Pentland Floating Offshore Wind Farm

Floating Steel Substructures at Scale - A developers view

Wednesday 18 September 2024, Marios Papalexandrou

PENTLAND FLOATING OFFSHORE WIND FARM

Copenhagen Infrastructure Partners and Copenhagen Offshore Partners

Copenhagen Offshore Partners (COP) work exclusively to develop Copenhagen Infrastructure Partners (CIP) offshore projects.

Copenhagen Infrastructure Partners (CIP)

CIP
Copenhagen Infrastructure Partners

- Founded in 2012, Copenhagen Infrastructure Partners P/S (CIP) today is the **world's largest dedicated fund manager within greenfield renewable energy investments** and a **global leader in offshore wind**.
- The funds managed by CIP focuses on investments in offshore and onshore wind **(circa 50 GW in development)**, solar PV, biomass and energy-from-waste, transmission and distribution, reserve capacity, storage, advanced bioenergy, and Power-to-X.
- CIP manages 12 funds and has to date raised approximately **EUR 28 billion** for investments in energy and associated infrastructure from more than 160 international institutional investors.

EUR ~28 billion AUM

+80 GW greenfield projects

Climate & ESG leader

Innovator & industry pioneer

Global organisation with local presence

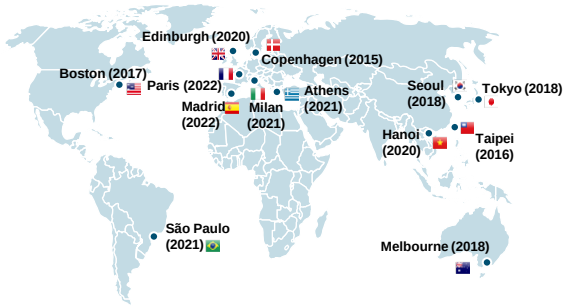
Integrated platform with large investment team

35+ greenfield CIP investments in utility-scale renewable energy infrastructure across all key markets and technologies

Copenhagen Offshore Partners (COP)

COP
COPENHAGEN OFFSHORE PARTNERS

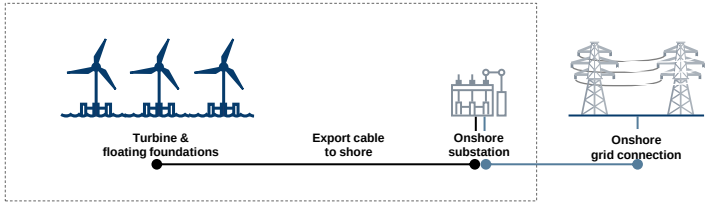
- Founded in 2015, **exclusive service provider to CIP**, responsible for all development, procurement and project delivery activities for CIP's offshore wind projects.
- COP's management team members, led by Henrik Scheinemann and Lars Thaaning Pedersen, **have an executive background** from offshore wind business.
- **400+ employees**, the majority of which have an engineering background and/or engineering management experience.
- COP has established offices in all countries above with the ability to provide strong local support to the projects.



Introduction to the Pentland Floating Offshore Wind Farm

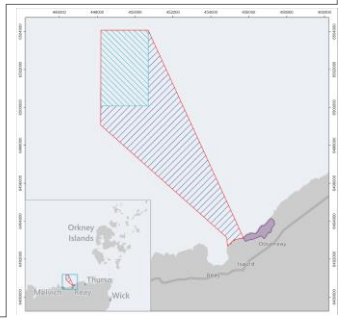
First floating offshore wind project in the CIP portfolio – deploying and demonstrating technologies that will enable industrialisation.

