UiA University of Agder

Master

The Jones Act and U.S. Offshore Wind Turbine Installation Strategies

A qualitative analysis of the strategic implications of the Jones Act on the transport and installation of wind turbine generators in the U.S. offshore wind industry

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Preface

This thesis examines the impact of the Jones Act regulation on the transport and installation of Wind Turbine Generators in the U.S. offshore wind industry. We conducted this research with guidance from our supervisor Øyvind Ottersen. We are very grateful for his guidance.

We would also like to thank the people and staff on the MBA program at the University of Agder that we have been a part of since 2018. The education and support provided during the program have been valuable, giving us new perspectives and knowledge on several different subject areas.

The process of researching and writing this thesis presented several challenges, such as limited previous research on our specific topic and difficulties in gathering data due to the strategic sensitivities in the industry. However, the insights we were able to collect from industry stakeholders have made this research possible, and we would like to thank all the candidates that participated in the interviews for this research.

Balancing this research with our full-time jobs as managers and our family responsibilities extended our thesis timeline to three years. We owe a great deal of appreciation to our families for their patience and support during this time.

We hope that this thesis will add valuable perspectives to the discussions regarding transport and installation of wind turbine generators in the U.S. offshore wind industry and serve as a useful resource for stakeholders in the industry. This work represents a key achievement in our professional lives and a testament to our dedication to continuing education and personal development.

Asbjørn Njerve & Ronny Greipsland

Executive summary

This thesis explores the regulatory and strategic impacts of the Jones Act on the transport and installation of wind turbine generators in the U.S. offshore wind industry. The research specifically addresses two primary questions:

- How does the Jones Act impact the transport and installation of wind turbine generators in the U.S. offshore wind industry?
- What is the best overall solution to comply with Jones Act, for transport and installation of wind turbine generators in the U.S.?

The U.S. has significant ambitions to expand its offshore wind capacity, with a federal target to deploy 30 gigawatts by 2030. The Jones Act, a century-old maritime law, presents both challenges and opportunities in this context. It requires that transportation between U.S. ports is performed by U.S. flagged vessels, which has significant impact on the transport and installation of wind turbine generators for offshore wind farm developments in the U.S. This study identifies two main methods for transport and installation of wind turbine generators:

- U.S. flagged Wind Turbine Installation Vessel
- Foreign flagged Wind Turbine Installation Vessel with feeder barges

The thesis is based on a qualitative method using semi structured interviews with four key strategic stakeholders from the industry. This research is organized by using the Gioia method and supported by established guidelines about how to do qualitative research and case studies.

The thesis concludes that neither of the strategies are clearly better than the other across all aspects. The strategic decisions must consider specific project needs, stakeholder priorities, and the regulatory landscape. However, based on the favorable operational workability, this thesis outlines the U.S. flagged installation vessel as the best solution in the long-term perspective, despite the higher upfront capital investment. On the other hand, the foreign-flagged WTIVs with feeder barges present a lower upfront investment but may lead to increased operational complexities and challenges.

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1. Introduction

1.1. Background for selected topic

The last decade has seen an increased focus and development of offshore wind as a renewable energy source. Large offshore wind farms have been developed in Europe and Asia, and the ambitions are continuously growing in scale and into new regions. One of the new regions, is the U.S., where there is currently no offshore wind farm in operation. The ambitions are high, and the Biden administration announced several actions to catalyze the development of offshore wind energy after taking office in 2021. “The President set a bold goal of deploying 30 gigawatts of offshore wind by 2030, enough to power 10 million homes with clean energy, support 77,000 jobs, and spur private investment up and down the supply chain.” (White House, 2022).

A diversifying factor for the U.S. offshore wind market is the maritime trading law, known as the Jones Act. This is basically a cabotage law, which excludes foreign flagged vessels to transport people and cargo between U.S. ports. One of the areas influenced by this law is the transportation and installation of wind turbine generators (WTG) for an offshore wind farm.

There are several challenges and hurdles with regards to this scope of work and we will in this thesis present relevant theory, the different methods of solutions and explore the different point of views through interviews with key stakeholders in the industry.

1.2. Research problems incl delimitations

The Jones Act severely impacts several aspects of the maritime industry in the U.S. and many research studies have explored the strengths and weaknesses. We have chosen to focus this research to specifically cover the transportation and installation of wind turbine generators for an offshore wind farm. This scope of work must be executed by a specialized type of vessel which has never before operated in the U.S. We aim to explore the effects of the Jones Act on this scope of work, hence, our first research question is:

How does the Jones Act impact the transportation and installation of wind turbine generators in the U.S. offshore wind industry?

Furthermore, we wanted to investigate the best possible solution to comply with the Jones Act. The key elements covered are time, cost, and risk to build and operate such a type of vessel. This leads us to the second research question:

What is the best overall solution to comply with Jones Act, for transportation and installation of wind turbine generators in the U.S.?

In order to make the thesis as focused and valuable as possible, we have made some delimitations. The first delimitation is that we solely focus on the transportation and installation scope for offshore wind farm developments. The second delimitation is that we chose to not include the supply chain challenges for offshore wind industry in the U.S., including location of staging ports, which can impact the decision-making process. Our third delimitation is that there will be no substantial adjustments in the Jones Act which may lead to changes in the restrictions.

1.3.Previous research

We have searched, also assisted by the University of Agder, in available libraries and sources to find existing academic research and publications. The following libraries have been used; AURA, Web of Science, IEEE Explore, ASME Digital Collection, Google Scholar, and other open online search engines. We have identified analyses, reports, and papers from the industry. These publications have been used to enrich the theory and support our discussion of the findings.

1.4.Structure of the thesis

We have based our thesis on a qualitative methodology, focused on an in-depth analysis and understanding of the various elements. We have selected candidates representing different stakeholders, with key insights into the industry. To analyze the findings, we have used the Gioia method. This has led to the first-order concept, second-order themes, and the aggregated dimensions, which form the structure of our discussions.

The structure of our thesis consists of several chapters. We present the background of our thesis and the research questions in Chapter 1. In chapter 2 we describe the relevant theory regarding Jones Act regulations and the transportation and installation methods, including previous research. In the following chapter 3, we describe the chosen methodology used in this thesis, including the use of the Gioia analysis structure, data collection, reliability, and validity amongst other. Furthermore, we have presented the findings and the discussions in chapter 4. Finally, we conclude on the research questions in Chapter 5, including the limitations of this thesis and our proposals for future research.

2. Theory

2.1. Introduction

The purpose of this chapter is to provide a theoretical platform for our analysis and discussion. First, we will describe the Jones Act regulation and introduce offshore wind. Then we will present the offshore wind in the U.S. and describe the implications related to the Jones Act. Furthermore, we will present the applicable methods for transportation and installation of wind turbines including previous research.

2.2. The Jones Act

As early as 1789, the government of the US introduced a law dealing with maritime activities for the first time, but it was in 1920 that the federal law we know as the Jones Act was passed (Transportation Institute, n.d.). This law describes, amongst others, the requirements for vessels transporting cargo and passengers between U.S. ports. One of the primary reasons for the law was to secure sufficient maritime competence and capacity related to national security and emergency situations. The Jones Act consists of four main requirements (Transportation Institute, n.d.). The vessels must be:

- Owned by U.S. companies that are controlled by U.S. citizens with at least 75 % U.S. ownership.
- At least 75 % crewed by U.S. citizens.
- Built (or rebuilt) in the U.S.
- Registered in the U.S.

2.3. Offshore wind in the U.S.

Offshore wind energy can be defined as the energy generated from the wind at sea (Dincer, Cozzani & Crivellari, 2021, p. 8). The wind is absorbed by large wind turbines which are installed in clusters at sea, called offshore wind farms, and then converted into high voltage electricity, exported by sea cables to transformer stations at shore and supplied into the electricity network onshore (Dincer, Cozzani & Crivellari, 2021). As shown in Figure 1,

the offshore grid connection is designed to efficiently transport wind power to the mainland (TenneT, n.d.)

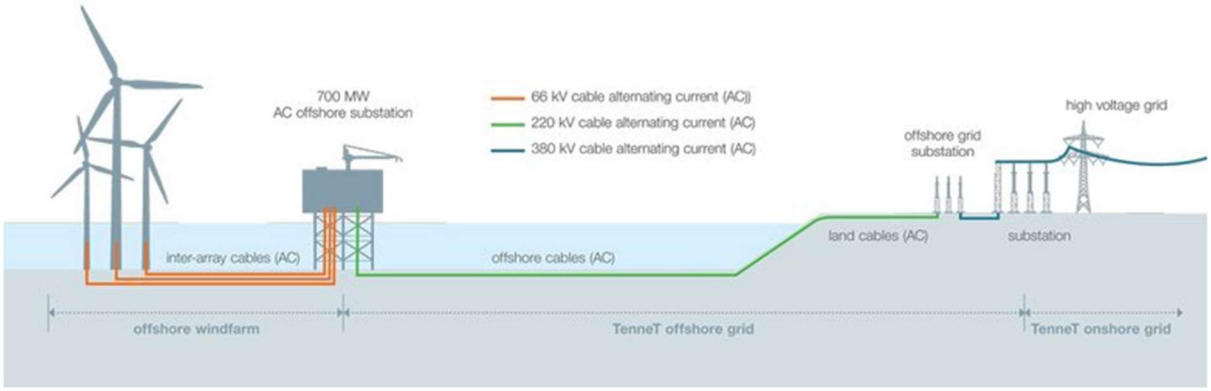

Figure 1: Schematic representation of an offshore wind farm (TenneT, n.d.)

Offshore wind farms are built over water, typically on the continental shelf (Nord-Lock, 2020). These locations can be in relatively shallow water near the coast or further out to sea in deeper water. The latter is referred to as deepwater offshore wind farms. Depending on the water depth at the dedicated location there can be installed wind turbines either on the seabed for shallow water less than 60 m, called fixed installations, or floating wind turbines for deepwater as shown in Figure 2.

Figure 2: Schematic representation of offshore floating, offshore fixed and onshore wind turbines (Nord-Lock, 2020)

There are currently two minor operational offshore wind farms in the U.S. today, both located at the East coast (U.S. Department of Energy, 2022) and being fixed to bottom. The first ever offshore wind farm was the Block Island Wind Farm, which consisted of 5 turbines with a combined capacity of 30 MW (Maritime Executive, 2016). The second wind farm is the Coastal Virginia Offshore Wind Project. This wind farm currently has only two turbines in operation but is planned to have over 150 turbines when the project is completed (Offshore Wind, 2020).

In 2021, the Biden administration announced efforts to reach 30 GW of offshore wind energy capacity by 2030 (White House, 2021). The U.S. offshore wind energy industry will grow exponentially, with many large installations in various stages of planning, development, and operation. This growth will require an expansion of the domestic supply chain and workforce.

While there are just two domestic offshore wind farms currently in operation, many more are in development as displayed in Figure 3. The development of wind farms will typically be fixed installation on the east coast and floating wind turbines on the west coast, due to water depths (Ocean Energy Resources, 2023).

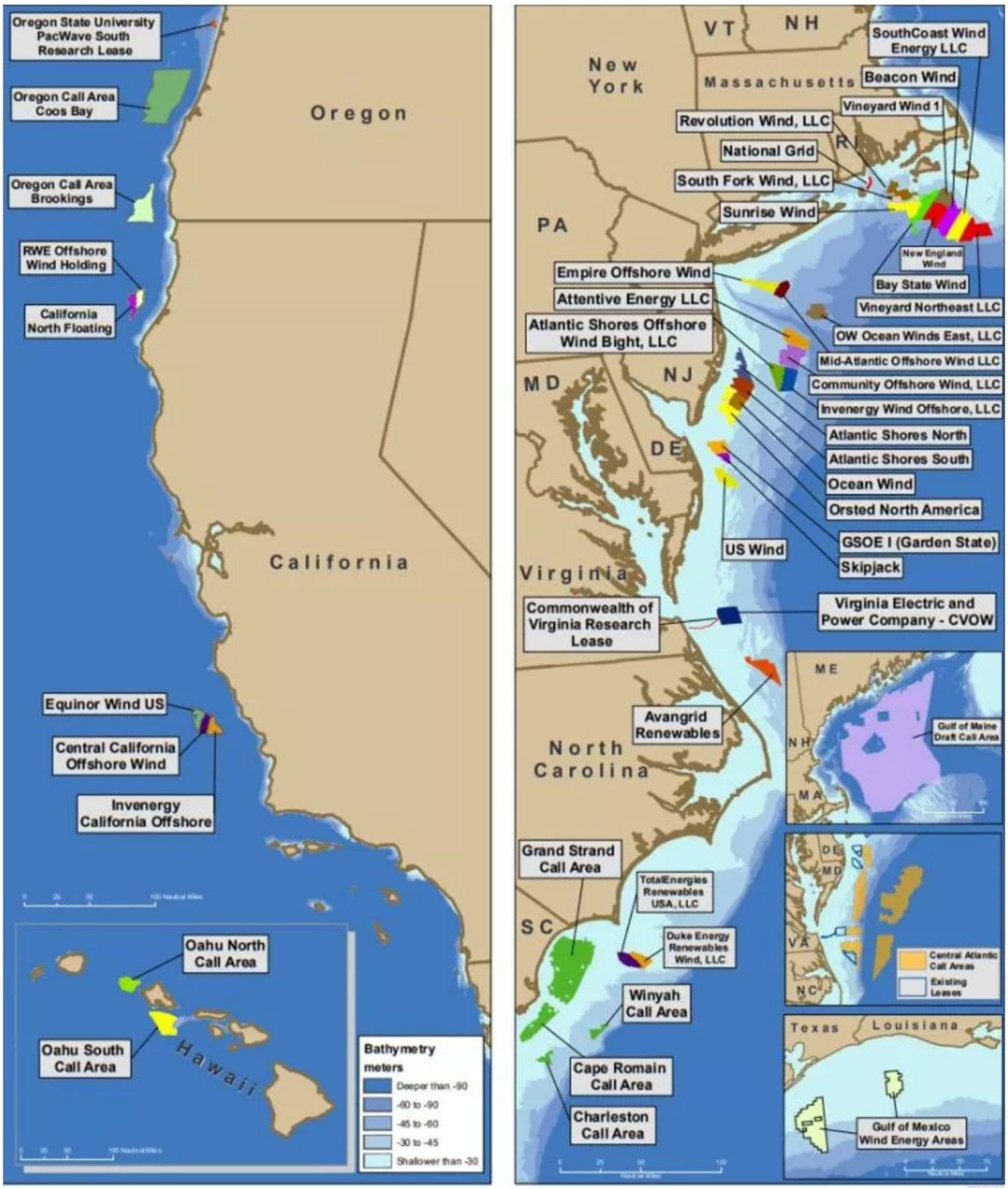

Figure 3: Overview of all the upcoming Offshore Windfarms on the east and the west coasts of the U.S. (Ocean Energy Resources, 2023)

The locations on the east coast have been explored to be the most favorable for fixed installation due to its relatively shallow waters, its favorable wind climate, the proximity of great ports and as well as close to end consumers. But this also means that the weather conditions in the operating areas are challenging, with occasional high wind and waves.

2.4. Outer continental shelf and coastwise point

All vessels which transport cargo or personnel between points in the U.S. must comply to the Jones Act requirements. However, the definition of a U.S. point, pristine seabed and type of activities related to offshore wind farm work makes it complicated for most people to get an overview of the regulations. Sandra L. Knapp, which holds a J.D. Law and is a Partner at Gawthorp Greenwood, explains the interplay of offshore wind farms and Jones Act in an article issued May 8, 2023 (Knapp, 2023).

She explains that under the Outer Continental Shelf Lands Act, "points in the United States" also includes installations attached to the seabed in the Outer Continental Shelf which is erected for the purposes of producing resources or installation of a device to transport such resources (U.S. Congress, 1953). And according to the Bill from 118th Congress, National Defense Authorization Act for FY 2021 amended the law to include "non-mineral energy resources." (U.S. Congress, 2023). Consequently, all wind farm installations on the Outer Continental Shelf must comply to the Jones Act and all vessels transporting cargo and personnel from a U.S. port to the wind farm installation must be transported on a Jones Act compliant vessel.

