disrupting
offshore wind

From prototype
to commercial-scale

The PivotBuoy experience

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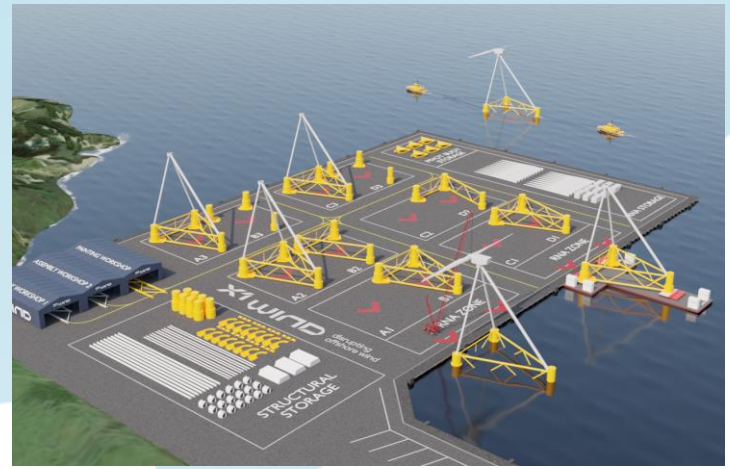
II Congreso Eólico Marino, 7-8 Noviembre 2023, Las Palmas de Gran Canaria

Our technology roadmap:

A stepped approach to de-risk and qualify the technology, ready for scaling-up and industrialization phase

Under preparation

Phase 4
From 2026



Large scale deployment
Commercial roll-out of fully industrialized product for large-scale commercial deployment

Current Focus

Phase 3
2022-2026

Pre-commercial phase
Focus on pre-commercial operation, industrialization & bankability to get ready for commercial phase.

Phase 2
2019-2023

Technology demo
Fully functional prototype with Vestas V29 exporting power in real sea conditions to PLOCAN

Phase 1
2018-2021

Validation in lab
Small scale validation & technology optimization

PivotBuoy Project:
Demonstration of the X30 platform in real sea conditions

PivotBuoy Project

- EC Grant Nº815159: 1st Apr 2019 – 31st Mar 2023
- 4M€ project with 9 European Partners
- PLOCAN test site (Canary Islands, Spain)
- X30 platform (1:3 scale fully operational)
- 50m water depth
- Vestas V29 + 20kV cable connection