Overview of infrastructure assets and project location



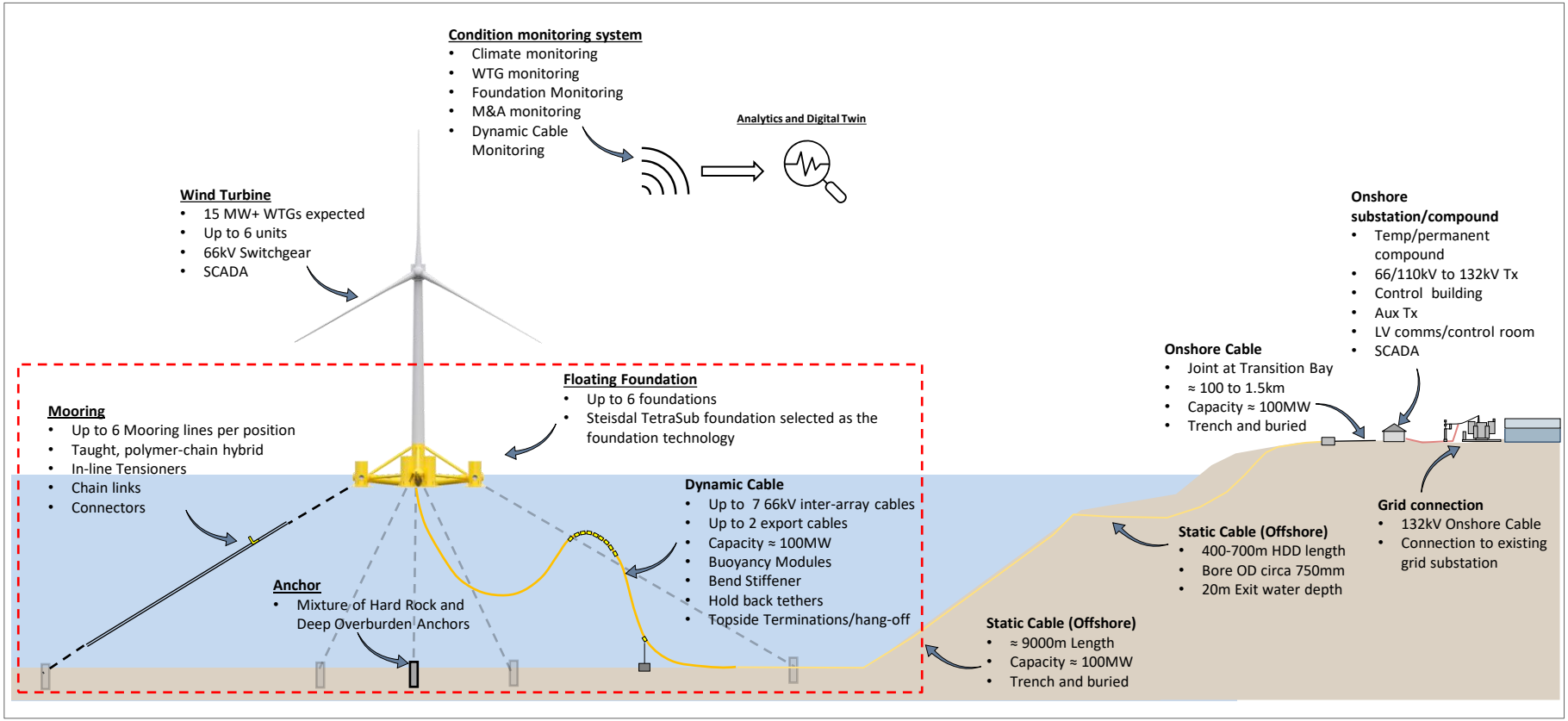
Key project facts

Background	• Advanced stage floating wind demonstration project up to 100 MW. • Objective to deploy technologies that will enable industrialisation in floating offshore wind. • Stiesdal offshore technologies Tetrasub technology selected.
Capacity	• 6 x WTGs up to total capacity of 100 MW.
Location	• Located 7.5 km off the coast of Dounreay, North Scotland. • Situated close to existing and planned transmission level grid infrastructure and with good access to suitable port facilities.
Site conditions	• The site area is ~10 km^2 • Wind speeds of ~10+m/s • Water depths of 75-101m LAT • FLiDAR campaign complete and Offshore Geophys/tech complete.
Lease, Consenting and Land	✓Lease option agreement secured with CES. ✓Offshore consent granted for 100MW with 25-yr operations. ✓Onshore consent granted in early 2023.
Grid capacity	✓Grid secured for up to 100 MW.



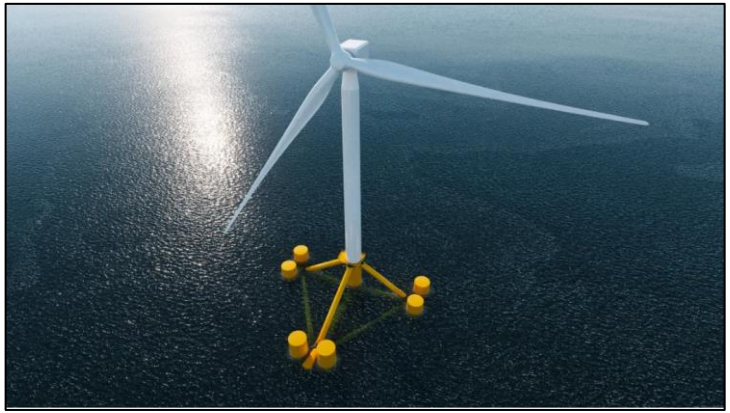
Project concept & scope overview

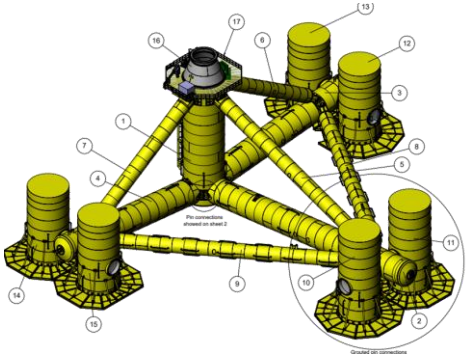
Overview of current design thinking, subject to refinement and finalisation.

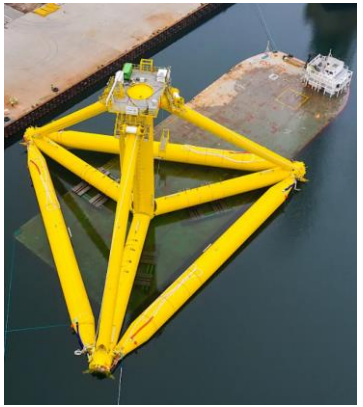


Stiesdal A/S TetraSub

Stiesdal A/S TetraSub, designed to take advantage of established tower manufacturing SC; building on experience gained from TetraSpar.







