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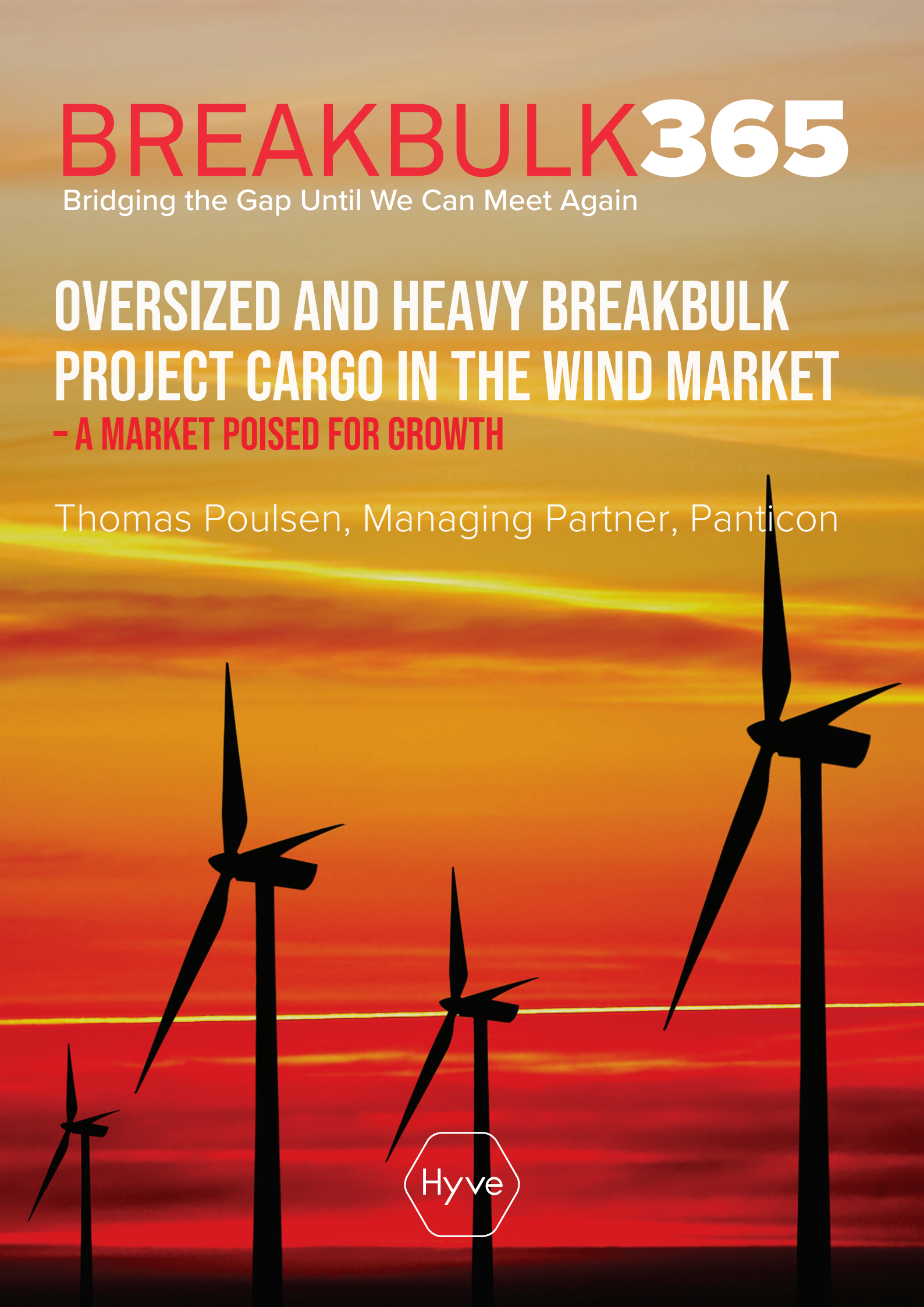
OVERSIZED AND HEAVY BREAKBULK PROJECT CARGO IN THE WIND MARKET

– A MARKET POISED FOR GROWTH

Thomas Poulsen, Managing Partner, Panticon



Hyve

As governments across Europe continue to prioritise green energy and economics, the role of wind has expanded greatly in European markets.

