



# Learning from the Experts Webinar Series

## How Offshore Wind Farms are Installed



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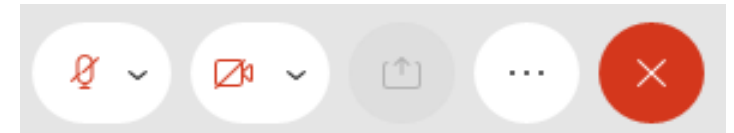
**November 8, 2023**


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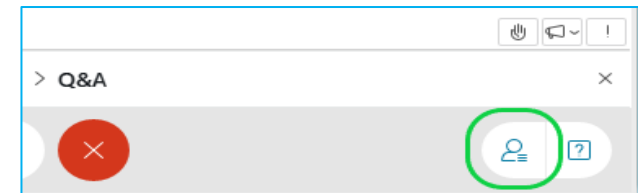
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**You'll see  when your microphone is muted**



# Learning from the Experts

This webinar series is hosted by NYSERDA's offshore wind team and features experts in offshore wind technologies, development practices, and related research.

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NYSERDA



WEBINAR

# *Learning from the Experts:* How Offshore Wind Farms are Installed

8 November 2023 | 1 pm – 2 pm EST

## Speakers



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GM Americas



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60+ Full Time Employees  
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## Maritime Techs

Industry experts applying data science  
to the maritime sector



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engineering companies

# Offshore Wind: Data-backed Market Intelligence



Millions of public data points tracked daily



**11,000+**  
vessels

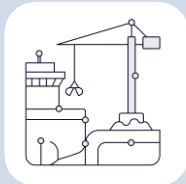
**3M+** <sup>Daily</sup>  
vessel positions

**10M+** <sup>Daily</sup>  
weather points

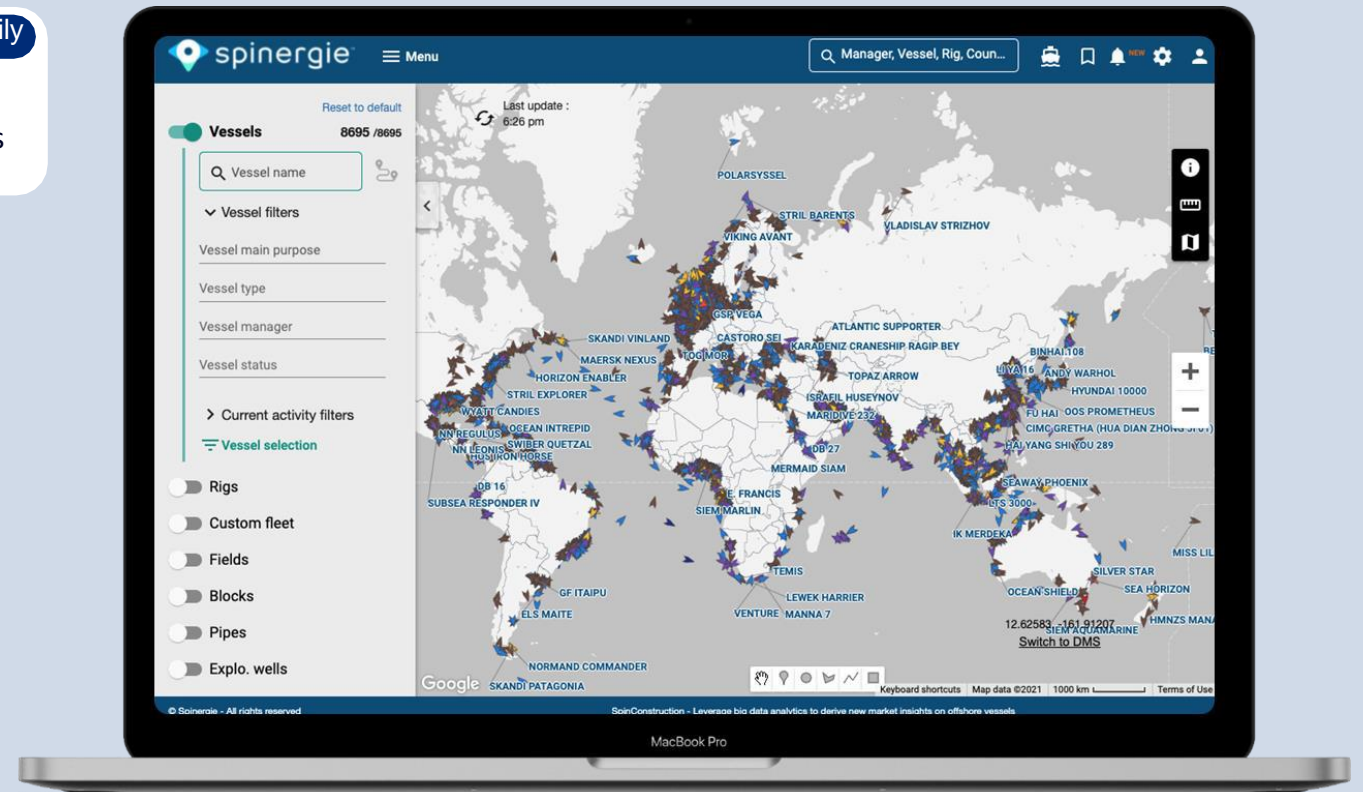


**900+**  
wind farms

**17,000+**  
km subsea cables



**1,400+**  
ports & yards



# Our technology is trusted by the largest maritime construction players



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## Recognitions & Memberships





# Contents

**Outlook for Offshore Wind in the US and New York**

**Stages of an Offshore Wind Project development**

**Constructing an Offshore Wind Farm: Components & Vessels**

**Offshore Wind in the US: Major Considerations**

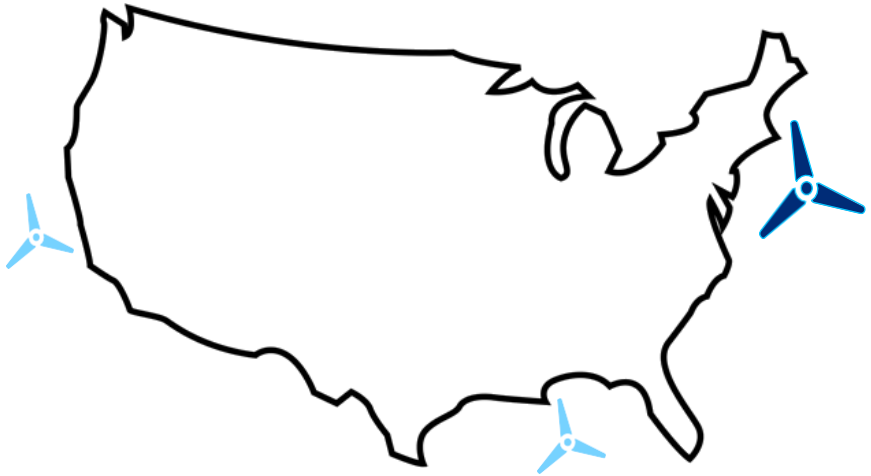
**Case Study: Building the South Fork project**

