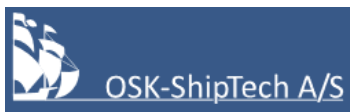


Offshore Wind Logistics brief report 3
***- Drivers and challenges facing
globalization of offshore wind:
Opportunities for European
companies***



Supporting organizations



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This *Offshore Wind Logistics brief report 3* is part of a series of brief industry-focused reports on the key conclusions from the global wind energy shipping and logistics PhD research project. The reports have been crafted by the Panticon team during the months of January through October 2019 in order to crystalize the main findings from the academic research project in a non-academic language and style which would support industry in implementing the key changes proposed as a result of the PhD research project. The report has been created primarily based on the PhD research project output, i.e. the PhD thesis and the academic publications produced by Thomas Poulsen during the PhD research project. Where necessary, additional data sources have been utilized as well in order to ensure that the findings are relevant and up-to-date (see Reference section).

The report contains forward-looking statements, which by their very nature, address matters that are, to different degrees, uncertain as they pertain to the future. These, or any other uncertainties, may cause the actual future results to be materially different than those expressed in the forward-looking statements as contained within this report. At Panticon we do not undertake to update our forward-looking statements, nor do we assume any liability for actions or dispositions made by firms, organizations, and/or individuals based on information contained in this report.

Panticon is particularly strong in the Offshore Wind and Logistics sectors within the three core disciplines of Strategic Management Advisory, Mergers & Acquisitions, and Market Intelligence.

This report has been sponsored by Den Danske Maritime Fond (grant 2018-144) as well as by Panticon.

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ISBN 978-87-93809-12-3

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Report information: Report release version: 1.1
Release date: October, 2019

This report has been produced by:



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1. Introduction

This *Offshore Wind Logistics brief report 3* is the third in a series of eight short industry-focused reports. The goal of the brief reports is to make the latest research in the market for logistics within the global offshore wind industry more accessible and usable for a wide range of constituencies on a global basis. The brief reports can be read consecutively or individually.

This third report in the series highlights opportunities for European companies by pinpointing the drivers and challenges facing the internationalization and globalization of offshore wind.

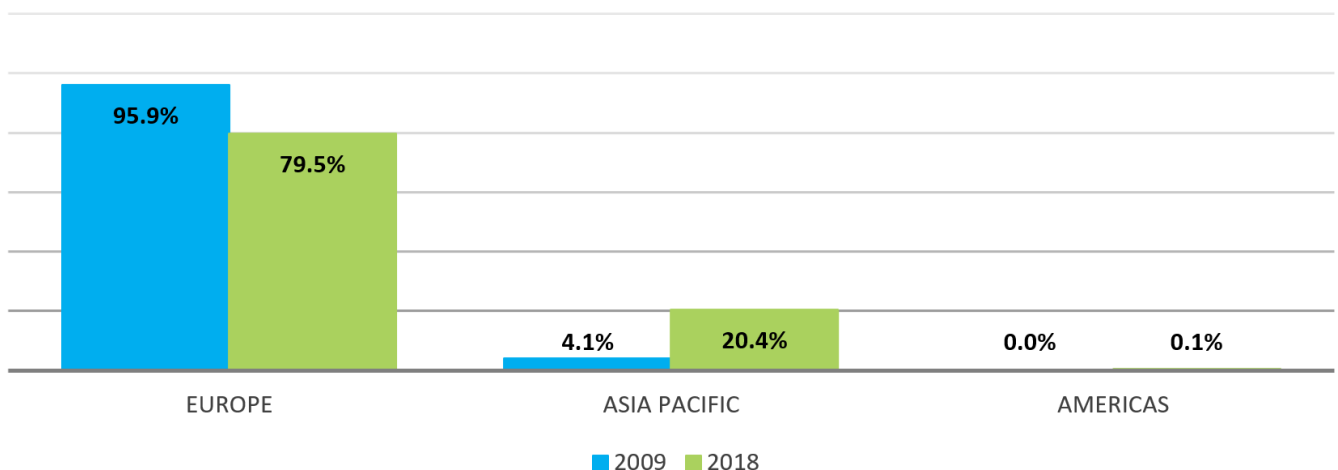
2. Developments in offshore wind the past decade

Globalization of offshore wind can be understood from the demand side as well as from the supply side. The demand side relates to the offshore wind markets, i.e., developers, assets owners, and, ultimately, consumers. The supply side relates to the offshore wind industry, i.e., the entire supply chain – from the development and consent phase through to the construction and commissioning, operations and maintenance, and the decommissioning phases.