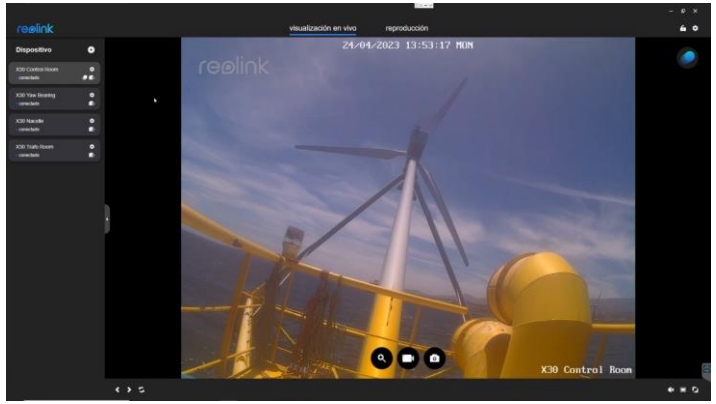
Project Partners

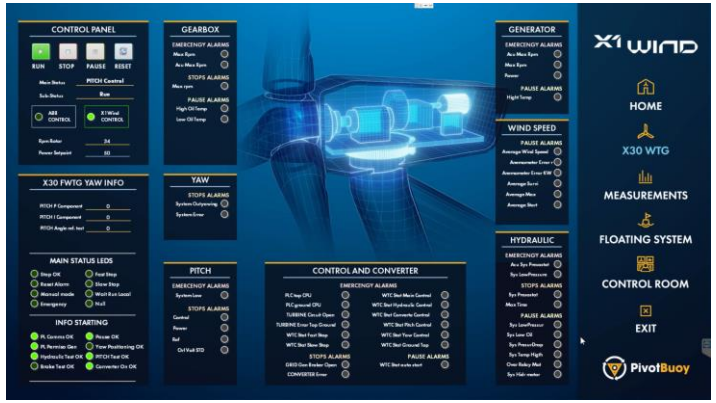
X1 WIND · edp · NEW ENERGY WORLD · DNV·GL · Worley energy | chemicals | resources · DEGIMA · ESM · DTU Technical University of Denmark · WavEC Offshore Renewables · PLOCAN Plataforma Oceánica de Canarias · Gobierno de Canarias

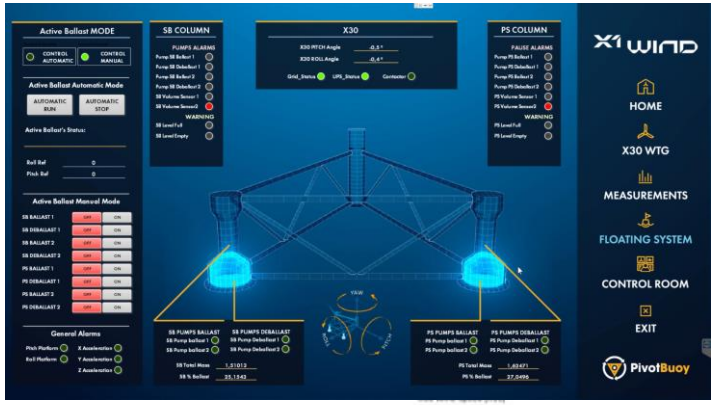
This project has received funding from the European Union's H2020 research and innovation programme under grant agreement Nº815159

Data shows excellent platform behaviour & self-alignment

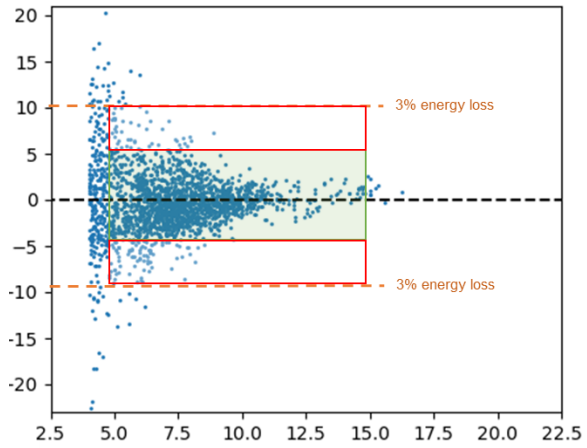
Real time data monitoring with **X1 FMS SCADA**



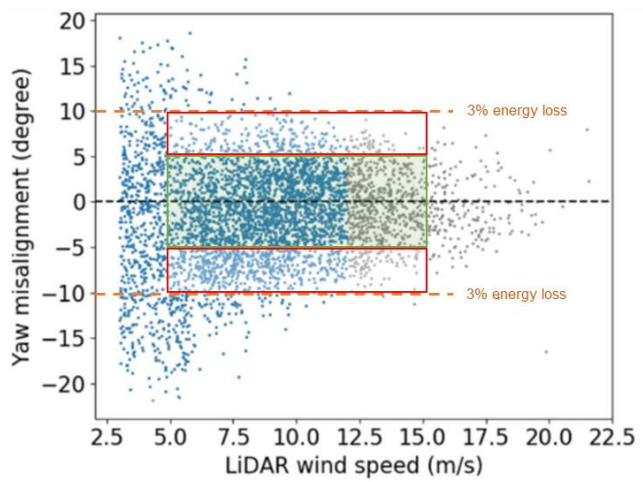




X30 misalignment distribution during with passive yaw (30 days)



