligere erfaring innenfor større konstruksjoner. • Vi har et godt utgangspunkt da vi har satt mange digre konstruksjoner offshore, både bunnfaste og flytende. • Aibel som selskap har ambisjoner om å være både på turbinsiden og substasjon siden innen flytende vindkraft. • Vi har jobbet aktivt med kunder som driver med pilotparker og testing innenfor dette segmentet. • Vi har god kommunikasjon med våre underleverandører og utviklingsavdelinger. Vi oppdaterer dem om hva vi trenger, så får vi tilbakemeldinger på hvordan prosjekter ligger an uten å måtte investere tungt. • Allerede 10 år etter at vi begynte med bunnfast havvind har markedet begynt å lukke seg. De store selskapene som Aibel, ABB og Siemens leverer substasjoner. • Det er vanskelig for andre å infiltrere markedet da det fort kommer krav for å kunne levere prosjekter eller konstruksjoner, som kan være basert på tidligere leveranser, erfaringer osv. Dette er noe som fort kan forekomme dersom man ikke er med på nye markeder ved oppstart

- Være posisjonert tidlig for markedet kan fort bli låst
- Det er viktig å satse tidlig for å kunne være med og posisjonere seg for å kunne bli med på den videre satsingen og utviklingen. Det kommer ikke gratis.

Hvordan jobber dere for at norsk offshore vindkraftteknologi skal bli fremst i verden?

- Vi gjør interne initiativ på egen kost for å kunne investere i de ansatte og fremme ideer. Utvikler egen kunnskap ved å ha interne studier som for eksempel hvordan vi vil løse offshore problemer eller muligheter.
- Før en kunde kommer til oss, spør de ofte hvilken SUB-struktur som er best, når det for eksempel er kost effektivt å gå fra bunnfast til flytende.
- Presenterer interne svar på konferanser
- Vi jobber aktivt for å utvikle kunnskap for det selger seg inn og styrker vår posisjon mot flere kunder
- Viktig å kapre prosjekter og kunder ved å ha relevant kunnskap for å kunne være med på bølgen tidlig. Interne initiativ og konferanser er med på å utbedre kunnskap og vår posisjonering.

Betyr leverandører eller underleverandører mye for deres utvikling innen innovasjon eller ekspansjon innen havvind, hvordan?

- Ja, både leverandører og underleverandører er essensielle for å kunne fremme videre ekspansjon eller utvikling innen upløyd mark.
- Vi ser igjennom erfaring at det er viktig å ha langsiktige partnere både i bunnfast og offshore hvis vi ønsker å utvikle prosjekter.
- Det er viktig å integrere leverandørenes utstyr tett slik at man trenger minst mulig plass eller areal på sjøen. Forståelse til hverandre og hvordan alt virker er viktig. For å kunne optimalisere en operasjon kreves det dypt samarbeid.
- Soil conditions, ngi (norsk geologisk) og flere andre er viktige. Trenger noen man kan jobbe med fast slik at man ser på hverandre som partnere. Hvis ikke vil man møte ulike kommersielle hindringer i vår drift.
- For å lykkes må man samarbeide.

Jobber dere for å nå klimamålene som ble satt i Parisavtalen?

- Aibel har en strategi rundt klimamål og å være bærekraftig
- Bottom line er at Aibel som alle andre ønsker å ha en business i fremtiden.
- Bærekraft er viktig i form av at olje skal bli produsert
- Det er helt nødvendig å ha fokus på bærekraft for å ha en langsiktig business.

Hva er hoved utfordringene for å lykkes innen flytende/bunnfast havvind?

- Det kan for eksempel være de ulike konstruksjonene og ulike tilpasninger tilknyttet disse
- Oppnå konkurransefortrinn
- Være tidlig ute for å kunne bli med på bølgen
- Levere relevante løsninger til en fornuftig pris

Hva betyr offentlige myndigheter for dere når det kommer til videreutvikling? - **Finnes det ordninger som blir tilrettelagt for dere eller andre?** - **Støtteordninger (støtte, subsidier, særskatter, etc.)?**
• Det er viktig da prosjektene som regel ikke er lønnsomme i startfasen. Man er avhengig av å kunne fordele risiko og kostnadene slik at man kan bygge prototyper for videre progresjon. • Man må som regel bare begynne ettersom man vet at det ikke er kommersielt • Det er viktig å ha en hjelpende hånd fra norske myndigheter da de innfører ulike støtteordninger, incentiver og liknende slik at vi kan fokusere på progresjon og ikke kostnadene direkte. • Aibel er en leverandørbedrift og har ikke penger til å drive med direkte investeringer i ny teknologi, men kan motta støtte fra ulike aktører. • Samarbeider jevnt med ulike forskningsråd for å optimalisere prosjekter. Spleiselag fra forskningsråd og aktører kan opprettes, noe som bidrar til at bransjen utvikles som et fellesskap hvor informasjon deles innad. • Trenger de som drar i gang prosjekter, de store trenger også å få støtte + fjerne risiko for å være villige til å investere i disse prosjekter.
Hvordan har Covid-19 påvirket deres arbeid om utviklingen og ekspansjon innen flytende havvind prosjekter?
• Innenfor vind er alt som før, foreløpig. Det kan snu fort men det er vanskelig å spå • Hjemmekontorer og karantener skaper litt ekstra utfordringer da vi ikke får jobbe på samme måte som vi vanligvis gjør • Prosjektene våre er store og tunge, noe som fører til at de drives som normalt for det kan ta lang tid og stoppe ett prosjekt for så og gjenstarte det senere.

