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Paving the Way for Ceará's Offshore Wind Industry

Webinar presentation to ABEEólica's Offshore Wind Working Group

October 10, 2022



Ramboll in brief

- Independent architecture, engineering and consultancy company
- Founded 1945 in Denmark
- 16,500 experts
- Present in 35 countries
- Particularly strong presence in the Nordics, the UK, North America, Continental Europe, and Asia Pacific
- Creating sustainable solutions across Buildings, Transport, Energy, Environment & Health, Water, Management Consulting and Architecture & Landscape.
- EUR 1.9 billion revenue
- Owned by Rambøll Fonden – The Ramboll Foundation
- Over 500 experts working worldwide in offshore wind

Today's presenters

Lisa Keaton

Team Lead & Chief Consultant
Project manager



- More than 12 years and 9 GW experience in global project development, advisory, execution and technical project management, onshore and offshore
- Technical project manager in owner's engineering and due diligence
- Expertise in offshore strategic advisory, recently for World Bank Offshore Wind Roadmaps for Turkey and Sri Lanka
- Experience in recent supply chain and port studies in Turkey and South Korea

Pierre Amiot

Chief Consultant
Expert: Transport and Installation & Ports



- 12+ years working in offshore construction including 3 years on-site experience
- Extensive technical experience in T&I operations, technologies, installation methods, and assets – including floating wind
- Experience in development of T&I and fabrication strategies
- Marine warranty surveyor in renewables
- Previously worked in Brazilian oil & gas sector

Agenda

Introduction

01

Reference Wind Farm in Cear 

02

**Supply Chain
Gap Analysis**

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1. Introduction

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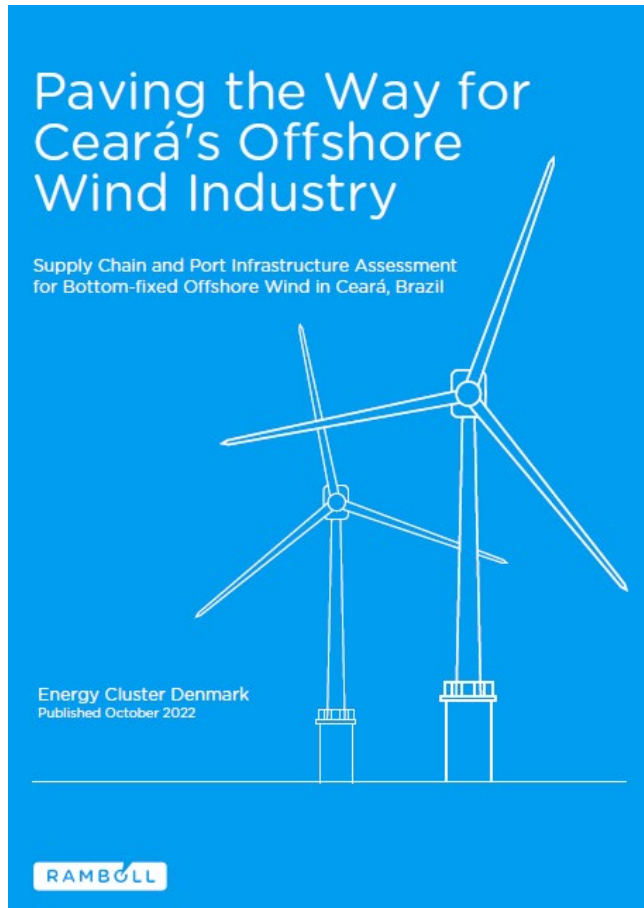
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Photo: Porto do Pecém

Paving the way for Ceará's Offshore Wind Industry

Supply Chain and Port Infrastructure Assessment for Bottom-fixed Offshore Wind in Ceará, Brazil



This report is part of the “**Wind Energy Innovation Collaboration - Brazil and Denmark (INNOWIND Brazil & Denmark)**” innovation project, funded by the Danish Energy Agency. The INNOWIND project’s purpose is to strengthen the Brazilian wind industry and supply chain through positioning Danish innovative competencies and know-how within wind energy in Brazil. Additionally INNOWIND will support the development of an innovative energy cluster in the state of Ceará, Brazil.

- The report focuses on offshore wind projects off the coast of the State of Ceará
- Aim is to identify trends and larger themes, which can be used as a springboard to further policy discussions, as well as foster supplementary detailed analyses which support the emerging Brazilian offshore wind market.
- The two primary scopes of this report are a high-level opportunities and gap analysis of the Brazilian supply chain for offshore wind, as well as a high-level analysis of port suitability for offshore wind projects off the coast of the State of Ceará.
- Work was performed through July 2022