A possible alternative to comply with the requirements is to load the components on to the installation vessel in a port outside the U.S. This has been exemplified in the Block Island Wind Farm, where the turbines were installed by a foreign-flagged installation vessel, which brought the turbines from Europe (Maritime Executive, 2016). This was also done for the Coastal Virginia offshore wind project, where the turbines were installed by a foreign-flagged installation vessel, which transported the turbines from port of Halifax in Canada (Offshore Wind, 2020). However, the extensive time spent on transportation will be a bottleneck and hardly be scalable for larger wind farm developments.

2.5. Transport and installation methods for WTG in U.S.

Offshore wind projects in the U.S. requires creative methods to accommodate the implications due to the Jones Act. As part of the development project, it is required to transport the wind turbine components from a port to the offshore location, where the components are installed. This has been seen to be a logistical challenge, due to the impact by

the Jones Act, which requires the use of U.S.-built and flagged vessels for transporting goods between U.S. ports. Alternative methods have been considered and the two most common methods are called the “U.S. flagged WTIV” and “Foreign flagged WTIV with feeder barges”.

2.5.1. U.S. flagged WTIV

The U.S. flagged Wind Turbine Installation Vessel (WTIV) method utilizes vessels that are compliant with the Jones Act, meaning they are built, owned, and operated under the U.S. flag. This method uses a single vessel to carry out the transportation of turbine components from U.S. ports directly to the installation site (GustoMSC, 2017). The vessel is equipped with a dynamic positioning system and a jacking system to lift the vessel above sea to provide stability during installation. They are designed with a large deck space for storage of components and a huge crane for lifting and installation. The vessels can transport up to 4 sets of components from port to the offshore wind farm location. The components typically consist of turbines, transition pieces and rotor blades. This method reduces the logistical complexities associated with coordinating multiple vessels, thereby minimizing the risk of delays, and enhancing operational efficiency. This is in accordance with the standard procedure in Europe, which has been refined over the last decades and has the following sequence of events (Maloney, Bourg, Humphreys, & Townsend, 2018):

1. Arrive at the port
2. Load and secure WTG components
3. Transit to the offshore wind farm location
4. Install the WTG components
5. Return to port and repeat the cycle

As the size and capacity of wind turbines continue to increase, WTIVs are continuously evolving. Newer generation vessels are being developed with enhanced lifting capabilities, longer boom lengths, and taller crane heights to handle larger and more advanced turbine models. As shown in Figure 4, the new WTIV design by Havfram is optimized for the latest generation of wind turbines (Splash, 2023).

Figure 4: New WTIV Design by Havfram (Splash, 2023)

2.5.2. Foreign flagged WTIV with feeder barges

The method using a foreign-flagged WTIV with feeder barges is an approach that can be used to navigate the restrictions of the Jones Act in the U.S. This method involves two types of vessels, a foreign-flagged WTIV and U.S.-built feeder barges. The operational sequence for this method is to load the wind turbine components onto a feeder barge at a U.S. port (Maloney et al., 2018). The feeder barge transports the components to the offshore installation site. This transportation complies with the Jones Act because it involves a U.S. compliant feeder barge transporting goods between U.S. ports.

Once the feeder barge reaches the offshore location, the components are transferred to the foreign-flagged WTIV. As shown in Figure 5, the design of the Maersk WTIV incorporates advanced features with barges to ensure efficient transfer of components (Maersk Supply Service, 2023).

Figure 5: Design of the Maersk WTIV with barge (Maersk Supply Service, 2023)

While the WTIV installs the turbine components onto the pre-installed foundations, the feeder barges return to the port to load more components.

2.6. Previous research on the two methods

There are two thorough studies which describe and analyze these implications. The first one is called “U.S. Jones Act Compliant Offshore Wind Turbine Installation Vessel Study” and is made by GustoMSC in 2017 and prepared for multiple state authorities. This study describes the requirements of a WTIV from technical and financial perspectives (GustoMSC, 2017). The second study is called “An analysis of alternatives for the development of Jones Act compliant windfarm construction vessel fleets” and is made by MiNO Marine LLC in 2018 and is based on the Block Island Wind Farm project. This was a pilot project developed in 2016 and limited to only five 6-megawatt turbines. Since then, the size of these turbines and supplemented equipment has been significantly increased and now requires larger and more complex vessels to carry out the transport and installation (Maloney et al., 2018). However, the outcome of these two studies addresses the various implications concerning cost, time, and risk for the two methods, which will be presented below.

Initial capital expenditures for U.S.-flagged vessels are significantly higher due to the requirements of the Jones Act, because these vessels are built and operated under U.S. regulations (GustoMSC, 2017). Although this upfront cost is substantial, the operational expenses might be lower in the long term because the process involves fewer moving parts and potentially fewer days at sea. On the other hand, employing foreign-flagged WTIVs with feeder barges can lower the initial cost, as these vessels are often available on the international market at competitive rates (Maloney et al., 2018). However, the operational costs are typically higher due to the increased logistical demands and the added complexity of managing a multi-vessel operation, which includes additional fuel, crew, and port fees.

Furthermore, the U.S. flagged WTIV method generally presents a more efficient operation, minimizing the transition times between different stages of the installation process. GustoMSC (2017) notes that this method reduces the dependencies on multiple vessels, which can significantly decrease the likelihood of delays due to logistical complexities. Maloney et al. (2018) point out that for the Foreign-flagged WTIV method, the coordination between barges and the installation vessel can be a potential source of delay and impact the project timelines. This method depends on precise timing and the efficiency of the feeder system, which can be disrupted by adverse weather or sea conditions. The U.S. flagged WTIV method primarily carries financial risks associated with the high cost of vessel acquisition and maintenance. GustoMSC (2017) highlights that the method involving a Foreign-flagged WTIV with feeder barges introduces several operational risks. Maloney et al. (2018) points out the potential for mechanical failures during critical lifting operations and the increased human error margin due to complex operations. These factors both increase the risk of delays and can also lead to higher insurance costs and potential liabilities.

In summary, both methods offer specific advantages and challenges. The choice between using a U.S.-flagged WTIV or a foreign-flagged WTIV with feeder barges depends on the specific requirements for each project, in terms of budget constraints, time efficiency, and risk tolerance.

Hence, for projects with less restrictive budgets that prioritize timeline compliance and lower operational risk, the U.S.-flagged WTIV method may be beneficial. On the other hand, for projects aiming to minimize initial capital expenditures and can manage more complexity and risk, utilizing a Foreign-flagged WTIV with feeder barges might be more favorable.

2.7.Other previous research

There are several publications related to the Jones Act regulation and, in this section, we will present the other relevant publications for this thesis.

The Organization for Economic Cooperation and Development (OECD) states that the Jones Act is the most restrictive maritime trade law among all OECD countries (OECD, 2022).

Another OECD publication concludes that repealing the Jones Act will strengthen the economy and the competitiveness of the shipbuilding industry in the U.S. (OECD, 2019).

Furthermore, there is also a publication from the CATO Institute which addresses the burdens of the Jones Act. The publication touches on several interesting elements that are relevant to our research. One of these is the requirement to build vessels within the U.S. CATO highlights that this requirement has the greatest impact and is the most burdensome to the industry as it increases the cost of construction and reduces efficiency, thereby reducing competitiveness (Mulligan, 2020).

3. Methodology

3.1. Introduction

The objective of this research is to explore the regulatory and strategic factors that impact the transport and installation of Wind Turbine Generators in the U.S. offshore wind industry. This thesis uses a qualitative research approach, based on the guidelines in Creswell's *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (2014), as well as Yin's *Case Study Research: Design and Methods* (2009), and Gioia, Corley, and Hamilton's *Seeking qualitative rigor in inductive research: Notes on the Gioia methodology* (2012).

The design of this research aims to explore the complexities in the U.S. offshore wind industry by methodically examining the impact of the Jones Act regulation and furthermore the alternative strategical choices when deploying WTGs in the U.S. By using a qualitative methodology, this thesis is focused on an in-depth analysis and understanding of the various factors that impact this part of the industry.

This chapter will describe the methodological framework used in this thesis and explain how the research design and chosen methods align with the nature of this study. It will also provide insight into the data collection and analysis process and how they address the research questions.

3.2. Research design and approach

The research design and approach are important to make sure this thesis and study is valid. Based on Creswell's (2014) guidelines about how to do qualitative research and Yin's (2009) approach to case studies, we are looking closely on factors that affect the U.S. offshore wind industry, particularly focused on the impact of the Jones Act regulation. We have chosen to study this through detailed case studies as it is a suitable way to do an in-depth examination of the factors impacting the industry and the installation of WTGs in the U.S.

We have chosen to organize this research using the Gioia method (Gioia, Corley & Hamilton, 2012) which helps us sort the findings and information into themes and dimensions. This method supports our aim to bring deep insight from the information we gather, which is crucial to understanding the factors impacting the possible strategies.

Furthermore, we will do a thorough analysis of the data we collect, categorizing the findings into a theme-based structure. By doing this, we will make sure that we are representing what the candidates in our study share of information and build a holistic understanding of factors that is shaping the current landscape in the industry and for installation and transportation of WTGs in particular.

However, our approach to this research is flexible, allowing us to adjust the focus as new insight is presented throughout the study. This flexibility means that the study can adapt based on the information that is given out by the candidates. The following sections will go into the themes we find in our research in more detail.

3.3.Sampling data and Participants

When deciding how and who to include in this study, the most important thing was to make sure we were able to gather as much detailed and valuable information as possible. We followed the advice from Creswell (2014) and used the detailed Gioia method (Gioia, Corley & Hamilton, 2012) to support this approach, and in line with Yin (2009) about looking closely into case studies, especially to understand how the Jones Act impacts the U.S. offshore wind industry.

Candidates were selected based on their significant engagement and expertise within the offshore wind industry, as well as their competence and insight to the U.S. market and the implications of the Jones Act regulation. Having said that, we also worked hard and found it challenging to get hold of the candidates we wanted given the current strategic sensitivity in this emerging market. Ideally, we would have found a few more, but we are extremely satisfied with the four candidates we got, which are very much key personnel engaged in the core of this industry.

3.3.1. The selected candidates

This study will focus on a concentrated but highly specialized group of candidates. The exclusive information shared by these candidates, due to the early development phase and somewhat discreet nature of this industry in the U.S., gives the study significant depth and

value. We firmly believe that this research still holds strong integrity by using a focused sample of candidates. The insight of these participants, chosen for their quality and relevance to the thesis, contributes substantially to the qualitative credibility of this analysis. The process of candidate selection is also in line with the qualitative research design structure, outlined by Creswell, Yin, and Gioia. This ensures that the findings are processed on a solid methodological base.

The selected candidates:

Name	Lars Christians Østeby
Position	Shipbroker & Partner
Company	Pareto Shipbrokers AS
Background and experience	17 years as broker, mainly in offshore segments. For the last few years with a focus on offshore wind and the U.S. market. Have been involved in several studies and projects related to offshore wind in the U.S. regarding chartering, construction, installation, and maintenance, with partners like Equinor and Siemens amongst others.

Name	Deniz Ekici
Position	Marine Operations Leading Engineer
Company	Equinor
Background and experience	Last 5 years in Equinor and 7 years before that in DNV, and another 7 years with Technip Offshore. Responsible for the overall offshore wind marine operations and developing the master plan for transportation and installation for Equinor in the U.S. Ekici is also managing the Transportation and Installation tenders and selection

	process for Equinor. Before Equinor he worked many years in the offshore wind industry and was during his time in DnV involved in the Block Island project.

Name	Francesc Ronda
Position	Transport and Installation Manager for Offshore Wind
Company	EDF Renewables North America & Atlantic Shores Wind
Background and experience	Last 2 years in EDF Renewables North America and before that more than 6 years in Van Ord and DEME as Offshore Construction Manager. Responsible for the development of EDF's Offshore windfarm projects in the U.S. Both for bottom fix and floating offshore windfarms. Representing EDF in the joint venture with Shell for the Atlantic Shores Wind development project in the U.S.

Name	Kåre Anthonsen
Position	Vice President Commercial
Company	OIM Wind Ltd
Background and experience	More than 6 years in OIM, and before that experience from various companies, focusing on sales and business development in the offshore industry. OIM is developing business plans specifically to enter the U.S. market with a Jones Act-compliant installation vessel.

3.4.Data collection

We put a lot of thought and consideration into how to collect data for this thesis in a detailed and structured way and chose the Gioia method to structure the data supported by the approaches suggested by Creswell (2014) and Yin (2009) for exploring case studies carefully. We aimed to really understand the complex factors related to the choice of strategies and the impacts of the Jones Act regulations in the U.S. offshore wind industry.

Data were primarily collected through semi-structured interviews, chosen for the flexibility and ableness to get detailed insights based on real-world experiences and context. The candidates from Pareto, Equinor, EDF & Atlantic Shores Wind and OIM Wind Ltd participated in deep and comprehensive discussions which intended to reveal the various factors related to the Jones Act regulation and the possible strategic alternatives.

3.5.Data analysis

The data analysis framework for this thesis were chosen to analyze the complex factors of the Jones Act within the U.S. offshore wind industry, with focus on its impact on the transportation and installation strategies for WTGs. The chosen analytic approach is based on the Gioia methodology (Gioia, Corley & Hamilton, 2012), which enabled us to categorize and structure the findings from concepts and themes into two aggregated dimensions named “Regulatory Impact” and “Strategic Decisions”.

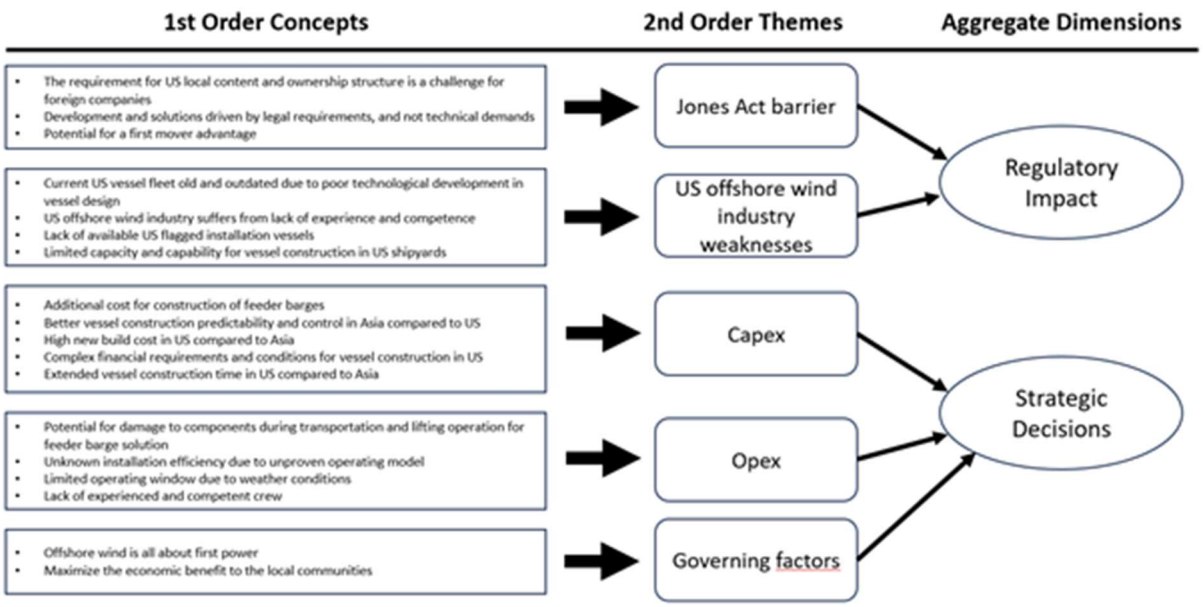

Figure 6: Data structure

The "Regulatory Impact" dimension goes into the direct and indirect problems caused by the Jones Act, supported by the underlying themes named "Jones Act barriers" and "US offshore wind industry weaknesses". These themes give insight into the legislative complexities and challenges caused by the regulations, and how they have affected the industry and its capabilities.

The other aggregated dimension, "Strategic Decisions" examines the various factors influencing the strategical decision processes for installation and transportations of WTGs, with themes concentrated on "Capex" (Capital Expenditures), "Opex" (Operational Expenditures) and "Governing Factors". These themes give insight into financial investment considerations as well as operational workability aspects and the impact of governing decisions in the strategic process.