Interview II: Aker Solutions

Navn på selskap, ditt navn og rolle?
Knut Vassbotn, Head of Business Development, Offshore Wind hos Aker Solutions
Går det fint at vi bruker ditt navn i oppgaven og at vi tar opp samtalen til eget bruk?
Ja, så lenge jeg får lese igjennom eventuelle notater og referanser hvor mitt navn eller Aker nevnes i oppgaven.
Hva er målet til Aker når det kommer til flytende vindkraft?
• For å ta litt av historien til aker så er vi ett 180 år gammelt selskap som ikke er ett nytt selskap til fornybar energi. Når Norge ble elektrifisert for hundre år siden så leverte vi turbiner til vannkraft. På ett visst tidspunkt hadde vi 80% markedsandeler på turbiner. Historisk sett så kan Aker fornybar bransjen og vi ser at dette er ett område hvor vi har noe å tilføye. • Vi har vært engasjert i en rekke forskjellige segment i løpet av disse årene. Vi begynte produksjon av ovner, har hatt skipsverk og vært innenfor en rekke industrielle sektorer. • Det vi har operert med hovedsakelig er maritimt hvor vi bygger på kompetanser i bunn av selskapet og innenfor marine, mekanisk, elektro. • Når vi begynte å se på havvind med nye øyne for 5-6 år siden, så vi på hvor vi kan ha ett fortrinn, vurderte sol, bølgekraft, tidevann, bunnfast havvind og andre løsninger. Fant raskt ut at flytende vindkraft var en preferanse for selskapet. • Jobber med dette i noen år og fått en posisjon i markedet. Bakgrunnen for vår inngang til markedet er at vi har produkter innen alt annet enn turbinen. Dynamiske kraftkabler, substasjon, fundamenter til flyter. Dette er noe vi har jobbet med i oljen over 50 år. De som har utviklet vind kommer fra Onshore selskaper og det er disse som foreløpig preger markedet. • Aker Solutions er en kommersiell aktør som har planer med ambisjoner for flere år som knyttes opp mot strategien for hele selskapet som heter 20/25/30. Innen 2030 skal 20% av omsetningen komme fra fornybare ressurser, hvor havvind er den største og 25% fra lavkarbon. Dette er en indikasjon for hva ambisjonen vår er innenfor en 10 års horisont. Innenfor denne horisonten vil nok totalinvesteringer innen havvind være større enn investeringer innen olje og gass.
Hvor stort anslår dere potensialet for norsk offshore vind er?
• Vi har våre egne vurderinger men det er interessant å se at Wind Europe (EUs vindorganisasjon) har tegnet opp ett bilde over hvis Europa skal nå sine mål for elektrisitets produksjon fra fornybare kilder og dermed leve opp til Parisavtalen. • For at dette skal bli reelt må det leveres 450 GW elektrisitet fra havvind. For å sette dette i perspektiv vil dette koste (når havvind blir konkurransedyktig rundt 2030), 3 milliarder dollar for å bygge ut 1 GW. Dette forklarer litt over hvor stort dette markedet vil være. I samme rapport er en naturlig ambisjon for Norge å kunne levere 30 GW i år 2050.

Har dere et godt utgangspunkt for å drive flytende vindkraft, hvorfor?

- Vi kan offshore da vi har levert produkter her i mange år. Vi kan levere alle produkter som er nødvendige for å drive med flytende havvind. Faktum er at i dag er det ingen store flytende havvind parker.
- Dette er en stor mulighet for oss i Aker Solutions og Norge. Det er lettere å komme inn i ett marked som ikke er modent hvor det forventes stor vekst. Det er dalige debatter hvordan Norge skal finne en ny fot og stå på i tillegg til oljen. Ett av de alternativene for å bygge videre på den kompetansen vi har nå kan være havvind.
- Vi har brukt mye tid på hva som skal være våre bidrag til bransjen. Typisk i oljen er det vanlig å legge med tidligere erfaring eller prosjekter. Faktum er at dette ikke er en stor industri i dag og man må derfor finne sin del av verdikjeden som ditt selskap er godt egnet.
- Slik som ståstedet er i dag så er dette markedet upløyd mark da ingen har levert tidligere prosjekter og har mye historie å vise til. Så lenge du har noe som kan behøves i den industrien er det ett godt tidspunkt å investere på.

Hva betyr cluster/nettverk/samhold for dere i sammenheng med flytende havvind?

- Dette er noe som er viktig. Sitter selv som styremedlem i Norwegian Offshore Wind Cluster. De har gjort en god jobb med å få på plass metcenteret og ett område som er gjort tilgjengelig for testing av flytende havvind og liknende produkter
- Det er en rekke node clustere i for eksempel Bergen, Kristiansand, ett Sintef NTNU miljø i Trondheim.
- De spiller en avgjørende rolle som en katalysator for kommersielle aktører for flere i verdikjeden, både store og små.

Betyr leverandører eller underleverandører mye for deres utvikling innen innovasjon eller ekspansjon innen havvind, hvordan?

- Det er naturlig for oss å ta med leverandører som vi allerede har ett forhold til. Spesielt leverandører som har et fotspor i den lokasjonen eller landet som vi skal bygge. For eksempel i Korea, som ett selskap har vi nok levert mer enn 1 million tonn stål, som viser at relasjonene her er essensielle for videre drift.
- Vi har relasjoner i USA som vi bygger videre på, en stor tilstedeværelse i Skottland. Her i Norge er det veldig interessant for her har man en stor og oppegående verdikjede med store spillere og bidragsytere.
- Må være forsiktige å tro at tidligere relasjon kan sikre deg flyt eller prosjekter utenlands. Man er avhengig at man sikre seg en posisjon i markedet hvor man er sterkest for deretter og kunne bygge videre eller ekspandere til andre markeder.
- Når man kommuniserer med ministere og sittende regjering. Det er viktig med ett godt hjemmemarked for å løfte norsk leverandør industri. Da kan man trene på ulike prosjekter i Norge slik at man kan bli god innenlands for å deretter bli god utenlands.