2. Reference Wind Farm in Cear 

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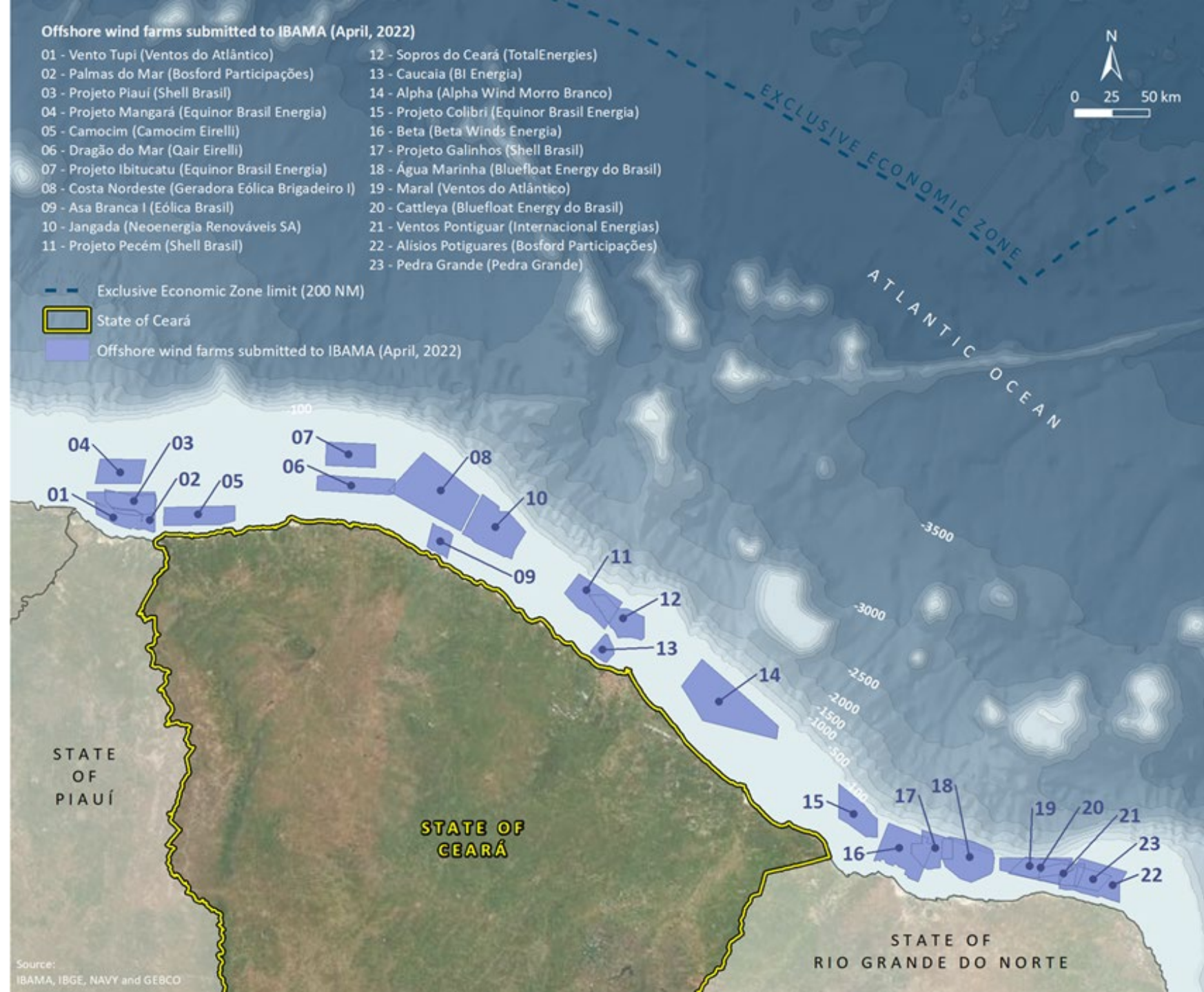


Offshore Wind in Ceará

As of April 2022: 11 offshore wind farms proposed in the waters of Ceará, with an additional 12 offshore wind farms proposed in the waters of the two neighbouring states.

Last IBAMA map in August 2022 shows additional applications, but does not change the picture significantly

- Average wind speed of the sites is 8.5 m/s (range from 8.1 m/s to 9.1 m/s)
- Average water depths of -22 m (range from -8 to -36)



Ceará's Reference Wind Farm

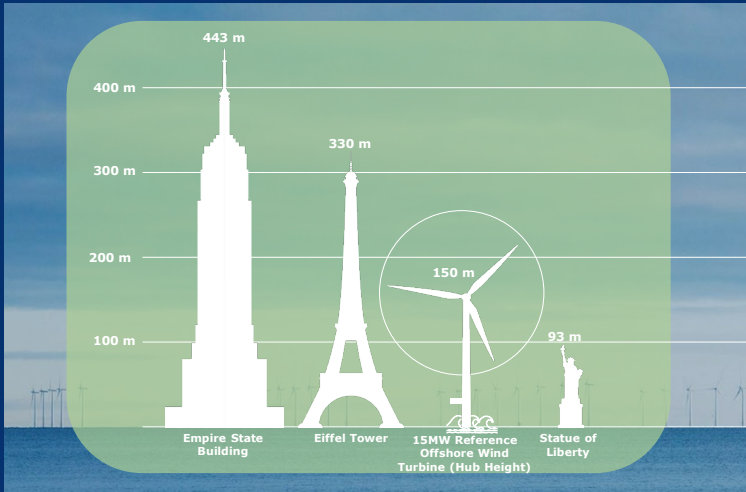
Component	Characteristic	Comment
Wind Farm Location	Offshore Ceará state, up to 50 km from the coast	Based on distance from shore of offshore site applications for the state of Ceará to IBAMA.
Commercial Operations Date (COD)	2030	Typical development times for North Sea countries with mature permitting and route-to-market regimes are in the range of 5-8 years. Uncertainties in permitting and route to market, as currently the case in Brazil, prolong these development times. Ramboll believes 2030 COD would be the earliest reasonably achievable in Brazil.
Site Water Depth	- 22 m	Ceará sites range from -8 m to -36 m, with -22 m as the average across the sites examined.
Windfarm Size	500 MW	Frequently utilized baseline for offshore wind farm studies in the industry.
Turbine Capacity	14 – 15MW range	8 of the 11 IBAMA applications filed in Ceará utilize either a 14 or 15 MW turbine.
Foundation Type	Monopile	Assuming suitable seabed conditions, the relatively shallow water depths are favorable for monopiles, which are generally the lower-cost foundation type.