**Conclusion**

# US Offshore Wind capacity is set to take off in the next few years



## Offshore Wind development areas in the US



### EAST COAST

- Suitable for investments
- Mature offshore wind industry

### WEST COAST

- Deepsea continental shelf
- Upcoming leases planned in 2024

### GULF OF MEXICO

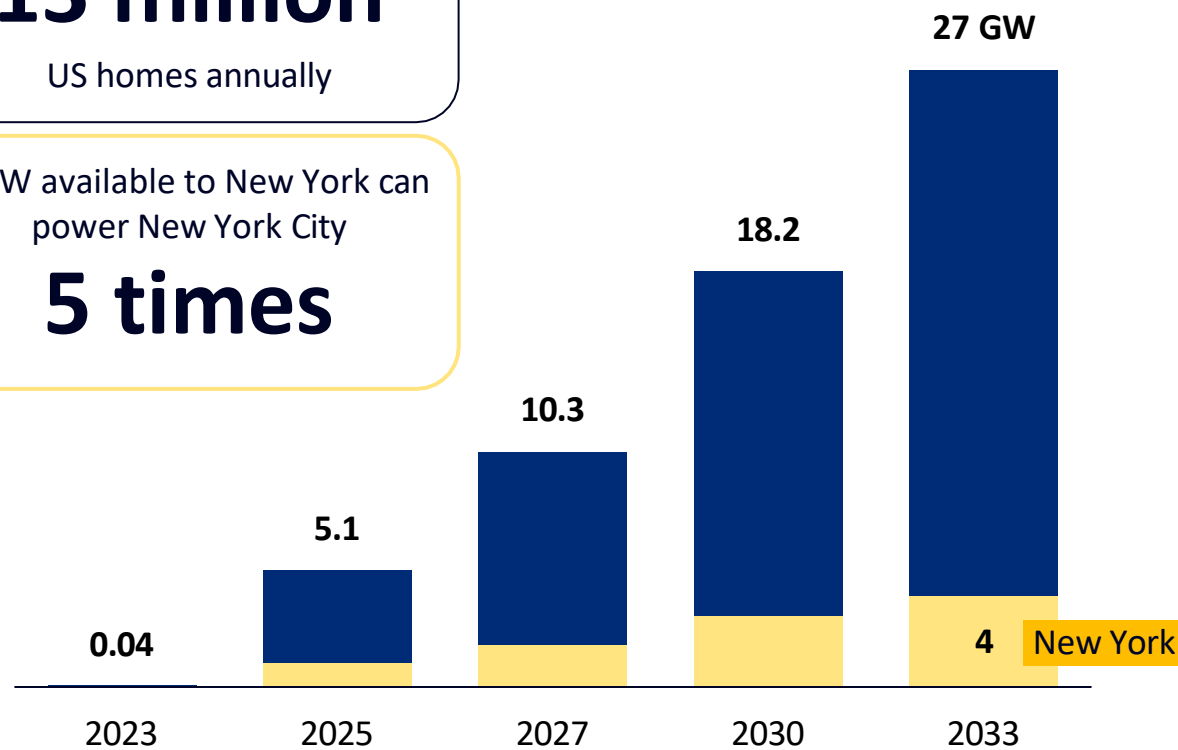
- Mature offshore industry
- First auction happened 2023

## Offshore Wind Forecast for the US

Cumulative commissioned capacity in GW | Fixed-bottom | USA | Next 10 years

27 GW enough to power  
**13 million**  
 US homes annually

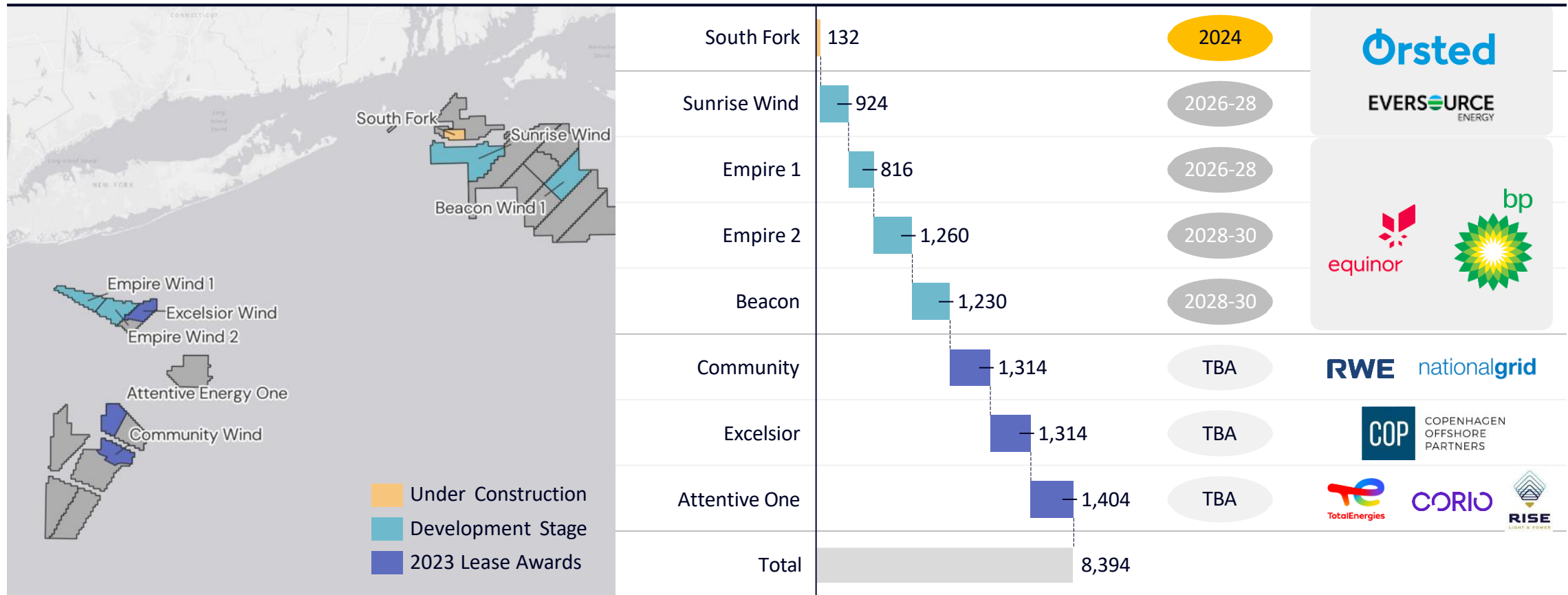
4 GW available to New York can  
 power New York City  
**5 times**



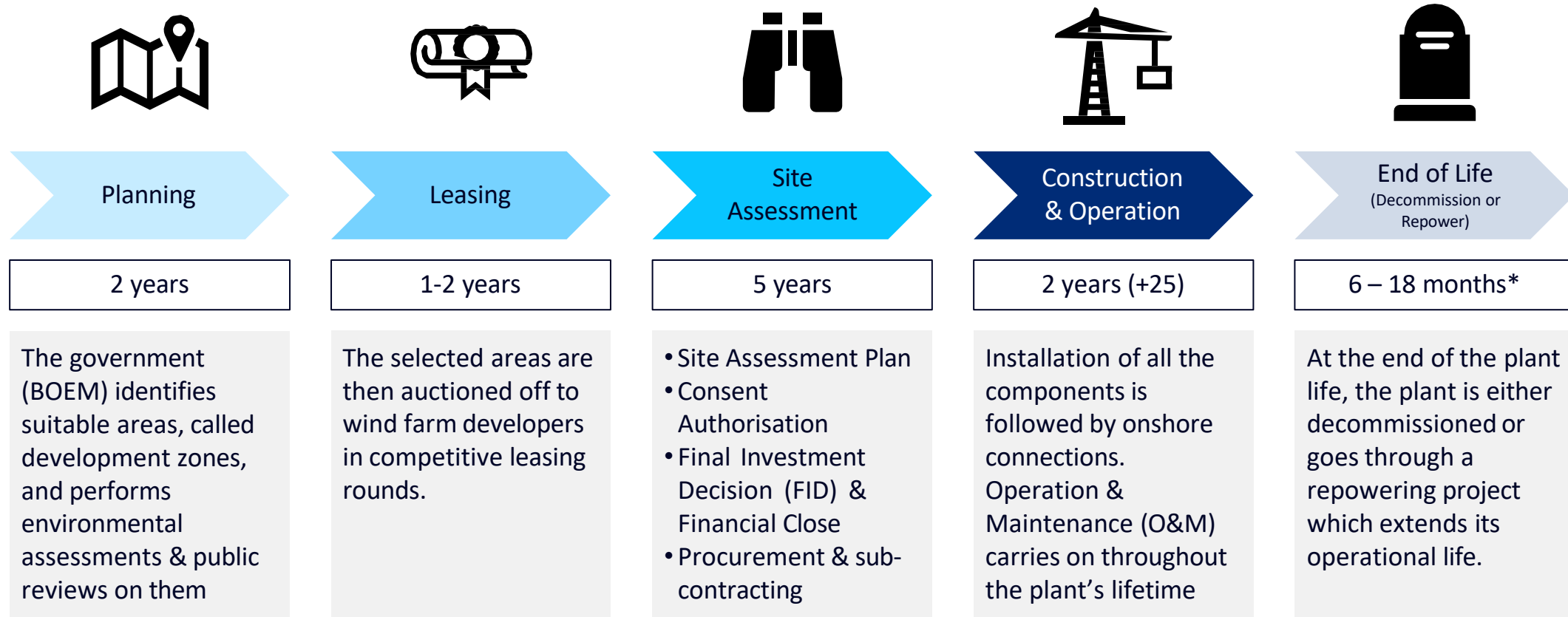
# The state of New York currently has more than 8,000 MW of offshore wind capacity identified



