North Atlantic Ports Association AGM: Offshore Wind – Ports and Marine requirements

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December 2, 2021

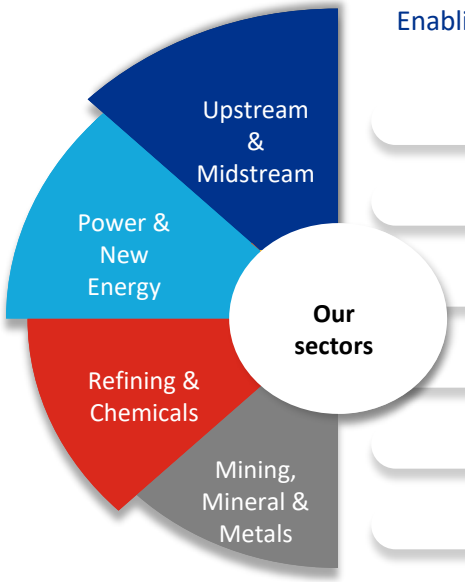
Worley
energy | chemicals | resources

A leading global provider of professional services headquartered in Australia, delivering project and asset services in the energy, chemicals and resources sectors around the world. Public listed company – **ASX:WOR with 2019 revenue of 6.44bn USD**

48,000 People

49 Countries

Enabling capabilities across all our sectors



- Power
- Ports, marine and rail
- Water
- Environment and geosciences
- Social license to operate
- Energy transition services

Asset Lifecycle and Our Services

1 IDENTIFY > 2 EVALUATE > 3 DEFINE > 4 EXECUTE > 5 OPERATE

Advisian
Worley Group

Worley
energy | chemicals | resources

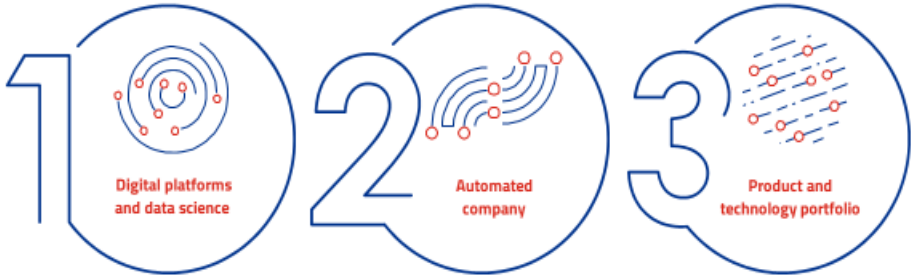
Worley's global consulting firm
3,000 advisors, strategists, and engineers that can articulate a problem and devise a solution at any point of a project

A planet-sized pool of over 52,00 global experts
ready to help develop, build and maintain complex facilities across the energy, chemicals and resource sectors

Advisian & Digital offers consulting services and solutions across the life cycle