Har Equinors Hywind prosjekter betydd noe for dere?
• Har vært noen ledende aktører og prosjekter hos Equinor. • Vi har kjøpt oss inn i Principle power som leverer wind float prosjektet. Dette prosjektet har størst markedsandel, nærmere 50% lav markedet leveres med disse konsepter. Vi har 25% eierskap i dette selskapet. • Får se hvilke aktører som er med når dette blir en stor industri, det er ingen tvil om at Equinor har store ambisjoner innenfor dette.
Har Hywind Tampen gitt inspirasjon eller tanker innenfor industrien?
• Vi har våre egne konsepter som vi først og fremst kjører på egenhånd. I ett marked som bygges opp fra små volum så vil alle gode krefter kunne dra bransjen i samme retning som er i utgangspunktet positivt
Jobber dere for å nå klimamålene som ble satt i Parisavtalen?
• Som en kommersiell aktør setter vi ikke mål politisk globalt men vi ser på hvordan den industrien her kan levere på de målene som er vedtatt politisk • Hva betyr det å redusere karbonfotavtrykket? Hvilke nye teknologier kan hjelpe til å levere her? Her kommer vi med løsninger som kan besvare politikernes spørsmål. Hva gjør Norge når gasseksporten til UK skal reduseres med 90% hvis UK skal nå sine mål. Hvordan kan vi hjelpe de forskjellige landene sine mål. Her må vi sette opp våre ambisjoner mot målene til andre land.
Finnes det noen miljøutfordringer eller aktivister som hindrer videre ekspansjon?
• Vi bruker mye tid med andre interessenter som opererer i og rundt det vi prøver og få til. Jobber med selskaper som er interessert i strøm, kommuner som kan ha mulighet til å ta imot strømmen for å sette opp en onshore substasjon. Når det kommer til havet jobber vi mye med fiskeri for ikke å påvirke fiskeriaktiviteter, aquakultur for å se om man kan sette opp vindpark i samme område. Vi er i dialog med fugleforeninger for å se på typiske trekkruter. Vi bruker mye tid på å unngå å komme i konflikt med slike organisasjoner, i tillegg til samfunnet generelt. • Fordeler med flytende havvind er at de kan plasseres utenfor horisonten. Det er veldig viktig å fortsette med dialoger med interessenter som kan bli påvirket underveis.
Møter man noen utfordringer når det kommer til utbyggingstillatelser fra myndighetene?
• Dette går tilbake på behovet for fornybar elektrisitet. Mye av landets og vår produksjon er elektrifisert. • Vi opplever at regjeringen og politikere støtter opp mot videreutvikling og forskning når det kommer til flytende havvind. Forventer at politikerne er i stand til å levere på de ambisjoner som etterhvert blir satt. • Vi ser at lokale kommuner og samfunn er med på å støtte opp videreutvikling av slike prosjekter da det kan bringe verdi tilbake til det lokale samfunnet. Ser at

utbygging gir tilbake til enkelt kommuner i tillegg til sørvest landet og Norge som nasjon

Hva er hoved utfordringene for å lykkes innen flytende/bunnfast havvind?

- For Norge: Tror at man må etter hvert må sette seg en ambisjon. Hva ønsker man å få til.
- Etablere ett sett med virkemidler for at det kan lykkes. Åpne opp områdene på utsiden av Nord og sørlige Nordsjø to. Man må få til en pakke hvor man kan satse på en industri, som kan bli Norges topp 5 eksport industri. For Norge er de viktigste områdene eksport av teknologi og reelle arbeidsplasser. Over tid kan det øke Norges strømproduksjon i forhold til å redusere karbonavtrykket.

Hva betyr offentlige myndigheter for dere når det kommer til videreutvikling?

- **Finnes det ordninger som blir tilrettelagt for dere eller andre?**
- **Støtteordninger (støtte, subsidier, særskatter, etc.)?**

- Alle store industrier i Norge har ett særskilt sett med virkemidler som muliggjør industrien. Innenfor olje og gass har man en fordelaktig skatteposisjon, innenfor maritim og rederi har man en tilsvarende.
- Forventer at det vil bli satt opp ett eget regime som gjør at man er i stand til å ta en ledende posisjon. Det må være muligheter å tilpasse det til at man også har en organisering av ny tildeling av ny tildeling av områder.
- Man må kunne fortsette og levere strøm til Norge og kontinentet når man er i stand til å produsere til å levere disse prosjektene som kan konkurrere med andre energiprodukter.

Skaper prosjektene dere driver med innenfor havvind sysselsetting og verdier for Norge?

- Noen av prosjektene vil være internasjonale men vil gi oss aktivitet innenlands. Sammenlikning med Aibel som har 40% av sin omsetning fra fornybart og er stort sett igjennom utlandet. Dette kan bli en industri hvor det er titalls tusen mennesker som er engasjert innenfor prosjekter i Norge eller internasjonalt.
- Viktig å ha de første prosjektene i Norge for å få en ledende posisjon og ha ett bredt aktør mangfold blant utviklere eller leverandører til Norge eller globalt.

Hva mener dere er de rette løsningene for å kutte produksjonskostnader forbundet med flytende vindturbiner?

- Det som må til for å få nå ned kostnadene er skala, i forhold til størrelse på turbin. Vi kan se at de har vokst fra 250kw og vokst til 9,5 MW. Vi ser at konkurrenter og andre aktører har klart å levere produkter med høyere skala.
- Størrelse på turbin er viktig i tillegg på størrelse på vindpark. Man må opp i størrelse for å få ned kostnadene globalt.

Hvilke innovative løsninger tror dere vil spille en viktig rolle for utviklingen et bærekraftig produksjonsnivå?
• Nedstrøms havprodusent – trenger en turbin, samme turbin som nå blir industrialisert i bunnfast vind. Produktene er tilgjengelig men her vil det foregå endringer og opp skalering. • Vil trenge dynamiske kraftkabler, to deler av verdikjeden, Array – kabler mellom turbinene. • Substasjon – for havdyp som er mindre enn 100-120meter er det naturlig å ha en bunnfast substasjon. For andre havdyp (dypere) er det naturlig å se på flytende substasjon eller en subsea substasjon. Her vil man trenge en dynamisk høyspent kabel. • Det er flere komponenter som ikke er nevnt som også behøves men de som er nevnt er nøkkel komponentene. Av de teknologiene som er i dag er det noen mangler men det jobbes aktivt med teknologi utvikling av flere prosjekter. I dag er det for eksempel ikke levert store flytende substasjoner eller subsea substasjoner.
Hvordan har Covid-19 påvirket deres arbeid om utviklingen og ekspansjon innen flytende havvind prosjekter?
• I en del av de prosjektene som vi har ligger litt frem i tid. • Kort oppsummert har det hatt liten effekt for oss. En rekke prosjekter som jobbes med og som vi fortsetter med å utvikle. Vi tror at det ikke vil være en stor innflytelse dersom vi klarer å komme tilbake til en mer normal situasjon fortløpende