## Projects with New York PPAs | Bottom-fixed Offshore Wind | Capacity in MW

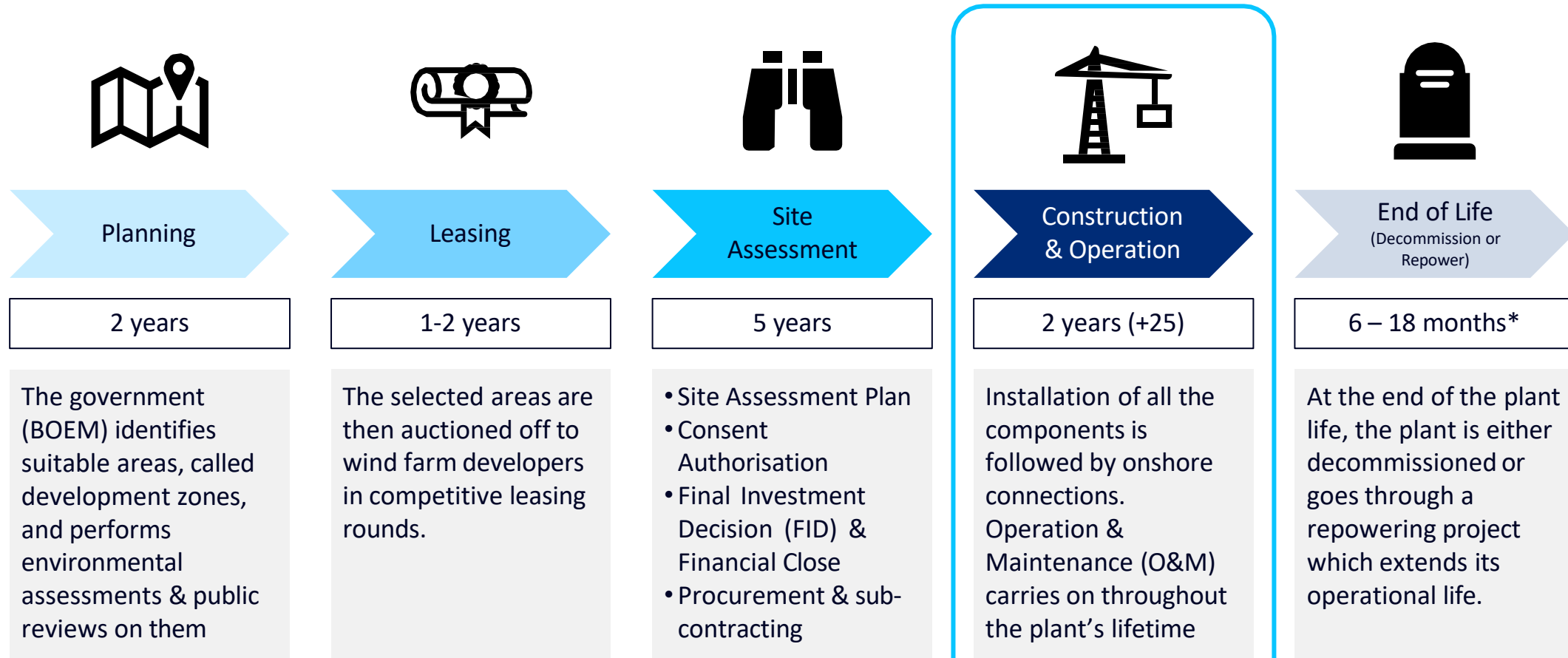


# From conception to commissioning, offshore wind farm development can take up to 10 years



*\*Based on limited examples observed. End of life is relatively new process in offshore wind*

# From conception to commissioning, offshore wind farm development can take up to 10 years

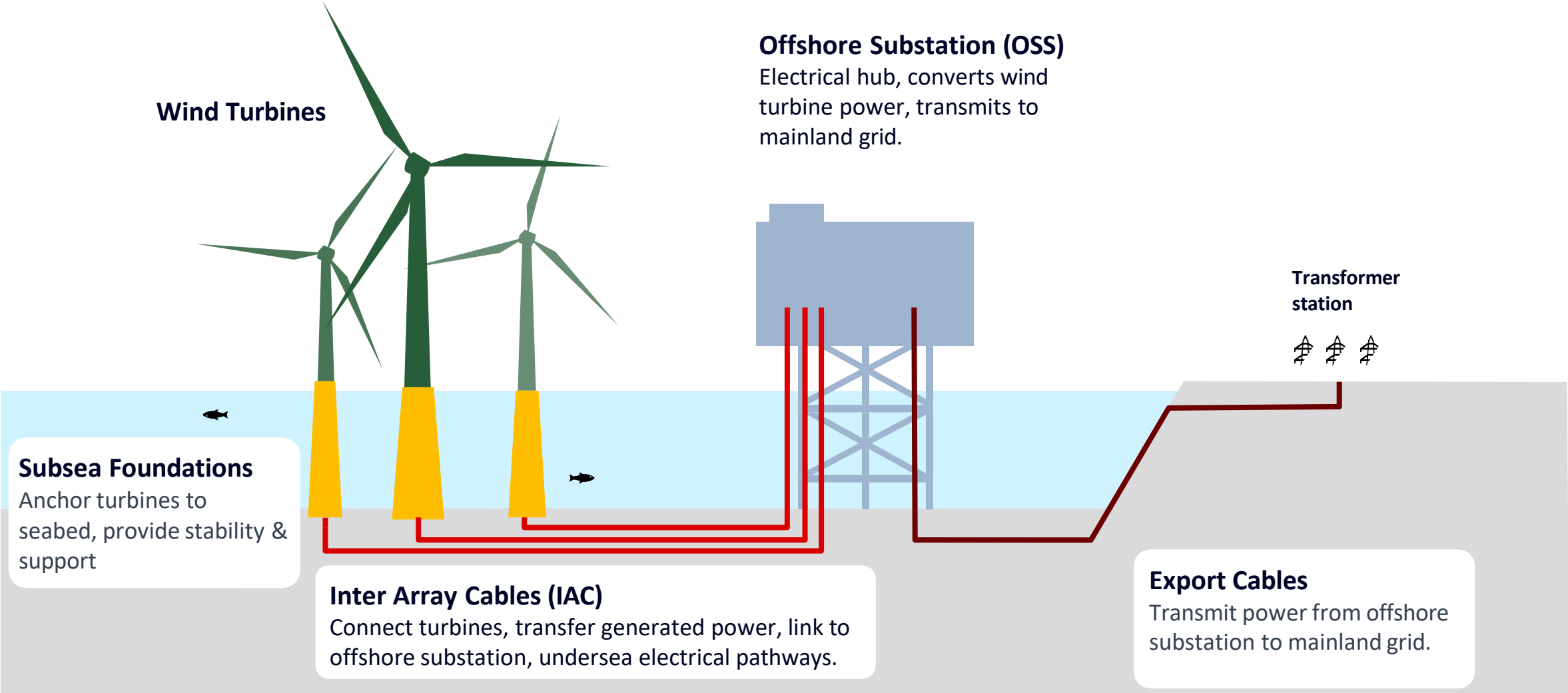


*\*Based on limited examples observed. End of life is relatively new process in offshore wind*