Key elements of our accelerated digital strategy

Our three focus areas



Through focused execution of the strategy and enabling tactics

Accelerated digital strategy

Innovation | Automation | Data | People

We embed digital into everything we do

Global wind delivery

Electrical on/offshore/substation

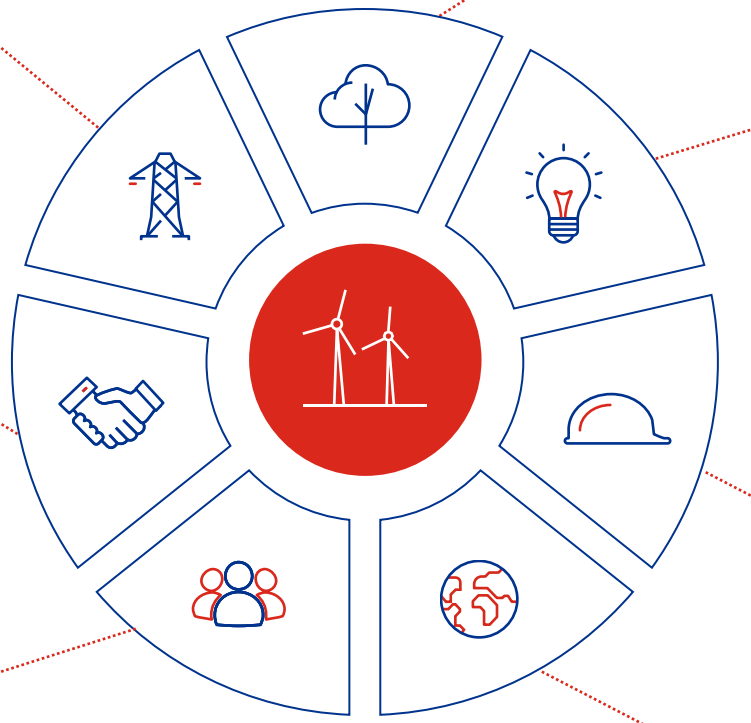
Worley has developed strong advisory and delivery business in the electrical transmission/integration in the US. Delivering complex substation projects across the globe. World renowned for renewable integration and battery storage design and delivery. HVDC SME's support new technologies.

O&M

Worley have recently entered the O&M market as a result of the acquisition of 3Sun Group. This knowledge and capability is being leveraged across our entire offshore wind offering. Ability to bring to US markets.

Advisory

Worley are working with developers across technology readiness levels to improve their technology. This knowledge is also applied to the financial community for project evaluation of floating and fixed wind projects.



Environmental/Front end services

In addition to the fixed and floating wind markets, our involvement in a wide range of projects globally across market sectors such as offshore hydrocarbons, ports and marine terminals, civil and infrastructure provides us with a comprehensive base of knowledge and experience.

Detailed Design foundations/topside substation /specialist engineering

Strong delivery and detail design capability. We understand the technical and economic requirements to deliver a successful offshore wind project.

- Hydrodynamics
- Mooring systems
- Marine systems
- Control systems
- Umbilical and cables
- Structures – jackets, monopiles, and floating
- Foundations and geotechnical engineering
- Materials coatings and corrosion protection
- Advanced analysis (FEA, CFD)

EPCI / OE / PMC

Our involvement starts at the development planning stage, assisting developers achieve the optimum outcome, and continues with Investment Decision Support, acting as Owner's Engineer, or EPC Contractor's Engineer, through fabrication, installation commissioning. Project Management Consultancy (PMC) to support overall development oversight