Interview III: Norwegian Offshore Wind Cluster

Navn på selskap, ditt navn og rolle?
Arvid Nesse, Cluster Manager, Norwegian Offshore Wind Cluster
Går det fint at vi bruker ditt navn i oppgaven og at vi tar opp denne samtalen til eget bruk?
Ja..
Hvor stort anslår dere potensialet for norsk flytende offshore vind er?
Ifølge Menon-rapporten anslår man at Norge kan klare opp imot 20% av det globale markedet.
Hvordan jobbes det for at norsk offshore vindkraftteknologi skal bli fremst i verden?
Jobbes med i klynger – på flere fronter. Bringer bedrifter sammen og jobber innovativt. Norge har et godt utgangspunkt gjennom maritim og olje/gass næringen, hvor en har en sterk næring. Det andre finner vi igjennom innovasjon; fremtidens vinnere er de som klarer å gjøre dette mest kostnadseffektivt. I Norge som har relativt høye personellkostnader må en være enda smartere og ennå mer innovative – har gode forutsetninger.
På hvilken måte mener du et godt nettverk/cluster betyr for utviklingen av offshore havvind?
Det å jobbe sammen er viktig. Både for å få fram en helhetlig verdikjede, men også for å få fram nye innovative og gode løsninger.
Hva tror du Equinors Hywind prosjekter har betydd for andre norske bedrifter som driver med flytende havvind?
Equinor, Norges ledende energiselskap, og at de velger å bruke sin olje og gass kompetanse på havvind betyr veldig mye. I dag er Equinor ledende på flytende teknologi, med Hywind konseptet – som er det mest velutprøvde teknologien på flytende havvind. Har utvilsomt stor betydning. Aker Solutions – sterkt involvert i den nest mest uprøvde teknologien (WindFloat). Dr.Techn. Olav Olsen – fundament skal testes ut. Tre av de fire mest utviklede teknologien per dags dato er norske og er sterkt koblet til Norge.
Hvordan miljøutfordringer finnes det for en utbygging av store havvind parker?
Det er en kontinuerlig diskusjon i påvirkning av fisk; er uavklart. Jobber sammen med en bedrift fra Bergen for å avdekke forskningsutfordringer og avklaring på disse områdene. Støy på gyteområder – ulike oppfatninger. Håper å få denne debatten mer kunnskapsbasert fremover. Utover det, diskusjon om fugl, men er veldig mye mindre på sjøen enn på land.
Er det noen aktivister som kjemper mot og hindrer en videre ekspansjon av utbygging?
Ikke noen med stor kraft for øyeblikket. Registrerer noen: blant annet, Norges Miljøvernforbund, men i stor grad oppleves det at de fleste miljøorganisasjoner er av den oppfatning det er større fordeler med havvind enn ulemper.

Hva betyr det offentlige og myndighetene når det kommer til en utvikling for norske bedrifter?

Veldig spiller en viktig rolle for å få fram ny teknologi, både igjennom Forskningsrådet. Innovasjon Norge og Enova.

- Vært avgjørende for Hywind Tampen kommer i gang

Viktig at norske myndigheter kommer med ordninger for å få fullskala industrielle vindparker i Norge. Det har vi ikke sett ennå, men ser at det er en politisk interesse.
Det som så langt har blitt framlagt fra myndighetene har ikke vært tilstrekkelig for å få ting på plass.

Hva mener du er de rette løsningene for reduksjon av produksjonskostnader forbundet med flytende vindturbiner?

Det er to ting:

1. alltid jobbe med ny teknologi – teknologiutvikling
2. få skalaeffekten. Få dette industrialisert – få læringseffekt av utbygging

Hvis vi ser på bunnfast teknologi har læringseffekten vært veldig tydelig og gitt en bratt kurve fra de første vindparkene knyttet til kostnader.

Tror du at det er vanskelig for nykommere å infiltrere seg inn i markedet?

Generelt for alle bransjer, erfaring teller!
For flytende havvind er det få prosjekter å vise erfaring til, derfor vil det være viktig at flest mulig norske bedrifter får være med på de første prosjektene og dermed skaffe seg en erfaring på et tidlig stadium.

Har du oversikt over hvor mange norske bedrifter som mer eller mindre driver med utviklingen av flytende havvind?

Nei, det har jeg ikke. Men har en oversikt over hvem som er med i vår klynge – **Norwegian Offshore Wind Cluster.** Finnes på nettsidene våre.

I klyngene, er det slik at alle er med på deling av kunnskap og læring, eller er det noen som holder mye for seg selv?

Varierer det. Alle har sin måte å jobbe på. En del ting diskuteres ikke i åpne forum, altså ting som er konfidensielt. Men det er ikke uvanlig at bedrifter møtes separat og deler informasjon seg imellom i et mer lukket forum – hvor det er ting en ikke vil dele tidlig stadium og miste sitt konkurransefortrinn.

Tror du at mange av prosjektene vil skape verdier og sysselsetting for Norge?

Ja, det er det ingen tvil om.
På bunnfast havvind er den norske markedsandelen på 3-4 prosent. På flytende havvind har en potensiale for å nå mye høyere opp; noe som er sysselsetting.

Hvilke innovative løsninger spiller en viktig rolle for utviklingen av industrien?

Handler om ulike teknologier i alle deler av verdikjeden. Handler om å få ned kostnadene – få fram de mest kostnadseffektive løsningene som ofte skjer i form av å få større volum.

Har Covid-19 preget industrien og videre utvikling?

Tror ikke det har hatt noen negativ innvirkning, men tror heller det synliggjør omstillingen som er på vei bedre. Viser at olje og gass er på en langsiktig nedovergående trend.

Finnes det plasser utenfor den norske kysten som egner seg bedre for store vindparker enn andre, hvorfor?
Det finnes flere plasser, men hvor det også oppstår konflikter med fiskeri og skipsfart – noe som vil gjelde overalt. Derfor må en finne egnede områder. NVE har utpekt at **Utsira Nord** er den mest velegnede for den første plassen for flytende storskala prosjektet på grunn av det ligger relativt nært land og man har kapasitet til å ta imot strømmen derfra. **Sørlige Nordsjø II** ligger nærmere kontinentet og det vil være billigere å selge strøm direkte enn å ta den inn til Norge for så å eksportere den ut. Samtidig er Sørlige Nordsjø II i grenseland mellom bunnfast og flytende dypdemessig – som betyr at ikke alle teknologier vil fungere der, som blant det for blant annet vil være for grunt for Hywind-teknologien.
Tror du andre selskaper vil kopiere Tampen-prosjektet på den måten Equinor skal gjøre det ved å drifte oljeplattformer med energi utvunnet av flytende vindturbiner?
Det er en del som har søkt om muligheten til å forsyne olje og gass plattformer med vindparker. En rapport fra Rystad ser på muligheter for å bygge vindparker som skal forsyne olje og gass plattformer, og ser på business-casen der.