Due to the size and shape of wind components, project cargo companies are poised to enjoy significant contract demand in the near future. They will act as vital cogs in Europe's green machine moving forward, ensuring projects are completed on time, efficiently and effectively.

This white paper from Thomas Poulsen, Managing Partner, Panticon/The Wind Logistics Group, in partnership with Breakbulk Events & Media takes a deep dive into how the project logistics sector can greatly benefit from this increased wind activity.



WIND ENERGY IN EUROPE: THE BACKGROUND

Towards the end of the 19th century, scientists in both UK, the US, and Denmark pioneered the use of wind turbines for electricity generation. These wind turbine generators were perfected during the 20th century and during the oil crisis in the 1970s, and wind energy emerged as a hot topic on the global energy agenda.

The US government channelled research and development through NASA and focused especially on developing wind turbine designs in the US as well as improving a very promising three-bladed Danish wind turbine built in 1956. The first commercial serial production of wind turbines commenced in Denmark in 1979 which enabled operators of wind turbines to acquire more wind turbines of similar design and run several wind turbines in the same geographical area. With this, the modern-day wind farm as we know it today was born.

Since 1979, the rated capacity of serially produced wind turbines has changed a lot with the first machines yielding 22 kilowatts (KW) based on a nacelle mounted on a 12-meter tower sporting three 5-meter blades.

Continuous wind turbine product innovation and massive upscaling in terms of yield has led to the largest offshore machines today yielding 12 mega-Watts (MW) with towers of 150 meters, a nacelle weighing upwards of 500 tonnes, and blades boasting a length of 107 meters with each blade weighing more than 60 tonnes. As of the end of 2019, a total of 651 giga-Watts (GW) of wind capacity had been installed on a global basis with wind turbines installed onshore accounting for 622 GW and offshore wind turbines accounting for 29 GW, or approximately 95%/5% respectively.

The first offshore wind turbine was erected in 1991 and the offshore wind industry only started to mature and gain critical mass around 2008. Offshore wind has therefore been playing catch-up to onshore wind and in 2019, offshore wind turbines accounted for 10% or 6.1 GW of the globally installed volume of 60.4 GW.

THE DEVELOPMENT OF WIND ENERGY

The wind energy industry has developed rapidly since the first wind turbine generator was put into serial production:

Onshore wind
It all began in **1979**

Offshore wind
The first offshore wind farm was erected in **1991**

2019 installations worldwide:

Total number of wind turbine generator sets **close to 23,000 wind turbines installed in 2019**
Onshore wind installations yield in 2019 **54.3 GW (approx. 90% share of 2019 installed)**
Offshore wind installations yield in 2019 **6.1 GW (approx. 10% share of 2019 installed)**

Wind energy until the end of 2019 on a global basis:

Onshore wind installations yield **622 GW (approx. 95% share)**
Offshore wind installations yield **29 GW (approx. 5% share)**

2050 outlook:

Onshore wind **5,000 GW**
Offshore wind **1,000 GW**

Sources: Panticon analysis based on Global Wind Energy Council, The International Renewable Energy Agency, and T. Poulsen (2018) "Logistics in offshore wind", Aalborg Universitetsforlag, Ph.d.-serien for Det Ingeniør- og Naturvidenskabelige Fakultet, Aalborg Universitet

GOVERNMENT SUPPORT & ONGOING DEVELOPMENT

Invented largely based on government funding to mitigate climate change and reduce emissions, wind energy has traditionally been enabled by government subsidies.

Over time, a strong political desire to reduce and ultimately eliminate such subsidies has put tremendous pressure on costs within the wind market.

As a result, the cost of wind energy has decreased dramatically during the 2010s and when using measures such as levelized cost of energy to compare the cost of different energy sources, wind is now very competitive with other energy forms.