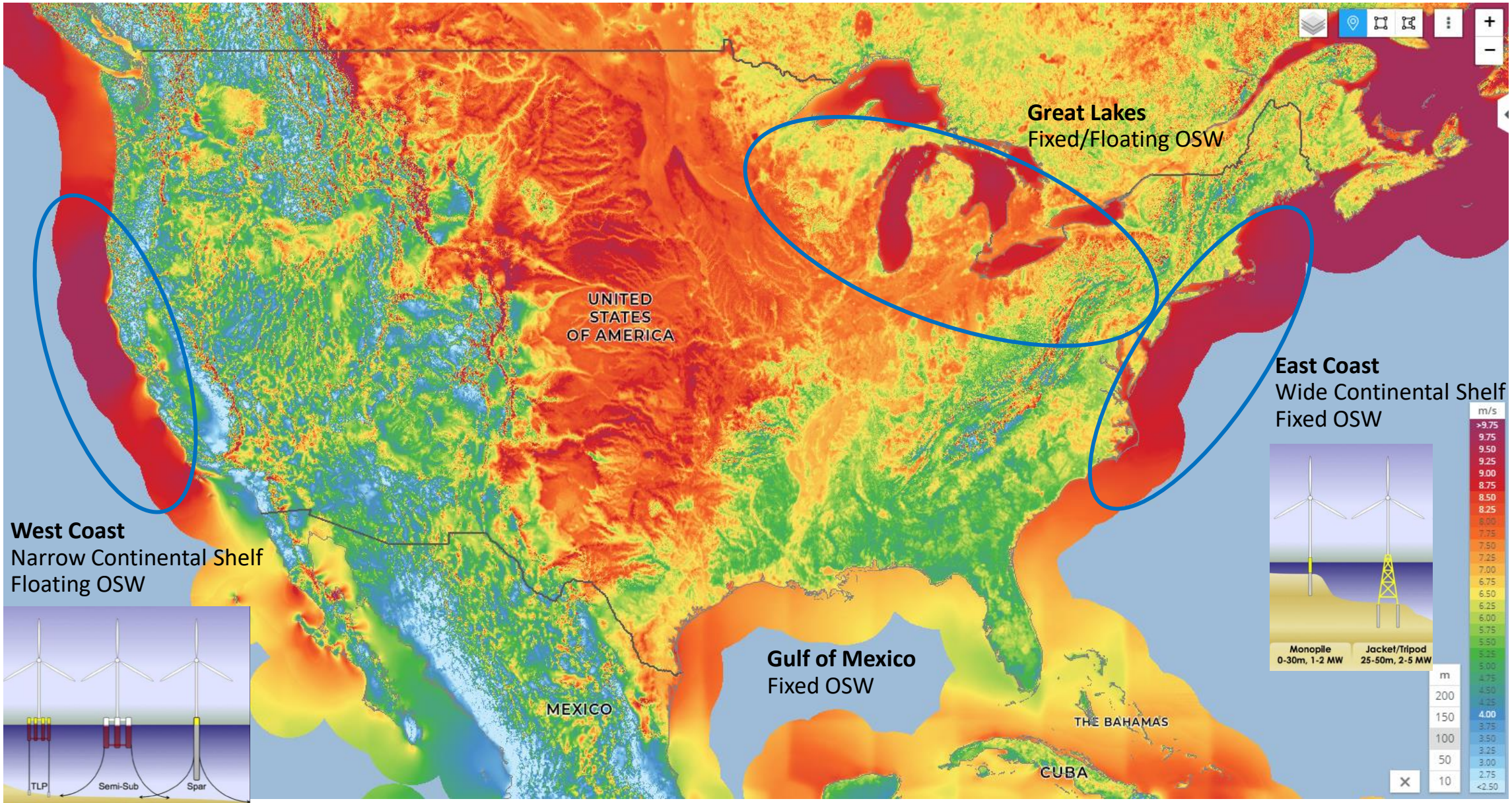
Local Presence

A strong presence across the US/Europe and Asia. We are currently developing a delivery office to service the Offshore Wind market in NE US & Taiwan.

Ports and Marine Needs and Criteria

03

The potential of offshore wind



Current status

- 30 GW of planned generating capacity to be installed in the next 10 to 15 years, which means 2,500 to 3,000 turbines in the next 10 years
- Private finance is not readily available to support port development as investment is following the investment for offshore wind – as such, creating a lag between start of offshore development and port development.
- All facilities need to be evaluated to determine their role in supporting offshore wind as this would be dictated by each facility's specific limitations or enablers. Some factors to be considered apart from physical and environmental are:
  - Local environmental considerations
  - Access to supply chain – technical services
  - Access to competent resources
  - Enabling infrastructure such as highways and rail, IT, power and utilities
  - Supporting infrastructure – retail, housing, commercial space
  - Some facilities are multi-purpose so consideration around simultaneous operations, limited channel availability from other activities

Port terminal types & infrastructure needs

Fabrication & Construction

NJ Wind port
Source: NJEDA

- Construction, staging, and preassembly of components
- Transport hub for device components and materials
- Fabrication of nacelle, blade, foundation, cables, hubs, cable, etc.