# Constructing an Offshore Wind Farm



# Offshore Wind Farm: Fundamental Components



Adapted from: [https://www.researchgate.net/figure/Schematic-representation-of-an-offshore-wind-farm-wind-turbines-and-subsea-power-cables\\_fig1\\_340787563](https://www.researchgate.net/figure/Schematic-representation-of-an-offshore-wind-farm-wind-turbines-and-subsea-power-cables_fig1_340787563)

# Subsea foundations are the base on which offshore turbines are mounted

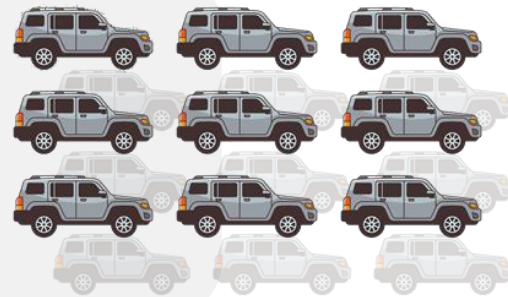


## One foundation...

weighs  
800 – 2,000  
metric tons



**900+**  
SUVs



stands tall at  
100 – 400 ft



**305 ft**

Statue of Liberty

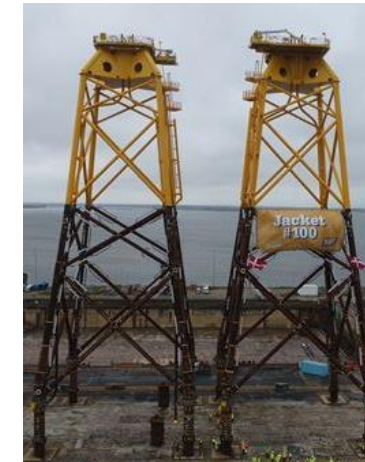


## Two major types of foundation designs

### Monopiles

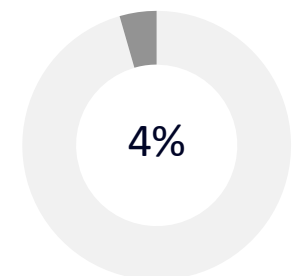
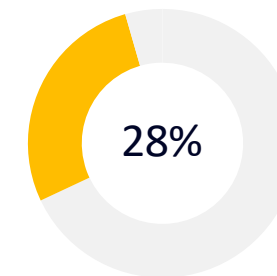
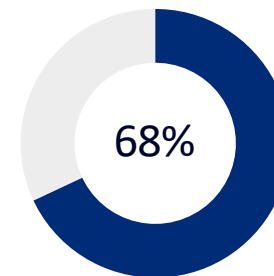


### Jackets



### Other

**5+**  
other  
types



Share of foundation type in wind farms installed since 2016

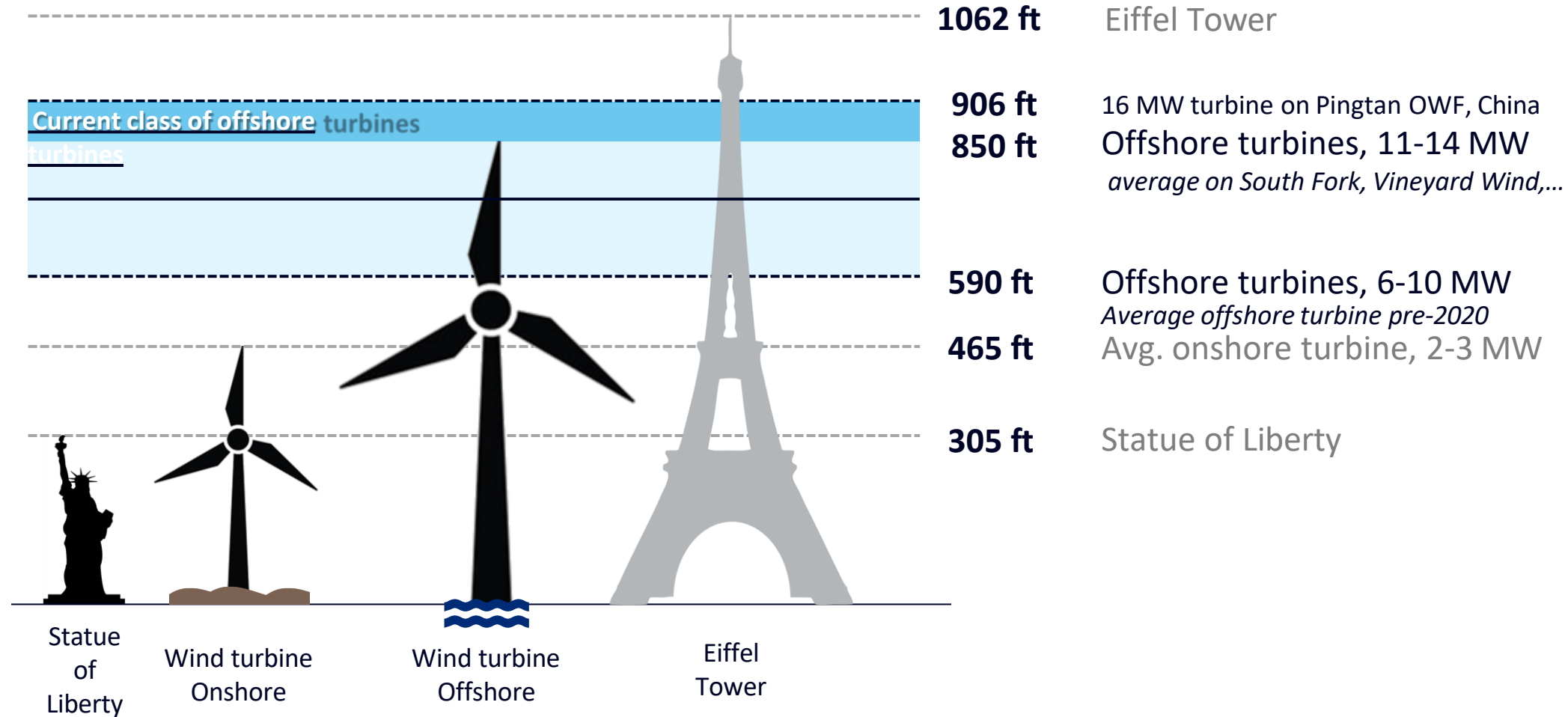
Excludes demonstrators, floating wind, and China



# Offshore Wind turbines are giant assets capable of producing immense electric power with each turn



Next-generation turbines currently being installed offshore US can rise above 800 feet



# Export Cables



Export cables are used to connect the offshore wind farms to land, to transport power to the mainland grid. These cables are laid on the under the sea and have to be well-protected and sturdy enough to withstand any environmental conditions for 25 years, or longer.

**2**

min. export  
cables per project

Length of each export cable ranges from

**12 - 100 miles**

depending on wind farm location

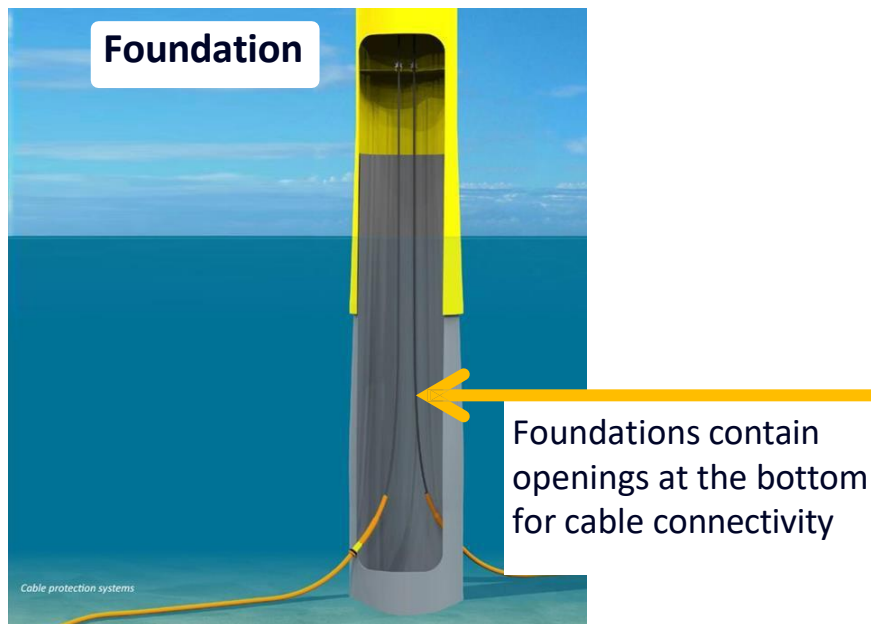


# Inter-Array Cables



An inter-array cable in offshore wind farms is a submerged electrical cable that connects individual wind turbines to each other and to the offshore substation, facilitating the transmission of generated power and ensuring grid integration within the wind farm.