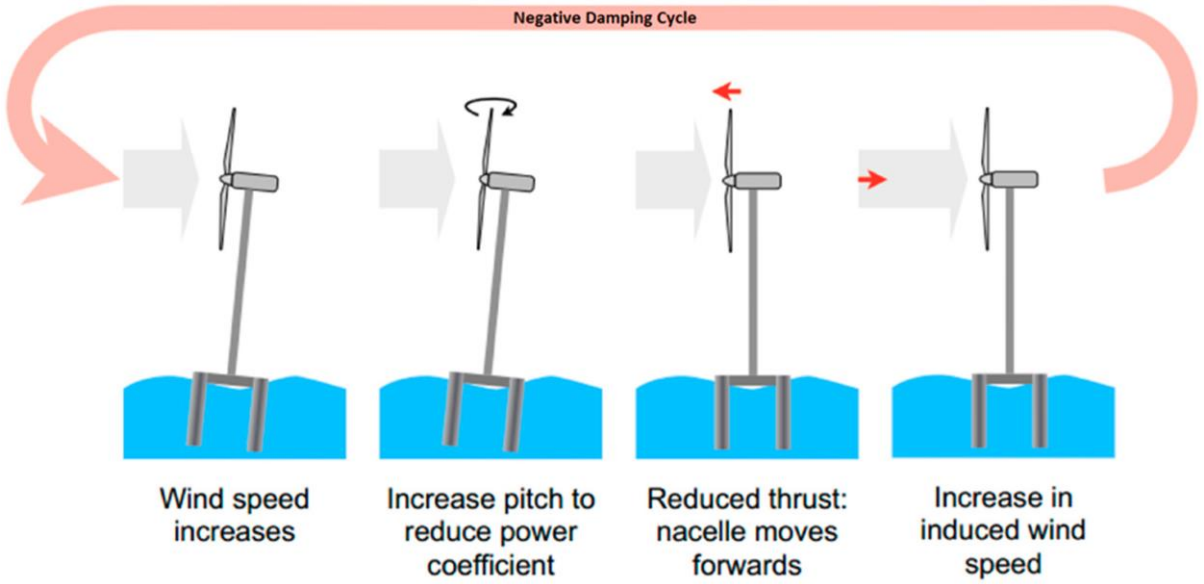
Misalignment for an upwind fixed turbine with active yaw control[1]



[1] (Senvion 3.2 MW) https://ventus.group/case-study/lidar-based-turbine-performance-verification-2

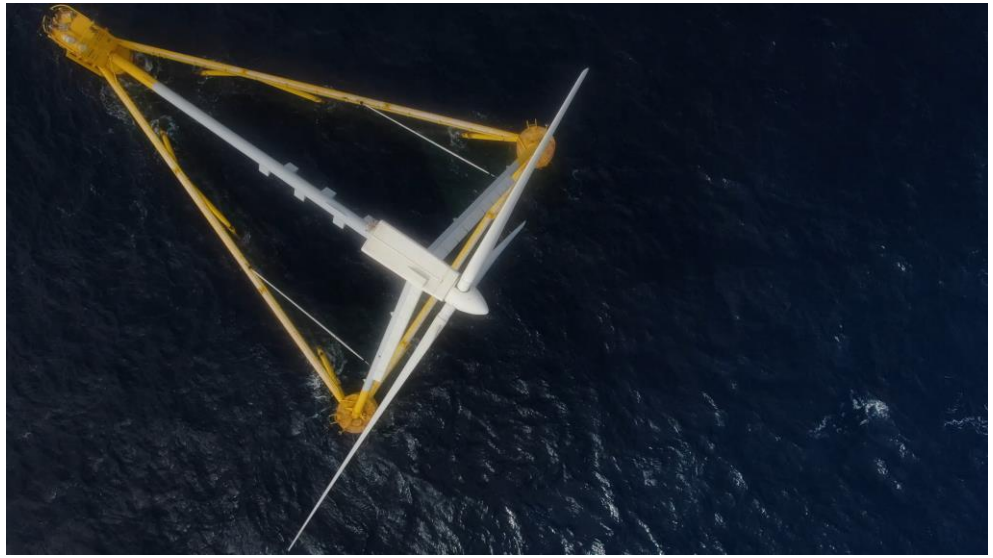
No adaptations in turbine control required during operation

- Current systems (except TLPs) need to adapt “fixed” turbine controls to wind-induced pitch motions (negative damping, inducing tower fatigue).
- Larger motions and excursions also induce fatigue on dynamic cable (except TLPs, but traditional TLPs imply very high mooring loads).