Commercial Operations Date

2030

Turbine Class

14 – 15 MW



Size comparison for 15MW reference turbine used in INNOWIND report

3. Supply Chain Gap Analysis

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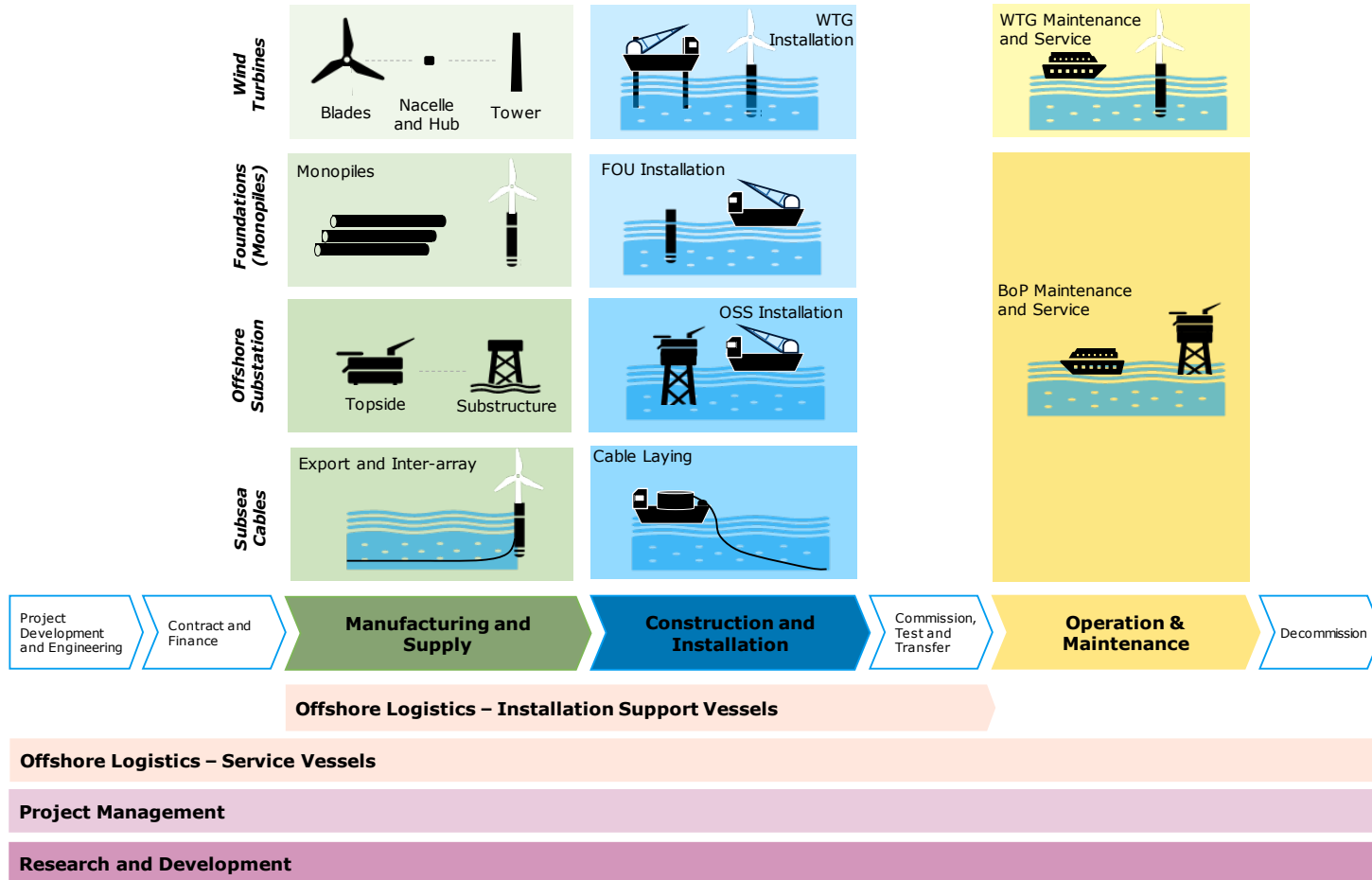
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Photo credit: Vestas



Categories Considered

Supply Chain Gap Analysis



- The supply chain analysis sections take a holistic view of the Brazilian supply chain for offshore wind to identify the key anticipated gaps and suggest recommendations on how to close them.
- This study considers that the entire Brazilian supply chain is available to support wind farms in Ceará, as European experience has shown that water transport, even over large distances, is commercially viable.
- 17 supply chain categories were reviewed as part of this analysis.