- Length of each section being around 1-2 miles – depending on the distance between two turbines or a turbine and a substation
- Cables a cut between each two section of turbines



# Construction of an offshore wind farm can take more than 10,000 days' worth of vessel work (1/2)

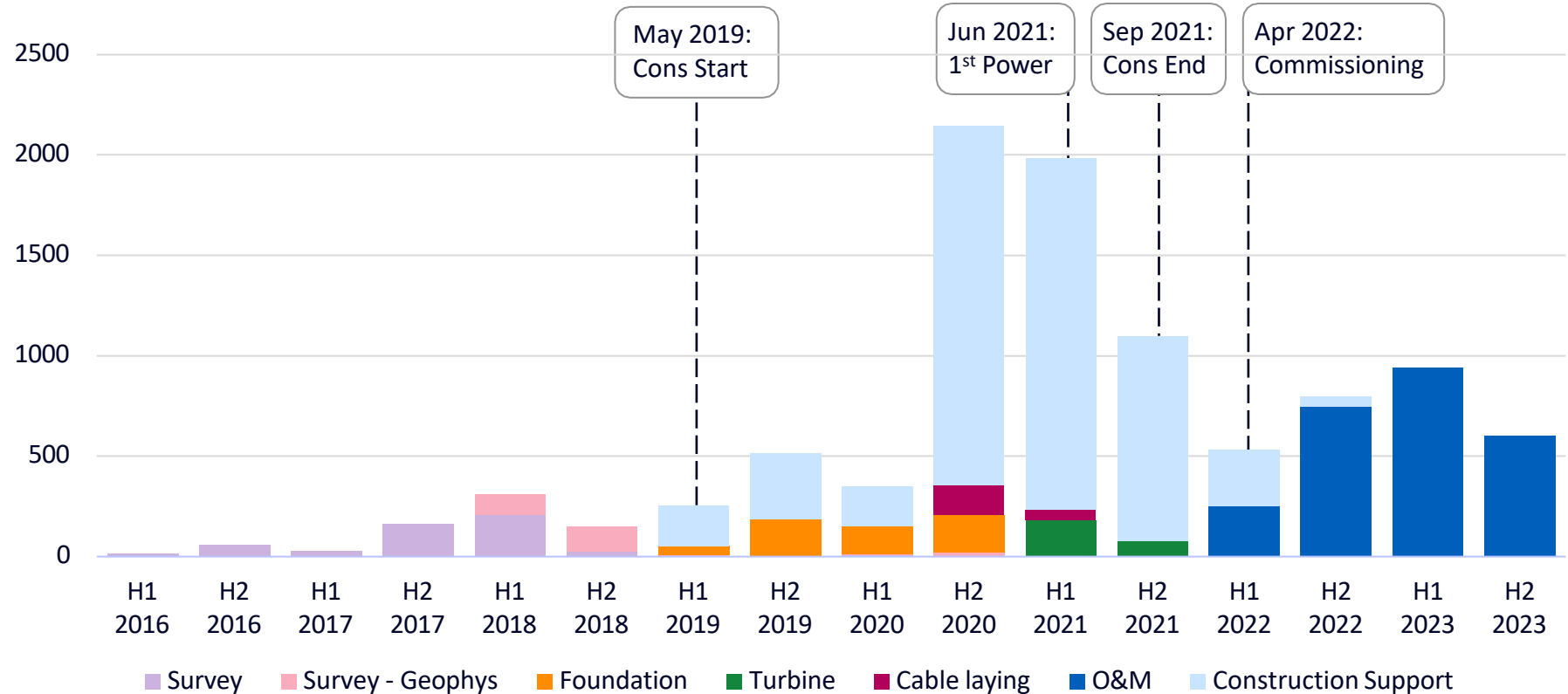


**Moray East**  
Offshore Wind farm

Capacity  
**950 MW**

**100**  
turbines

Operational since  
**April 2022**

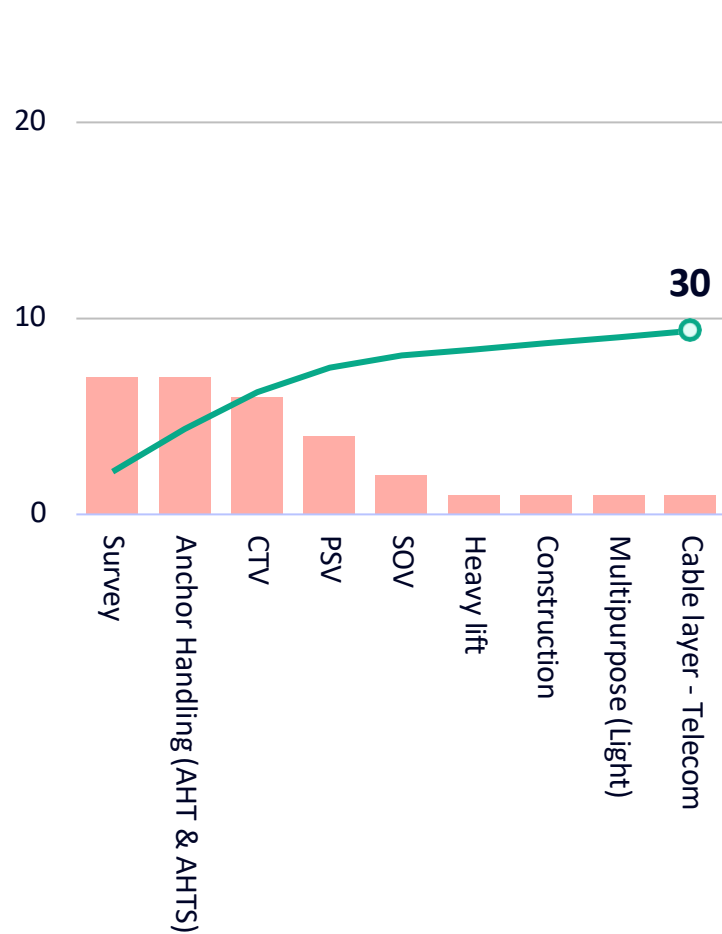


# ...employing 70+ vessels, across dozens of vessel types (2/2)



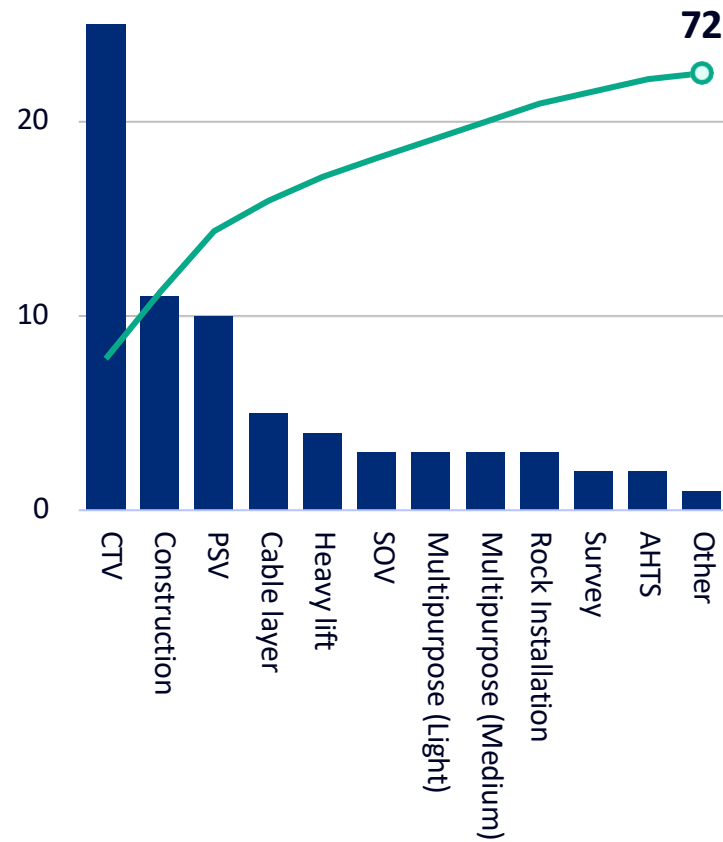
## Pre-construction Phase

Moray East OWF | Feb 2016 – Apr 2019



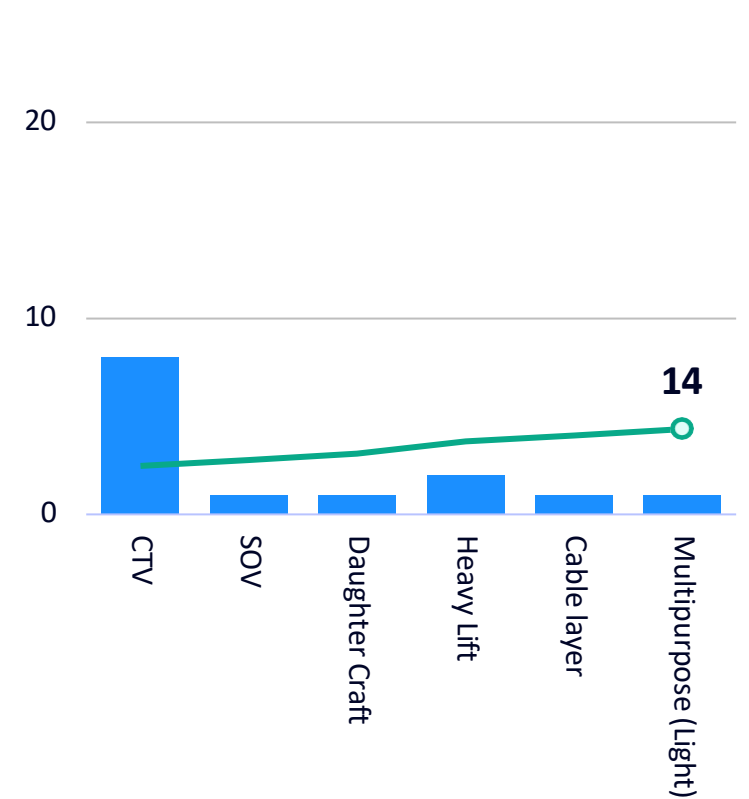
## Construction Phase

Moray East OWF | May 2019 – Mar 2022



## O&M Phase – 1 year

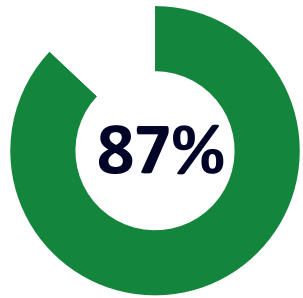
Moray East OWF | Apr 2022 – Apr 2023



# Heavy Lift Jackups, aka WTIVs, primarily used to perform turbine installations



## Wind Turbine Installation Vessel (WTIV)



of turbines installed  
since 2016



of foundations  
installed since 2016

Length

**400 – 600 feet**

Weight

**8,000 – 30,000 tonnes**



# Heavy Lift Floaters is another set of vessels primarily engaged in the installation of foundations

## Foundation Installation Vessels (or Floaters)



of turbines installed since 2016

of foundations installed since 2016

Length

**Above 650 feet**

Weight

**150,000 – 200,000 tonnes**



# Cable laying vessels often transport and install the subsea cables



## Double the job: Transporting & Installing

Unlike their heavy lift counterparts, cable laying vessels (CLVs) participate in both the supply of the subsea cables and their installation. This is because subsea cables generally require specialty equipment for loading, storage, & unloading – which is generally missing from cargo carriers.