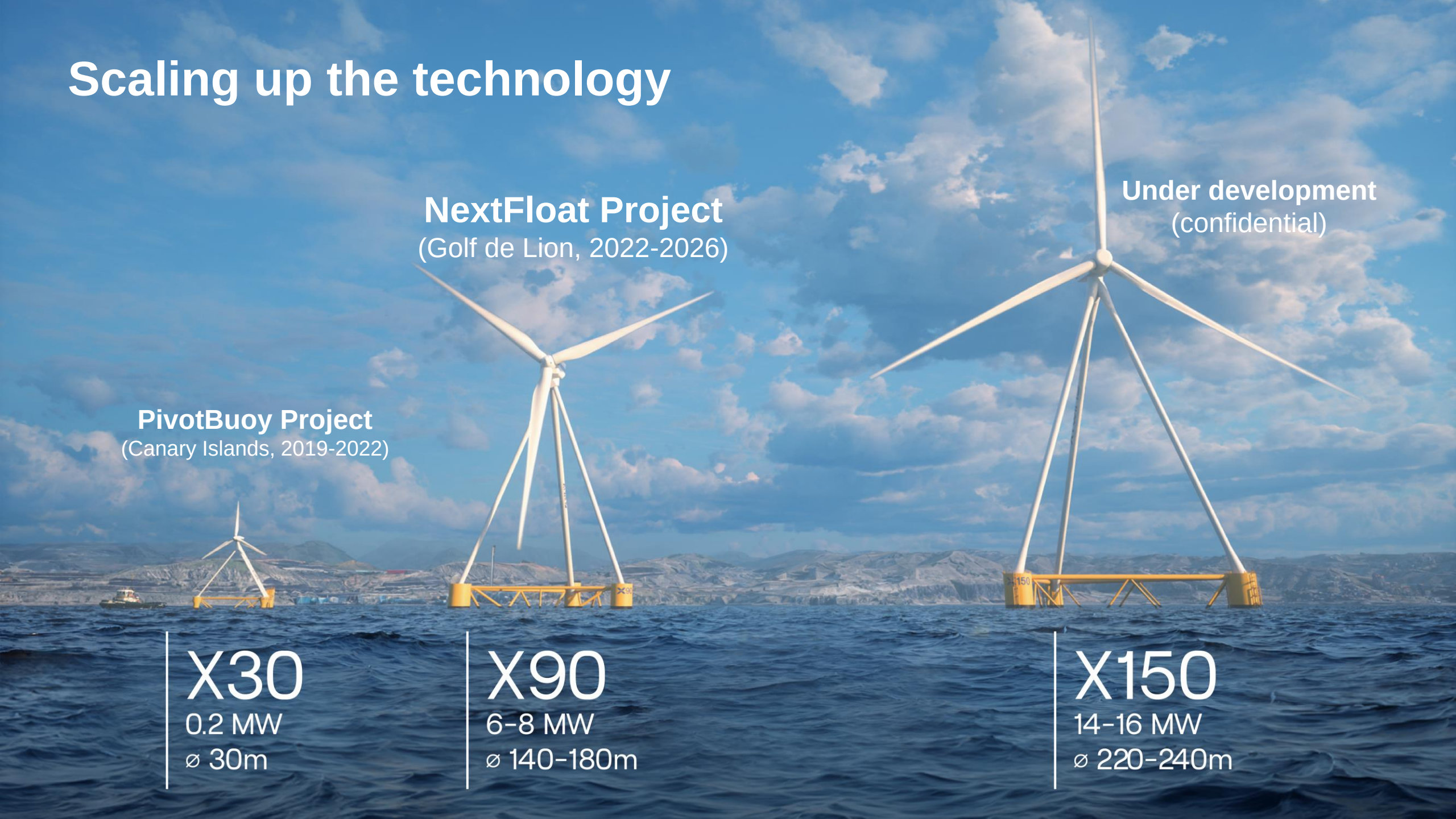
Source: https://doi.org/10.3390/en12101897