The analysis, based on the methodological guidelines by Creswell (2014) and Yin (2009), and structured through the Gioia method, is designed to give a solid understanding of how the Jones Act regulation shape the strategic and regulatory landscape of the offshore wind industry in the U.S. By collecting information and insight from interviews with industry experts from Equinor, Pareto, EDF & Atlantic Offshore Wind and OIM Wind Ltd, this study makes a thorough analysis of the strategic challenges that the offshore wind industry in the U.S. faces.

3.6. Ethical considerations

This research into the strategic and regulatory aspects of the U.S. offshore wind industry, has been conducted with commitment to the high standards in research, based on the ethical guidelines outlined by Creswell (2014) for qualitive research, which highlights the importance of maintaining integrity, respect, and ethical treatment of all research participants. We have used an ethical framework when obtaining consent and ensuring the right to confidentiality of research participants. The process ensured that participants were fully informed about the objectives of the thesis, their involvement, and the use of their input. The ethical guidelines and principles recommended by Creswell were complemented by the methodological integrity ensured by the Gioia methodology (Gioia, Corley, & Hamilton, 2012).

3.7. Validity, reliability and credibility

It has been crucial to ensure validity, reliability, and credibility in this thesis, given the qualitative nature of the research. The methodological framework based on Creswell (2014) and the analytical structure from the Gioia methodology (Gioia, Corey, & Hamilton, 2012) has formed the baseline to meet the standards of these important research principles.

To make sure our findings were valid, we carefully matched our research questions with the data we collected and how we interpreted it. We checked the data against the limited theories and existing research. The way we collected data through detailed interviews with the candidates underlined the validity of the research. This method could also be used and done again under the same conditions, which makes it reliable.

Furthermore, reliability was strengthened by the systematic use of the Gioia method in our data analysis. The structured coding and progress into themes made the analytical process transparent and consistent, which is important for the integrity of qualitative research.

Credibility was ensured by checking of information with candidates, where they had the opportunity to review and verify the accuracy of the findings and how they were interpreted. This ensured that the findings reflected the experience and perspectives of the candidates. This also increases the trustworthiness of the research, and its overall validity, reliability, and credibility.

3.8.Summary

In this Methodology chapter we have outlined the qualitative research approach and methods we have chosen to use in this thesis. We have gone through the research design, how we selected candidates, how we collected data and how we plan to analyze the data, which sets a strong foundation for our study.

Our work is primarily grounded in Creswell's (2014) guidelines for quality, the analytic data structure by Gioia, Corley, & Hamilton (2012) and Yin's (2009) approach to case studies. This finds a solid foundation to deeply understand the different aspects and complexities of the U.S. offshore wind industry and the installation and the transportation of Wind Turbine Generators in particular.

Furthermore, we selected the candidates thoughtfully and designed our interviews to get as much detailed, accurate and insightful data as possible.

As we move on to the findings and discussion parts of this thesis, it is important to recognize the methodological foundation that enables us to deeply investigate the challenges and complexities related to regulatory impact and choice of strategies. We believe this prepares us well to do a solid research.

4. Findings & discussion

4.1. Introduction

We have chosen to combine the presentation of our findings with the corresponding discussion for the two aggregated dimensions. Within each dimension, we have structured the findings according to the respective 2nd order themes. This has been done in order to better facilitate a clear and comprehensive presentation. Based on the findings, we have identified key takeaways that form the foundation for a discussion that connects these findings to existing theories and previous research.

As explained in chapter 3, we decided to use the Gioia method (Gioia, Corley, & Hamilton, 2012) to execute the analysis and categorize the codes and themes into two aggregated dimensions, named “Regulatory Impact” and “Strategic Decisions”. The Regulatory impact dimension contains the findings related to Jones Act regulations and the consequences for the U.S. offshore wind market, while the Strategic Decisions dimension contains the findings related to the choice of transport and installation method.

The responses from the candidates were naturally divided into 2nd order themes. For the Regulatory Impact dimension, we have chosen to split it into two 2nd order themes, named “Jones Act barriers” and “US offshore wind industry weaknesses”. For the last dimension, named Strategic Decisions, we have split it into three 2nd order themes, named “Capex”, “Opex” and “Governing Factors”. The 2nd order themes and dimensions will be further described and reasoned during each section in this chapter.

From these 2nd order themes and aggregated dimensions, we will systematically present our findings and include quotes from the candidates to highlight the key takeaways. Subsequently, we will categorize and discuss the findings in relation to relevant theory and the research questions as restated below:

- How does the Jones Act impact the transportation and installation of Wind Turbine Generators in the US offshore wind industry?
- What is the best overall solution to comply with Jones Act, for transportation and installation of Wind Turbine Generators in the U.S.?

Furthermore, we will in the discussion utilize the insights and experience from the candidates and include relevant theory to explore the challenges and opportunities for the two transport and installation methods. As described in the Chapter 2, these two methods are:

- U.S. flagged WTIV
- Foreign flagged WTIV with feeder barges

4.2. Presentation of findings - Regulatory impact

During the interviews it became clear that all candidates were aware of the implications of the Jones Act regulation and the impact this has on industry in the U.S. Through our questions we revealed that the candidates have a common opinion on the challenges, while somehow different views on the impact and how to manage them. The responses from the candidates were naturally divided into two 2nd order themes, named Jones Act barriers and U.S. offshore wind industry weaknesses, which will be described and presented in this section.

As an introduction, we asked the candidates how the Jones Act affect the offshore wind industry in the U.S., from their perspective. Some clear statements were given by the candidates:

"Jones Act is here to stay, and we see no way it will change, especially now during the escalating security and geopolitical situation in the world." (Østeby, Pareto)

"It's the law. Suitable or not, it's there to comply with." (Ekici, Equinor)

"I would say the Jones Act impacts the industry drastically, both negatively and positively. This applies for both developers and installation companies." (Ronda, EDF & Atlantic Shores Wind)

"The challenges for wind industry in US is a combination of the Jones Act limitations and the fact that this is a new and immature industry." (Anthonsen, OIM Wind Ltd)

Furthermore, the candidates highlighted the origin and purpose of the regulation and the importance for the relevant stakeholders to understand the involved limitations.

"Jones Act has been there for many years and is a serious act of protectionism of a limited part of the offshore wind industry containing logistics of cargo and personnel between US ports." (Anthonsen, OIM Wind Ltd)

"First of all, we have to understand what Jones Act is. It is in fact a Cabotage law, which describes transport of goods or passengers between two points within US economic zone, including an offshore location within 200 nautical miles from shore." (Ekici, Equinor)

"The Jones Act is a law from the beginning of the century, which also enforce local content in the US. I would see this to be positive and an opportunity for the US market if it wants to grow as big as 30 GW. US build vessels would then need to do the work efficiently and maximize the number of jobs that it generates in the US, not only in the construction phase, but also in the maintenance phase." (Ronda, EDF & Atlantic Shores Wind)

We started the interviews by asking the candidates about the general impact on how the Jones Act affects the offshore wind industry in the U.S., and if they considered it to be suitable for the industry today. In addition, we asked about the influence specifically for the transport and installation vessels, if this could be attractive for foreign vessel owners and if this could potentially become a first-mover advantage.

4.2.1. Jones Act barrier

One of the first elements the candidates raised were the requirements from Jones Act which demand U.S. local content and ownership. This is obviously a barrier for foreign companies according to the candidates.

"The Jones Act regulation requires a minimum of 75% ownership by US citizens, which makes it an entry-barrier for foreign vessel owners." (Østeby, Pareto)

"US makes it unnecessarily complicated in my opinion. Protectionism can be positive for the national economy, but there is more than one solution to it. We understand the requirement to utilize US workforce, but you must also adjust to developments during time." (Østeby, Pareto)

The candidates also argue that the 100-year-old regulation is not fit for purpose for the coming high demand in the offshore wind market in U.S. However, they see no real possibility for exemptions to be granted by the authorities.

"We see a lot of people looking for exemptions towards Jones Act, but no, that will not happen." (Ekici, Equinor)

"Jones Act is not fit for purpose, in our opinion. It should at least be possible to apply for an exemption from Jones Act during installation campaigns, in order to secure a more efficient project execution and reduce the time to operate for wind farms in US. One alternative is to see how Brazil are managing same type of regulations where they open up for foreign flagged vessels if no local flagged vessel can be sourced." (Østeby, Pareto)

The candidates continued to discuss the challenges and potential workarounds to comply with the regulations. Consequently, the alternatives in the U.S. are primarily driven by legal requirements, while in Europe the focus has been to finetune operational efficiency and not limited by vessel flag and ownership. Hence, the technical solutions which are currently being investigated for the U.S. market are focused on new ways to transport components from shore to ship and still be compliant to the Jones Act.

"It is quite painful, to be honest, because you need to change the way you do things. It is not driven by a technical requirement, but rather a legal requirement. So, you need to be creative with for instance the feeder barges, not because you need to tackle a technical problem, but rather a legislative problem." (Ronda, EDF & Atlantic Shores Wind)

"The developers in the US must come up with their solutions to comply with the Jones Act regulations. The challenge there is the expansion of the Jones Act beyond what is meaningful and it's an interesting subject because it's also affecting the oil and gas operations. So, whatever we decide here in the offshore wind side, it directly effects the oil and gas operations also. So, it's a joint effect there." (Ekici, Equinor)

The candidate from OIM Wind Ltd interestingly points out that the definition of a U.S. port is, from his point of view, not necessarily straight forward.

"In addition to the already mentioned challenges, there is also a discussion with regards to the definitions of the offshore location as a US port, according to Jones Act. Is really a steel monopole jacked down to seabed far out at sea an US port? I'm sure this will continue to be discussed and be a profitable time for the lawyers going forward." (Anthonsen, OIM Wind Ltd)

The same candidate also highlighted that it is not the regulation itself which causes the obstacles, but rather how it is being managed by the developers. In his opinion, the developers have misjudged the complexity and time-consuming process that is needed in advance to prepare a compliant vessel.

"I believe that Jones Act limits the industry, but that is mainly because stakeholders haven't approached the challenges in a sufficient early phase. In my opinion, this is related to poor contract management by the developers, something which they will probably never admit. The developers know they require a certain number of vessels for the installation program, and they have assumed that compliant vessels can be chartered. However, now they realize that this has become a big challenge as there are no such vessels available in the market." (Anthonsen, OIM Wind Ltd)

While the regulation clearly poses severe challenges and consequently a barrier to entering the U.S. market, this could also be seen as an opportunity as it limits the number of potential competitors for the upcoming contracts. When asked if this could be seen as a potential first-mover advantage for a U.S. flagged vessel, the candidates agreed that this could be the case, however with some pre-requisites in place.

"It could be an advantage as we think that for the first movers, the entry barrier could protect them from competitors. Such vessels will simplify the logistics, especially for repair and maintenance phase." (Østeby, Pareto)

"This is exactly the reason why we are currently exploring this opportunity. As there are no other vessels available, we can take a market position as first movers. As of now, the competition is minimal." (Anthonsen, OIM Wind Ltd)

"Economic and financial aspects apart, whoever has a vessel available will have an advantage, I would say." (Ronda, EDF & Atlantic Shores Wind)

"It's a tough question. I mean, it's a simple supply and demand market. And it depends on the vessel rate. If U.S. government dictates that it has to be a U.S. flagged vessel, it would clearly be an advantage, however, I don't believe they would ever do so." (Ekici, Equinor)

To summarize the Jones Act barrier theme above, the findings indicate challenges regarding ownership structure for vessels and the requirement to use U.S. workforce. There are no indications for possible exemptions or flexibility to the regulations. The only alternative for foreign flagged vessels is to create new technical solutions. Another finding is that these barriers can limit the competition and pose a first-mover advantage.

4.2.2. U.S. offshore wind industry weaknesses

During our coding of 1st order concepts, we found a pattern of findings related to various weaknesses and negative impacts to the industry. These concepts were aggregated up to a new 2nd order theme which has been named "U.S. offshore wind industry weaknesses". The weaknesses have been identified and can be linked both directly and indirectly to the Jones Act regulation.

"We believe that the Jones Act has completely destroyed the US market for modern high specification vessels, due to the restriction in importation of foreign flagged vessels and no construction of such vessels in U.S. shipyards." (Østeby, Pareto)

The candidate from Pareto also highlighted the old and outdated vessel fleet currently in the U.S. and lack of development in high specification vessel design as an important negative consequence of the regulation through the last few decades.

"There is no doubt that the current fleet of vessels is old and outdated from our perspective. The market hasn't changed for the last decades as the requirements for vessel specification haven't changed. There are international oil companies such as Exxon Mobil and Chevron, which have not demanded changes or adjustments to the Jones Act, and consequently being a slowing legacy. This has ended up with an U.S. offshore industry that has not kept up with the international technological development of vessels within fuel consumption, use of LNG and batteries. That's why they look at these wind installation vessels almost like spaceships." (Østeby, Pareto)

The candidate from OIM Wind pointed out another weakness which is the limited capacity and capability for construction of such vessels in U.S. shipyards.

"Another element is that U.S. shipyards do not have the relevant experience for construction of installation vessels, nor required infrastructure in place for such projects compared to Asian shipyards. This introduces the alternative to import foreign flagged vessels." (Anthonsen, OIM Wind Ltd)

Furthermore, the candidate from Equinor highlighted the lack of relevant crew competence and experience for operating such vessels in the U.S., as well as the lack of available vessels.

"The handicap in offshore wind is the experience gap and then the vessel availability. There are no such vessels here at the moment, which are compliant with Jones Act requirements. Also, there is a lack of qualified crew to operate these types of vessels in U.S." (Ekici, Equinor)

To summarize the U.S. offshore wind industry weakness' theme above, the findings point out the underdevelopment in the U.S. industry for the last decades. Consequently, the market

consists of an outdated vessel fleet, with a lack of ability to construct and operate modern high specification installation vessels. These weaknesses will also be further elaborated on when we present the findings related to the Strategic Decisions dimension.

4.3.Discussion - Regulatory impact

Based on the findings above regarding Regulatory Impact, we have chosen to categorize the discussion into five main topics.

4.3.1. It’s the law

One of the main reasons to implement Jones Act in the first place was to ensure national capacities and capabilities in the U.S. maritime industry. This is by no means exceptional or unique, as most countries have the same intentions to protect their own interests. This is practiced differently around the world, and according to The Organization for Economic Cooperation and Development, Jones Act provides the most restrictive example of global cabotage law (OECD, 2019). Østeby from Pareto sees no way the Jones Act regulation will change, especially as the current security and geopolitical situation in world has been escalating recently.

In addition to the security aspects, the Jones Act intends to support and protect their domestic industries. It intends to help local businesses grow, protect their markets, and make them less dependent on other countries.

As Østeby from Pareto interestingly points out we can look at Brazil’s approach, for instance. Just as the U.S. has regulations for its maritime operations, Brazil has its own regulations. Brazil's maritime transport agency, ANTAQ, has a "circularization process" for vessels (Agência Nacional de Transportes Aquaviários [ANTAQ], 2021). This process is similar to the Jones Act, but it is a bit more flexible. This lets foreign vessels work in Brazilian waters under certain conditions, provided there is no Brazilian flagged vessels qualified for the specified required period and project. This means Brazil is trying to protect its own industry but also opens to international alternatives.

Whether it is the Jones Act in the U.S. or ANTAQ's regulations in Brazil, these regulations want to help their own country first. However, people always discuss their effects, like how

they impact foreign investments and international competition. Even though the main goal of these laws is to strengthen local industry and job opportunities, they also raise questions about their larger impact on the industry and their nation's competitiveness.

Ekici from Equinor raised a question if the U.S. government could force the wind farm projects to use only U.S. flagged vessels. This would have a major impact on the supply-demand dynamics in the market, and if this happens, charter rates of these vessels could become even more expensive, raising the overall costs for the projects. However, as he points out, this is highly unlikely. It is also worth noting the massive ambitions from the White House regarding offshore wind developments in the coming years (White House, 2021). Such hypothetical enforcement could most probably challenge the timeline of these ambitions by limiting the supply chain of vessels, which most certainly would be the outcome if they exclude foreign flagged vessels entirely.

4.3.2. Made in America

As mentioned in the theory chapter, the Jones Act requires that in order to qualify as an U.S. flagged vessel it has to fulfill the following four elements (Transportation Institute, n.d.).