## Not just offshore wind cables

Laying subsea cables goes beyond the scope of just offshore wind projects, as many regions are now developing subsea interconnection networks – for next-generation grid connectivity and power exchange. CLVs are essential in installing these large scale cable interconnector networks.





# **US Offshore Wind: Major Considerations**

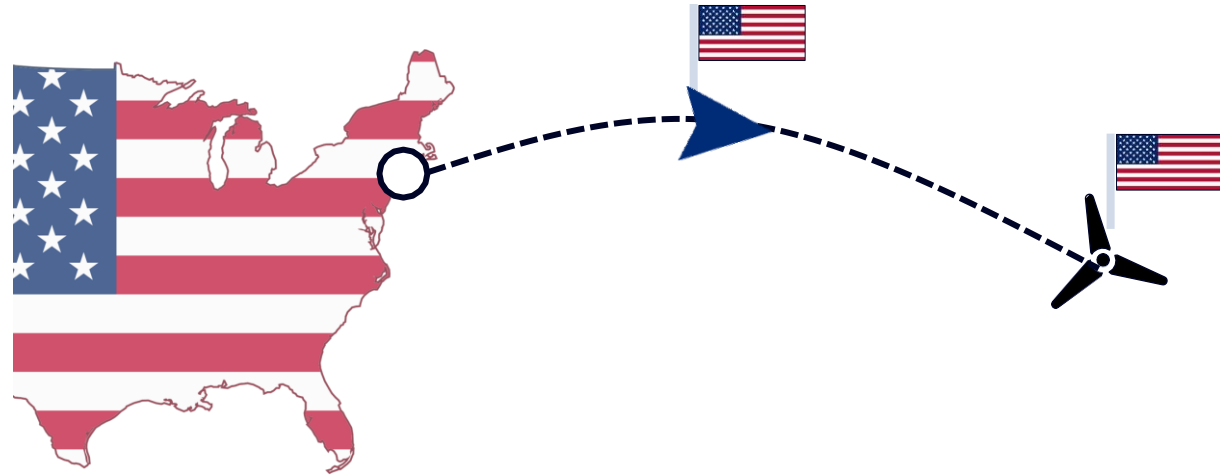
A faint, light blue line-art illustration of offshore wind turbines and their foundations is visible in the background. The turbines are positioned in the upper right, and their foundations, which are arched structures, extend across the bottom of the page.

# Understanding the Jones Act



## Fundamentals of the Act

- The Merchant Marine Act of 1920, aka the Jones Act, is a federal US Law
  - The law requires that vessels transporting merchandise between two US “points” – US flagged.
- 
- **A US-flagged vessel is**
    - ✓ built in the US,
    - ✓ registered in the US, and
    - ✓ primarily crewed by American citizens or residents
- 
- **A US point includes**
    - ✓ a US port
    - ✓ a wind turbine on US waters
    - ✓ a vessel fixed on US seabed



## Challenges & Opportunity for the US Offshore Wind Industry

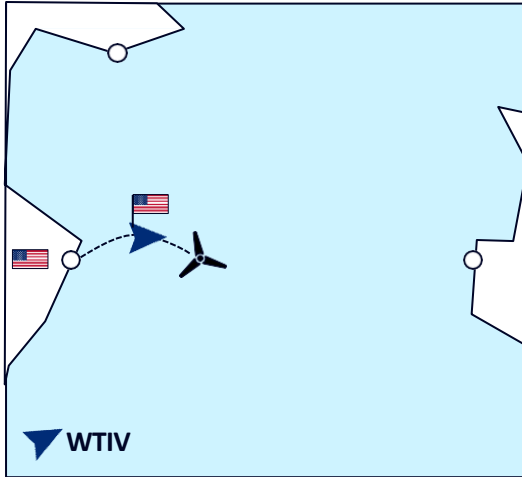
Currently, there are **no US-flagged vessels available** to perform installations of offshore wind turbines, foundations and substations.