Interview IV: Arbeiderpartiet

Hva er ditt navn og rolle i Arbeiderpartiet?
Ruth Grung, stortingsrepresentant Arbeiderpartiet. Energi- og miljøkomiteen
Går det fint at vi bruker ditt navn i oppgaven og referer til informasjon vi har fått av deg?
Ja
Hva er målet til regjeringen når det kommer til flytende vindkraft eller nye industrier?
Regjeringen har lagt frem en strategi for havvind og har til vurdering 2/3 områder for testing av teknologi. AP mener det trengs sterkere virkemidler for å utvikle ny havvind industri. Det er for få insentiver i dag til å vri leverandørindustrien mot flytende havvind. Det er ikke nok å overlate det til markedskreftene, slik regjeringen gjør. Norge trenger nye lønnsomme arbeidsplasser og eksportinntekter. Norge har gode forutsetninger med havvind: Vi har etter Australia de største havvindressursene, en verdensledende leverandørindustri spesialisert på offshore og vi er en ledende energinasjon.
Hva kan regjeringen bidra med når det kommer til nye industrier?
Norge er det eneste landet rundt Nordsjøen som ikke har satt et måltall for utbygging frem til 2030. Vi mener det bør settes et mål om 5 GW og at vi tar 10% av verdensmarkedet, petroleumsskatteregime bør vurderes på all havvind, ikke bare den som skal benyttes til elektrifisering av sokkelen. Nysnø bør få tilført mer midler, Enova bør utvikle støtteordninger tilpasset flytende havvind. Sokkelen bør hovedsakelig elektrifiseres med havvind. Det må utvikles forretningsmodeller og distribusjon frem til sluttbruker av energien
Finnes det ordninger eller regelverk som blir tilrettelagt for nye industrier som for eksempel flytende havvind? eller andre? - **Støtteordninger (støtte, subsidier, særskatter, etc.)?**
I dag er det et juridisk rammeverk for petroleumsinstallasjoner og ett for havvind. Det bør harmoniseres. Petroleumsskatt gjelder bare dersom formålet er petroleumsrettet. Alle andre støtteordninger kan brukes også på havvind. Enova, innovasjon Norge, Nysnø osv
Hva gjør dere for at Norsk offshore vindkraftteknologi skal bli fremst i verden?
Utover det som står lenger oppe mener vi at offentlig støtte skal stille krav til en viss andel norsk produsert. Det gjorde ikke regjeringen i Enova støtten til Tampen. Vi er opptatt av at et bredt spekter av aktører får mulighet til å teste ut teknologi i de test områdene som snart blir klargjort.
Hvordan jobber dere for at norsk offshore vindkraftteknologi skal bli fremst i verden?
Vi jobber i tett dialog med ulike deler av næringen, forskningsmiljø og ulike interesseorganisasjoner.

Ap fremmet eget forslag om en havvindstrategi i stortinget for ett år siden. Vi har etterlyst mer konkretisering fra regjeringen og løfter frem flytende havvind som et motkonjunturtiltak.
Hva betyr aktiv kommunikasjon mellom dere og aktører i denne industrien?
Helt avgjørende både for faglige innspill, men også for å få næringen med på satsingen
Hvordan kan selskap skape innflytelse eller påvirke stortinget/regjeringen til å tillate dem til å ekspandere innen nye industrier?
De kan jobbe inn mot ulike politiske miljø og ta egne initiativ. Det er flere spennende piloter på gang.
Har Equinors Hywind prosjekter betydd noe for troverdigheten til flytende havvind for regjeringen?
Ja! Vi er helt avhengig av at industrien viser interesse, vilje og tro på at havvind har verdiskapings potensiale
Det finnes flere muligheter for en satsning på flytende havvind, blant annet: - **Et aktivt hjemmemarked** - **Elektrifisering av olje- og gassproduksjon** - **Eksport til utlandet** **Har dere noen preferanser på hva som bør satses på?**
- Den største svakheten med havvindsatsungen så langt er mangel på kobling til hvordan energien skal anvendes/selges. Det må det jobbes videre med. - Elektrifisering av sokkelen er opplagt både for utprøving og bruk. - ZEEDS prosjektet ser på muligheten for å etablere hub'er i Norsjøen som både kan levere ulike drivstoff til skipsfart/fiskeri men også til omlasting. De tenker at omgjøring av energien fra vindmøller til grønn ammoniakk - Ammoniakk har vi lang erfaring med å transportere sjøveien - Det drøftes også å bruke eksisterende gasskabler til transport av hydrogen. - Vi er derfor åpen for ulike løsninger.
Hva vektlegger dere når det subsidieres til bedrifter?
At det skaper lønnsomme norske arbeidsplasser, gir inntekter til samfunnet (både direkte men også som salg av teknologi og løsninger) og har et akseptabelt miljøavtrykk.
Differensieres det når det kommer til subsidier mellom små, mellomstore og store bedrifter, hvorfor?
Vi har mest fokus på at vi bidrar til å opprettholde helhetlige verdikjeder. Det innebærer at det ikke etableres monopoler men at det er sunn konkurranse i alle ledd som bidrar til innovasjon og internasjonal konkurransekraft. Vi trenger både sterke lokomotiv og kreative småbedrifter.
Er det noen utfordringer selskap kan møte når det kommer til utbyggingstillatelser?
Regelverket skal sørge for minst mulig ulempe for andre næringer, spesielt fiskeri. Vi er også opptatt av at de skatter til Norge.
Tror du at flytende havvind kan skape sysselsetting og verdier for Norge?
Ja!

Har Covid-19 hatt store betydninger for din arbeidsdag, eventuelt samarbeid mellom regjering og arbeidsliv når det kommer til idemyldring og videre forskning?
Med hjemmekontor har vi fått lest oss opp, og deltatt på mange nettmøter, men de gode idemyldringene skjer i fysiske møter. Korona og oljeprisfallet har rammet Norge hardt og vår sårbarhet er blitt synliggjort. Forventer at det er økt forståelse for behovet for å satse på ny industri, men også at vi sikrer norsk kjernekompetanse i alle deler av verdikjeden.
Andre tanker?
Tror dere har vært innom det meste.