2.1. Demand side

At end of 2009, the global offshore wind market was concentrated in European waters which accounted for roughly 96% of the 2.2 giga-watts (GW) global cumulative installed capacity. Asia-Pacific accounted for the remainder while the Americas literally had none. After a decade, at end of 2018, the global cumulative installed capacity rose by more than ten times to 23.3GW. Europe's share dropped to 79.5%. Asia-Pacific's and Americas' shares climbed to 20.4% and 0.1%, respectively (see Figure 1). So, globalization of offshore wind markets can be said to be the emergence of new offshore wind markets beyond the European waters. The primary driver is decarbonization of electric power generation as countries fight fossil-fuel driven air pollution and climate change in general.

Figure 1: Regional share of global cumulative capacity: 2009 vs 2018



Source: Panticon, based on GWEC and WindEurope data

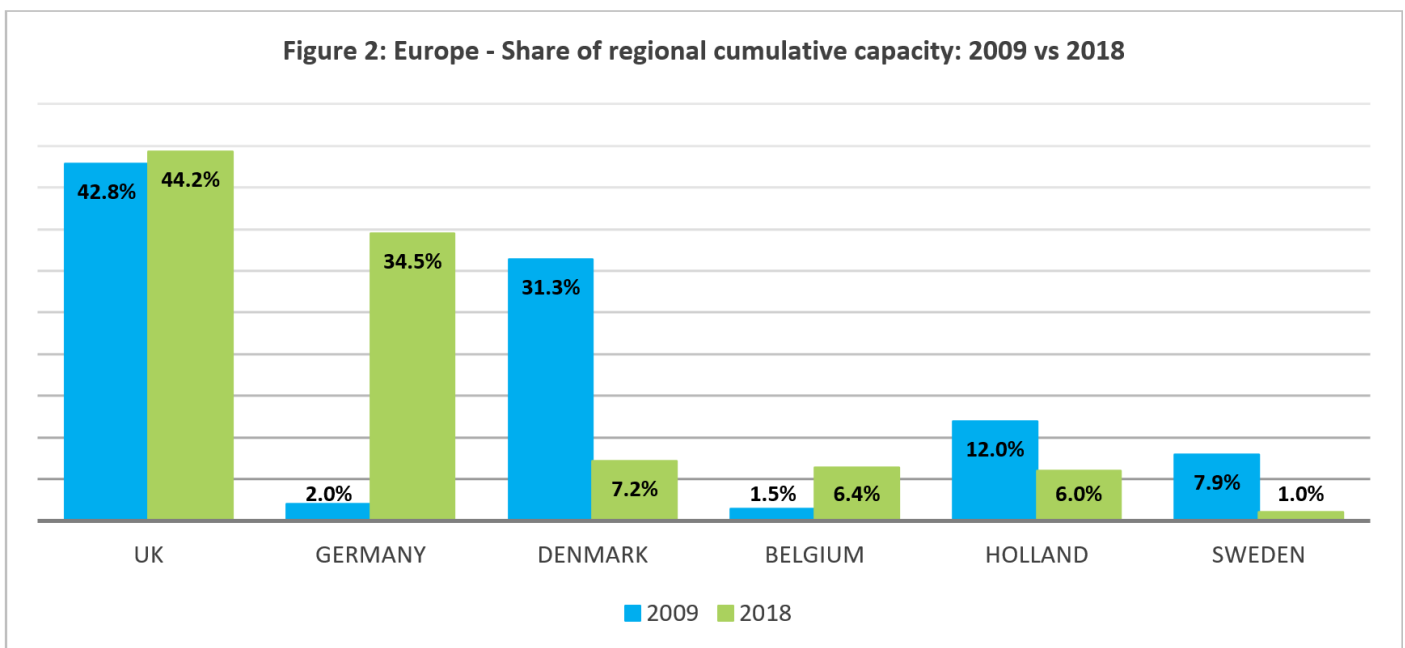
2.2. Supply side

Europe's pioneering role in offshore wind market development has led to the emergence of leading supply chain players across the entire offshore wind life-cycle phases (see the next in the series: *brief report 4*). While the European offshore wind industry has been maturing, it has attracted companies from other industries seeking diversification opportunities, e.g., aerospace, offshore oil and gas, shipping. The decade 2009-2018 has seen intensified competition and innovation as national governments continued to cut subsidies to offshore wind development. As part of staying competitive, European supply chain players have outsourced parts of offshore wind turbine components (e.g. towers) and balance of plant (e.g. foundations and vessel manufacture) to locations outside Europe, particularly Asia-Pacific. Therefore, the offshore wind supply chain has so far globalized more than the offshore wind markets.