Methodology

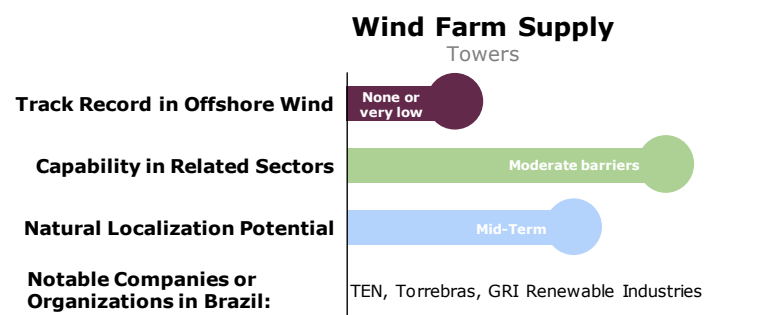
Supply Chain Gap Analysis

- Ramboll developed a set of three criteria to assess key categories of the Brazilian offshore wind supply chain's current capabilities and potential to serve the future offshore wind farm's off the state of Ceará.
- The three criteria are:
 - Track record in offshore wind
 - Capability in related sectors
 - Natural localization potential

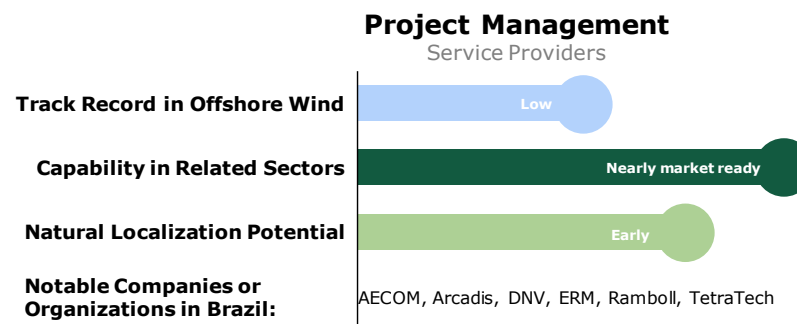
Criterion	Score	Description
Track record in offshore wind	None or very low	No experience in offshore wind
	Low	Low experience in offshore wind or additional specialized equipment needed
	Moderate	Moderate experience in offshore wind
	Extensive	Extensive experience in offshore wind, global-level supplier
Criterion	Score	Description
Capability in related sectors	None or very low	No capability in related sectors
	High barriers	Companies in related sectors that can enter market with high barriers
	Moderate barriers	Companies in related sectors that can enter market with moderate barriers
	Nearly market ready	Companies in related sectors that enter market without significant barriers
Criterion	Score	Description
Natural localization potential	Late	Late natural localization, cumulative installed capacity of 10+ GW
	Mid-Term	Mid-term natural localization, cumulative installed capacity of 3 – 10 GW
	Early	Early natural localization potential, cumulative installed capacity of up to 3 GW
	Local capacity exists	Local capacity already exists, and industry is strongly utilized. Potential to become a global exporter for the offshore wind industry

Key Opportunities

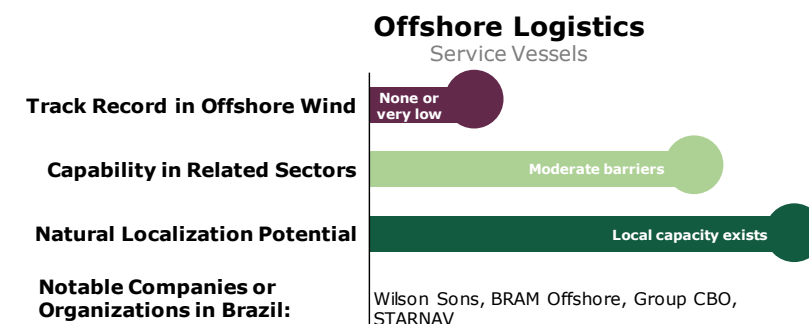
Supply Chain Gap Analysis



- Brazilian onshore wind does have a track record in steel tower manufacturing, however at smaller dimensions than required for offshore wind
- Brazil also has a local steel industry, which is an advantage many established tower manufacturing markets do not have
- Upgrades to waterfront facilities and equipment, as well as logistical constraints to transport the large components may slow down the localization of offshore wind tower supply



- Service providers are well-established for Brazil's related sectors, such as onshore wind and oil and gas, however will need to acquire specialized knowledge for offshore wind from outside of Brazil
- Service providers like AECOM, Arcadis, DNV, ERM, Ramboll and TetraTech are multinational companies with offices also in Brazil, some of which have provided offshore services elsewhere in the globe and are capable of quickly transferring knowledge to their existing Brazilian subsidiaries