- The vessel has to be owned by a U.S. company which is controlled by U.S. citizens with at least 75% U.S. ownership.
- There must be minimum 75% U.S. crew.
- The vessel must be built in the U.S. in accordance with the definition by U.S. Coast Guard.
- Registered in the U.S.

The candidates are unified in the opinion that these requirements are clearly causing a barrier for foreign vessel owners to enter the U.S. market. Østeby from Pareto concludes that the Jones Act, originated from the 1920s, does not really fit with the fast-growing requirements of the U.S. offshore wind industry. Because of the strict regulations, especially about who can own vessels, foreign companies must come up with new ways to do business in the U.S. The ownership structure could be solved by different models of joint-ventures, bareboat

agreements, or other ways of partnerships between foreign companies and U.S. stakeholders. You could argue that this is adding more bureaucracy and delay rather than the needed value creation for the fast-growing industry.

An important negative impact that the candidates detected is the combination of an outdated vessel fleet and the shipyard's lack of capability to construct modern high-spec vessels. As stated by one of the candidates, the Jones Act "has completely destroyed the U.S. market for modern high-specification vessels". They find that the lack of development in vessel design is caused by hardly any change in the demanded requirements from the major end-customers. Consequently, this has left the U.S. shipyard industry in a poor state and not ready to supply this new demand of high-spec vessels needed for the installation of wind turbines offshore. This is backed up with the fact that only two or three shipyards in the U.S. are considered to have the required infrastructure in place to be able to construct such vessels, according to screenings executed by both Pareto and OIM. These statements from the candidates are supported by the publication from the CATO Institute describing the burdens of Jones Act (Mulligan, 2020). The reason for why the market has developed in this direction is because the demand has mainly been related to high-volume production of vessels to the traditional industry, such as cargo vessels, supply vessels, and the U.S. marine vessels. From a shipyard perspective, this can perhaps be commercially justified due to a higher degree of predictability and well-known specifications. In this context, it is worth noting that offshore wind industry has been developed and matured internationally outside the U.S. for several decades. The same cannot be said for the U.S. wind industry, which has just recently kicked off and can be defined as immature. The related challenges are influenced and reinforced by the fact that the Jones Act causes a barrier and, in many ways, separates the U.S. industry from the international market.

Additionally, our research identifies a weakness related to the local content. The requirement stipulated by Jones Act is to have minimum 75% of the crew onboard to be U.S. citizens. However, as there are no such vessels currently operating in the U.S., the candidates have identified a lack of qualified crew. As stated by the candidate from Equinor this is clearly a handicap and further reinforces the impression of an immature and unprepared industry in the U.S. as per today. On the other side, and to challenge the candidates' view on this, it is worth noting that the Jones Act still opens for 25% of foreign crew. This can be allocated to the most specialized positions, and over time transfer experience and competence over to local

crew. It must also be considered that also foreign flagged vessels will have to utilize a certain amount of local workforce due to the requirement of appropriate working permits. For foreign crew it is required to have an exempt from the Coast Guard where it is justified that the relevant competence cannot be fulfilled by local workforce. In practical terms, this means that both U.S. flagged, and foreign flagged vessels will operate with a high share of U.S. workforce, especially for lower rank positions. In many ways this dilutes the concern from the candidates that the Jones Act requirements, on this specific item, are a significant barrier.

4.3.3. Coastwise point

Another element related to the impact of the Jones Act is the definition of an U.S. port. Anthonsen from OIM questions if "a steel monopole jacked down to seabed far out at sea an U.S. port?". This might be a relevant point that has been discussed in various forums in recent times. However, as described in the theory chapter, this is clearly defined by the Letter issued in 2021 by the U.S. Customs and Border Protection ruling that once the scour protection rocks are placed on the seabed, a coast point is created at that location (U.S. Congress, 1953). Hence, for an installation vessel, which are installing foundations and wind turbines, the location is considered as a coastwise point and consequently an U.S. port that must comply with Jones Act regulations.

4.3.4. Tackle a legislative problem!

The Jones Act has undoubtedly left the industry with a problem to solve. On one hand, you have an U.S. industry which in general is not prepared to construct and operate the required vessels, while on the other hand, you have an international industry that is eager to take part but is restricted by the Jones Act regulations. Either way "you need to change the way you do things" as stated by the candidate from EDF & Atlantic Shores Wind. Normally, the innovation in the offshore wind industry is driven by technical improvements to enhance efficiency and safety, but in this case the innovation is mainly focused on finding a solution to the legislative problem.

As described in the theory chapter, the Jones Act is a 100-year-old regulation (Transportation Institute, n.d.). The regulations have not passed the test of time according to some of the

candidates, and deems it not fit for purpose for modern industries such as offshore wind developments. The candidate from Pareto proposes that exemptions should at least be possible during installation campaigns, to secure more efficient project execution. However, as the candidate from Equinor stated, he believes there will be no exemptions made, despite this topic being frequently raised and discussed in the industry.

This introduces the two main methods for transportation and installation of wind turbines offshore in the U.S., which are the U.S flagged WTIV and Foreign flagged WTIV with feeder barges, both described in detail in the theory chapter. The candidates are unified in the conclusion that these two methods are currently the only considered options and solutions to tackle the Jones Act regulation.

Regardless of the choice of methods, which will be discussed in the following sections, Anthonsen from OIM stresses the importance of starting the planning process early to secure the availability of required vessels. In his opinion this is not currently the case due to "poor contract management by the developers". If developers start their preparation early, they can handle the problems and complexity the Jones Act represents, he concludes. Even though the cost to hire an installation vessel is estimated by OIM to be approx. 5% of the total project cost, the consequence of no available installation vessel at the planned time can be detrimental for the overall project execution.

4.3.5. The opportunities

Despite all the restrictions and potential negative impacts caused by the Jones Act regulations, there are also opportunities that could be explored. As Ronda from EDF & Atlantic Shores Wind is stating "I would see this to be positive and an opportunity for the U.S. market if it wants to grow as big as 30 GW". As announced by the Biden administration in 2021 (White House, 2021), the political ambitions and actions for developing offshore wind in the U.S. have increased massively. These actions are mainly driven by the ambitions to build a clean energy economy, focusing on creating American jobs. Østeby from Pareto, despite considering the Jones Act to be a barrier in general, he also agrees that the "protectionism can be positive for the national economy". Regardless of the setup and strategic direction, these massive ambitions create a new market for the offshore wind industry in general.

From a foreign vessel owners' perspective, protectionism is obviously a challenge and an entry barrier. There are two main alternatives to enter the market, which is by importing a foreign flagged vessel supported by U.S. flagged feeder barges or to construct an U.S. flagged vessel. Both alternatives must comply with Jones Act regulations, however in different ways. Either way, this could be seen as an opportunity and possibly an advantage for stakeholders which are able to find the solution for this complex equation. As the regulation creates barriers to entering the market, it also limits the competition which is normally beneficial for the vessel owner.

In our research we asked the candidates if constructing an U.S. flagged vessel could be seen as a first-mover advantage. "This is exactly the reason why we are exploring this opportunity. As there are no other vessels available, we can take a market position as first movers", concludes Anthonsen from OIM. This is backed up by Østeby from Pareto which also highlights the benefits of having a U.S. flagged vessel in place after the installation campaign is completed, as this could simplify the logistics especially in the repair and maintenance phase. While the upcoming offshore wind market in the U.S. is of a significant size, the transport and installation scopes are arguably a niche segment. This, in combination with the strict and protective regulations, could present a significant first-mover advantage.

It is worth noting that there are different kinds of perspectives when discussing the impact of the Jones Act. From a developer's perspective, the transport and installation of the wind components is only one part of the total project, whereas many other variables must be considered and planned for. As states by Ekici from Equinor, which is a developer, it all "depends on the vessel rate". This means that the cost for transportation and installation is a key factor when considering strategic decisions. On the other hand, Ronda from EDF & Atlantic Shores Wind concludes that apart from the financial aspect "whoever has a vessel available will have an advantage".

These aspects form the foundation for the further discussions of strategic choices and decisions related to transport and installation of wind turbine generators in offshore wind developments in the U.S.

4.4. Presentation of findings - Strategic decisions

The next aggregated dimension in our Gioia coding matrix we have named Strategic Decisions. Through our questions we revealed that the candidates have different preferences and opinions on the various topics around strategy. The findings were converted into 1st order concepts, and we have chosen to divide these concepts into three 2nd order themes, named "Capex", "Opex" and "Governing factors".

Before we dive further into these three 2nd order themes, we started asking the candidates, regardless of their choice of method, if they consider the U.S. offshore wind market attractive from a foreign vessel owner's perspective, either by use of a foreign flagged vessel or alternatively a U.S. flagged vessel build in the U.S. The answers were not unanimous.

"The U.S. market is not attractive for foreign vessel operators, as foreigners are limited to a maximum of 25% ownership of an U.S. build vessel. Another alternative is to bring a foreign flagged vessel into the U.S., but I do not find that attractive either as there are other markets in demand, with less limitations. It might look attractive as the daily rates are high, but taking the complexities and limitations into account, I would say no." (Anthonsen, OIM Wind Ltd)

"The US is obviously an attractive market for foreign vessel operator" (Ekici, Equinor)

"We can sense a significant interest from foreign vessel operators. There will not be many new builds in the US, so there must be foreign flagged vessels. However, this is definitely a niche market." (Østeby, Pareto)

"In the situation we are now with plenty of job everywhere why would an operator take such a big risk going to the US when you can go elsewhere with your current vessel or even a new build. With a lower risk profile somewhere else, why would you take this risk?" (Ronda, EDF & Atlantic Shores Wind)

Furthermore, we asked the candidates what their company's preferred transport and installation method is, and to elaborate on their assessments regarding key elements leading up to their choice of strategy. As described in the theory chapter, the two main alternatives for transport and installation of components to the offshore wind farm in the U.S., is either by use of an U.S. flagged vessel or a foreign flagged vessel with feeder barges. While the candidates seemed to agree on the various elements involved, there are clearly different opinions on the best choice of strategy going forward.

"Our strategy is to build a Jones Act compliant vessel in the US and not to import a foreign flagged vessel. We have no trust in the feeder solution to be functional. This is our only strategy for the US." (Anthonsen, OIM Wind Ltd)

"Our strategy is obviously the feeder solution as we have already chosen Maersk for our project for the transportation and installation scope." (Ekicic, Equinor)

"I cannot give the particular opinion of my company on the strategy due to lack of non-disclosure agreement. In general, as a developer, what a developer wants is a cost-efficient way of doing things regardless of what you are using. Personally, I believe the best way to go is the way we are performing at the moment in Europe, which is transporting and installation with the same vessel, or at least avoiding the transfer of components floating to fixed." (Ronda, EDF & Atlantic Shores Wind)

Going further into the Capex and Opex 2nd order themes, we discovered during the interviews a differentiated focus by the candidates regarding the phases before and after the vessels start to operate. The findings revealed pros and cons for each method during the construction phase and the operational phase. The candidates highlighted how the two methods are impacted differently from a cost, time, and risk perspective in these two phases.

4.4.1. Capex

When studying the findings, it appeared natural to categorize the 1st order concepts related to the construction phase of both alternative strategies into a 2nd order theme, which we have named Capex. We have defined the theme to be the period containing the various elements of cost, time, and risk from start of construction until the vessel is ready to operate.

One of the main findings is related to cost, which the candidates had a common view of. They all seemed to agree, perhaps not surprisingly, that the cost of construction is significantly higher in the U.S. compared to Asia.

"There is a considerable higher cost for vessel construction in the U.S. compared to Asia. Our calculations indicate approximately 50% higher investment cost in the U.S." (Anthonsen, OIM Wind Ltd)

However, it might not be as straightforward as quoted above, considering the additional cost of feeder barges needed for a foreign-built vessel to be compliant with the Jones Act regulation, as highlighted by the candidate from Pareto.

"International built vessels will have in addition to the vessel cost itself, also have to include the cost of feeder barges, which needs to be constructed in the U.S. This must also be considered when comparing the total cost of the two different strategies." (Østeby, Pareto)

It is also noted from the candidate from OIM Wind that the payment scheme required by the shipyards are different and more favorably in Asia compared to U.S. Asian shipyards demand less upfront payment at contract signature which makes it easier for vessel owners to raise the needed equity.

"Also, another element is that the financial scheme is better arranged for such projects in Asia." (Anthonsen, OIM Wind Ltd)

According to the candidates from EDF & Atlantic Shores Wind and Pareto, the financial risk carried by vessel owner and associated investors for building a U.S. flagged vessel, can be mitigated by increased financial commitments from the developer.

"So, in order to secure US-build installation vessel, I believe that developers need to invest money to create sustainable financial conditions for the installation companies and relevant stakeholders." (Ronda, EDF & Atlantic Shores Wind)

"The segment is attractive for investors, but a prerequisite for obtaining financing from investors is to be able to show a long-term contract that ensures earnings and thus also reduces the risk of investment." (Østeby, Pareto)

Another interesting finding is that even if the cost and time are significantly higher when constructing a U.S. vessel, the investments could be rewarding in the longer term. This is because a local vessel could be seen as an advantage from a national perspective in the U.S. when new tenders are announced.

"Personally, I think that if you invest the time and money in a U.S. built installation vessel, it will be possible to secure several contracts in the foreseeable future. Normal consensus is that local assets are preferred if possible. In other words, it could probably be a profitable investment. However, you will have to bankroll an investment of approximately 5-600 MUSD." (Østeby, Pareto)

Another finding is the difference in construction time of the vessel, which could be important for the overall project timeline and impact the choice of strategy. It became clear that the construction time of a vessel in U.S. will be longer compared to Asia.

"According to our estimates it will take approximately 50% more time, 36 months compared to 24 months, from steel cutting to a completed vessel ready for delivery in the US compared to an Asian build vessel." (Anthonsen, OIM Wind Ltd)

While the candidates agreed on the expected construction time for both alternatives, the additional feeder barges needed for the foreign build vessels must be included in the equation. However, it is not expected to impact the total construction time, since the feeder barges are expected to be completed within the construction period of the installation vessel.

"It is expected that construction time for installation vessels built in the US will be more than 50% longer compared to international build vessels. Expected construction time in Asia is 24 months from first steel cut until delivery, while in the US the expected time is more than 36 months. The building of feeder barges related to international build installation vessels, is expected to be less than 24 months, and hence not impact the total construction time." (Østeby, Pareto)

As cost and time are important elements in the evaluation there are also uncertainties in the construction execution, especially in the U.S. This will impact both the time and cost elements, hence it is important for the stakeholders to include them in their evaluation. As the candidate from EDF & Atlantic Shore Wind highlighted below, there are also uncertainties regarding execution of such a construction project in the U.S.

"I guess the cost and the uncertainties to build this kind of vessel are much higher in the US compared to Asia. The vessel can be built in Asia for approx. 300-400 MUSD, and you could expect the vessel to be ready in a reasonable time. Can it be the same in the US? I don't know. I expect the cost to be higher and the construction time to be longer in the US. So, the final cost might be 600 or 700 MUSD. And is the vessel going to be delivered in time? I believe that construction in Asia is more predictable." (Ronda, EDF & Atlantic Shores Wind)

There is clearly a risk element related to the construction of vessels in the U.S., which are also supported by the findings described previously in the U.S. offshore wind industry weaknesses 2nd order theme. In order to construct such a vessel, the shipyard is required to have a combination of large construction cranes, a deepwater quayside and it is necessary to have no height restrictions when transporting the vessel in and out of the quay. This is currently a limitation as highlighted by the candidate from OIM Wind.

"According to our prescreening process, we have only identified two, maybe three, shipyards which have the required infrastructure in place for construction of an installation vessel." (Anthonsen, OIM Wind Ltd)

"It's all subject to availability of shipyards in the US who are capable of building an installation vessel." (Østeby, Pareto)

In addition to the limited suitable shipyards in the U.S., another finding is the lack of relevant track record for construction of complex installation vessels. Consequently, the available competent workforce is limited, as also identified in the U.S. offshore wind industry weaknesses 2nd order theme.

At the same time, Asian shipyards have accumulated advanced industrial construction methods over the last decades. Hence, they are considered to be a more reliable and predictable shipyard.