Assembly

Arthur Kill Terminal
Source: AOT

- Preassembly of components received from manufacturing plants
- Components received either by road transport or, increasingly, by sea

Operations & Maintenance

Proposed O&M Facility

- Close sailing distance to windfarm
- Crew transfers
- Minor maintenance and repairs
- Operations homeport
- Storage or materials
- Homeport for pre-installation surveys (bathy, benthic, etc.)
- Heli-Port

Example of existing cluster/fabrication/assembly ports

Bremerhaven, Germany
Image: Martina Nolte

Ostend, Belgium
Photo: Port of Ostend

Assembly ports

- Preassembly of components received from manufacturing plants.
- Components received either by road transport or, increasingly, by sea.

Ostend, Belgium
Photo: Port of Ostend

Proposed Assembly Facility, Arthur Kill Terminal – NY
Image: AOT

Fabrication and construction port

- Construction, staging, and preassembly of components.
- Transport hub for device components and materials.
- Fabrication of nacelle, blade, foundation, cables, hubs, cable, etc.

Bremerhaven, Germany
Photo: Eurogate

Proposed NJ Wind Port
Image: NJEDA

Port terminal infrastructure considerations

Critical Location

Sufficient water draft, air draft and channel width

Critical Port Infrastructure

Sufficient upland quayside laydown area

Capacity and load bearing improvements for quayside and yard

Sufficient lift capacity

Sufficient shore utilities

Logistics & Connectivity

Sufficient connectivity (road/rail) to receive equipment and parts

Workforce availability

US supply chain: Typical port criteria (approximate)

Criteria	Fabrication and Construction	Assembly	O&M
Harbor Location	Sheltered	Sheltered	Sheltered < 40 nmi from site
Channel Width	150-200 ft	200-300 ft	100 ft
Channel and Berth Depth	25-40 ft	25 – 40 ft	12 ft
Air Draft	200 ft +	200 ft +	50-100 ft
Min Berth Length (Single Berth)	~500 ft	~500 ft	100 ft
Wharf Area	10-50 acres (component dependent)	50 – 100 acres	1-2 acres
Road/Rail Access	Road and Rail	Road req'd. Rail pref.	Road only
Crane	500-1000 ton	1000 ton	5 ton
Bearing Capacity	1000 – 2000 psf	1000 ton	400 – 500 psf

Offshore Wind Development Challenges

04

OSW developer point of view

- Some lease awards have been announced, more may follow
- Developers still in the planning stages
- Need to know what port facilities are available and options for use
- They are not familiar with ports
- This will guide how they plan to execute a project, costs to construct and maintain
- Need to know this information before they bid on leases

05 Port and Terminal Offshore Wind Development Challenges

Port expansion challenges

View scape for nearby communities

Land space available to expand

Lease terms of existing tenants

Alignment with Port master plan goals and objectives

Conflicts with current customers and tenants

Stakeholder and environmental concerns

Potential need for further dredging and/or deepening existing basin and navigation channels