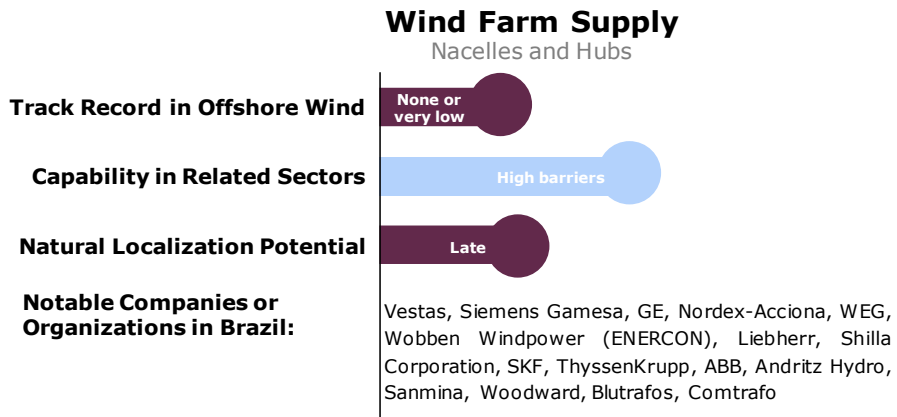


- Within the past decade, Brazil's oil and gas industry began a push to increase the number of Brazilian-built and/or Brazilian flagged service vessels utilized in the oil and gas industry. The campaign was quite successful
- These vessels are not built specifically for the offshore wind industry (may sacrifice certain offshore wind-specific characteristics), however they may allow for a local offshore service vessel market
- Shipyards in Brazil are also capable of retrofitting existing vessels, for example upgrading supply vessels to add walk-to-work (W2W) with systems, or newbuilding offshore wind specialized crew transfer vessels



Key Gaps: Nacelle and hub supply

Supply Chain Gap Analysis



- High value components for the wind turbine manufacturers
- Three primary offshore wind turbine manufacturers: Vestas, Siemens Gamesa Renewable Energy, and GE Renewable Energy. Each of these players has already secured their manufacturing capability in Brazil within onshore wind.
- In the global offshore wind market, nacelles and hubs are supplied from few, select locations. Offshore wind increases the sizes of the components significantly as well as requires waterfront fabrication, which prevent current manufacturing facilities from being used.
- For nacelles and hubs, high barriers are expected, requiring an estimated pipeline of at least 10 GW of projects before a local supply chain would begin to develop.

DANISH EXPERTISE

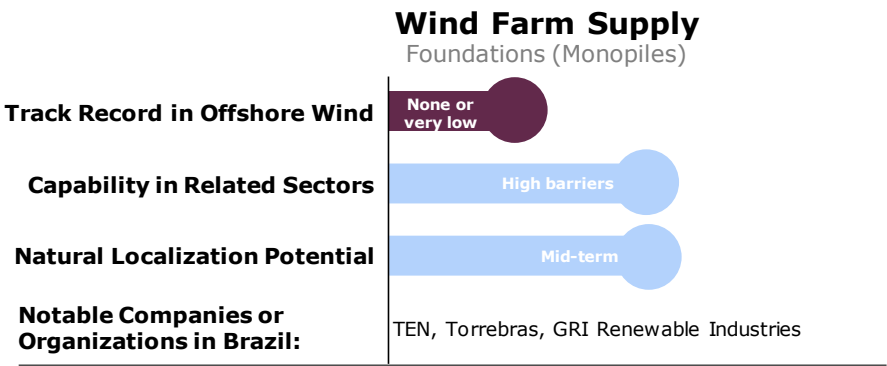
Experience and export will be needed to help scale up to offshore wind dimensions.

Denmark is home to **Vestas**, a key turbine supplier, who is also actively engaged in the Brazilian market, as well as companies such as **LM Wind Power** a multinational blade fabricator, **Welcon** the tower fabricator, as well as system suppliers like **KK Wind Solutions**, **Jupiter Bach** and **Mita-Teknik**.



Key Gaps: Monopile foundations

Supply Chain Gap Analysis



- Brazil does not have a monopile industry, though suppliers of rolled tubes may be able to enter the offshore wind market, however with high barriers. For example, this may include onshore wind turbine tower manufacturers.
- The primary challenges in such a transition are the investments in waterfront facilities with ample storage space, larger or new equipment for rolling of plates with significantly larger diameters and wall thicknesses, as well as training of workforce.
- For monopile foundations, high barriers are expected, requiring an estimated pipeline of 3 – 10 GW of projects before a local supply chain would begin to develop.

DANISH EXPERTISE

Experience and knowledge sharing will be needed to transition existing industries into monopile fabrication.

Brazil does have onshore wind tower manufacturing, steel structure fabrication from shipbuilding and oil and gas, as well as raw materials, however has not yet translated this for monopile fabrication.

Bladt Industries is an example of a Danish company, who is a key player in the industry for fabrication of both monopiles and transition pieces.



DANISH EXPERTISE

International vessels and service providers will be required for safe and proper installation of WTGs in Brazil. Danish companies have a long history in transport and installation.

Danish **Cadeler** operates two jack-up vessels with a robust history of installing turbines. Cadeler is also constructing a new generation of vessels for 15MW + turbines.

A2Sea, now part of **DEME Group**, was headquartered in Denmark. Furthermore, Danish companies, such as **K2 Management** and **Ramboll** have extensive experience in managing T&I of components and Danish companies such as **Blue Water Shipping** hold extensive experience in offshore logistics.