3. Regional offshore wind markets

Three regions of the world accounted for the 23.3 GW cumulative installed offshore wind capacity at the end of 2018 (Figure 1). Europe, particularly six European countries around the North Sea and Baltic Sea, account for the lion's share. Asia follows, dominated by China. The Americas has a mere 30 MW installed in the United States of America (USA). Ongoing developments and national targets in these three regions point to a global cumulative capacity exceeding 50 GW and 100 GW by 2025 and 2030, respectively. Asia is set to overtake Europe.

3.1. Regional offshore wind markets: Europe



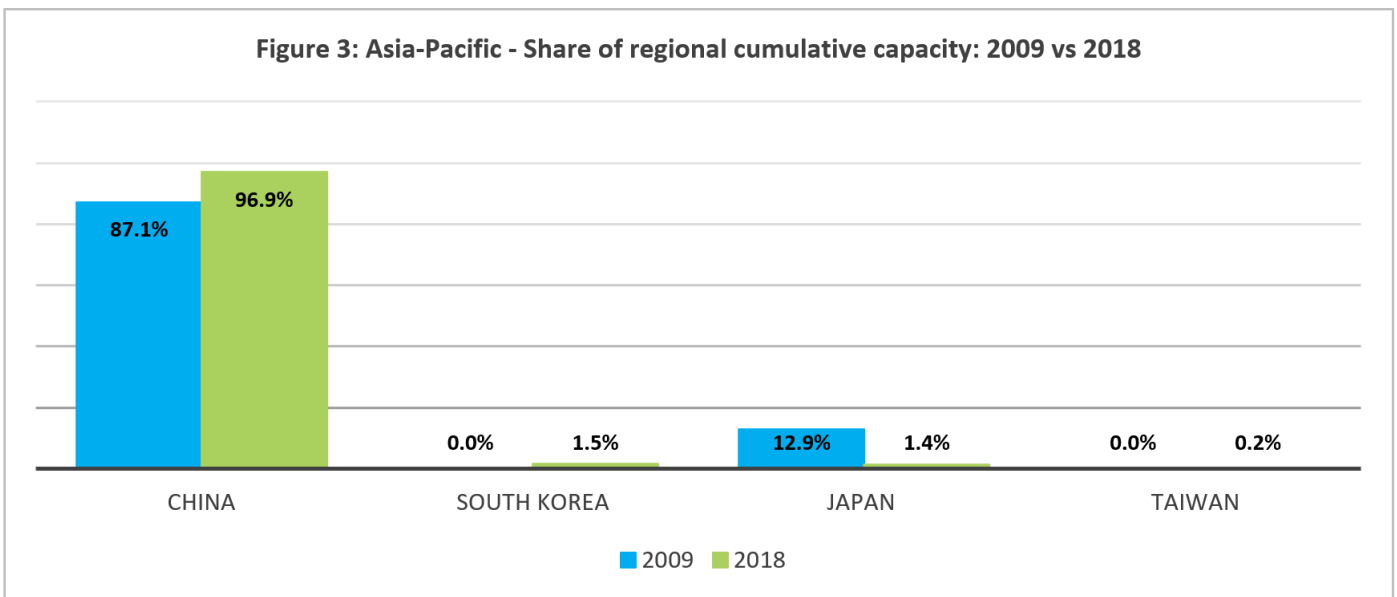
Source: Panticon, based on GWEC and WindEurope data

Europe's five mature markets are Belgium, Denmark, Germany, Holland, and the United Kingdom (UK). Europe's top six markets at end of 2009 were the same as at end of 2018. The UK maintained its leadership while the ranking amongst the remaining markets changed. For the period, the markets in

Denmark and Holland remained active while their supply chains expanded in serving the rest of the European as well as global markets. Sweden’s offshore wind market has been passive for the period but is expected to pick up thanks to pro-offshore wind policy developments. Other European markets outside the top six that have been passive include Finland, Ireland, Norway, Portugal, and Spain.