Interview V: Norwegian Offshore Wind Cluster (part II)

Hvilke produkter er essensielle og kan man ikke være foruten når det kommer til å lykkes innen flytende vindkraft?
Det er en helhet. Selve vindturbinene er levert av standard leverandørene, men øvrige er total leverandørkjede som må på plass. Du må ha ankersystemer, kabler, fundament, osv.
Hva vil du si hovedutfordringen når det kommer til produksjon av elementene til vindturbinen og er avgjørende og utbedre for at flytende havvind skal utvikles? (Flytefundament, bladene, sub-stasjoner og kabler, sensorer)
Det som er avgjørende er å få ned kostnadene – for at flytende havvind skal bli et stort marked må kostnadene ned. Skal kostnadene ned må det en industrialisert produksjon til, må få læringseffekter fra prosjekt til prosjekt; erfaring fra bunnfast havvind hvor kostnadene er under 50 øre KW/t. Kan ikke peke på enkelt elementer, men det er behov for utvikling og ny teknologi på ankersystemer, dynamiske kabler osv.
Hvor er det størst forbedringspotensialer?
-
Er man avhengige av å utvikle nye produkter med en radikal endring eller holder det med inkrementelle justeringer?
Teknologien er tilstede, ref Hywind-prosjektene. For å kostnads effektivisere kan det være at det bare er behov for små endringer, men det kan være at noen finner på noe smart som ingen har tenkt på – drastiske endringer. Poenget er at det er viktig å legge til rette for teknologiutvikling slik at man får fram nye teknologier.
Knyttet til prosessen ved ferdigstilte turbiner og sette dem i drift; hva ser dere på som en langsiktig og økonomisk løsning her: • **Ferdigstille dem på land og slepe dem ut?** • **Nye løsninger som å slepe dem ut til området dem skal operere i og sette dem opp på stedet ved en teleskopløsning?** • **Andre?**
Ja, det jobbes med en slik løsning (teleskop). Om det kommer til å bli løsningen, eller om det blir den som installeres på land, det kommer til å vise seg. Løsningen som tilslutt kommer til å bli brukt er den løsningen som får de laveste kostnadene. Teleskopløsningen har spennende aspekter i forhold til vedlikehold, men man vet ikke. Det er masse ulike ideer for hva som er den beste løsningen og her vil framtiden vise hvem som vil lykkes.
Hvor mange år anslår man at en flytende vindturbin kan være i drift?
Mellom 20-30år – minst 20 og kanskje opp imot 30.
Hva slags løsninger finnens det knyttet opp mot vedlikehold av turbinene?
Kommer alt an på hva som må gjøres og hvor omfattende reparasjonen er..alt fra en liten bryter til girkassen, blader, etc. Er ikke et standard svar på det – kostnaden vil vise hva som er den rimeligste løsningen. Alt fra å taue en turbin inn til land eller frakte et kranskip ut til stedet å reparere der.

Array-kabler og dynamiske kabler, kan du utdype deg om disse?

Array-kabler er kabler som går imellom enhetene til en oppsamling internt i vindparkene.
Dynamiske kabler: deler av kabelen kan bevege på seg – laget for å bevege på seg.
Flytende enhet må en kunne tåle bevegelser ettersom turbinen vil bevege seg etter bevegelser i sjøen.
Eksportkablene trenger for så vidt ikke å være dynamiske, det kommer litt an på hvor dypt det er. Men er oppsamlingsstasjonen/substasjonen en flytende enhet så vil en måtte ha deler av eksportkablene (nærmest substasjonen) som dynamiske kabler. Ligger det på bunn er det ikke behov for dynamiske kabler.
Det er mange som har utviklet dynamiske kabler, men det er et behov for å lage enda bedre og smartere løsninger for dynamiske kabler

Fordeler / ulemper med clusters?

Fordelen er:

- Aktørene samarbeider og får til ting man ellers ikke ville fått til.
- Hele ideen med klyngen er at man skal få mer igjen enn det man putter inn av tid og ressurser.

Ulemper er:

- Ser ikke mange …

Hvor mener du norske bedrifter har konkurransefortrinn og bør satse for å kapre markedsandeler?

Ser man vekk fra turbinen vil de fleste områder innenfor flytende havvind vil passe for norske bedrifter …

Hvordan fungerer disse møtene? Hvem deltar? Hva er kostnaden for å være medlem?

På de fleste arenaer har vi et program, men det kan variere veldig fra seminarer til åpne konkurranser til mer spisset ting.
Pågår også samarbeid som ikke er offentlige arrangement, men grupperinger som samarbeider for å etablere et nettverk, hvor vi bistår dem et stykke på vei.
Kostnaden for å delta er på 10.000, - vært år, men dette kan variere mellom forskjellige clustere.
Det varierer veldig mellom hvem som deltar, noen er veldig aktive, andre ikke fullt så aktive – sånn vil det alltid være.

Testsenteret på Karmøy, hvordan fungerer dette (vær, vind, bølger)?

På testsenteret får dem det været som er «der ute» - utendørs i full skala.
En typisk ting som er viktig er bevegelsesmønsteret; hvordan installasjonen beveger seg i forhold til bølger og vind.

Når et selskap skal inn å ta prøver på testsenteret, vil informasjonen bli konfidensiell eller vil dette bli tilgjengelig?

Nei. De som tester eier informasjonen om hvordan testing har gått.
Konkurransesensitiv informasjon

Er det mange som benytter seg av testsenteret når det kommer til bunnfast eller flytende havvind?
Foreløpig er det bare: • *Hywind* • *Og* et prosjekt som heter *Makani* som har logget der ute. *Makani* var der i fjor sommer. Følgende har planer om å ta i bruk testsenteret • Til sommeren skal det installeres et prosjekt som heter *TetraSpar* (Stiedal offshore technologies som er et dansk prosjekt). • Også jobbes det med et svensk firma *SeaTwirl* som kanskje kommer i 2021. • *Flagship* kommer i 2022/2023 Dette er prosjekter som koster mange millioner kroner med lange planleggingsfaser. Unntaket er Mekani-prosjektet som bare var der én sesong.