"It is easier to contract a new build in Asia compared to the US. We find it easier to control and follow up the yards in Asia, due to the extensive volume of construction of complex vessels for the last decades." Anthonsen, OIM Wind Ltd)

Another finding highlighted by the candidate from Pareto, in addition to the lack of track record for construction of these type of vessel, is the lack of preference from a shipyard's point of view to take on such complex project. U.S. shipyards are likely to prefer "high volume - low complex" projects, rather than the opposite.

"The U.S. shipyards have to construct vessels which are significantly more advanced, and complex compared to previous build vessels. This is a big challenge. And extremely cost demanding. Our understanding is that the shipyards prefer not to take on these one-off, expensive, and complex projects and rather focus on serial construction of vessels. As an example, if they would be in a position to construct a series of 10 identical vessels for the U.S. Navy, which is currently introducing a significant new build program, there is no doubt that this option would be preferred." (Østeby, Pareto)

The candidate from Equinor in many ways summarizes the above elements of risks related to construction of a vessel in U.S., and this have seemingly played a deciding role in their choice of strategy.

"It is possible to build an installation vessel in the U.S., but it is not easy. There are so many unknowns out there; steal prices, labor, timing, schedule slip, experience, and many more in

my opinion. Hence, from our point of view, it has been a straightforward decision." (Ekicic, Equinor)

However, construction of vessels in U.S. are evidently still an option with currently one vessel under construction as per today as described in the theory chapter. But the candidate from Equinor questioned whether the investments can be justified considering the significantly higher construction cost.

"Currently there is only one US flagged vessel being built, and even when operational it will not be sufficient for the vessel demands in the US. So, the question will be, what are the day rates going to be to compensate for the investments you make in the vessels? (Ekicic, Equinor)

To summarize the Capex 2nd order theme above, the findings indicate that an U.S. build vessel will be more costly, have a longer construction time and add more uncertainties, while the Asian shipyards have a proven track record, can provide a favorable payment scheme, and have the needed competence and workforce in place.

Based on these findings it looks to be a straightforward choice to go with a foreign flagged vessel strategy. However, when moving on to the next 2nd order theme, we will dive into the operational phase to present the findings related to the similar elements for each alternative strategy, which may challenge this preliminary "straightforward" perception.

4.4.2. Opex

For the next 2nd order theme, we have categorized the 1st order concepts related to the operational phase of both alternative strategies, which we have named Opex. We have

defined the theme to be the period containing the various elements of workability, efficiency, and risk for the installation vessel during installation campaigns.

The established transportation and installation method used worldwide is that the installation vessel itself sails to port and picks up the components and transports them to location, and then starts the installation. In the U.S., this transportation method can only be performed by a U.S. flagged installation vessel. According to the Jones Act, a foreign flagged vessel is not allowed to carry cargo between ports in U.S. Thus, the foreign flagged installation vessel needs to stay outside port limits and be supplied by U.S. flagged feeder barges which transport the wind components from shore quay on to the vessel. This solution is currently not used anywhere in the world today, hence this is a custom made and unproven alternative solution for a foreign flagged vessel in order to comply with the Jones Act regulation. All the candidates were aware of this, but the big question they raised is how the alternative solution will perform.

"The big challenge is to get the feeder barges to match the performance of the installation vessels working in Europe today." (Ronda, EDF & Atlantic Shores Wind)

"The main challenge is related to the feeder barge solution when transferring the wind turbine generators and associated equipment from the feeder barge to the installation vessel." (Østeby, Pareto)

"You always want something to be cost effective, but the problem I see here is that you are not comparing apples to apples, when it comes to vessel and technologies, because one is a proven one while the other is not. Are we sure that the feeder barges going to be effective?" (Ronda, EDF & Atlantic Shores Wind)

The candidates states that the weather conditions are critical for operations in general, however, the feeder barge solution is far more vulnerable than the installation vessel. This is mainly related to the lifting of heavy and highly sensitive components from the feeder barge onto the installation vessel. Damage to these components can potentially be detrimental for the installation campaign, due to the high cost and long lead time for replacement of such components.

"Main reason is that we don't find it efficient to have large barges to supply especially the wind turbine generators in the open Atlantic Sea. There will be a lot of movement during periods of high waves and windy conditions, which is not compliant with the strict weather criteria for lifting operations for these components. The risk of damaging the equipment is high in our view. We believe this will limit the operation window substantially." (Anthonsen, OIM Wind Ltd)

An interesting finding is that the weather conditions will limit the operating window for both alternatives, but to a greater extent for the feeder barge solution as they are dependent on calm sea states while executing lifting operations.

"The risk of damage is considerable due to rough weather conditions at the offshore location. The weather conditions will limit the operational predictability and can cause major impact on time and cost, due to waiting on weather. The lifting operations have to be paused when net wave heights are above 1-2 meters." (Østeby, Pareto)

As stated by the candidate from Pareto, non-productive time is more likely to occur with the feeder barge solution. During a campaign over several months, or years, this can have a major impact on the project timeline. This is also highlighted by the candidate from OIM Wind.

"During the contract period U.S. flagged installation vessel will be more cost-effective at the end, due to less number of days to complete the project." (Anthonsen, OIM Wind Ltd)

However, there are also shorter campaigns which will only last for a few months. For such campaigns it is likely to reduce the risk for waiting on weather, if they are planned for the summer period, as pointed out by the candidate from EDF & Atlantic Shores Wind.

"If the campaign only requires installation work during the summer season, where normally sea states are calm and weather conditions are good, the feeder solution might be an efficient way to do it." (Ronda, EDF & Atlantic Shores Wind)

Another element which came up during the interviews was related to the running costs for the operational phase. They are estimated to be approximately the same, with some differences in salary levels and crew size between the two alternatives.

"When in operation the daily cost of repair, maintenance, consumables, and spares will be the same. However, crew cost for the installation vessel itself will be different as a U.S. flagged vessel will have U.S. crew onboard which are more expensive than foreign crew, especially on lower ranks. On the other hand, the feeder barges will need additional crew. In total we believe this adds up and that a U.S. built vessel, without the feeder barge arrangement, will be more efficient and reliable." (Anthonsen, OIM Wind Ltd)

For the operational phase another finding is lack of relevant experience and crew competence to operate an installation vessel. Due to the significant increase of installation vessels worldwide, it is in general challenging to recruit qualified crew to operate the vessels. On top of this, it is even more challenging in the U.S. as there are currently no such vessels operating.

"For both strategies, there is still a risk related to the crew operating these vessels which will definitely impact performance and the total execution of the project." (Ronda, EDF & Atlantic Shores Wind)

"Foreign flagged vessels are already operating and have proven their capability and track record for many years. It is not only the vessel, but also the manning, competence and experience operating the vessels. All this takes time." (Ekicic, Equinor)

The candidate from Pareto highlighted another interesting element that we initially did not have in mind when formulating our research questions, which was the requirement of suitable vessels to perform maintenance and repairs of the wind turbines after installation.

"After the installation the projects enters into repair and maintenance mode of the wind turbine generators and blades. These operations would also require a vessel with the same specifications for crane capacity, which is basically an installation vessel. If a vessel should be mobilized from Europe for example, this would not be economically sustainable nor practical, due to long and costly mobilization and demobilization of the vessel." (Østeby, Pareto)

To summarize the Opex 2nd order theme above, the findings indicate that a foreign flagged vessel with supporting feeder barges clearly is an unproven technology with several related uncertainties. The candidates raised several questions related to workability, such as the risk of damage to components during transportation and lifting operation, and limited operating window due to weather conditions.

It was found that the running costs for each alternative, despite some differences, are expected to be similar in total. Both alternatives will be impacted by the lack of experienced

and competent crew, also highlighted in the U.S. offshore wind industry weaknesses 2nd order theme, but possibly to a higher degree for the U.S. flagged vessel.

The candidate from Equinor in many ways summarized the above and raised the main question whether the increased risk with a foreign flagged vessel with feeder barges can be justified commercially by a lower investment cost.

"Commercially the risk is obvious, you have a more expensive single vessel with a higher day rate on one hand, and on the other hand you have a foreign flagged vessel with a bigger fleet with barge feeders. The bigger fleet increases your HSE risk compared to the single vessel. That's obvious. However, does the commercial risk in-between compensate for it? That's the big question." (Ekicic, Equinor)

4.4.3. Governing factors

The last 2nd order theme is named Governing factors. During the interview the candidates indicated two essential contractual requirements which could be a governing factor in their choice of strategy.

The first requirement is the deadline to deliver power to shore. This requirement is an obligation the developers have committed to at the award of license. In general, there is a high demand to increase the capacity of offshore wind power supply. For the U.S. market any installation vessel will have to be constructed as there is no compliant vessel currently available. The consequence of breaching the contractual deadline could be severe in terms of penalty fees and negative financial impact. Due to this the developers have now entered and found themselves in a time squeeze, which may in fact be the decisive criteria for the choice of strategy.

"An important element is what commitment the developers are contracted to in terms of deadlines related to delivery of power to the shore net. Offshore wind is all about first power. If the developer has a firm Commercial Operation Date, which often is the case, they need to

start delivering power to the net. If the developer is not able to meet the deadline, they will be in breach of contract, and will suffer liquidated damage." (Ronda, EDF & Atlantic Shores Wind)

The candidate from OIM Wind points out that the reason why the developers are in a time squeeze is because they don't have adequate knowledge of the complex maritime operations required. He believes that the planning should have started earlier. Currently, there is a possibility that decisions are forced by deadline commitments rather than what is the best and most efficient solution.

"In my opinion, this has become complicated mainly due to the lack of maritime competence amongst the developers for how to mitigate risk in an early phase of such projects. Time is flying. They have painted themselves into a corner." (Anthonsen, OIM Wind Ltd)

A similar statement was also made by the candidate from Pareto, which believes that there are circumstances for the U.S. market that require the planning process to start earlier than for comparable projects in Europe and Asia. These circumstances are related to the need for a custom-built and Jones Act compliant vessel to be constructed. This is contrary to normal procedure and must be considered.

"I believe that especially for the installation vessels, because of the Jones Act regulations, the developer needs to start their tender process earlier than is normal procedures in Europe and Asia. This might be even before you have the detailed information about seabed conditions and what type of turbine to use. Less details means more assumptions and considerations compared to normal processes in Europe and Asia, where you first choose type of turbine (vendor), then detailed seabed survey and thereafter make accurate specifications for the installation vessel." (Østeby, Pareto)

The second contractual requirement is related to the demand for local content. In the award, the developers have made commitments regarding local spending and presence, and to maximize the economic benefit to the local communities. This is on top of the Jones Act regulatory requirements. As highlighted by the candidate from Pareto, this contractual demand could impact the choice of strategy.

"The developer has made commitments to carry out local purchases, use local workforce and leave as much money as possible in the local environment. In other words, the developer will try to push as many of these obligations as possible onto the subcontractors, so that they can have some flexibility themselves." (Østeby, Pareto)

This is also commented by the candidate from OIM Wind, which believes this is a governing factor in the choice of strategy by the developer.

"In the tender process they have committed to a specific local content, and they push this on us as much as possible. I'm sure this affects their decisions." (Anthonsen, OIM Wind Ltd)

To summarize the Governing factors 2nd order theme above, the findings indicate that there are governing factors such as power delivery deadline and local content, which can impact the choice of strategy possibly at the expense of elements described in the Capex and Opex 2nd order themes.

"So, it's a very complicated puzzle to put together." (Ronda, EDF & Atlantic Shores Wind)

4.5. Discussion - Strategic decisions

Based on the findings above regarding Strategic decisions, we have chosen to categorize the discussion into the following main topics.

4.5.1. The attractiveness

As part of our research, we asked the candidates if they consider the U.S. offshore wind market to be attractive from a foreign vessel owner's perspective, regardless of the choice of strategy. One could assume that the recognized opportunities are naturally followed by a perception of an attractive market. However, on this topic, there were clearly different opinions amongst the candidates.

An interesting element is how the developers from Equinor and EDF & Atlantic Shores Wind has different views. Ekici from Equinor states that the U.S. market is "obviously an attractive market", while Ronda from EDF & Atlantic Shores Wind questions "why would a vessel owner take such a big risk". This is an interestingly contradicting perception. Ronda argues that there is so much activity internationally outside the U.S., stating there is "plenty of jobs everywhere", with less risk profile and less regulatory complexities. Then why should these foreign vessel owners still decide to enter the U.S. market? An important factor in this dilemma is the potential benefit of getting an early foothold in a market with high entry barriers. This is backed up by the candidate from OIM, who despite claiming the market is not attractive in general, still finds the U.S. market attractive due to the potential for a first-mover advantage.

4.5.2. Construction cost

In order to develop an offshore wind farm, huge investments are required. The total costs of the project may influence the end price for power to the consumer. There are many elements included in the total project scope, however, our research thesis is limited to the transport and installation of wind turbines. The capital expenditures investment for this specific part has been estimated by Anthonsen from OIM Wind to be approximately 5% of the total project cost for the developers.

The 5% cost consists of the actual daily vessel rate to hire the vessel and associated services. The vessel rate consists of financing costs for the vessel owner, daily operational expenses, and profit margin, adjusted for various risk factors. Hence, the cost for constructing the installation vessel will directly influence the vessel day rate and consequently the cost for the total project. However, there are two variables in this equation, day rate and number of days. In other words, a higher day rate could in the end still be more cost-effective if the number of days to complete the installation is less. The 5% estimate stated by OIM Wind has not been mentioned by any of the other candidates, and we have not been able to find documentation to support or challenge this statement.

There is a broad consensus amongst the candidates that an U.S. build vessel will be more expensive compared to an international build vessel. The cost difference is, based on the findings from the candidates, estimated to be approximately 50% more for a vessel build in the U.S. compared to internationally. Higher construction cost for the U.S. flagged WTIV is also outlined by the publication from GustoMSC (2017) because of the higher construction cost in the U.S. Furthermore, the general higher cost of building in the U.S. is highlighted in the publication by Mulligan (2018, p.6) that "American-built coastal and feeder ships cost between $190 and $250 million, whereas the cost to build a similar vessel in a foreign shipyard is about $30 million". This is not the same type of vessels but underlines the significant higher cost of constructing in the U.S. compared to foreign shipyards.

The international build vessels come with an additional cost that must be accounted for in the total scope, as the feeder barges need to be included to be compliant with the requirements of the Jones Act. However, this additional cost is considered to not impact the overall construction cost differences significantly for the two alternatives, according to the candidates.

Another important element when considering the cost, is the financial scheme differences highlighted by the candidate for OIM Wind. Historically, the Asian shipyards have accepted to take a higher financial risk on their side during the construction phase. They have a track record of accepting a low initial payment at the start of construction, with most of the payment executed when the vessel is delivered. Naturally, this is a more attractive scheme for the investors and weighs positively for the foreign-flagged alternative, especially in scenarios where there are no signed agreements for the vessel in place. The financial installment schemes and requirements from the various shipyards are subject to negotiations between the

parties and not publicly disclosed. Hence, these elements are based on the findings from the candidates only.

4.5.3. Construction risk

Another element is the difference in time to complete the construction at the shipyard. Like the cost aspect, there is a consensus amongst the candidates that it will take approximately 50% more time to construct an installation vessel in the U.S. compared to Asia. This is based on quotations collected by the candidates from the various shipyards in Asia and U.S. An important note on this is the level of reliability. As the shipyards in Asia have a long track record of constructing these types of vessels, we can assume that the estimates are relatively accurate. While on the other hand, the shipyards in the U.S. have no such track record on these types of vessels to back up the estimates. This must be taken into consideration when comparing the two alternatives.

Another element weighing in negatively for the U.S. alternative is the limited number of capable shipyards. According to the findings there are only two or three shipyards in U.S. which have the required infrastructure in place to take on such projects. While this element isolated is not a major concern, it must be seen in conjunction with the findings stating that the shipyards prefer to construct vessels in serial with less complexity, for example traditional cargo vessels.

Perhaps an even more crucial element in this discussion is the lack of competence in the U.S. shipyard industry, related to these kind of highly specified installation vessels. While the shipyards in Asia have a long track record including procedures, systems and competence in place, the U.S. shipyards must adjust accordingly. You could argue that this also add more uncertainties to the U.S. alternative.