3.2. Regional offshore wind markets: Asia-Pacific

At the start of the global wind energy shipping and logistics PhD research project in 2013, China, Japan and South Korea were the leading new offshore wind markets in Asia-Pacific. China was already way ahead of the other two at the time. At end of 2018, it has pulled further ahead. China became the third largest market in the world in 2016 in terms of cumulative installed capacity. It went on to installing the global highest annual offshore wind capacity for the first time in 2018.



Source: Panticon, based on GWEC and WindEurope data

From 2016 through to 2018, Taiwan emerged with more concrete offshore wind development plans and policy. It is pulling ahead of Japan and South Korea, which have responded with more positive policy developments in 2017 and 2018. Also, India has emerged as an offshore wind market, signifying a wider regional market take off in the decade up to 2030. Other potential markets in the region include Australia, Vietnam, Thailand, Singapore, and Bangladesh.

3.3. Regional offshore wind markets: Americas

The only market in the Americas with offshore wind installed capacity is the USA which accounted for a meagre 0.1% global share at the end of 2018. Momentum in the USA has gathered pace. States are competing for localization of jobs and have announced ambitious offshore wind targets. Brazil has shown interest to embrace offshore wind. It is yet to reveal concrete plans but is expected have its first offshore wind farm, albeit a pilot, by 2025.

4. Opportunities and Challenges in new markets

As offshore wind globalizes beyond Europe, new offshore wind markets outside Europe are looking to harness European expertise to kick-start their offshore wind markets thus creating business opportunities for experienced European players. The new markets need the European expertise primarily because of the novelty and complexity associated with the offshore wind industry.

At the same time, the new markets are keen to localize supply chains. In addition, governments in these markets are demanding power prices comparable to European prices even before they establish local supply chains capable of reducing costs. This, including other crucial barriers such as cultural differences, is creating a myriad of challenges for European players to navigate. Challenges can be understood at three levels. The first, *barriers*, are elements in the supply chain that slow down, hinder, or block the diffusion of offshore wind and renewable energy. The second, *bottlenecks*, are imbalances in the supply chain where the supply chain capacity is smaller than the demand. Finally, the third, *constraints*, are challenges faced by certain resources in the supply chain that cause the capacity to be less than optimal compared to demand. In what follows, barriers, bottlenecks, and constraints are seen jointly as challenges of offshore wind globalization.

4.1. Drivers of offshore wind globalization

Political resolve Many new offshore wind market countries have announced ambitious offshore wind capacity targets. China is ahead of the pack. Taiwan and the USA, which has been streamlining permitting procedures, follow while Japan and South Korea are also bringing their offshore wind policies up to speed.

Conventional power plants reaching end of lifecycle Coal power plants (e.g., in Australia, India and the USA) as well as nuclear power plants (e.g., in Australia and the USA) are nearing the end of their lifecycles. Besides environmental costs, replacing them is not as economical as new build renewable energy power plants. Meanwhile, large hydro resources in countries like China and Vietnam have peaked. In January 2019, China Three Gorges, citing various factors including high local costs and limited domestic hydro (river) resources, announced it will no longer develop more hydro power in China but rather focus on offshore wind.

Post-Fukushima disaster opposition to nuclear power There is continued public backlash against power generation from nuclear following the Fukushima disaster in 2011. In addition, nuclear power has been losing its cost competitiveness over wind power generation.

Good offshore wind resources and long coastlines Naturally, the new offshore wind markets outside Europe have good to excellent offshore wind resources. They also rank among countries with the longest coastlines in the world. Some, e.g. Brazil, have coastlines with a shallow continental shelf.

Proximity to population centres Offshore wind resources, unlike other renewable energy resources, are typically located close to densely populated coastal cities, thereby reducing investment costs in long transmission lines.

Growing power demand Population growth, urbanisation, and industrialisation are driving electricity demand, especially in developing countries such as India and Vietnam, which are expanding their status as global centres for outsourcing manufacturing. In developed countries such as the USA, there is increasing demand for renewable energy power from corporations such as Apple, BMW, Facebook, Google, IKEA, LEGO, Microsoft, and Walmart. This trend, epitomized by increased focus on Environmental, Social and Governance, is expected to expand globally, and encompass offshore wind eventually, thanks to the globalized supply chains of these corporations.