The first offshore wind projects depending fully on market driven electricity prices and without taxpayer subsidies are about to commence construction in Europe to be completed and in operation by 2022 and 2023.

Globalization and Innovation

Given this development in competitiveness of wind energy compared to other energy sources coupled with the allure of a zero-subsidy and job-creating industry, diffusion of wind energy is gaining momentum across many different countries around the world.

A significant portion of the most electricity consuming cities around the globe are, however, located in areas where the population is dense and where land is scarce, which cause application of onshore wind turbines to be restricted.

Many of these same cities are furthermore faced with weather conditions and/or water depths that render the affixing of offshore wind turbine foundations to nearby seabed areas impossible.

As a result, widespread testing of floating offshore wind foundations is ongoing at present.

These factors mean that by 2050, it is expected that a total of 5,000 GW of onshore wind and 1,000 GW of offshore wind will have been installed on a global basis.

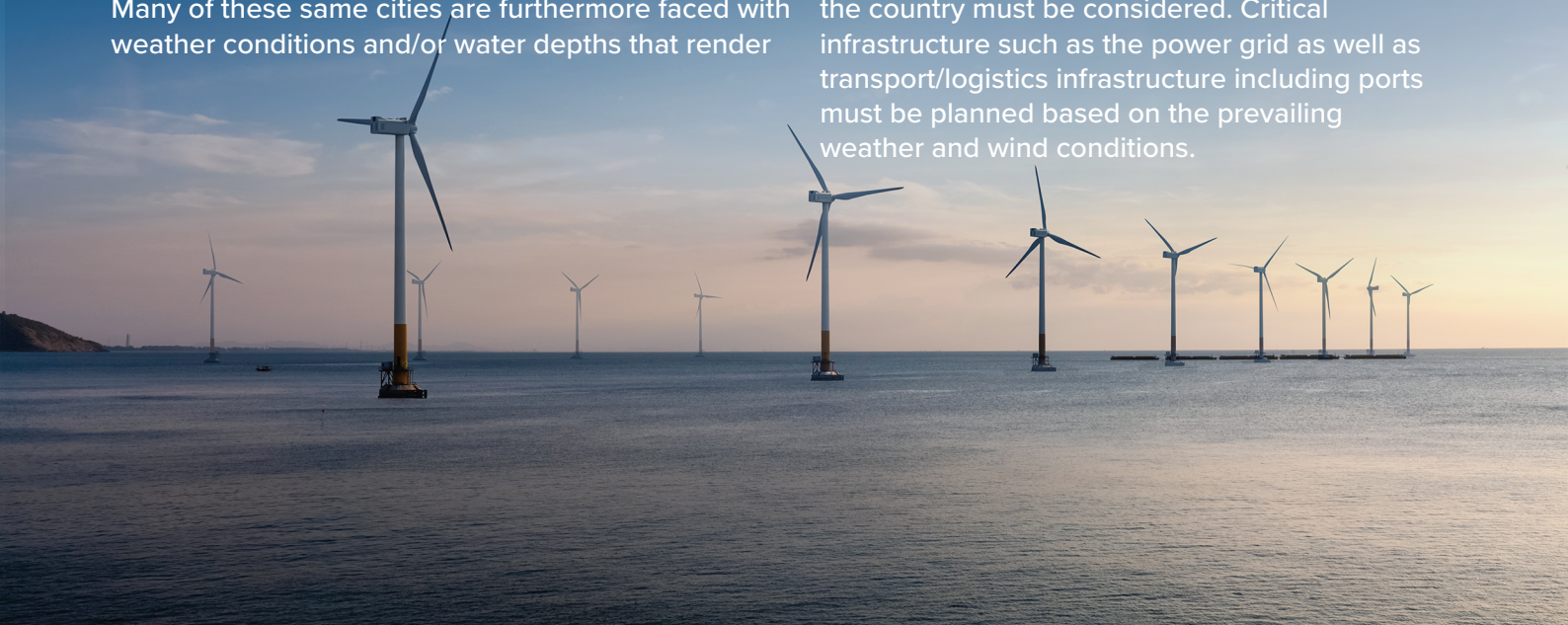
From a product innovation perspective, onshore wind turbines are in the process of being developed for land areas with lower windspeeds which means that the wind turbine generator yield increases along the length of the blades that can now reach 70 to 75 meters.