- X1 Wind TLP + SPM mooring, does not induce negative damping (allowing use of “fixed” controller).
- TLP and elastic coupling also reduce loads on dynamic cable (compared to catenary systems) and on tendons by at least 50% (compared to traditional TLP)



See X1Wind in operation in storm conditions, using the existing Vestas V29 “fixed” controller.

Scaling up the technology



PivotBuoy Project
(Canary Islands, 2019-2022)

NextFloat Project
(Golf de Lion, 2022-2026)

Under development
(confidential)

X30
0.2 MW
⌀ 30m

X90
6-8 MW
⌀ 140-180m

X150
14-16 MW
⌀ 220-240m

The NextFloat Project

Focus on industrialization and scaling-up to 20MW+

Deploy and test the X90 6MW floating unit

- Design for 20+ years lifetime, fabrication, transport and installation
- Testing period within EU project
- Pre-commercial operation >8 years through SPV

Focus: scale-up, industrialization & bankability

- Scaling up to 15MW & 20MW+ designs
- Fabrication, assembly and T&I optimization towards industrialization

Project consortium:

T.EN TECHNIP ENERGIES

X1 WIND

Naturgy

DTU

CENTRALE NANTES

2BENERGY

SCHWARTZ HAUTMONT CONSTRUCCIONES METALICAS, S.A.

Hydro

Cocas

Ocean Ecostructures

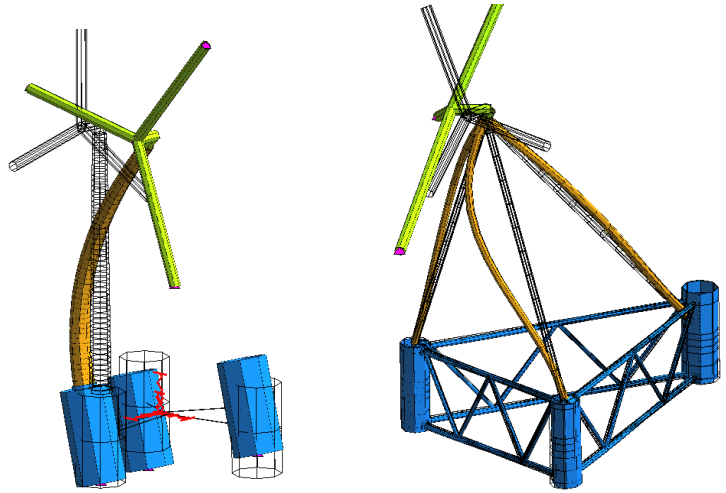
Tersan SHIPYARD

HELLENIC CABLES

Improved upscaling to 15-20MW+: its stiffer tripod configuration enables lower weight of the nacelle support structure

1. The small natural period (higher frequency) of the tripod-tower allows it stay further away from the 3P excitation range of the turbine, compared to traditional single tubular towers.

2. The period of the tripod-tower is not significantly affected by the upscaling of the floating substructure, hence allowing for an easier design integration between the substructure and tower



Weight Comparison		**6 MW**	**15 MW**	**20 MW**
RNA weight	t	370	800	1 250
Tower weight	t	320	1 215	1 880
Tripod weight	t	350	830	1 140