Limited land for onshore wind power and solar power development Renewable energy technologies, currently more cost competitive than offshore wind, namely onshore wind and solar, are competing for land in the typically densely populated the new offshore wind markets outside Europe. In addition, where the land is available, the population densities are low and hence the need for further investment in transmission infrastructure.

Employment and offshore wind supply chain hubs Governments in new offshore wind markets, most of which face either youth unemployment or dying industries in coastal areas, see employment creation opportunities in offshore wind development. These new markets are also seeking to position themselves as supply chain hubs in an industry that is about to become truly global.

Deteriorating air quality Many of the new offshore wind market countries face rapidly deteriorating air quality which is largely driven by fossil (mainly coal) fuel power generation. According to IQAir AirVisual and Greenpeace's 2018 World Air Quality Report's ranking of the most polluted capital cities in the world, Delhi (India), Dhaka (Bangladesh), Beijing (China), and Hanoi (Vietnam), ranked first, second, eighth and 12th, respectively. India and China have 22 and five, respectively, of the 30 most polluted cities globally.

Energy independence and security Most of the new offshore wind markets are poor in fossil fuel resources and are therefore major importers of coal, oil, gas or uranium. This is true for China, India, Japan, South Korea, and Vietnam.

Industry diversification and synergies Many of the new offshore wind markets outside Europe host major industries seeking opportunities to diversify because of economic downturns that followed the 2009 financial and economic crisis in the West. These industries, from offshore oil and gas in Brazil and the USA to shipbuilding in China, Japan, South Korea and Vietnam, provide synergies with the globalizing offshore wind industry. In addition, most of the new offshore wind markets have an existing onshore market and supply chain bases that already host European suppliers.

Cost competitiveness New offshore wind markets have been encouraged by the declining cost of offshore wind in the North Sea and the Baltic Sea. Offshore wind is increasingly becoming cost competitive against conventional power generation sources. In the USA's densely-populated North-East, power prices from conventional sources are higher.

4.2. Challenges facing the globalization of offshore wind

Cultural differences European players aiming to conquer the new Asia-Pacific and Americas offshore wind markets are faced with cultural differences at business level as well as at the political level.

Political uncertainty The political divide in some new offshore wind markets such as Australia, South Korea and the USA has contributed to a lack of policy consistency and hence hindered progress on previously announced ambitious offshore wind targets or plans. As recent as November 2018, local elections cast doubt in the otherwise well progressing Taiwan offshore wind market. In addition, powerful nuclear and coal lobbies in countries such as South Korea and the USA have contributed to slower offshore wind policy development. Meanwhile, general political and economic crises, e.g. in Brazil, have meant that renewable energy policy has not been prioritized.

Regulatory hurdles A lack of policy realignment across various local stakeholders has been a major hindrance in countries such as Japan and South Korea. Brazil, with maritime territory under federal ownership, still lacks a corresponding regulatory framework that allows the federal government to lease offshore areas to developers for offshore wind development. Though the USA, with similar maritime law architecture as Brazil, has leased zones for offshore wind development, much of the current momentum is driven at State level rather than at Federal level.

Preference for other renewable energy technologies All the leading new offshore wind markets outside Europe have, on average, more cost competitive onshore wind and solar than offshore wind. Others, e.g. Australia and Brazil, have abundant uninhabited areas for, e.g., solar power development. At the same time, hydro power import opportunities exist in the north of the USA, from Canada.

Fossil fuel dependence The leading new offshore wind markets count among the major global consumers of fossil fuel power generation. Using coal as an example, the dependence goes beyond power generation to employment as well as sustaining other industries such as the railway industry. At the same time, banks, which financed the newest coal power plants, are keen to maintain the status quo.

Other low carbon energy sources Asia is driving the growing demand for liquefied natural gas (LNG). Japan is the number one global importer of LNG. India and China are set to lead, in that order, the growth in LNG imports up to 2030. Thailand became an LNG importer in 2011 and its imports have grown ever since. Vietnam state companies are also investing in LNG infrastructure for gas power plants planned for early 2020s.

Project financing For developing countries, e.g. India and Vietnam, where the ambition is present, the business climate to attract project financing from abroad is lacking. These countries are unlike the European countries that had the local private and government financial support to kick-start offshore wind development or China whose state-owned enterprises have driven the offshore wind development.