For offshore wind turbines, several wind turbine manufacturers are releasing new prototypes, and most recently, a 14 MW machine was unveiled. Plans to start testing machines able to yield 25 MW are on the drawing board and the continued upscaling of the core wind turbine technology is therefore expected to continue.

Long-term Planning Process

When a country wants to consider wind energy, it usually starts with onshore wind as it is comparatively cheaper to erect and operate a wind turbine on land compared to offshore in the much harsher sea environment.

From a policy and legislative perspective, many dimensions need to be perused, and the electricity, heat, and power infrastructure of the country must be considered. Critical infrastructure such as the power grid as well as transport/logistics infrastructure including ports must be planned based on the prevailing weather and wind conditions.



Once ready, a country would then start to set up mechanisms to create zones for wind farms to be developed and operated for decades to come. A typical wind farm project takes between two and eight years to plan in terms of development and consent prior to construction, one to three years to install and commission, and the wind farm is expected to have a 25- to 30-year operations and maintenance lifespan before it is ultimately de-commissioned over a one to two-year period.

In Europe, the first countries to embrace wind energy were Denmark, Spain, and Germany. Today, all European countries have wind energy plans and policies in place, many also for offshore wind.

At the end of 2019, the top onshore wind countries in terms of installed capacity were:

- China **37%**
- USA **17%**
- Germany **9%**
- India **6%**
- Spain **4%**

Source: Panticon analysis

For offshore wind by the end of 2019, leaders in installed capacity were:

- United Kingdom **33%**
- Germany **26%**
- China **23%**

THE ROLE OF LOGISTICS IN EUROPE'S WIND MARKET

Logistics service providers and transportation asset owners have been instrumental in forging this development, and in general, the wind logistics and transportation market is split in two: A global market exists with global, regional, and local competition and in China, the market is predominantly made up of Chinese companies of which a significant portion are state-owned.

All life cycle phases of a wind farm project have significant logistics involvement. During the development and consent phase prior to construction, surveys of roads, sites, and ports need to be made. During the installation and commissioning phase, a complex supply chain needs to be orchestrated perfectly from a logistics and transport perspective for all tiers to be organised around a well-planned effort to be on time and on budget.

Predictive and efficient measures to manage the wind farm assets are critical in the operations and maintenance phase where technicians, tools, spare parts, and the necessary equipment need to be deployed to the site. When it finally comes to de-commissioning, a sustainable reverse logistics chain needs to be in place.

Added Complexity for Offshore Wind

From a wind energy transport and logistics market perspective, the added elements of water, distance to shore, salt, corrosion, and ice makes offshore wind more complex as well as more expensive than onshore wind.

In addition, the offshore wind turbines are bigger than those used on land given that there are no size and height restrictions offshore. Using a broad definition of logistics, academic research shows that the total logistics costs, when adding up line items such as air freight, sea freight, road freight, rail, customs clearance, port management, storage, warehousing, transfer of technicians, tools, and inventory carrying costs, make up at least 18% of the levelized cost of energy for offshore wind.

This is considerably higher than for other industries indicating that whereas installing wind turbines offshore is indeed expensive, this fairly young industry may benefit from an infusion of supply chain and logistics industry expertise and even further professionalisation.

Broad Range of Transport Solutions

The life cycle phases during which the wind farms are constructed and subsequently serviced for up to 30 years make up the largest contributors in terms of logistics spend. The movement of the thousands of parts that make up a nacelle largely takes place in standardised inbound-to-manufacturing supply chains as also known in other industries.

When fully assembled wind components like nacelles, hubs, blades, tower sections, foundations, cables, and substations leave their point of manufacture or assembly, the ensuing freight moves are far from standardised.