Funding for proactive infrastructure planning, design, and build out

Environmental & Regulatory considerations

Port Expansion to Support OSW Challenges

Land use compatibility

Available utilities

Surface transportation connections

Other marine activities

Legacy contamination

State and local permitting

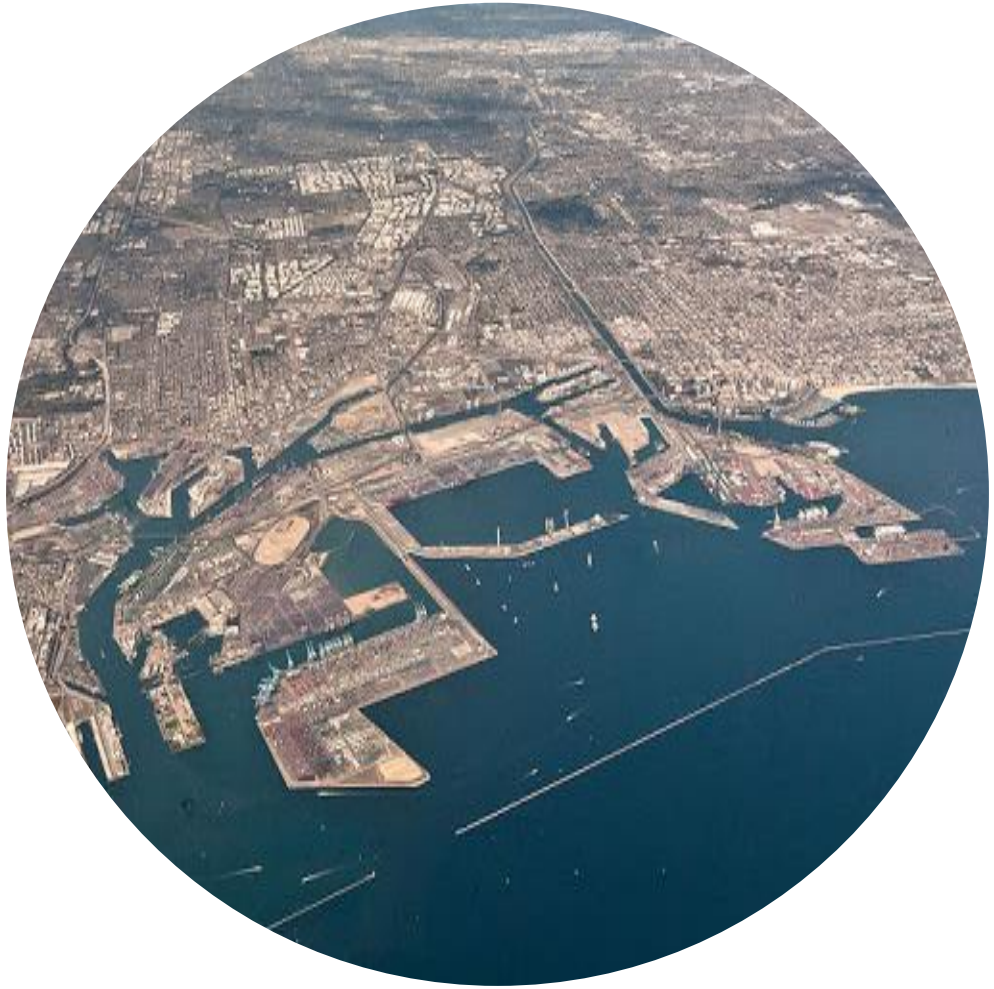
Endangered and threatened species

Species of concern to stakeholders

Environmental justice

Tribal/cultural concerns

NGOs



Operational development considerations for the port

Opportunities are dependant on available terminals, land use and competing cargo interests