**Cable-laying vessels are exempt** from the Jones Act, as per the most recent interpretation issued by the U.S. Customs and Border Protection in 2021

# Major ways to perform offshore wind installations in the US



## 1. Jones Act Compliant WTIV

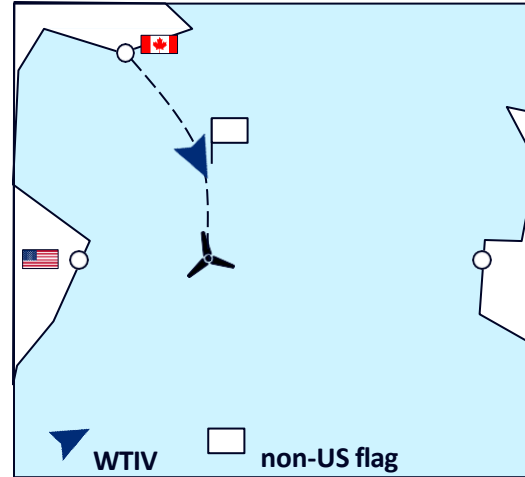


Using US-flagged WTIVs, the first of which will be delivered mid-2024, and booked till Q4 2025



Capacity slowly ramping up from zero vessels today to <5 by 2030. **Unscalable** to serve the demand.

## 2. Canadian Ports

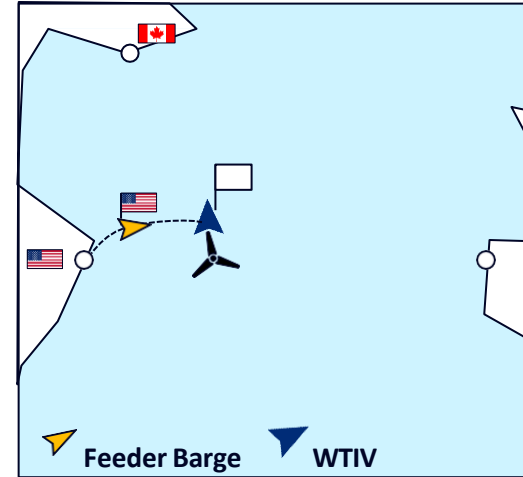


Canadian ports such as Halifax, & soon Argentia, can be used as Marshalling ports to get around Jones Act.



As project sites move southwards, this method **can become prohibitively expensive.**

## 3. US-flagged Feeder barges

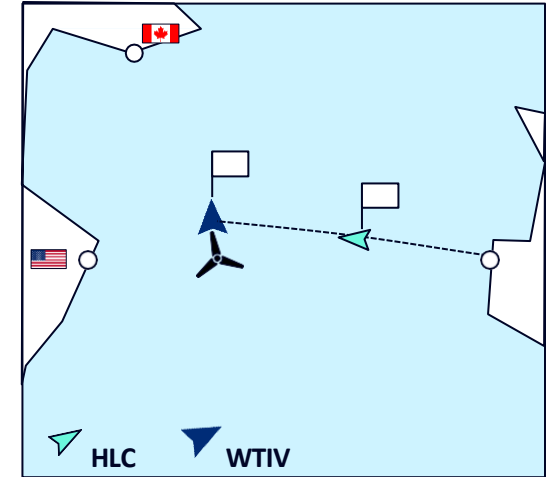


US-flagged feeder barges can be used to transport components to the WTIVs stationed directly at wind farm site.



Barge berthing issues with JUs need to be solved. **Potential to serve majority of the demand.**

## 4. Feeder with HLCs



Cargo vessels can be used to bring components directly from Europe to the wind farm site.



Significant transit distance, will need precise time coordination.

# The 132-MW South Fork wind project is one of the first two commercial scale wind projects in the US

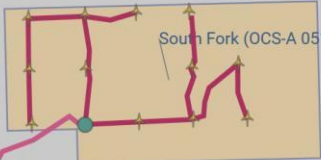


Case Study



Developed by  	Capacity <b>132 MW</b>	Turbines <b>12 x 11 MW</b>	Foundations <b>Monopile</b>	Expected Commissioning <b>Summer 2024</b>
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**South Fork Wind** | Powered by Ørsted & Eversource



South Fork (OCS-A 0517) (Orsted JV Eversource)

Distance to shore	<b>26 km</b>
Surface area	<b>55 km<sup>2</sup></b>
Water Depth	<b>29 - 44 m</b>

## Timeline: A long road to development



## Key facts

The seabed lease area under South Fork was the **first ever renewable energy lease auction** held by BOEM

It is expected to be the **first commercial-scale** operational offshore wind farm in the US

It is also the **smallest US project** under development, with total capacity less than 20% of the average US project in the pipeline

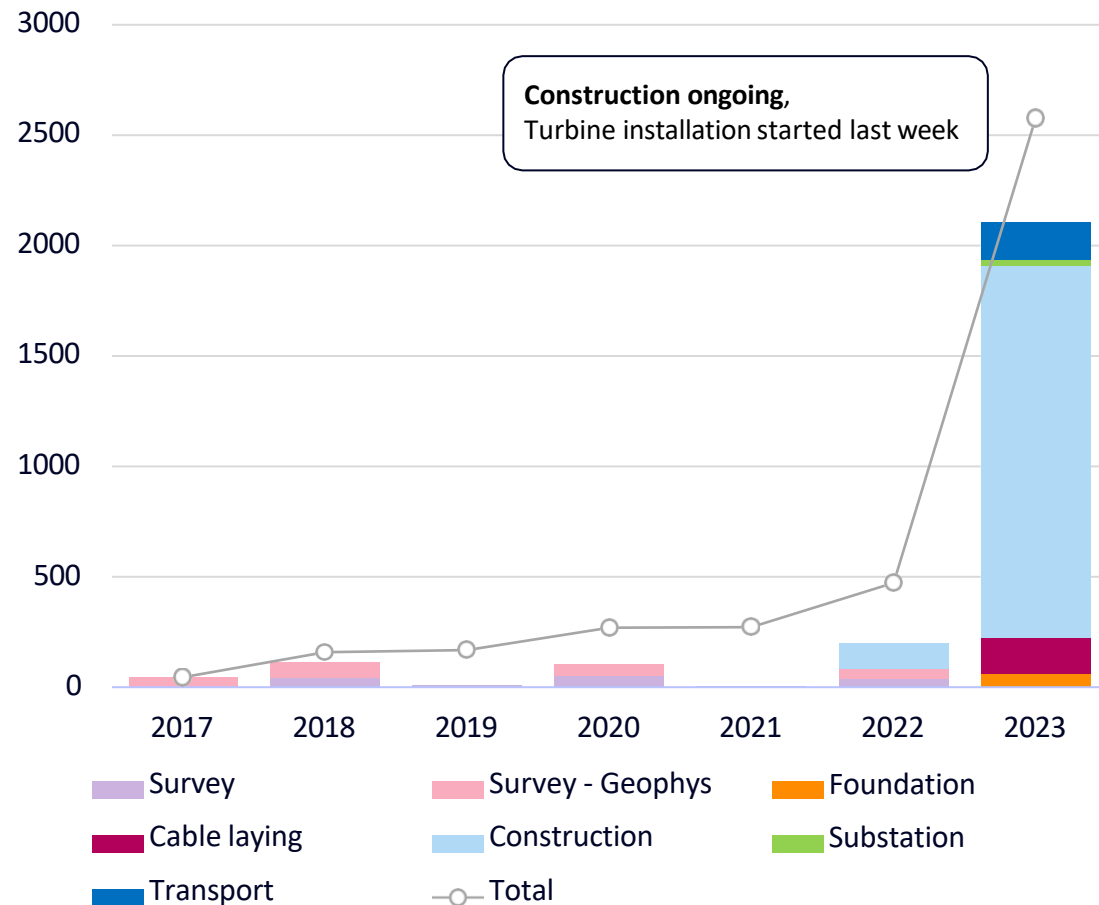
# Construction of South Fork is already amounting to significant vessel work