The volumes are significant with close to 23,000 wind turbines installed globally to make up the 2019 added capacity of 60.4 GW. Each of the wind components are oversized, heavy and in need of careful treatment during transport to avoid damages. Additionally, when subsequently paired up at a staging or preassembly marshalling point, the proportions get even more extensive.

Carefully Designed Infrastructure

Assets and equipment used for transport as well as lifting must be carefully designed, engineered, and manufactured to be able to facilitate economical and critical mass breakbulk project cargo type movements including installation in high wind speeds.

As an example, the main transport frame for the 107-meter blade weighs more than 15 tonnes and when transported on land, each of these blades must be moved using two high-precision operated self-propelled modular transporters.

It follows that many of the wind components must be produced near to the quayside for transportation to be feasible because the only alternative would otherwise be to perform portside light manufacturing and assembly operations where several modules are clicked together before being finally readied for loadout and subsequent offshore installation.



OFFSHORE WIND FARM SHIPPING AND LOGISTICS CONTRACTING CASE STUDY

The Kriegers Flak Offshore Wind Farm is located in the Baltic Sea between Sweden, Denmark, and Germany. It is expected that a total of four phases of this offshore wind farm will ultimately be constructed and that electricity will be supplied to all three countries. The first phase on the Denmark side was won by utility Vattenfall who is the developer and will also be the operator of the offshore wind farm. Installation & commissioning of the two offshore substations have been finalised and the work on the offshore wind turbines has just commenced as follows:

- Supply and installation of 2 offshore substations **Jan de Nul and Hollandia Offshore**
- Export cable supply and installation **ABB and Boskalis VBMS**
- Substation and export cable hub **Port of Rødvig**
- Foundation supply **EEW SPC**
- Transition piece supply **Bladt Industries**
- Foundation and transition piece installation **Van Oord**
- Supply of 72 offshore wind turbines **Siemens Gamesa**
- Marshalling harbour for installation of wind turbines **Port of Rønne, Bornholm, Denmark**
- Transport of nacelles, blades, and towers **Deugro Projects & Logistics**
- Transport of site parts **DHL Freight**
- Wind turbine installation **Jan de Nul**
- Port agency and stevedoring at Port of Rønne **BHS Logistics**
- Supply of inter-array cables between turbine positions **JDR Cable Systems**
- Inter-array cable installation **Global Marine**
- Vattenfall operations & maintenance hub **Port of Klintholm**

Source: Panticon analysis

For early UK projects, wind turbine components were largely manufactured in Denmark and transported to the UK, however, as local job creation became a critical political objective in the UK and a means to reduce overall cost, several manufacturing facilities were established in the UK including the Siemens Gamesa facility in Hull and the EEW facility in Stockton on Tees.

Pressure to Reduce Costs

As cost pressures are levied to all parties within the wind energy value chain, continuous improvements are also expected from the transport and logistics industry.

This is particularly challenging as the continued upscaling of wind turbine technology results in new dimensions and weights of the different wind components being imposed by the turbine manufacturers in a manner that does not always include an element of logistics and transport considerations during the front-end engineering and design phase of the wind turbine itself.

The step-changes in terms of size/scale/weight causes assets and equipment used for transport as well as lifting to become obsolete fairly quickly. Working closely in research and development settings together with wind farm developers and wind turbine manufacturers is therefore a critical element in staying ahead of competition through constant innovation.

Being able to sustain a business model that allows for adequate equipment and asset upgrades and/or depreciation options is also of great importance.

Experience, Track Record, and Partnerships

As more markets embrace wind energy and more wind turbines are erected globally every year, more experience is needed also in the important area of transport and logistics.

This includes recruitment of more personnel within already established transport and logistics companies active within the wind energy market as well as the entrance of additional transport and logistics companies with little or no prior wind energy experience.

The paradox of needing wind logistics track record in new markets, geographies, or within technological frontiers, is often solved through alliances, partnerships, and joint ventures, where the necessary skills and competencies are voluntarily transferred.

Outside Europe, examples include DEME partnering with COSCO in China, Van Oord partnering with NYK in Japan and Ørsted partnering with Dominion Energy in the US. Within Europe, established companies with track records from the different countries have been able to expand from their home markets and work within the entire EU.