Key Gaps: Wind turbine installation vessels

Supply Chain Gap Analysis

Wind Farm Installation

Wind Turbine Generators

Track Record in Offshore Wind

None or very low

Capability in Related Sectors

None or very low

Natural Localization Potential

Late

Notable Companies or Organizations in Brazil:

Keppel

- The installation of a wind turbine generator (WTG) is performed utilizing a specialized jack-up vessel, also known as a wind turbine installation vessel.
- Globally, these vessels are in high demand, as only a handful are in operation, and even a smaller number are poised to handle growing turbine component sizes. No suitable vessels are currently available in Brazil.
- This gap is a global offshore wind identified bottleneck and therefore not specific to Brazil.
- Brazilian options may include local new-build vessels or retrofit of existing Brazilian vessels. Both options are very expensive and require specialized shipbuilding capacities.

4. Port Infrastructure Assessment

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- The port infrastructure assessment analyses the **readiness and adequacy of port infrastructure** to serve offshore wind farms in Cear .
- The screening looks both at the **short-term and long-term potential** for installation ports using a port benchmark.
- The port benchmark differentiated between the “recommended” and “acceptable” benchmark criteria.
- **Recommended:** ports aiming to be a windfarm installation hub which enable a large variety of transport and installation (T&I) setups, e.g. ports aiming to function as a logistic harbor for consecutive projects.
- **Acceptable:** ports which would enable the development of a windfarm, however have a significant impact on the T&I strategy, through e.g. limiting the variety of vessels that can be mobilized.

Port Infrastructure Assessment



Offshore Wind in the Port of Esbjerg, Denmark

Installation Port Benchmark

Component	Recommended	Acceptable
Maritime access		
Distance to lease area	< 100 Nautical Miles	< 200 Nautical Miles
Air draft limitation	No	100 m
Loading and pre-assembly operations		
Quay length	300 m	200 m
Quay bearing capacity	40 mt/m2	10 mt/m2
Water depth at quayside	15 m	10 m
Storage capacity		
Storage capacity	> 16 ha	> 10 ha
Storage bearing capacity	10 mt/m2	5 mt/m2

Installation Port Findings

Port Infrastructure Assessment

Selection Criteria:

- Maritime Access
- Loading operations
- Storage capacity

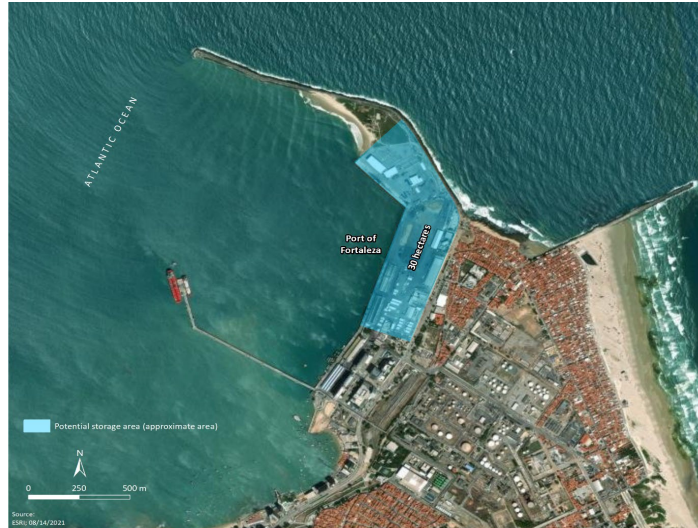
Necessary upgrades:

- Jack-up workability at quayside
- Storage availability
- Increase storage capacities
- Load-out and storage capacities: (RoRo, bearing capacities)



Suitable Ports

Port Infrastructure Assessment

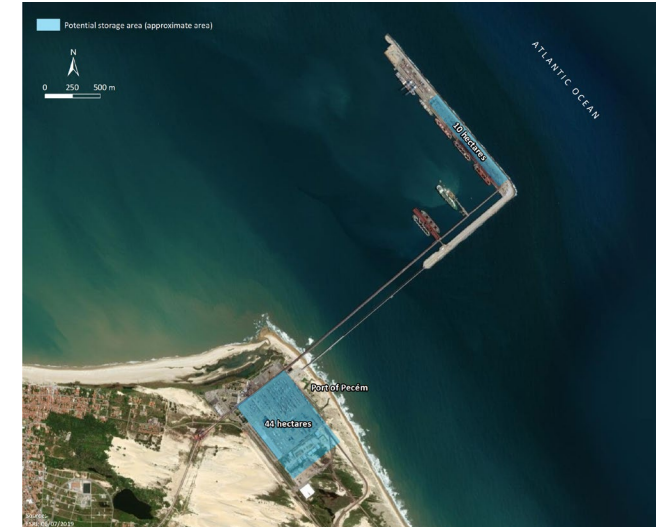


Port of Fortaleza

- **Central position** on the Ceará coast: All wind farm sites in Ceará are within 200 nautical miles
- Current infrastructures are missing loadout assets such as heavy-duty cranes or Ro/Ro ramps. **The quaysides are suitable for transport vessels**
- Working area of approximately 30 hectares identified is partially in use. **Spatial extension of the port area is not considered possible**, as the area around the port is already developed.