Interview VI: Equinor

Navn på selskap, ditt navn og rolle?
Equinor - Arne Eik, Leading Business Developer floating offshore wind
Går det fint at vi bruker ditt navn i oppgaven og at vi tar opp samtalen til eget bruk?
Ja, så lenge jeg får lese igjennom hvor mitt navn nevnes.
Hvor stort anslår dere potensialet for norsk offshore vind er?
Norsk industri og enkelte politiske partier snakker om 3GW i Norge innen 2025 og 2030, vi har ikke noe klart syn på hva tallet skal være, men tror 3GW for flytende havvind innen 2025 og/eller 2030 er svært ambisiøst. Vi har selv ingen ambisjoner eller klart syn på det, men vi registrerer at andre er svært ambisiøse. Opp imot 2050 i Norge; det kan bli stort.. grunnen til det, er først og fremst som følge av at krafteksport til Europa på sikt hvor vi vurdere å åpne områder sør i Nordsjøen med tanke på å eksportere kraft dirkete til Europa. Europa trenger 450GW for å nå klimamålene sine i 2050. WindEurope anslår at 30GW av disse kan komme fra Norge. Dette ser vi på som et realistisk mål og naturlig tall.
Hvorfor har dere et godt utgangspunkt for å drive flytende vindkraft?
Flere ting: • Vi begynte med Hywind og forskning på Hywind allerede i 2001. Har hatt Hywind-demo siden 2009 (nå overtatt av Unitech). Hywind Scotland – som leverer bra • Overall har vi erfaring med flytende havvind • Der vi kommer fra: olje & gass, marine operasjoner, store prosjekt, finansiering av store prosjekter – alt dette er overførbart til flytende vindkraft. Spesielt dette med prosjektgjennomføring er viktig å ha erfaring med når man jobber med store flytende vindprosjekter • Har erfaring fra bunnfast havvind; mye her er likt på det som går på flytende..
Hva betyr deres kunnskap for videre ekspansjon innen flytende havvind?
En del av det markedet som er relevant for flytende vind er de fleste enige om at Norge ikke er en del av, men internasjonal erfaring fra en del relevante land (som Sør-Korea)
Hva betyr cluster/nettverk/samhold for dere i sammenheng med flytende havvind?
Det er veldig positivt – hvor Norwegian Offshore Wind Cluster er veldig dyktige til å sette dette på det politiske kartet også. Samler seg for å understreke viktigheten her har så langt vært viktigere med clusterne enn at en nødvendigvis samarbeider om mange prosjekter Cluster er viktig, men det er helt sikkert ting som kan forbedres her også
Betyr leverandører eller underleverandører mye for deres utvikling innen innovasjon eller ekspansjon innen havvind, hvordan?
Det betyr absolutt mye for oss. Vårt Hywind Tampen-prosjekt har 6 hovedkontraktører – så jobber disse igjen med underleverandører. Så vi er ikke alltid de som skal finne på de gode ideene og løsninger for å redusere kostnadene, disse kan også komme igjennom hovedleverandører og

underleverandørene. Vi jobber i prosjekter sammen med hovedleverandører for å finne tryggere og bedre løsninger – det er helt avgjørende. Forskjellige prosjekter trenger ikke nødvendigvis å gi samme leverandører. Vi har ingen form for strategiske partnerskap med noen leverandører; ingen leverandører blir nødvendigvis foretrukket foran andre Vi er opptatte av å sørge for at norske bedrifter kommer i posisjon til å være med i konkurransen. Informere om prosjekter å være i dialog er avgjørende, men vi kan ikke kostnadsmessig lovmessig tildele kontrakter til norske bedrifter bare siden dem er norske og vi har jobbet med dem i tidligere prosjekter..
Jobber dere direkte for å fronte et hjemmemarked med å inkludere mest mulig lokale aktører?
Vi har en annen måte å fronte havvind på en feks. leverandørindustrien. Vi har også tro på at vi trenger et hjemmemarked i Norge for at norske leverandører skal bli gode «ute».., men det må også være en diskusjon på hvor stort et slikt hjemmemarked kan og bør bli. Det en også må se på hva er kraftbehov nå, og hva er kraftbehovet om 10-15 år? Mange sier at man kan ha 2-3 GW havvind til olje & gass. Men våre beregninger viser at dette verken er økonomisk eller teknisk vil være mulig. Ett prosjekt til som er betydelig større en Hywind Tampen kan gå (og kanskje to..), men det er ikke slik at man kan bygge 2-3 GW til olje & gass installasjoner. Her vil man da måtte bygge kraften inn til land; og da vil diskusjoner komme om man har nok kraft i Norge og om kraftprisen i Norge er så lav at det vil være behov for store subsidier for å utligne kostnaden for flytende havvind versus kraftprisen i Norge.
Når vi snakker om 2-3 GW, hva gir dette oss?
Her snakker vi om kapasitet på 3GW som er rundt 10-12 terrawatt (TW) årlig. Norge har en årlig kraftproduksjon på 130 TW/t. Så det er ikke slik at det kommer til å fundamentalt endre kraftbalansen i Norge hvis man hadde bygd 3GW som skulle forsynt Norge, men det ville kommet på toppen av det som allerede er et kraftoverskudd i Norge.
Jobber dere for å nå klimamålene som ble satt i Parisavtalen?
Ja det gjør vi. Se klimaveikartet vi kom ut med i januar. www.equinor.com Vi skal redusere både utslipp og produksjonsutslipp med 50% innen 2050 – noe som er i tråd med ambisjonen i Parisavtalen
Finnes det noen miljøutfordringer eller aktivister som hindrer videre ekspansjon?
Den store saken her er sameksistens med andre næringer, og da spesielt fiskeri – hvor det er for det meste er snakk om areal for fiskere.
Hvilke utfordringer møter man når det kommer til utbyggingstillatelser fra myndighetene?
En må se på konsekvensutredning hvor man ser på «alt», både fugl og fisk. Når man har tatt en konsekvensutredning om hvor mye fugl og fisk det er i området (som blir gjort før bygging), så ville dette bli sendt ut til høring hvor Norges fiskerlag og alle andre ha muligheten til å protestere der, og så skal regjeringen behandle en konsekvensutredning.

Hva betyr offentlige myndigheter for dere når det kommer til videreutvikling?

- **Finnes det ordninger som blir tilrettelagt for dere eller andre?**
- **Støtteordninger (støtte, subsidier, særskatter, etc.)?**

Helt avgjørende. Selv om vi har kuttet kostnader med Tampen sammenlignet med Hywind Demo så er vi på et kostnadsnivå som vil trenge støtte.
Vi ser nå av hvis vi skal bygge et betydelig prosjekt i Norge så vil vi få kostnadene ennå mer ned, men dette er litt avhengig av hvem som skal bruke krafta, hvor det vil være et gap møtes på en eller annen måte. Verken Equinor eller andre vil utvikle havvind hvis det er et tapsprosjekt.
Dette er ikke noe vi kommer til å tjene masse penger på; og de gjør vi absolutt ikke på Hywind Tampen.
Utrolig avhengig av hvilket marked du snakker om, men i Norge vil det være behov for støtte.

Hvordan kan / har dere påvirke(t) regjeringen til å tro og satse på flytende havvind?

Skaper prosjektene dere driver med innenfor havvind sysselsetting og verdier for Norge?