Grid issues The new offshore wind markets face the challenge of either upgrading or expanding their existing grid infrastructure to accommodate renewable energy. Energy storage technology, which would help accelerate offshore wind development in these new markets, has not yet reached

maturity level. Anti-renewable energy constituents use renewables' intermittency as a strong political argument

Inadequate port infrastructure Compared to the announced offshore wind targets, the port infrastructure of the new offshore wind markets outside Europe is generally insufficient to support construction of offshore wind farms.

Competing interests for the seas The Navy and fishing groups, among other key stakeholders, have expressed concerns over the impact of wind turbines on their operations.

Water depth and seabed conditions Identified offshore wind sites in most parts of Asia are characterized by extensive layers of weak clay and loose sands (India) or soft and muddy seabed (South Korea), making it difficult for vessels to jack up. Moreover, compared to Europe, most potential offshore wind farm project sites are in deeper waters (e.g., Japan, South Korea, the USA's west coast) at comparable offshore distances and therefore only suitable for floating offshore wind.

Challenging weather conditions Offshore wind resources in most parts of Asia are in typhoon-prone zones, conditions starkly different and more challenging than the North Sea and Baltic Sea where most of the offshore wind capacity is currently installed.

Local content requirements Governments are keen on localizing the offshore wind supply chain, via direct (e.g., Taiwan) or indirect (e.g., the USA) local content requirements, whilst reducing state incentives to support offshore wind diffusion.

Limited offshore wind supply chain Besides China, the new offshore wind markets have very limited offshore wind supply chains. Though some have industries with synergy potential, seen in the light of the announced targets, they have a steep learning curve to reach European levels. Compounding such efforts are, for example, Taiwan's prohibition of Chinese companies, which are geographically closer to Taiwan than European companies, to work on infrastructure projects. For vessels, the USA's Merchant Marine Act of 1920 (the Jones Act) is a key challenge. Meanwhile, as offshore turbine capacity size transitions into the 10-12MW range and demand in Europe continues to grow, next generation vessels will be a major bottleneck.

5. Conclusion

Offshore wind markets are set for a major globalization wave in the decade up to 2030. The challenges cannot be underestimated but the momentum behind the drivers points to significant opportunities for European companies with a resolve to tackle the challenges. To win, partnerships will be crucial. This can be done by building or consolidating partnerships with major European developers and turbine manufacturers that have already established a presence in these new offshore wind markets. It can also be done by establishing partnerships with local players in the new offshore markets. For the latter option, understanding and navigating the cultural differences will be vital.

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About Thomas Poulsen



Mr. Poulsen is a seasoned professional who has specialized in crafting strategy coupled with generating both tactical organic and strategic M&A driven growth for companies and organizations, mainly based on his experience in the shipping, transport, logistics, offshore wind, and supply chain industry. During his 30+ years in the business, Mr. Poulsen has lived in 8 countries namely his native Denmark, Indonesia (Jakarta), People's Republic of China (Shanghai), Singapore, Hong Kong (before hand-over to PRC), USA (New Jersey, California, and Florida), UK (London), and the United Arab Emirates (Dubai).

Abstract about Thomas Poulsen's PhD: Logistics in Offshore Wind

The PhD thesis is about offshore wind and focuses on logistics, broadly defined. As such, the research pertains to the offshore wind supply chain from the perspective of transportation and logistics tasks on land, through ports, at sea, and in the air. In addition, the research has dealt with logistics costs seen in relation to levelized cost of energy throughout the entire lifespan of an offshore wind farm project. The research has also dealt with the globalization of the offshore wind market, using China as the main example.

The results of the research have shown that logistics makes up a significant cost item within offshore wind. The results also revealed that it is important to organize logistics in an effective manner within those firms and organizations participating in the offshore wind industry. The eight academic articles which have been published as part of the PhD research project have been framed in the context of strategic management as well as the mergers & acquisition efforts forming part of the offshore wind industry as the market consolidation intensifies.

The research has been conducted in close collaboration with a series of leading offshore wind organizations and companies. The research was funded by Aalborg University and the Danish Maritime Foundation (Den Danske Maritime Fond) through grant number 2012-097.

What we do at Panticon

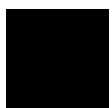
At Panticon, we are particularly strong in the Offshore Wind and Logistics sectors within our three core disciplines of **Strategic Management Advisory**, **Mergers & Acquisitions**, and **Market Intelligence**. We are mainly focusing on the business side to improve our clients' performance, create value in the long-term, and to create sustainable competitive advantages.

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