4.5.4. Operational cost

The cost to operate the vessels, regardless of chosen strategy, was found to be approximately on the same level. The U.S. flagged alternative consist of a single installation vessel, while the foreign flagged alternative consists of an installation vessel and a fleet of feeder barges.

Normally, a fleet of vessels are more expensive to operate compared to a single vessel, as it requires more crew to operate, more assets to maintain and administrate. The operational cost consists of elements such as insurance, crew, repair and maintenance, spare parts, communication and logistics, fuel, port fees, classification cost and admin costs. In general, the cost of manning drives the majority of the operational cost. The crew size for the installation vessel is equal for both alternatives. However, the salaries and social cost is higher for U.S. employees than for international employees, especially for the lower ranks. Consequently, as the U.S. flagged vessel has a minimum requirement of 75% of U.S. citizens according to the Jones Act, the crew cost will be higher. This extra cost will, according to the candidate from OIM Wind, be balanced by the additional crew, fuel and associated administration costs required to operate the feeder barges for the foreign flagged alternative.

The cost to repair and maintain the installation vessel will be identical for both alternatives, as they are operating in the same region and have the same type of systems and equipment. The same goes for procurement of spares and logistics. The cost for insurance of the U.S. flagged installation vessel is estimated to be slightly more than the foreign flagged installation vessel, due to a higher asset value. However, again this is considered to be balanced by the additional insurance cost for the feeder barges.

Hence, when looking into the two alternatives the operational cost was found to be approximately the same and not considered to be a deciding factor in choice of transport and installation method.

4.5.5. Post-installation work

During the interview, it was highlighted by the candidate from Pareto, that the repair and maintenance of the wind farms post-installation need to be considered by developers when selecting their choice of strategy. These operations will in most cases require the same type of vessel and capacities as during the installation phase. Østeby from Pareto, argue that it is not sustainable to charter such vessels from Europe or Asia due to high cost and time for mobilization and demobilization. Hence, he finds this to strengthen the business case for an U.S. flagged vessel. However, is this a valid statement? This require that the U.S. flagged vessel is in the region and is contractually available. In such case the vessel is in lay-up, which is not beneficial for the vessel owner. They will market the vessel and services for

work in other regions similar to any international competitors. Hence, they would have the same challenges related to mobilization and demobilization. On the other hand, if the U.S. government dictates that the post-installation repair and maintenance shall be executed by an U.S. flagged vessels, this would clearly be a significant advantage for the U.S. flagged alternative. However, as stated by Ekici from Equinor, this is not likely to ever be the case.

4.5.6. Workability

The overarching goal from a developer's point of view will always be to have the optimal solution regarding performance and efficiency. There are many factors to consider for operational workability. What is the best solution to install the wind components? This is the main question for developers to address when deciding the choice of strategy.

The foreign flagged alternative with use of feeder barges is a new and unproven solution, as highlighted by the candidate from EDF & Atlantic Shores Wind and is a custom-made solution to accommodate for the Jones Act regulations. How will the feeder barges perform in the challenging weather conditions found in the Atlantic Ocean at the east coast of U.S.?

An important pre-requisite for loading the wind components from shore to the vessel is to ensure that the port infrastructures are in place in terms of crane capacity, load-out area, water draft, horizontal clearance, and air draft (GustoMSC, 2017). The two alternatives will have similar demands for all of this except the air draft. The U.S. flagged installation vessel will have its legs fully jacked up reaching more than 100 meters, which presents a general limitation for port availability, and in some cases will mean that this alternative is not possible. While for the feeder barge alternative there is no such air draft limitation in practical terms as the installation vessel is not entering the port. Consequently, the feeder barge solution presents more flexibility in terms of the number of ports available.

The first operational sequence, as described in the theory chapter, is to load the wind components from port to the installation vessel or the feeder barge. This is an identical operation for both alternatives, provided the pre-requisites are in place, and not considered to be a deciding factor in choice of strategy. This operation is executed under calm conditions and in the bigger picture considered to be a low-risk operation.

The next operational sequence is the transportation of the wind components to the offshore location. The distance from the port to the installation site varies, depending on the locations of wind farm field and ports. Ideally the distance is as short as possible but can typically be in the range of some hours to a few days of transit time. As the wind components are highly sensitive there are limitations to weather conditions during transportation. In addition to the planned transportation time, it is required to include a safety margin in the sailing time in order to comply with insurance requirements. This is standard procedure in maritime operations and obviously limits the operational windows for transportation of wind components. According to the candidates the design criteria of an installation vessel is more robust compared to the feeder barges, which means that the U.S. flagged installation vessel has an extended operating weather window. The candidates indicated that they have no specific data or analysis for the transportation phase, but they raised a general concern that the feeder barges might have a significant limited sailing window compared to an installation vessel. Obviously, this presents an operational advantage for the U.S. flagged alternative.

Furthermore, at the offshore location, the installation vessel will need to maneuver itself in correct location and jack up into position. This operation is similar for both the U.S. flagged and the foreign flagged installation vessel. The key difference between the two alternatives then occurs. For the U.S. flagged alternative the wind components are already onboard, and installation can commence immediately, while for the feeder barge solution the lifting of the wind components from the barge to the installation vessel is the next step. This is considered to be the most critical task. As stated by the candidates from OIM and Pareto, there are strict weather criteria for these kinds of operations, normally limited to 1-2 meters of net wave heights. The reason for this is the risk of damaging the highly sensitive wind components during lifting operations. Damage to these components can potentially be detrimental for the installation campaign, due to the high cost and long lead time for replacement of such components. This will narrow the operating window and potentially cause substantial periods of non-productive time. Consequently, this is clearly a disadvantage for the foreign flagged alternative with the use of feeder barges.

Looking at the operational sequences altogether, there could potentially be an opportunity to optimize the efficiency. The traditional way of performing the transport and installation of wind turbine generators is to use the installation vessel for both transport and installation activities, meaning that the installation vessel will in large period be occupied with

transportation activities. In isolation, this transportation does not demand a high specification installation vessel. So, you could argue that there is potential to optimize the installation vessel time to only perform installation work. If the transportation of the components was dedicated to specialized transportation vessels, the installation vessel could continue to install the components while the feeder barges kept supplying a steady flow of new components. As previously discussed, the installation vessel is the capex demanding element, while the feeder barges are relatively low cost. Hence, it makes sense to let the high specification installation vessel focus on the installations while the low-cost vessels or barges perform the transportation activities to supply new components, provided sufficient weather conditions.

An interesting point in this regard, is the comparison with offshore drilling operations, where the drilling rig is constantly supplied with materials and components by specialized supply vessels, in order to avoid using the drilling rig to perform transportation activities and focus on the drilling operations.

So, why has the feeder barge solution not been used in the international offshore wind industry to optimize the use of the installation vessels? The answer to this is the size and weight of the components and the risk of damaging such equipment under challenging offshore weather conditions.

However, as pointed out by the candidate from EDF & Atlantic Shores Wind, short term campaigns during summer periods will not be impacted to the same extent as larger campaigns, due to calm sea states and weather conditions. Hence, the risk of waiting on weather and non-productive time, is less likely to occur.

The workaround to comply with the Jones Act regulation has effectively led to the foreign flagged vessel with feeder barges method as an alternative. Furthermore, this alternative has introduced the potential to optimize the usage of installation vessels. This could be seen as an advantage for the foreign flagged solution, including the feeder barges, in our opinion.

4.5.7. Crew competence and experience

Another finding highlighted by the candidates was the limited availability of qualified crew in an expanding global offshore wind market. As the number of installation vessels is

increasing, the supply for qualified and competent crew is becoming a bottleneck. This is a challenge to overcome and presents an operational risk for both alternatives. In addition, it presents a risk for increased crew costs due to an imbalance in the supply and demand for qualified crew. However, these risks are even more challenging for the U.S. flagged alternative due to the Jones Act regulation which requires a minimum of 75% of U.S. citizens. Consequently, this will limit accessibility to qualified crew, as highlighted by the candidate from Equinor.

However, for foreign crew to work in U.S. waters they will need an approval from the U.S authorities and be granted a valid work permit. This is not a straightforward process and requires sufficient documentation of competence that cannot be found available in the U.S.

In summary, the disadvantage of a limited accessibility to qualified crew for the U.S. flagged alternative, is somewhat equalized by the required work permit for foreign crew for the foreign flagged alternative. Thus, in practical terms you could argue that the advantage for foreign flagged alternative stated by the candidate from Equinor, can be questioned.

4.5.8. Local content

In the bigger picture, developers are normally committed to maximizing the economic benefit to the local communities, directly and through their contractors and subcontractors. These commitments are authorized in the award documents and have an impact for the transport and installation contractors. This was highlighted by the candidates from Pareto and OIM Wind during the interviews as a potential governing factor for choice of strategy. As developers would require some flexibility with regards to local content during the project, they would push their contractors as much as possible to absorb these requirements. The consequences for developers if breaching the requirements, could influence the choice of strategy and supersede other rational elements as elaborated in previous sections. Interestingly, these local content requirements were not mentioned by the candidates from Equinor and EDF & Atlantic Shores Wind as being specific areas of concern.

4.5.9. It's all about first power

As stated by the candidate from EDF & Atlantic Shores Wind, the most important contractual obligation for developers is the deadline to deliver power. A potential breach can cause significant liquidated damage and be detrimental for the stakeholders. Based on the factual status that currently there are no installation vessels capable to handle the larger wind turbines in the U.S., these vessels need to be built regardless of choice of strategy. Due to this and the additional requirements from the Jones Act, the overall project timeline is expected to be longer and more complex than comparable projects in Europe and Asia. Hence, more time should be allocated for pre-planning of these activities as stated by the candidate from Pareto. This is followed up by the candidate from OIM Wind who remarks that this has been miscalculated by developers and now have "painted themselves into a corner."

Given the hypothesis from the candidate from OIM Wind that time is running out and the needed preplanning has not been performed, it is likely that the strategic decisions are made to avoid breaching the contractual deadlines. However, can this be questioned? If the time aspect was this critical, you would assume that developers already had forced through a decision. On the other hand, developers would only commit themselves to the required investment provided that all other variables and puzzles are in place, as for example the sufficient infrastructures and supply chain.

4.6.Summary

As mentioned in the introduction to this chapter, we have used the Gioia method to structure the findings and subsequently discussed each element respectively. Before we move on to the next chapter, where we will seek answers to the research questions based on a holistic view on the outcome in this chapter, we will summarize the findings and discussions.

The discussed findings from the Regulatory impact dimension outline significant challenges related to ownership structure and the local workforce, and lack of ability to construct and operate modern high specification installation vessels. However, these challenges and weaknesses also present opportunities for a first mover and can be a catalyst for innovation of new technical solutions.

Furthermore, the findings which were discussed from the Strategic decisions dimension outline pros and cons for each transport and installation method. The construction phase heavily favors the foreign-flagged solution regarding cost, time, and risk. On the other hand, the operational phase favors to a large extend the U.S. flagged solution in terms of proven technology and lower risk related to workability, such as lifting operations and weather conditions. However, there are governing factors such as power delivery deadline and local content, that could impact the overall decision at the expense of the above elements.

5. Conclusion

In this section, we will collect the main features from the findings and the discussion and connect these to the research questions. This thesis has two main research questions and there are many perspectives to consider. We will present a balanced view of the main takeaways from our research, but still aim to draw measured conclusions where possible.

Let's revisit the first research question:

- How does the Jones Act impact the transport and installation of Wind Turbine Generators in the U.S. offshore wind industry?

It's clear from the research that the Jones Act has a fundamental impact on the offshore wind industry in the U.S. in general, and certainly also for the transport and installation of wind turbine generators. The requirements of the Jones Act initiate significant and complex barriers to entering this specific market. Hence, the importance of starting the planning process early to secure the required vessels and avoid bottlenecks.

The two main alternatives for handling the transport and installation work are the U.S. flagged vessel and the foreign flagged vessel with feeder barges. The impact of the Jones Act is somewhat different on the two alternatives.

For the U.S. flagged vessel, the main impact is the minimum requirements regarding national ownership, location of construction, and vessel crew. Consequently, our research reveals that these requirements over time have caused the U.S. offshore market to be isolated from international competition. As a result of the isolation, the industry suffers from lack of capability to construct and operate modern high-specification vessels which is needed for the transport and installation of wind turbine generators.

For the foreign flagged vessel, the main impact is the restriction to not enter the port to load components. Hence, the introduction of supporting U.S. flagged feeder barges, which transport the components from the port to the installation vessel offshore. As this method is completely new, it forces innovation and new technologies. Normally, the innovation in the offshore wind industry is driven by technical improvements to enhance efficiency and safety, but in this case the innovation is mainly focused on finding a solution to the legislative problem.

Which of these presented alternatives is the best overall solution leads us to our second research question:

- What is the best overall solution to comply with Jones Act, for transport and installation of Wind Turbine Generators in the U.S.?

To find the best overall solution will depend on several variables and might be weighed differently by the stakeholders, depending on their internal guidelines. There might be factors that are important for some stakeholders, but less important for others. We will go through the main elements and connect these to the research question, and ultimately draw conclusions where we also include the governing factors.

There are several factors supporting the U.S. flagged alternative as the best solution. A vessel built in the U.S. will have the similar design and specification as an international installation vessel. This is a proven technology with a long track record for transport and installation of wind turbine generators. This procedure is according to the best practice in Europe and other locations worldwide. Despite the higher upfront investment costs, longer construction time and potential shipyard uncertainties, the research has revealed that this solution has better operational performance. In terms of workability, this alternative will be able to operate in rougher weather conditions and in general have less risk of damaging the components due to no external lifting operation from feeder barges. In the longer term, the additional cost and time spent during the construction phase will be paid back in terms of higher efficiency and reliability.

On the other hand, there are also multiple factors in favor of the foreign flagged alternative to be the best solution. The research discloses that the cost and time spent for construction of an installation vessel is significantly better for the foreign flagged alternative. Based on estimates from the research, cost and time is found to be approximately 50% higher in the U.S. The general track record is better for the Asian shipyards and reduces the construction risk. Even if the introduction of the feeder barges add cost, the total construction cost and time will clearly be lower for the foreign-built vessel. In addition, this solution has the potential to be a catalyst for innovation and new technology in terms of performing heavy lifting operations in adverse weather conditions.

However, in a more holistic perspective the research has revealed that there are two governing factors which might impact the decision at the expense of the seemingly best solution. Firstly, and perhaps the most decisive factor, is the deadline to deliver power to shore. Breach of this contractual commitment will result in significant liquidated damages for developers. Hence, these liquidated damages are so important to avoid and forces developers to accept higher workability risk related to the foreign flagged solution in order to deliver on time.

Secondly, the focus on local content is found to be a governing factor that could impact the choice of strategy. Positive spin-offs to the U.S., state and local communities are one of the main contractual commitments for developers. Clearly, an U.S. build installation vessel is more favorable in this context.

To summarize, the research cannot give a clear-cut conclusion to what is the best overall solution, due to multiple variables and project specific requirements. However, we are inclined to outline the U.S. flagged installation vessel as the best solution in the long-term perspective, based on the favorable operational workability. This solution is the best practice in Europe and reduces the risk of potential political tightening in an unstable geopolitical environment, especially when it comes to energy security.

5.1.Limitation

This thesis has some limitations which should be addressed. The first limitation is the limited amount of historical data and previous research directly related to our thesis. Hence, a qualitative research method was selected, with the natural limitation this method brings.

An obvious limitation is the number of interviewees used in this research. We contacted 11 companies which had been awarded a license to develop an offshore wind farm on the east coast of U.S. However, due to the sensitive nature of these strategic decisions, several companies did not want to participate. The following quote was a representative reply from key employees in companies we contacted.

"On a personal level I'd like to be able to help, but unfortunately, I am not able to speak freely due to the confidentiality of our plans for the U.S. market. Even if you anonymized my name and company, I'm not able to share our plans or view of the market etc. Sorry about this." (Anonymous potential candidate)

Furthermore, a limitation in that regard comes from the increased risk of bias in the perspectives of the few candidates that accepted to participate in our thesis. Creswell (2014) highlights the importance of clarifying bias in the study, to "create an open and honest narrative that will resonate well with readers" (Creswell, 2014, p. 202).