Both ports are suitable for the development of a **500MW windfarm** without major upgrades, however limited to **one component campaign at a time** due to storage (in current state).

Either requiring both ports to be used for one wind farm, or subsequent campaigns, significantly extending installation time.



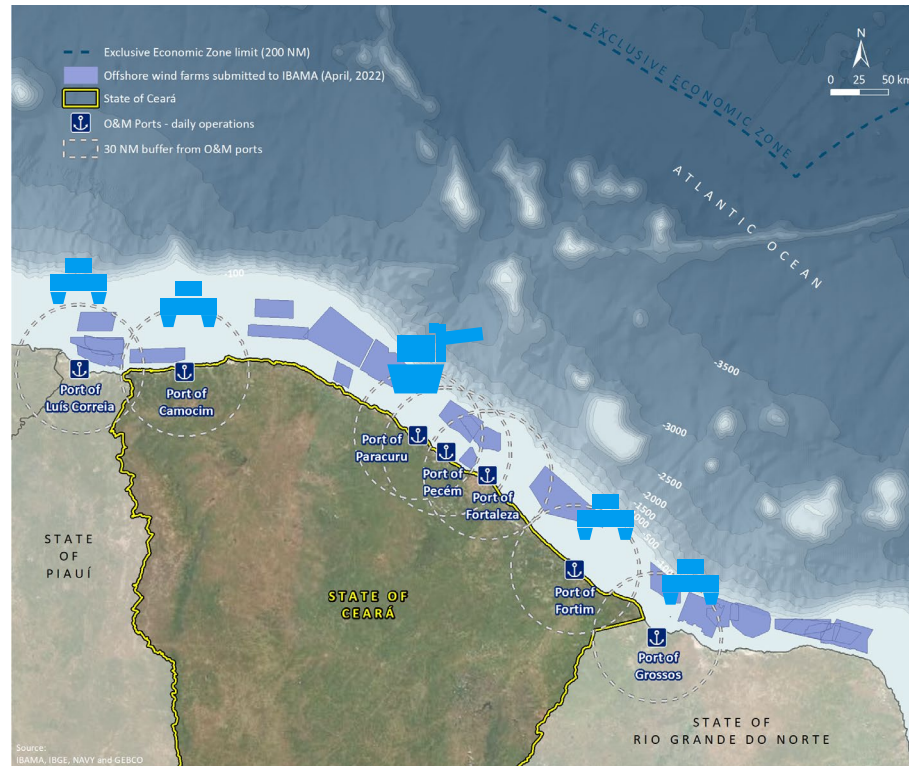
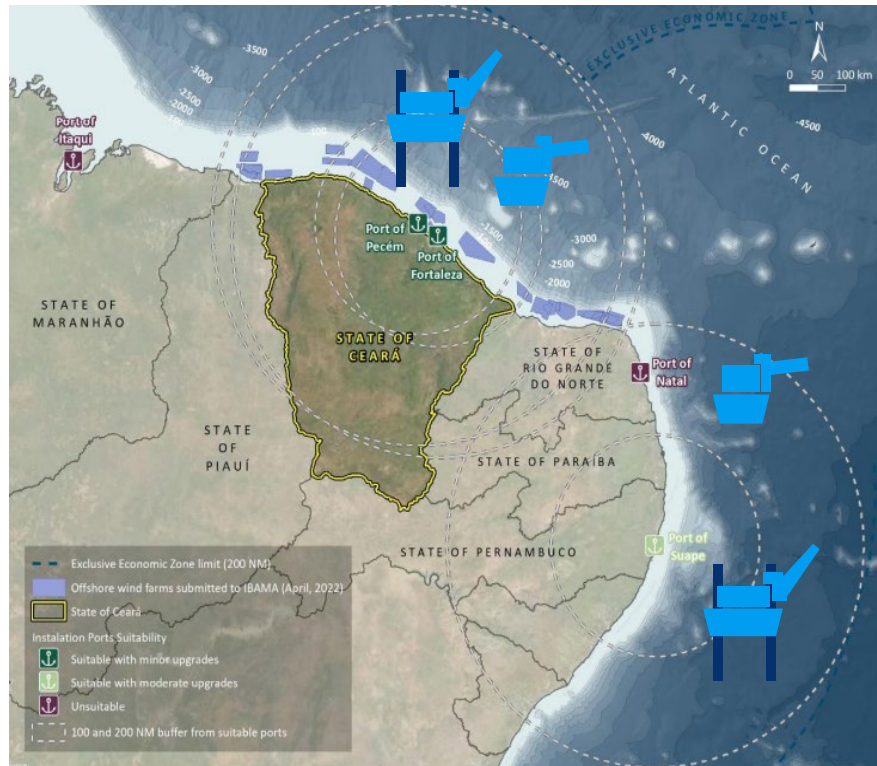
Port of Pecém

- **Central position** on the Ceará coast: All wind farm sites in Ceará are within 200 nautical miles
- Current infrastructures are missing loadout assets such as heavy-duty cranes or Ro/Ro ramps. **The quaysides are suitable for transport vessels.**
- Working area available on the quayside of approximately 10 hectares identified located on the breakwater. **Large onshore storage areas available via bridge**, however transport of components via bridge shall be investigated