Dette avhenger om hvor stort det blir.
Multiconsult gjorde en ringvirkningsanalyse for Hywind Tampen på hvor mange jobber prosjektet kom til å skape som ble antatt å være mellom 1500-3000 arbeidsplasser for dette er et relativt lite prosjekt.
Så det er ingen tvil om at hvis det blir en storskala industri i Norge, vil norske leverandører til å ta en del av kontraktene som vil gi jobber.

Hva vil du si hovedutfordringen når det kommer til produksjon av elementene til vindturbinen og er avgjørende og utbedre for at flytende havvind skal utvikles (Flytefundament, bladene, sub-stasjoner og kabler, sensorer)? Hvor er det størst forbedringspotensialer?

30% av totalkostnadene på et prosjekt går til vindturbinene, 30% på flytende fundamenter. Det vil være masse kostander å spare i alle elementer.
Kanskje den største utfordringen er flytende fundament. Dette er svære fundament, hvor det er mangel på kapasitet til å bygge/sette sammen; kreves store arealer til å sette dem sammen. Per i dag er det få verft i Norge og andre land som har kapasitet til å bygge et prosjekt på 500MW.
Vi har 8MW på Hywind Tampen, dette går på en installasjon som dette her, men hvis vi skal prøve å bygge 500MW i Norge per i dag, vil dette være en utfordring.
Det er også behov for teknologiforbedringer knyttet til fundamentene, men det er først og fremst kapasitetsspørsmål.

Hvilke innovative løsninger tror dere vil spille en viktig rolle for utviklingen et bærekraftig produksjonsnivå?

Vi følger med på utviklingen av nye fundamenter, men vi kan ikke la prosjektene våre stå på vent for å se om disse blir kvalifiserte om noen år..

Vårt fokus nå er at det må være store prosjekt, masseproduksjon og få ned kostnader, og da vil man i større grad bruke nåværende teknologi – samtidig som man følger og er delvis med på å utvikle ny teknologi.

Hva mener dere er de rette løsningene for å kutte produksjonskostnader forbundet med flytende vindturbiner?

Store prosjekter med stor skala.

Knyttet til prosessen ved ferdigstilte turbiner og sette dem i drift; hva ser dere på som en langsiktig og økonomisk løsning her:

- **Ferdigstille dem på land og slepe dem ut?**
- **Nye løsninger som å slepe dem ut til området dem skal operere i og sette dem opp på stedet ved en teleskopløsning?**
- **Andre?**

Vi bruker de løsningene vi føler er best per dags dato. Vi kan igjen ikke sitte å vente på nye løsninger. En løsning som man i dag bruker på bunnfast havvind er ønskelig også i flytende, men mer krevende pga. vær og vind.

Er man avhengige av å utvikle nye produkter med en radikal endring eller holder det med inkrementelle justeringer?

Det er ikke gitt at man klarer å komme ned på ekstremt lave kostnader på flytende havvind slik man har tenkt frem til nå med produktene og prosessene man på nåværende tidspunkt bruker. Skal du virkelig komme lavt ned i kost kan det hende du må tenke helt nytt. Det kan hende at om 10-15 år bruker industrien en helt annen teknologi enn det vi gjør i dag. Problemene med en slik tankegang er at man ikke får i gang nye prosjekter – og hvis man ikke gjør det kommer det ikke til å bli noe flytende havvind. For det er fortsatt ikke 100% gitt at flytende vind kommer til å bli stort, da må en vise skala og kostnadsreduksjoner.

Hvor mener du norske bedrifter har konkurransefortrinn og bør satse for å kapre markedsandeler?

Kompetanse på:

- Kabler
- Substasjoner
- Flytende fundament
- Anker-løsninger
- Sammenstilling
- Prosjektering

Gode muligheter internasjonalt, men noen deler av verdikjeden kommer til å være global, mens noe vil være forbehold lokalt som verft og sammenstilling og produksjon av flytende fundament, men hvor det vil være mulig å prosjektere og gjennomføre prosjekter i andre land med lokal arbeidskraft.

Hvor mange år anslår man at en flytende vindturbin kan være i drift?

Vi opererer med en levetid på 25-30 år, kanskje kan det være lengre.

Er markedet stengt, eller er det mulighet for nye bedrifter å infiltrere seg inn i, og bli en del av denne industrien?
Jeg tror på bunnfast er det ikke stengt, men det er klart at det har satt seg mer her. På flytende vind er det DEFINITIVT ikke stengt, her er det åpent. Det er fortsatt i startfasen, så her er det bare å hive seg rundt!
Hvordan har Covid-19 påvirket deres arbeid om utviklingen og ekspansjon innen flytende havvind prosjekter?
Covid-19 har kanskje ført til enda mere fokus på havvind fra et politisk syn. Vårt arbeid internt står med våre ambisjoner på klima og fornybar energi, men det hjelper ikke akkurat vår utvikling på havvind at oljeprisen blir lavere mtp. at selskapet går dårligere. Isolert sett for oss har ikke Covid-19 og lavere oljepris vært bra i forhold til fornybarsatsningen vår. Så får man med tiden se om det blir noen forsinkelser med prosjekter våre som følge av pandemien
Andre tanker?

8.2 Appendix II: Overview over floating offshore wind projects

Land	Prosjekt	Kapasitet (MW)	Idriftsettelse
Norge	Hywind Demo	2,3	2009
Portugal	WindFloat[8]	2	2011
Japan	Fukushima FORWARD	2	2013
Japan	Fukushima FORWARD	7	2016
Japan	Fukushima FORWARD	5	2017
Storbritannia	Hywind Scotland	30	2017
Frankrike	Floatgen	2	2018
Japan	IDEOL Kitakyushu Demo	3	2018
Portugal	WindFloat Atlantic	25	2019
Spania	Flocan 5 Canary	25	2020
Spania	Nautilus	5	2020
Sverige	SeaTwirl S2	1	2020
Storbritannia	Kincardine	49	2020
Storbritannia	Forthwind Project	12	2020
USA (Maine)	Aqua Ventus I	12	2020
Frankrike	Leucate Pilot Farm	24	2021
Frankrike	Groix Pilot Farm	24	2021
Frankrike	Provence Grand Large	24	2021
Frankrike	EolMed Pilot Farm	24	2021
Japan	Goto City	22	2021
Storbritannia	Katanes Floating Energy Par – Array	32	2022
Norge	Hywind Tampen	88	2022

Figure 13: Show exciting floating offshore wind parks or planned floating offshore wind parks in a short term. Source: Multiconsult (2019), CenSES (2019), Carbon Trust (2018), WindEurope (2018).