At the time of the interviews, Equinor had already opted for a foreign flagged vessel with feeder barge solution for their project in the U.S., which could naturally impact the views and insight given from the candidate from Equinor. It also became clear that the candidate from OIM Wind was actively working and focusing on an U.S. flagged solution for their projects, which similarly could sway the insight and views from this candidate in that direction.

Another potential limitation and bias are the perspective of the participants as being non-U.S. citizens. The perspectives might have been different for a U.S. citizen. This is also a valid point for us as authors of this thesis.

Hence, the conclusions made in this study should be considered with awareness of these limitations, and how they could impact the findings and discussions of regulatory and strategic aspects in this thesis. By acknowledging these potential biases and limitations, we believe it strengthens credibility and provides a grounded foundation for this research.

5.2. Future research

Based on the delimitations and limitations in this thesis, there are several interesting areas that could be a topic for future research. One area of interest is the supply chain challenges connected with the transport and installation scope of work. This could be port infrastructure and sub-supplier dependencies that could directly impact the strategic decisions covered in this thesis. Other areas of future research that we recommend are deep dives into elements like construction cost, feeder barge workability, seasonal optimization of installation

campaigns and local content ripple effects. Such research could potentially impact the overall decisions for transport and installation work for offshore wind farm developments in the U.S.

References

Agência Nacional de Transportes Aquaviários (ANTAQ). (2021, September 23). ANTAQ publica norma sobre afretamento de embarcação por empresa brasileira de navegação para operar na navegação interior. *Governo do Brasil.* https://www.gov.br/antaq/pt-br/noticias/2021/antaq-publica-norma-sobre-afretamento-de-embarcacao-por-empresa-brasileira-de-navegacao-para-operar-na-navegacao-interior

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Dincer, I., Cozzani, V., & Crivellari, A. (2021). Offshore renewable energy options. In I. Dincer, V. Cozzani, & A. Crivellari (Eds.), *Hybrid energy systems for offshore applications* (pp. 7-18). Elsevier. https://doi.org/10.1016/B978-0-323-89823-2.00002-6

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2012). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods, 16*(1), 15-31.

GustoMSC. (2017). *U.S. Jones Act compliant offshore wind turbine installation vessel study: A report for the roadmap project for multi-state cooperation on offshore wind.* New York State Energy Research and Development Authority (NYSERDA). https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/US-Jones-Act-Compliant-Offshore-Wind-Study.pdf

Knapp, S. L. (2023, May 8). What's new with offshore wind farms and coastwise trade laws in the U.S.? *Gawthorp Greenwood.* https://gawthrop.com/whats-new-with-offshore-wind-farms-and-coastwise-trade-laws-in-the-u-s/

Maersk Supply Service. (2023, December). Maersk WIV leaflet. *Maersk Supply Service.* https://www.maersksupplyservice.com/wp-content/uploads/2024/01/Maersk-WIV-Leaflet-2023-12-excl.-crane-curve.pdf

Maloney, K. J., Bourg, D. M., Humphreys, K. F., & Townsend, C. M. (2018). *An analysis of alternatives for the development of Jones Act compliant windfarm construction vessel fleets.* MiNO Marine, LLC.

Maritime Executive. (2016, August 5). First turbine installed at Block Island. *Maritime Executive.* https://maritime-executive.com/article/first-turbine-installed-at-block-island

Mulligan, C. B. (2020). *The Jones Act: A burden America can no longer bear.* CATO Institute. https://www.cato.org/publications/policy-analysis/jones-act-burden-america-can-no-longer-bear

Nord-Lock. (2020). Offshore floating wind energy. *Nord-Lock.* https://www.nord-lock.com/ru-ru/insights/knowledge/2020/offshore-floating-wind-energy/

Ocean Energy Resources. (2023, May 17). US targets 30 GW of offshore wind by 2030. *Ocean Energy Resources.* https://ocean-energyresources.com/2023/05/17/us-targets-30-gw-of-offshore-wind-by-2030/

Offshore Wind. (2020, May 6). Vole au Vent starts North American offshore wind tour. *Offshore Wind.* https://www.offshorewind.biz/2020/05/06/vole-au-vent-starts-north-american-offshore-wind-tour/

Organisation for Economic Co-operation and Development. (2019). *Local content requirements and their economic effect on shipbuilding.* OECD. https://read.oecd-ilibrary.org/science-and-technology/local-content-requirements-and-their-economic-effect-on-shipbuilding_90316781-en#page6

Organisation for Economic Co-operation and Development. (2022). *OECD services trade restrictiveness index: United States.* OECD. https://www.oecd.org/trade/topics/services-trade/documents/oecd-stri-country-note-usa.pdf

Splash. (2023, May 17). Havfram makes WTIV newbuild move as Sandbrook brings in another $250m. *Splash247.* https://splash247.com/havfram-makes-wtiv-newbuild-move-as-sandbrook-brings-in-another-250m/

TenneT. (n.d.). Offshore grid connection Borssele Beta ready to land offshore wind power. *TenneT.* https://netztransparenz.tennet.eu/tinyurl-storage/detail/offshore-grid-connection-borssele-beta-ready-to-land-offshore-wind-power

Transportation Institute. (n.d.). Jones Act. *Transportation Institute.* https://transportationinstitute.org/jones-act/

U.S. Congress. (1953). Outer Continental Shelf Lands Act. U.S. *Government Publishing Office.* https://www.govinfo.gov/content/pkg/COMPS-857/pdf/COMPS-857.pdf

U.S. Congress. (2023). National Defense Authorization Act for Fiscal Year 2021, H.R. 5991, 118th Congress. *Congress.gov.* https://www.congress.gov/118/bills/hr5991/BILLS-118hr5991ih.pdf

U.S. Department of Energy. (2022). What does offshore wind energy look like today. *Energy.gov.* https://www.energy.gov/eere/wind/articles/what-does-offshore-wind-energy-look-today

White House. (2021, March 29). Fact sheet: Biden administration jumpstarts offshore wind energy projects to create jobs. *The White House.* https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

White House. (2022, September 15). Fact sheet: Biden-Harris administration announces new actions to expand U.S. offshore wind energy. *The White House.* https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). SAGE Publications.

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Discussion Paper 1

Asbjørn Njerve

Competency Goal: INTERNATIONAL

Presentation of thesis

Our master thesis investigates the impact of the Jones Act on the transport and installation of Wind Turbine Generators (WTGs) in the U.S. offshore wind industry. The Jones Act, a maritime law established in 1920, restricts the transportation of goods between U.S. ports to vessels that are U.S. built, owned, and operated (Transportation Institute, n.d.). This regulation presents significant challenges for the offshore wind industry, particularly concerning the use of specialized installation vessels. Our research explores strategic implications and discusses two main strategies to be Jones Act compliant, being the use of U.S. flagged Wind Turbine Installation Vessels (WTIVs) or use of foreign flagged WTIVs with feeder barges.

Offshore wind energy is crucial for the U.S. to meet its renewable energy targets and reduce carbon emissions. However, the industry faces regulatory and logistical challenges due to the Jones Act. Our thesis aims to explore how these challenges can be handled effectively, considering both barriers and opportunities.

Offshore wind and the term international

Offshore wind energy is an important part of the global shift towards renewable energy. Countries around the world are investing big in offshore wind projects as part of their

strategies to reduce carbon emissions and transition to sustainable energy sources. The U.S. has significant offshore wind potential and will most probably become a major player in this global market. However, the Jones Act presents unique challenges and opportunities within this international market.

Technological developments made in other countries, particularly in Europe and Asia during the last decades, have set a high standard for the industry. European countries like the United Kingdom, Germany, and Denmark have played a key part in offshore wind development, resulting in significant developments in turbine design, installation methods, and operational efficiency (Dincer, Cozzani, & Crivellari, 2021).

Furthermore, the global supply chain for offshore wind components and expertise underlines the international scale of the industry. Components such as turbines, blades, and installation vessels are often produced and put together in different countries. This global supply chain is key for reducing costs and making sure of the availability of high-quality components. However, the Jones Act make this more challenging by regulating the use of foreign built vessels for transporting goods between U.S. ports.

How international trends and forces affect our topic

The international environment of the offshore wind industry makes it essential to consider international trends and forces. The global shift and focus on renewable energy has significantly influenced the offshore wind industry in recent years. European countries have been investing in offshore wind development for decades. These innovations have set a high standard for the industry and have also created a competitive international market for offshore wind technology. The U.S. offshore wind industry can benefit from these international developments by using best practices and foreign expertise already available.

However, the Jones Act restrictions on foreign vessels present a challenge. The requirement for U.S. built and flagged vessels limits the ability to directly import and use foreign WTIVs. This means that you either must construct similar vessel in a U.S. shipyard, which will add more cost and construction time, or use a foreign flagged WTIV with feeder barges, which on

the other hand will add logistical complexities (Maloney, Bourg, Humphreys, & Townsend, 2018).

The regulatory environment for offshore wind is different across countries, which also impacts the speed and scope of development. In Europe, you could argue that regulations have been made to support the fast deployment of offshore wind projects. These frameworks often include streamlined permitting processes, financial incentives, and helpful policies that incentivize investment and innovation. This supportive regulatory environment has probably been a key driver of Europe's leading role in offshore wind.

On the other hand, the U.S. regulatory requirements which in many ways has been shaped by the Jones Act, presents a more complex and challenging framework. The Jones Act aim to protect and support the U.S. maritime industry, but it also creates barriers to an efficient transport and installation of offshore wind components. The requirement for U.S. flagged vessels increases cost and limits the availability of installation vessels.

But even though there are challenges, there are also opportunities for the U.S. to look at the best regulatory practices in other countries. For example, the U.S. could adopt the "circularization process" used in Brazil (Agência Nacional de Transportes Aquaviários [ANTAQ], 2021). This process is similar to the Jones Act but is more flexible. It lets foreign vessels work in Brazilian waters under certain conditions, provided there is no Brazilian flagged vessels qualified for the specified required period and project. Brazil is with this flexible regulation, trying to protect its own industry but also opens to international alternatives. If the U.S. could adjust its regulatory framework to be more flexible, it could improve their competitiveness in the global offshore wind market.

The global supply chain for offshore wind has developed to optimize efficiency around cost, time, and risk. European companies, with their long experience, are key players in the market for operating transportation and installation vessels. These companies have established well-functioning logistics networks that continue to improve. For the U.S. offshore wind industry to compete on a global market, it should aim to participate and become part of this established international supply chain, but at the same time handle the challenges caused by the Jones Act.

A potential strategy is to increase the national construction capabilities for high specification installation vessels. This would not only comply with the Jones Act but also create local jobs and support economic growth. However, establishing robust domestic shipyards requires significant investment and time. In the shorter term, U.S. developers can work close with international suppliers and use their expertise and resources. By creating joint ventures and partnerships, U.S. companies can access advanced technology and best practices from established stakeholders in the global market.

Furthermore, increasing the construction capacity can improve flexibility and reduce dependence on international suppliers. This is particularly important in the context of the current geopolitical environment internationally. By investing in domestic construction capacity, the U.S. can ensure a more stable and reliable supply of high specification installation vessels for offshore wind projects. This approach aligns with the protectionist intent of the Jones Act and supports economic and strategic objectives outlines by the Biden Administration (White House, 2021).

Research Questions

In many ways the term international is a red line through our entire topic, and it naturally influences our research questions. Our first research question, addressing how the Jones Act impacts the transport and installation of WTGs in the U.S. offshore wind industry, was developed to explore the regulatory challenges caused by this old law. The complex interplay between domestic regulations and international best practices requires a detailed examination of how these factors influence the transport and installation choices of method and strategy.

The second research question, exploring the best strategies for complying with the Jones Act while maintaining cost, time, and operational efficiency, is directly influenced by international trends and forces. Technological innovations and regulatory frameworks in other countries give a benchmark for evaluating and discussing potential compliance strategies. The adoption of international best practices and the integration of global supply chain dynamics are crucial for developing effective solutions to these challenges.

Furthermore, international trends in offshore wind energy play a significant role in creating these research questions. The changing environment of the international offshore wind industry, driven by technological development and regulatory barriers, impacts the strategic decisions and operational workability within the U.S. Understanding these international trends and forces is important for addressing the regulatory and logistical challenges caused by the Jones Act and for developing efficient and competitive solutions.

Findings

Our research finds that there are two main methods to comply with the Jones Act, which is by using U.S. flagged WTIVs or by using foreign flagged WTIVs with feeder barges. While U.S. flagged WTIVs offer better long-term operational efficiency, they come with higher initial costs due the high cost of constructing in the U.S. shipyards (GustoMSC, 2017). The alternative approach is to use foreign flagged WTIVs with feeder barges. This comes with additional operational complexities but reduces the construction time and cost (Maloney, Bourg, Humphreys, & Townsend, 2018).

Our findings suggest that while both methods have their advantages and disadvantages, the choice of strategy depends on the specific project requirements and financial considerations. Moreover, the study highlights the need for a balanced approach that includes both domestic and international elements to optimize the transport and installation work.

Analyzing specific offshore wind projects in the U.S. and comparing them with international projects provides valuable insights into the challenges and opportunities presented by the Jones Act. The Block Island Wind Farm, the first offshore wind farm in the U.S., faced significant logistical challenges due to the Jones Act's restrictions. To comply with the law, the developers used a foreign flagged WTIV which transported the components from a foreign port to the installation site (Offshore Wind, 2020). This approach was legally compliant but had additional costs and complexities that are not practical for a large-scale project.

Unit of analysis

The main units of analysis in our thesis are the candidates from offshore wind developers, vessel owners, and brokers who were interviewed and provided valuable insights for our research. These candidates hold key roles in the offshore wind industry and provide different perspectives on the challenges caused by the Jones Act.

Offshore wind is an international industry. It depends on global supply chains, international collaborations, and shared technological developments. The Jones Act is a domestic regulation and regulates the transportation of goods between U.S. ports. This presents interesting questions about how a national regulation fits into an international industry.

As this is a new and upcoming industry in the U.S., it is essential that experience gathered from the international offshore wind development companies are transferred and used as basis for the developments in the U.S. Key elements for this is the project management, tools and the human resources involved. These projects have been developed in Europe for the decades already, hence lots of experience has been achieved. Some of these resources and capacities has been transferred to U.S. for assistance during the early phases of the project planning.

A factor in our research is that the interview candidates were not U.S. citizens. Their perspectives on the Jones Act are shaped by their international backgrounds and roles within the global industry. However, their insights are valuable because they represent various stakeholders and interests in the offshore wind sector, including developers, vessel owners, and brokers.

These different perspectives highlight the complexity of the offshore wind industry and the challenges of domestic regulation in an international industry. The feedback from these stakeholders underlines the need for a balanced approach that considers both national regulatory requirements and international collaboration.

Conclusion

The Jones Act presents both challenges and opportunities for the U.S. offshore wind industry. If the stakeholders can understand the international trends and forces in this industry, they can use this insight to make the right strategic decisions for the U.S. offshore wind market.

Important factors to achieve this are to collaborate internationally across companies and borders for technological improvements, innovation and experience transfer. The supply chain challenges need to be streamlined and optimized. Adjustment of the strict cabotage law in the U.S. could be beneficial for overcoming the barriers caused by the Jones Act and furthermore improve the competitiveness of the U.S. offshore wind industry in the international market.

The implementation of international best practices and technologies can improve the development of the U.S. offshore wind industry, create jobs, and contribute to economic growth. The U.S. could potentially take a leading position in the international offshore wind industry by using this strategic and collaborative approach,

Furthermore, the commitment to international collaboration can strengthen the role of the U.S. in the global effort on the climate change. The U.S. can contribute significantly to reduce carbon emissions and transition to sustainable energy. The lessons learned and innovations developed in the U.S. can also benefit other countries, supporting a global trend towards a cleaner and more sustainable future.