Coverage for Planned Offshore Wind Farms

Port Infrastructure Assessment

OPERATIONS PORTS



OPERATIONS PORTS

Within 30 nautical miles (daily operations), or 200 nautical miles (repair campaigns)

- Quite well covered,
- Gap between Port of Camocim and Port of Paracuru



Jack-up



SOV



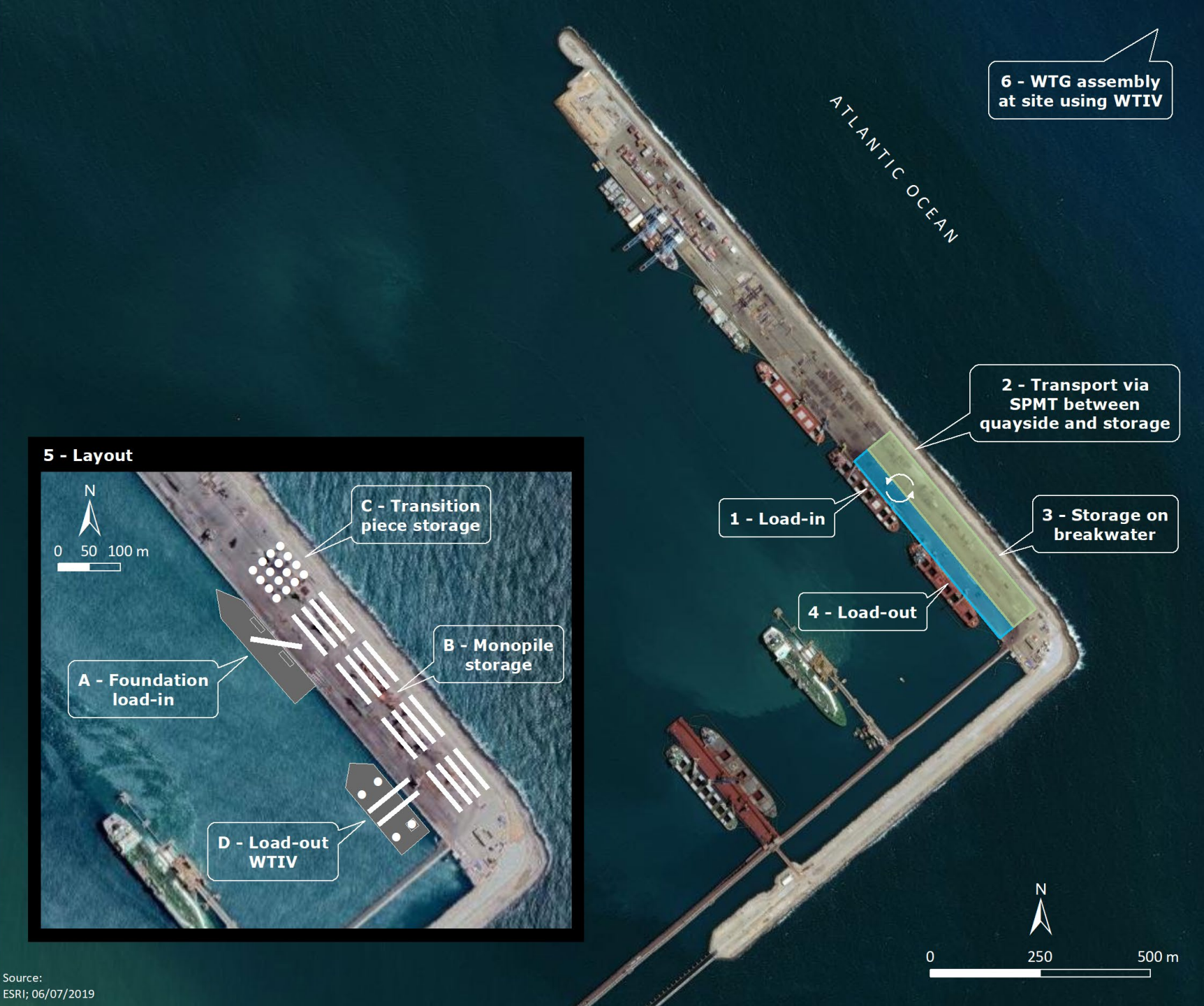
CTV

Case Study Port of Pecém

Port Infrastructure Assessment

Utilization plan for the port using its current infrastructure to host the transport and installation (T&I) activities for a single 500 MW wind farm

Pros	Cons
Early deployment	Right on time delivery
Built-up know-how	Constraints on transportation vessels
Limited upgrades	No WTG pre-assembly
	Impact on current port activities
	Reduced efficiency



Case Study Port of Pecém

Port Infrastructure Assessment

Development of Port of Pecem to a T&I regional hub by upgrading current port infrastructures

Pros

Upgrades of Breakwater and bridge

Potential to reclaim additional storage area onshore

Cons

Replacement of current port activities

Long hauling route and major impact on port logistics



Case Study Port of Pecém

Port Infrastructure Assessment

Development of Port of Pecem to a T&I regional hub by extending the breakwater and constructing a new terminal dedicated to offshore wind

Pros	Cons
State of the art infrastructures	Construction duration
Development of new port activities	Construction costs
Optimized port logistics and layout	
Separated terminal	



Thank you!

Q&A

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