Market and regulatory understanding for OSW

Economic evaluation to determine terminal leases

Long term market forecast and sequencing with other competing tenants

Government incentives and funding options, carbon capture/reduction legislation

Regulatory compliance and permitting challenges

Interaction with neighboring communities

Workforce availability and training

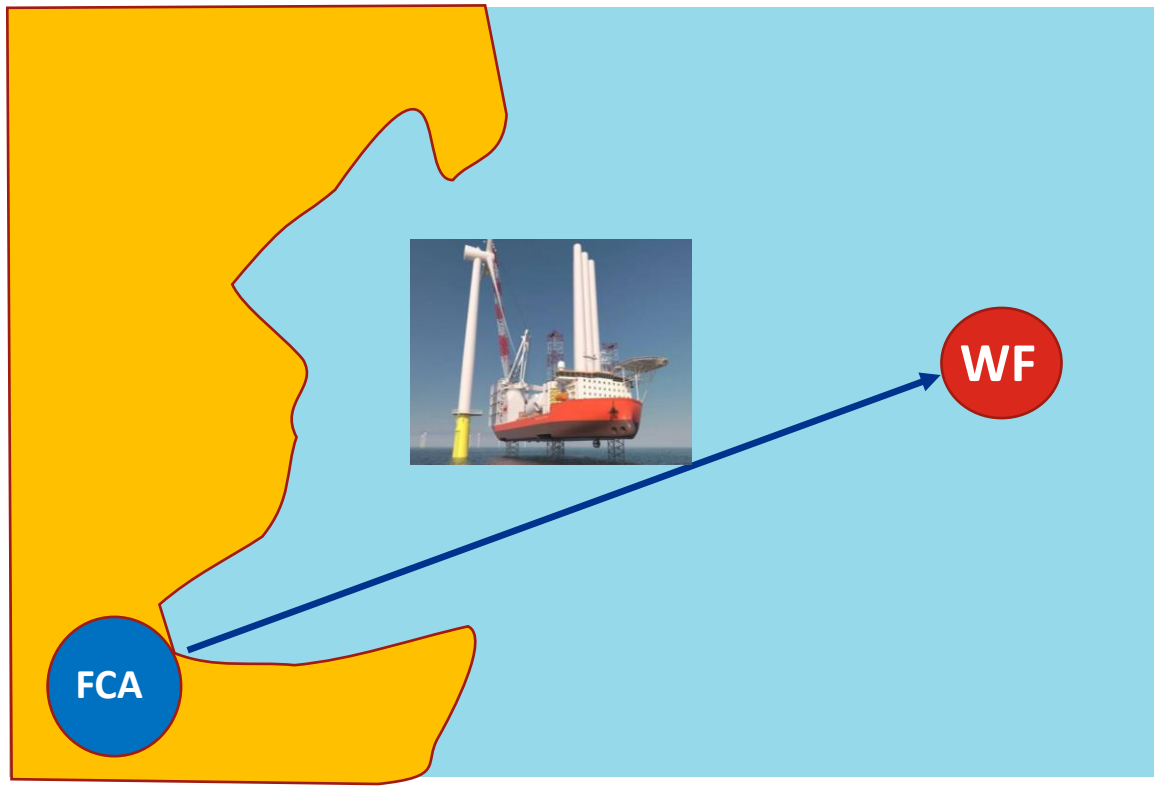
Terminal usage is consistent with updated Strategic and Master Plans