Important cross-pollination is necessary based on industry track record and innovation from serving other relevant industries such as aerospace, automotive, truck assembly, composites, fibreoptic cables, nuclear, oil & gas, rail, and shipyards.

Especially the project cargo/breakbulk angle is challenging in the wind industry and a need for strong focus on health, safety, security, environmental, and quality considerations is required. Formalised project management skills as well as supporting IT planning software is a prerequisite along with a healthy risk appetite, willingness to invest, and a sound strategy in place to deal with the continuous upscaling of assets and equipment used for transport and lifting tasks.

Collaboration Across the Supply Chain

Only very few companies can provide an all-encompassing, end-to-end transport and logistics scope for wind farm projects. Therefore, a highly recommendable pathway forward is to fertilise cross-supply chain collaboration across different types of constituencies and stakeholders from a transport and logistics perspective in the value chain.

In this way, different perspectives and unique ideas can be born from multiple constituencies working towards the same target in a manner that ultimately generates breakthroughs enabling the leapfrog required for the wind industry to keep up with and further develop transport and logistics in the years to come. The Denmark-based Wind Logistics Group is one such cross-supply chain, business-to-business initiative with a global outlook that started as an academia initiative with a transport and logistics focus eight years ago, in 2013.

ABOUT WIND LOGISTICS GROUP

Wind Logistics Group is a business-to-business network dealing with transport, shipping, and logistics in the wind market. Wind Logistics Group was founded in 2013 as an academic Reference Group for the Global Wind Energy Shipping and Logistics PhD research project of Thomas Poulsen. Towards the end of 2018 when the PhD research project was completed, Wind Logistics Group started with an objective of being for business and a global scope geographically. Wind Logistics Group is now housed by Denmark-based Transportens Innovationsnetværk (Transport Innovation Network, TINV) and meets up every 6 months. Projects are launched for smaller teams to work on within the Wind Logistics Group and these projects take up at specific challenges and/or opportunities of logistics in the wind energy business. The project groups may meet more frequently and a webinar with participating companies from Wind Logistics Group will be organised prior to Breakbulk Europe in Bremen next year. For more information, please refer to www.windlogisticsgroup.com, www.windscm.com, and www.tinv.dk.

Undoubtedly, the wind market is poised for further and rapid growth which will only pick up in pace during the years and decades to come. To serve this market from a transport and logistics perspective, specialisation is required along with a strong track record and domain expertise. Given the often counter-cyclical nature of the wind transport and logistics market, this green energy form offers a strong supplement to other project cargo logistics operations. And wind energy is here to stay. Breakbulk Europe remains committed to supporting and aiding Europe's wind sector wherever it can. From the event's revised date, Breakbulk will continue to serve renewables cargo owners and freight transporters.

Our industry-leading show is taking place on 18 – 20 May 2021 in Bremen, Germany. Hundreds of logistics companies across all modes will be there, letting attendees find the perfect transport solutions for their wind projects.

Exhibitor booking is open for our 2021 show. Visit our website to reserve your place or for more information.

Visit Breakbulk Europe now

ABOUT THE AUTHOR



Thomas Poulsen is the Managing Partner of Denmark-based consultancy, Panticon. Specialising in transportation, logistics, and the supply chain as one focus area as well as renewable energy with emphasis on the wind market, Panticon renders services within the areas of strategic management consulting, mergers & acquisitions, and market intelligence. Poulsen obtained his PhD in global wind energy shipping and logistics from 2013 – 2018 and assembled a group of organisations to act as a Reference Group to the steer the research development in a practically useful direction based on a shipping and logistics representation from across the supply chain. Through Denmark-based Transport Innovation Network (Transportens Innovationsnetværk or TINV), Poulsen continues to spearhead the cross-value chain wind energy transport and logistics non-profit network he started during his PhD research period, now Wind Logistics Group. In addition, Poulsen serves as a non-executive member of select supervisory Boards of Directors.

For more information, please refer to www.panticon.com.