References

Agência Nacional de Transportes Aquaviários (ANTAQ). (2021, September 23). ANTAQ publica norma sobre afretamento de embarcação por empresa brasileira de navegação para operar na navegação interior. *Governo do Brasil.* https://www.gov.br/antaq/pt-br/noticias/2021/antaq-publica-norma-sobre-afretamento-de-embarcacao-por-empresa-brasileira-de-navegacao-para-operar-na-navegacao-interior

Dincer, I., Cozzani, V., & Crivellari, A. (2021). Offshore renewable energy options. In I. Dincer, V. Cozzani, & A. Crivellari (Eds.), *Hybrid energy systems for offshore applications* (pp. 7-18). Elsevier. https://doi.org/10.1016/B978-0-323-89823-2.00002-6

GustoMSC. (2017). *U.S. Jones Act compliant offshore wind turbine installation vessel study: A report for the roadmap project for multi-state cooperation on offshore wind.* New York State Energy Research and Development Authority (NYSERDA).

https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/US-Jones-Act-Compliant-Offshore-Wind-Study.pdf

Maloney, K. J., Bourg, D. M., Humphreys, K. F., & Townsend, C. M. (2018). *An analysis of alternatives for the development of Jones Act compliant windfarm construction vessel fleets.* MiNO Marine, LLC.

Offshore Wind. (2020, May 6). Vole au Vent starts North American offshore wind tour. *Offshore Wind.* https://www.offshorewind.biz/2020/05/06/vole-au-vent-starts-north-american-offshore-wind-tour/

White House. (2021, March 29). Fact sheet: Biden administration jumpstarts offshore wind energy projects to create jobs. *The White House.* https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

Transportation Institute. (n.d.). Jones Act. *Transportation Institute.* https://transportationinstitute.org/jones-act/

Discussion Paper 2

Ronny Greipsland

Comptency goal: RESPONSIBLE

Presentation of thesis

Our master thesis investigates the impact of the Jones Act on the transport and installation of Wind Turbine Generators (WTGs) in the U.S. offshore wind industry. The Jones Act, a maritime law established in 1920, restricts the transportation of goods between U.S. ports to vessels that are U.S. built, owned, and operated (Transportation Institute, n.d.). This regulation presents significant challenges for the offshore wind industry, particularly concerning the use of specialized installation vessels. Our research explores strategic implications and discusses two main strategies to be Jones Act compliant, being the use of U.S. flagged Wind Turbine Installation Vessels (WTIVs) or use of foreign flagged WTIVs with feeder barges.

The research questions addressed in our thesis are:

- How does the Jones Act impact the transport and installation of Wind Turbine Generators in the U.S. offshore wind industry?
- What is the best overall solution to comply with Jones Act, for transport and installation of Wind Turbine Generators in the U.S.?

These research questions aim to explore challenges and opportunities for the U.S. offshore wind industry and find the best overall strategy for transport and installation of wind turbine generators.

Offshore wind and ethical challenges

The offshore wind industry brings several ethical challenges. These ethical challenges include various elements such as environmental responsibility and workforce implications.

The ethical responsibility to reduce negative environmental impacts is extremely important. Offshore wind projects must be developed with a strong focus to minimize the environmental footprint (Dincer, Cozzani, & Crivellari, 2021). This involves careful planning to avoid damage to marine ecosystems and implement actions to mitigate negative impacts. Companies have an ethical responsibility to make an environmental assessment of impacts and cooperate with stakeholders as early as possible. It is important to include local communities and environmental groups, to address concerns and include feedback in the project plans.

Another significant ethical consideration is the workforce implications. The development of offshore wind projects can create substantial employment opportunities within local communities (White House, 2021). There is an ethical responsibility to create jobs and ensure the development of a skilled workforce both within the local communities and in the U.S. This can be done by collaborating with the local labor union, including securing fair wages and safe working conditions for the employees. In order to build trust and support in the local communities these elements are highly important.

How ethical challenges affect our topic

The offshore wind industry brings several ethical challenges that affect our topic. These ethical challenges include various elements such as environmental responsibility, workforce implications, regulatory compliance, and safety and operational integrity.

Offshore wind projects must be developed with a strong focus to minimize their environmental footprint (Dincer, Cozzani, & Crivellari, 2021). The ethical responsibility to mitigate negative effects on marine ecosystems is important. This involves careful planning and execution to minimize habitat disruption, pollution, and other environmental damage. Companies must balance industrial activity with environmental management to ensure that the development of offshore wind farms does not come at the expense of the local marine

ecosystems. The best way to do this is to carry out thorough impact assessments for the environment, include local interest groups like fishermen unions, and find the best solutions together to ensure common interests.

The potential impacts on marine life, such as noise pollution from construction activities and the physical presence of the turbines, must be carefully assessed and managed. Companies need to adopt best practices that minimize these impacts, such as scheduling construction activities to avoid sensitive periods for marine species like whales. Working together with marine biologists and environmental scientists is essential to make this work. Furthermore, continuous monitoring of the environmental impacts is important to address that may occur during and after the project.

The development of offshore wind projects described in this thesis will create employment opportunities within local communities. There is an ethical responsibility for the stakeholders involved to create jobs and develop the competence within the local communities related to the projects. It is important that the companies work together with the labor unions in order to secure safe working conditions for the employees, including fair wages. Companies must ensure that they are providing training and opportunities for the employees and actively work to enhance the competency and attractiveness in the industry in the U.S.

The transition to renewable energy and green economy is not just about technological developments, but just as much about the people involved. To succeed with this, it is essential to have a skilled and motivated workforce and make it competitive and attractive compared to other business areas. As described in the thesis, a key concern amongst the candidates interviewed, is a lack of skills and competence on offshore wind in the U.S. The only way to mitigate this is to invest in human capital. This investment in human capital is not just an economic element but also an ethical one, to make sure that the local communities and the U.S. are not left behind in the shift towards offshore wind energy.

Another ethical challenge in our thesis is the legal requirements of the Jones Act. One of the main intentions of the Jones Act is to secure marine competence and capacity in the U.S. by excluding foreign flagged vessel from transporting goods and cargo between ports. The alternative solution presented in our thesis with foreign flagged WTIV supported by feeder barges, is essentially a workaround of the Jones Act regulation. You could question if this is ethical as it allows for foreign flagged vessel to operate in the U.S. at the expense of U.S.

flagged vessels. In this sense it seems more ethical to choose the U.S. flagged alternative described in our thesis. The consequence of choosing the foreign flagged alternative is obviously negative and damaging for the domestic shipyards in the U.S. and the related workforce and communities, as it reduces the domestic construction activity.

Another key ethical element relevant in this thesis is operational safety in order to protect both workers and the environment. Transparent and strict safety procedures must be implemented and maintained throughout the project lifecycle. Companies must balance cost, time and risk considerations, which has been widely described in the thesis, up against the operational safety in the project. Ethical leadership is important in this regard as there is a high focus on execution and to deliver on time and in accordance with the political ambitions. Such ethical leadership involves prioritizing safety over financial implications, and to build a strong culture of safety first. This includes regular safety audits, training programs, and the adoption of best practices from other industries.

Furthermore, the installation of offshore wind components may be performed in harsh and unpredictable environments, which requires strict safety procedures. Such work involves risks to the employees that operate with heavy machinery in high winds and rough seas. To meet the safety standards, it requires extensive training programs, emergency response plans, and a commitment to continuous improvement in safety. Ethical responsibility includes protecting the environment from accidental oil spills and other potential hazards associated with offshore operations.

By following these ethical principles, companies can ensure the responsible development of offshore wind projects.

Research Questions

Our research questions touch many aspects of the ethical challenges and considerations described above. Our first research question, which addresses how the Jones Act impacts the transport and installation of wind turbine generators in the U.S. offshore wind industry, was made to explore the regulatory challenges caused by this century-old law. In addition to the regulatory aspects, the research question may have underlying ethical challenges.

Fundamentally, this regulation has its purpose and is implemented to protect U.S. interests. However, our intention with the research question was to explore and uncover the negative consequences and impacts of this regulation. This is perhaps not clear from the research question but was the underlying intention with the research question. In hindsight, this could have been more discussed and explained in the thesis.

The second research question was made to explore the best overall solution in order to comply with Jones Act, for transport and installation of Wind Turbine Generators in the U.S. Our intention with this research question was to identify the decisive elements of the interviewed stakeholders, which was not open and common knowledge available due to the strategic sensitivity. These decisive elements contain ethical considerations regarding efficiency and safety, compared to cost and time.

Findings

In our research we identified several interesting findings. The two main presented methods for transport and installation were confirmed by the candidates to be two only valid methods. In the perspective of responsibility and ethical considerations, two of the most relevant findings are the local content and the importance of delivering shore power within the contractual deadline.

Local content is one of the requirements for the developers discovered in our research. This included the requirement to invest in the local community in terms of creating jobs, training of local personnel and local subcontractors and collaborations with local interest groups. The two different alternatives, being the U.S. flagged WTIV and the foreign flagged WTIV supported by feeder barges, have different impacts on local content beyond what is the contractually required. It is clear that from an ethical point of view, the U.S. flagged alternative has significantly more positive ripple effects and value creation for the local communities compared to the foreign flagged alternative. To my understanding from the interviews this was not a factor that the candidates paid particularly much attention to this, which perhaps is not a surprise as none of the candidates were U.S. citizens. Ethical considerations regarding this would probably be different if the candidates were Americans.

As highlighted by the candidates, the contractual commitment for the developers to deliver shore power in time, could potentially be prioritized at the expense of any rational arguments, including the ethical.

Unit of analysis

There are several units of analysis in our thesis, such as the different stakeholders, the interviewed candidates and the regulatory authorities. The Jones Act regulation is in itself an interesting unit of analysis and impacts pretty much all aspects of the thesis.

One interesting ethical aspect of the Jones Act is restrictions of the transportation of goods between U.S. ports. This cabotage law can lead to higher costs and reduced competition in the offshore wind industry, which can slow down the industry due to higher cost and reduced efficiency. On the other hand, the Jones Act supports the U.S. maritime industry and protects jobs for American workers. This protection of domestic industries can be seen as an ethical commitment to defending national economic interests and employment.

Another ethical aspect is the potential delays and higher costs related to using the U.S. flagged alternative, which could slow down the activity and speed of the projects. This delay could impact the overall timeline of renewable energy sources in the U.S., which furthermore could potentially be an obstacle for the progress in reducing carbon emissions. Ensuring efficient development of renewable energy is an ethical consideration from an environmental and responsible perspective.

Conclusion

This discussion paper highlights the importance of balancing efficient offshore wind developments with ethical responsibilities. This includes minimizing environmental impacts, ensuring workforce safety, and supporting local communities. Offshore wind projects must perform detailed environmental assessments and involve local stakeholders to address relevant issues.

Offshore wind is a big industry and plays a key role in the transition to renewable energy worldwide. The political ambitions are high and there is significant pressure to deliver in time. There is certainly a risk that decisions are made to meet the expectations at the expense of ethical considerations and responsibility. Hence, it is important to focus and highlight the ethical aspects such as environmental consequences, operational safety and local communities. It is the offshore wind developer's responsibility to ensure that these ethical aspects are taken into account and to be a frontrunner in achieving the trust and transparency needed to manage the progress effectively.

The responsibility which is in large parts is placed on the offshore wind developers,

References

Dincer, I., Cozzani, V., & Crivellari, A. (2021). Offshore renewable energy options. In I. Dincer, V. Cozzani, & A. Crivellari (Eds.), *Hybrid energy systems for offshore applications*. Elsevier. https://doi.org/10.1016/B978-0-323-89823-2.00002-6

White House. (2021, March 29). Fact sheet: Biden administration jumpstarts offshore wind energy projects to create jobs. *The White House.* https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/

Transportation Institute. (n.d.). Jones Act. *Transportation Institute.* https://transportationinstitute.org/jones-act/

Appendixes

Information letter

Do you want to participate in the research project

Challenges concerning Jones Act regulation impact on transportation and installation of Wind Turbine Generators for Offshore Wind Farm Developers in US

This is a matter for you to participate in a research project whose purpose is to map their views on the impact of the US Jones Act on the offshore wind industry. In this writing we provide you with information about the goals of the project and what participation will entail for you.

Purpose

The purpose is to shed light on the following issues and research questions:

1. Jones Act regulations:
    - How does the Jones Act affect the transport and installation of WTGs in the Offshore Wind industry?

2. Developer strategy:
    - How does Jones Act influence the Offshore Wind Developers' strategy for installation of WTGs?
    - How does it impact time to operate/production?
    - How does it impact project installation cost?
    - How does it impact project risk?

This is for use in a Master's degree program at the University of Agder.

Who is responsible for the research project?

The University of Agder is responsible for the project.

Why are you asked to participate?

You will be asked to participate because you are assumed to have in-depth knowledge, experience and expertise that are relevant in this study.

What does it mean for you to participate?

The method is an interview. It is believed to take up to about 60 min.

It is voluntary to participate

It is voluntary to participate in the project. If you choose to participate, you can withdraw your consent at any time without giving any reason. All your personal data will then be deleted. It will have no negative consequences for you if you do not want to participate or later choose to withdraw.

Your privacy – how we store and use your information

We will only use your information for the purposes we have disclosed in this writing. We process the data confidentially and in accordance with the data protection regulations.

- Only the assignment group's students and supervisor will receive information about the names of participants and companies.
- Video of the interview will be deleted after completion of the thesis.
- Names and company information will not be published unless otherwise agreed between the parties

What happens to your data when we finish the research project?

The information is anonymized when the project is completed/thesis is approved, which is scheduled for February 2023. At the end of the project, video interviews and transcripts will be deleted.

What gives us the right to process personal data about you?

We process information about you based on your consent.

On behalf of the University of Agder, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with the data protection regulations.

Your rights

As long as you can be identified in the data material, you have the right to:

- access to what information we process about you and to obtain a copy of the information
- to correct information about you that is incorrect or misleading
- to have personal data about you deleted
- to lodge a complaint with the Norwegian Data Protection Authority about the processing of your personal data

If you have any questions about the study, or would like to know more about or take advantage of your rights, please contact:

- University of Agder by Øyvind Ottersen, supervisor.
- Our Data Protection Officer: Ina Danielsen

If you have any questions related to NSD's assessment of the project, please contact:

- NSD – Norwegian Centre for Research Data AS by email (personverntjenester@nsd.no) or by phone: +47 55 58 21 17.

Sincerely,

Project Owner	Students
(Researcher/supervisor)	
Øyvind Ottersen	Asbjørn Njerve and
	Ronny Greipsland

Declaration of consent

I have received and understood information about the Challenges concerning Jones Act regulation impact on transportation and installation of Wind Turbine Generators for Offshore Wind Farm Developers in US, and have been given the opportunity to ask questions. I agree to:

- ☐ to participate in interviews
- ☐ That information about me be published so that I can be recognized – if applicable
- ☐ that my personal data is stored after the end of the project – if applicable

I agree that my information will be processed until the project is completed

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(Signed by project participant, date)

Interview guide & presentation for the interviews

Master thesis

A study of Jones Act-compliant strategies regarding installation vessels for offshore wind developers in the United States

By
Ronny Greipsland
Asbjørn Njerve

Introduction

- The main objective for thesis is to analyze and discuss the impacts of Jones Act regulations in the booming offshore wind farm developments in US
- We have chosen a qualitative approach with interviews of key stakeholders in the business, as there is limited previous research
- We will interview 4-6 candidates
- By studying the key personnel and stakeholders, it will be possible to discuss and understand the key elements to fulfill the purpose of this research

Information

- The thesis will be publicly available
- Information document
- Declaration of consent
- Recording of interview will be done (via TEAMS) in order to ensure correct statements and quotes, and will be deleted shortly after project completion

Introduction of interview candidate

- Name
- Position
- Company
- Background
- Current role and responsibility
- Relevant experience related to US Offshore wind

- Part I -
Impact of the Jones Act regulation

1. How does the Jones Act affect the offshore wind industry in the United States, from your perspective?
2. How do you find the Jones Act to be suitable (fit for purpose) for offshore wind industry in the United States?

- Part II -
The US offshore wind market - WTIV

1. How does Jones Act influence the US offshore wind market for installation vessels?
2. Do you consider the US market attractive for foreign vessels owners?
3. Can Jones Act compliant vessels become an advantage for the first movers?

- Part III -
The US Offshore Wind developer's strategy

1. What is your company's preferred strategy for Jones Act compliance, if any?
2. What is your view and considerations on the time to operate of the two different strategies?
3. What is your view and considerations on installation cost of the two different strategies?
4. How do assess the overall project risk of the two different strategies?

AOB

- Are there any aspects you think are missing?
- We will notify you when this recording is deleted

Thank you for your time!

Much appreciated!