Case Study

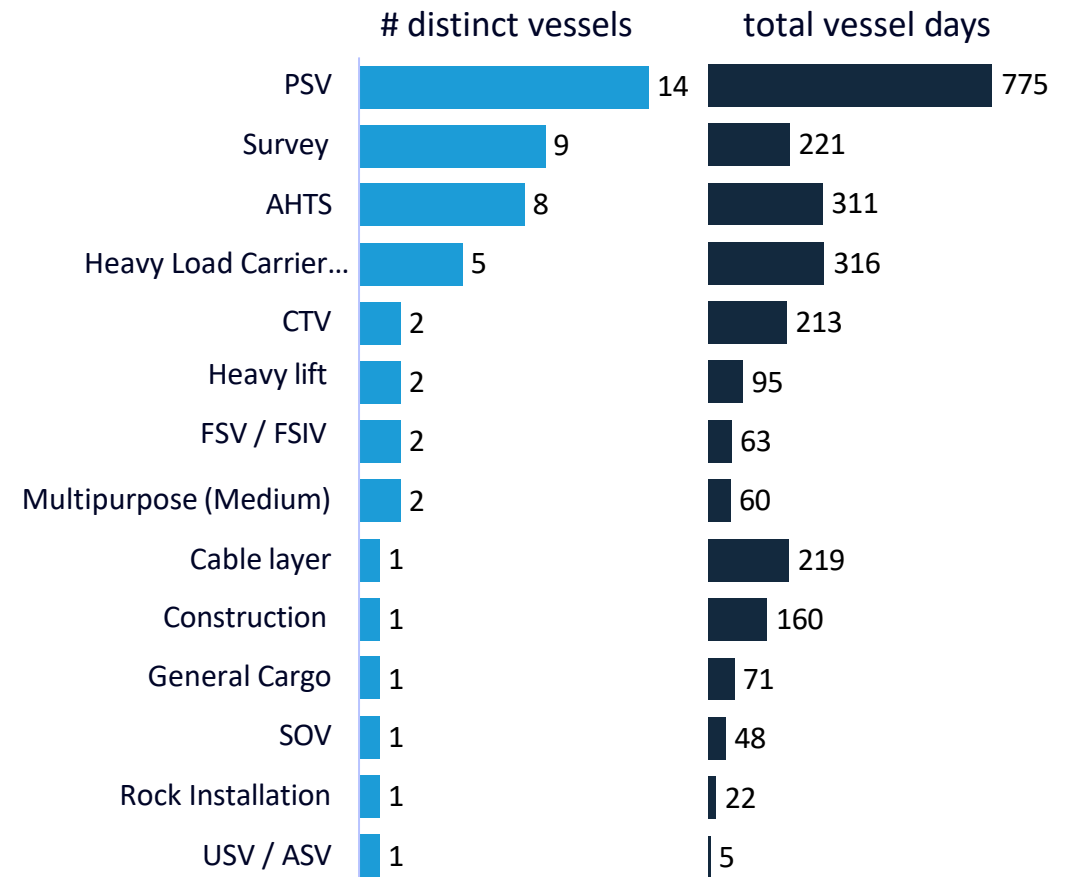
## The project has so far contracted 2,500+ days of vessel work

Number of vessel days | by workpackage | 2017 – 2023 ytd



## Employing 50 vessels across 15 distinct categories

Number of vessels and vessel days | by vessel type | 2017 to 2023 ytd



# The project is using feedering assemblies to perform Jones Act compliant installations



Case Study

## Component Installation & Major Vessels

### Foundations & Substation | June – August 2023

- Installed by Heavy Lift Floater, BOKALIFT 2
- The campaign used the Feeding methodology #4, using three Heavy Load Carriers to feed foundation components directly from the manufacturing site located in Germany

### Cables | February – September 2023

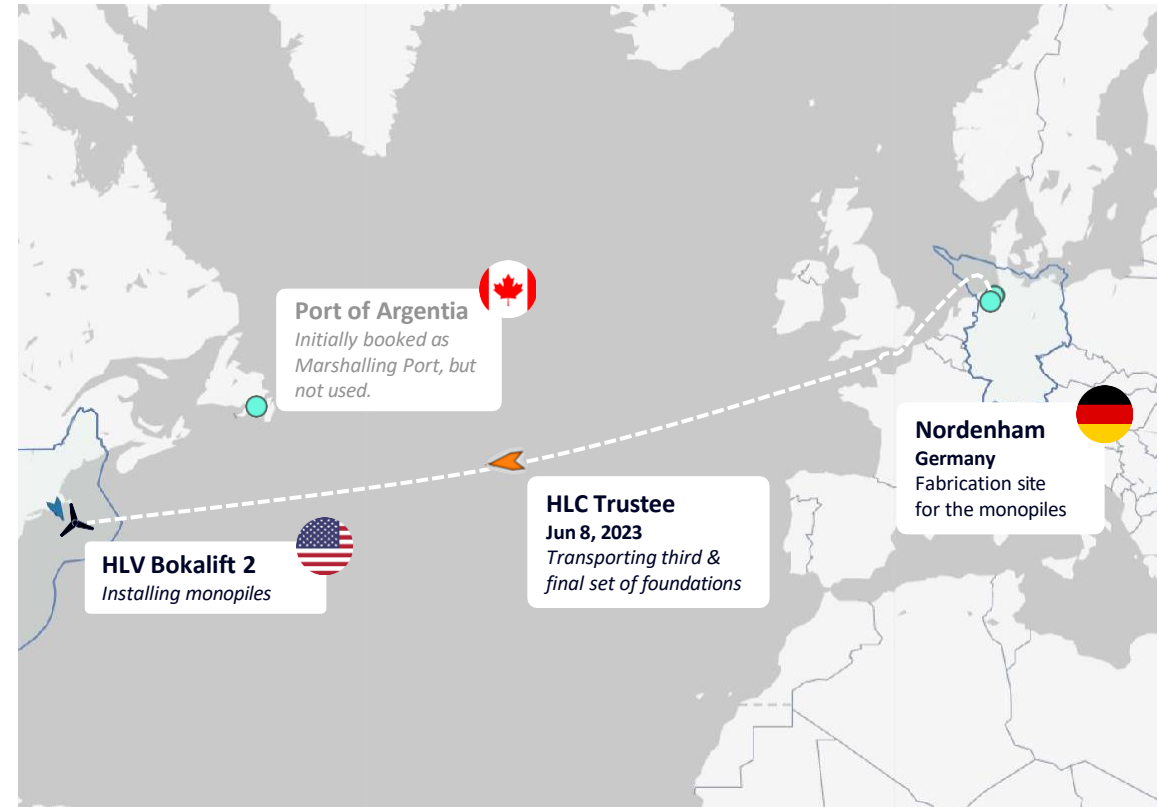
- Installed by Cable Laying Vessel LIVING STONE
- Export cable installation started in Feb 2023, and lasted till end of July 2023. Array cable laying work started after foundations were installed and finished mid-September.

### Turbines | November – December 2023 (expected)

- Installation ongoing by Heavy Lift Jackup, AEOLUS
- The campaign is using Feeding methodology #3 – using speciality barges to transport turbines from the State Pier, New London port to the vessel stationed at the wind farm

## Foundation installation on South Fork

Boskalis used HLCs to feed monopiles directly from fabrication site, [bypassing need for Marshalling Port](#)



# Conclusion

- Development of an Offshore Wind farm can take more than 10 years, from leasing of the seabed area to installation and commissioning of the project.
- Installation of major components of an offshore wind project can take up more than 10,000 days of vessel work, employ 50+ vessels across dozens of distinct categories
- Local protection requirements set forth by the Jones Act means creative solutions are needed to perform offshore wind installations
- This presents additional market development opportunity for local barges and vessel industries, along with port and other infrastructure development



# Thank You Questions?



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