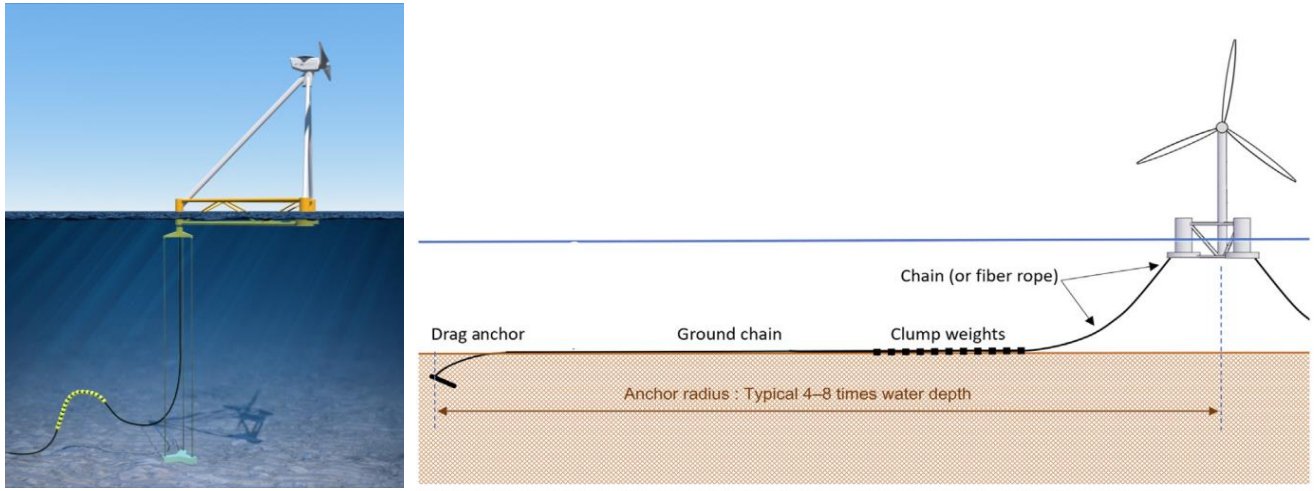
Table 12: Weight according to turbine power.

40% weight reduction compared to traditional tower for 20 MW design

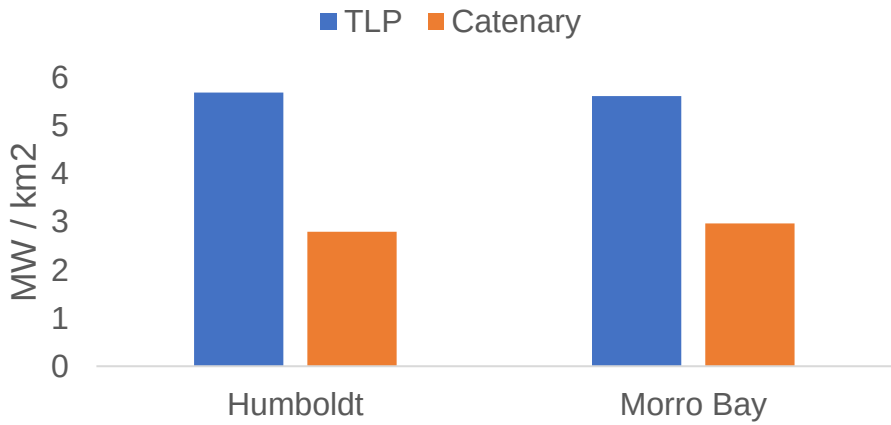
Results from joint OSES paper (Marc Cahay, TEN, 2023)

Improved scalability at farm level: TLP allows install more units per for the same area, specially when moving to deeper waters

X1 Wind's has demonstrated world's first fully functional TLP (TLP reduces dramatically mooring footprint compared to catenary)