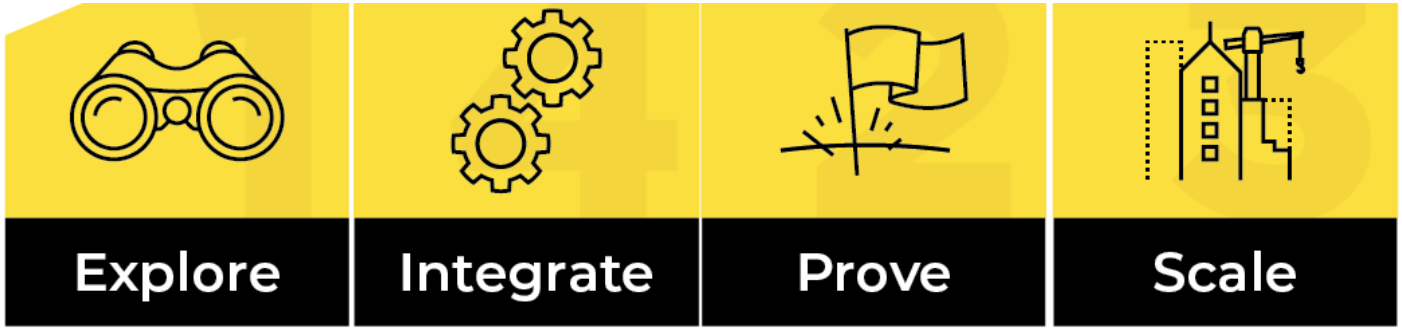
Some fundamental questions from developers

- What turbine can I install?
- Semisub, TLP or barge?
- Steel or concrete?
- To weld or not to weld?
- Taut, semi-taut or catenary mooring system?
- What anchor type?
- Does it make economic sense?

Before achieving industrialisation, design and fabrication maturity shall happen

- Qualification process for new designs/products shall be carefully considered in the project design timelines.
- Collaboration between WTG OEM, Floater designer, mooring designer and dynamic cable designer are key for a compliant design and a smooth design process.
- Strong engagement with supply chain to ensure design is easy to be fabricated, assembled and easy to be installed offshore.
- Engagement with MWS, insurers and technical advisors to ensure there are no red flags before moving to construction.

Target: Reduction of timelines and uncertainties for design to get it certified and for supply chain to fabricate, assemble it and install it at final location.
Getting a trusted, mature design easy to deploy at scale!



On our path to industrialisation: we should look at Fixed offshore wind

An efficient supply chain.

Design
Streamlined design process, well understood from designers and certifiers.

Experienced and efficient supply chain

- Contracts well developed and understood.
- Experienced players familiar with fabrication and installation process.
- Jack up vessels for construction and O&M.
- Crew transfer vessels and SOVs for construction, commissioning and O&M.

Marshalling

- Few WTG fabrication port hubs that can be supported by local hubs if required.
- Efficient ro-ro transport of WTG and foundation components

Efficient completion of work

- Timing for installation of WTG: approx. 1-3 days.
- Array cable installation and energisation can be independent of WTG installation
- Timing for WTG installation and commissioning of at least 1 week.
- Major component replacement can be sourced relatively easy with small jack up vessels available and work can be completed within a week.

Floating offshore wind – where we are now

A supply chain taking its first steps.

Design and Fabrication

Design process not well understood from designers and certifiers.

Supply chain experience not yet established for efficient operations

- Contract terms not clear/standard
- Ring cranes are scarce.
- Teams not experienced and familiar with installation processes – additionally, not yet streamlined technology design and processes.
- Mooring installation, tow, hook-up and cable installation not done in such scale before.
- Major interventions require tow to port.
- Weather limitations not well established and understood.

Marshalling

Few WTG Marshalling ports.

Completion of work non-optimal

- Timing for installation of WTG: approx. 1-2 weeks
- Array cable energised post WTG installation requiring diesel generators.
- Timing for WTG installation, tow out and commissioning of at least 1.5 months.
- Major component replacement needs tow to shore with costs prohibitive and similar to construction costs. Work will need minimum 2 months to complete.

Floating offshore wind – where we want to be

A matured and efficient supply chain.

Marshalling

- WTG Marshalling port hubs established with ring crane available that allow for WTGs ready for tow out every 3-5 days.

Efficient supply chain

- Standard contract terms and streamlined design processes
- Bespoke flexible vessels for hook up-and subsea installations. Weather limitations well established and understood.
- Teams experienced and familiar with installation process
- ROV remote operations efficient and well established.
- Major interventions in situ.

Efficient completion of work

- Timing for WTG installation at port: 1 day.
- Timing for installation, tow and hook up of WTG: <5 days.
- Array cable energised pre-WTG installation (fishbone set up)?
- Timing for WTG installation, tow out and commissioning in less than 3 weeks.
- Major component replacement at site with special crane vessels/special cranes attached to floater: Complete work within 1 week.