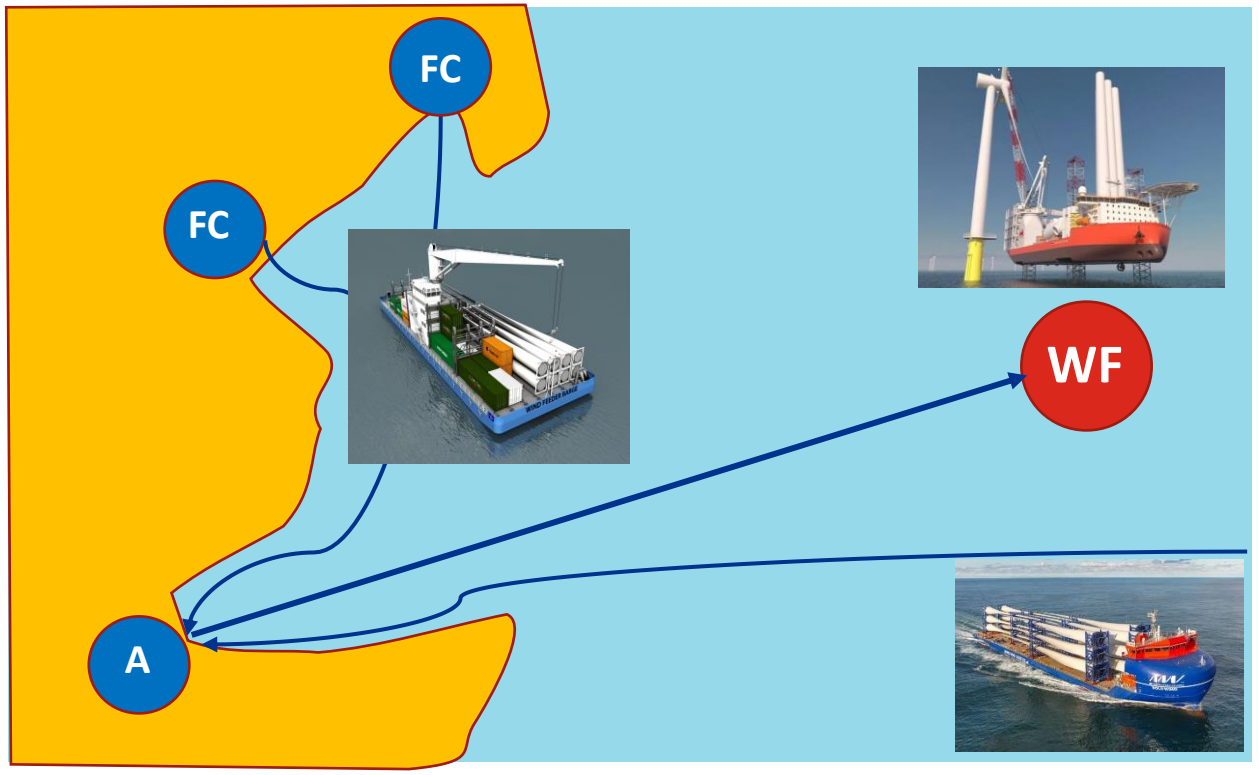
06 Port Opportunities

Port opportunities

- Business sector diversification
- Long term carbon neutral port tenant
- Alternative bunkering fuels
- Access to grant funding for general plan and infrastructure improvements
- Further green port goals and visibility
- Potential to acquire carbon credits through partnering
- Sustainable employment and revenue generation

Installation strategy





FC – Fabrication and Construction

A – Assembly

WF – Wind Farm

Most common to have some preassembly in the port.

Vessels

Jones Act: Installation vessels:

- Enforcement of Jones Act… what new Administration clarification. How it applies… feeder barges.
- Vessel build plans:
  - Installation vessel – jack up – delivery end of 2023 (144 m x 56 m x 11,5m leg length 105m (est))
  - Service Operation Vessel (SOV)
  - Rock Installation Vessel – delivery Q1 - 2024

The GustoMSC NG-16000X-SJ O*ffshore wind turbine installation jack-up vessel design for Dominion Energy will be constructed by Keppel AmFELS. Image: GustoMSC rendering*

The Service Operation Vessel will be engineered, constructed and operated by ECO
Image: ECO

Great Lakes Dredge & Dock will build the first U.S.-flagged Jones Act-compliant, inclined fallpipe vessel for subsea rock installation. The 461'x112' vessel will service the U.S. offshore wind energy industry. Great Lakes Dredge & Dock rendering

Operation and Maintenance Ports

Atlantic Wind, Block Island

O&M Facility, Northeast US

- Close sailing distance to windfarm
- Crew Transfers
- Minor maintenance and repairs
- Operations homeport
- Storage or materials
- Homeport for pre-installation surveys (bathy, benthic, etc.)

Offshore Substations (OSS)

Heerema Marine Contractors – Heavy Lift Vessel – Aegir, OSS, Greater Changhua 1 and 2 Offshore Wind Farm, Taiwan:
Photo: Heerema, LinkedIn

Operations and maintenance facility - Major offshore wind developer

- O&M facility in NE US, with marine infrastructure to support crew transfer vessel (CTV) operations between the base and the wind farm.
- Facility includes warehousing, office buildings, marine infrastructure, crane, and associated site infrastructure/services.
- Worley scope of work includes project management, civil, structural, and electrical engineering for site development, costs estimating, scheduling and project controls, and HSE management.
- We will also be engaging specialized subconsultants for permitting, marine and dredging engineering for marine infrastructure, and architectural and engineering for facilities infrastructures.

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