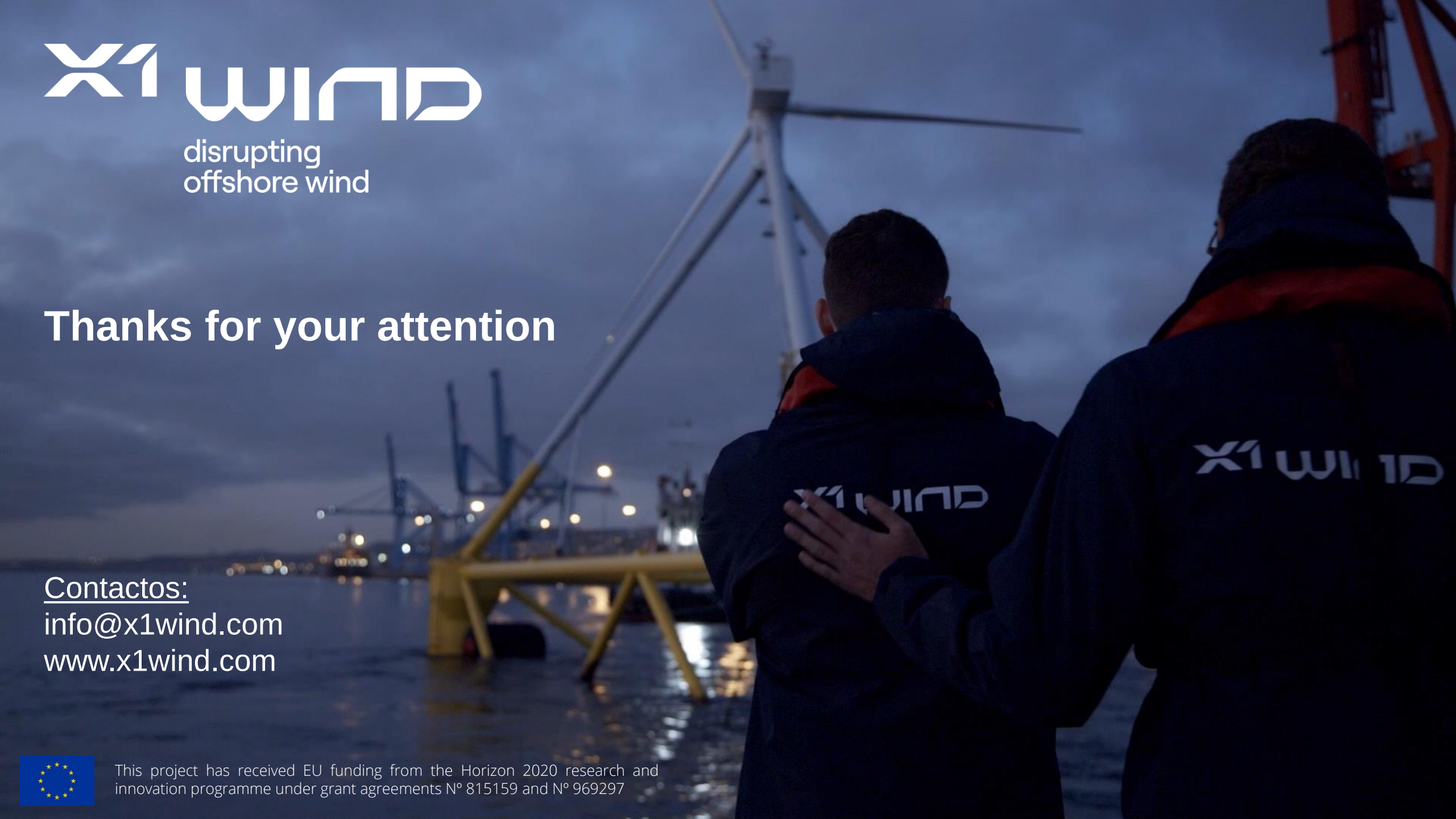


NREL study[1] shows that the capacity density (MW/km^2) for the same area in California doubles with TLP



Other NREL study[2] also significant improvement in farm yield when using downwind turbines with negative tilt angles

1. NREL, Assessment of Offshore Wind Energy Leasing Areas for Humboldt and Morro Bay Wind Energy Areas, California, https://www.nrel.gov/docs/fy22osti/82341.pdf
2. Advanced Techno-Economic Analysis of Highly Flexible Wind Turbine Rotors, NREL 2022



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