



Energy Competence Center

Applied Innovation in Energy

Project FLOWIND

Spyros Voutsinas



ECC: MULTI-SHAREHOLDER, MULTI-SECTOR



συγκοινωνίες
αθηνών
ΟΑΣΑ Α.Ε.



- 4 RTO
- 3 Energy
- 3 Shipping
- 1 Water/Wastewater
- 1 Transport
- 1 Local Authority

PRIVATE SECTOR

PUBLIC SECTOR CONTROLLED



ABOUT US

FLOWIND is one of ECC's projects, dedicated to **off-shore wind energy with a focus on floating systems.**

Contributors in **FLOWIND's** are:

Hydrus Engineering from the private sector

The **National Observatory of Athens,**

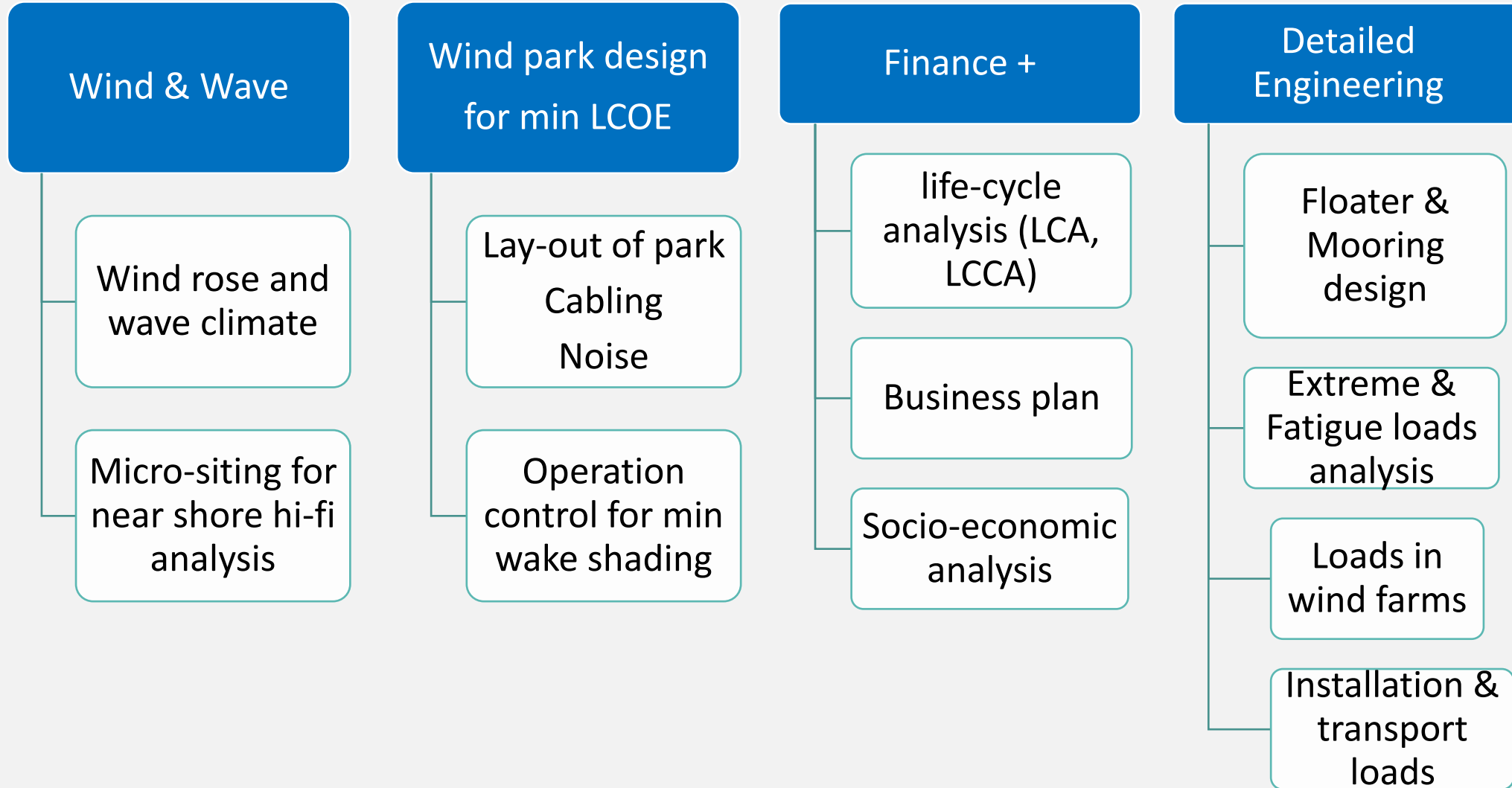
The **University of Western Macedonia** and

The **National Technical University of Athens** from the research world

With partial funding by the General Secretariate of Research and Innovation

AT A GLANCE

Services & solutions



HIGHLIGHTS



We show,

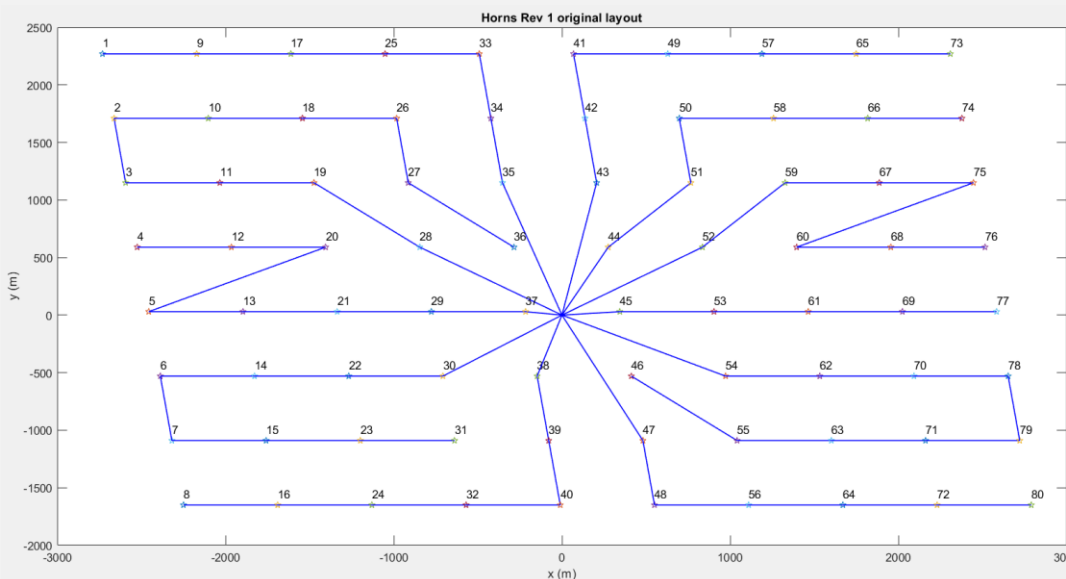
1. The re-design of the Horn-Rev I wind park that
lowers the LCOE
2. Recent benchmarking of our floater design tool (2023) showing
predictions of high quality and accuracy in extreme wave conditions
3. Hi-Fi aeroelastic modelling of WTs in turbulent wind based on LES-CFD that
offers higher confidence in the prediction of loads

1 WIND PARK DESIGN

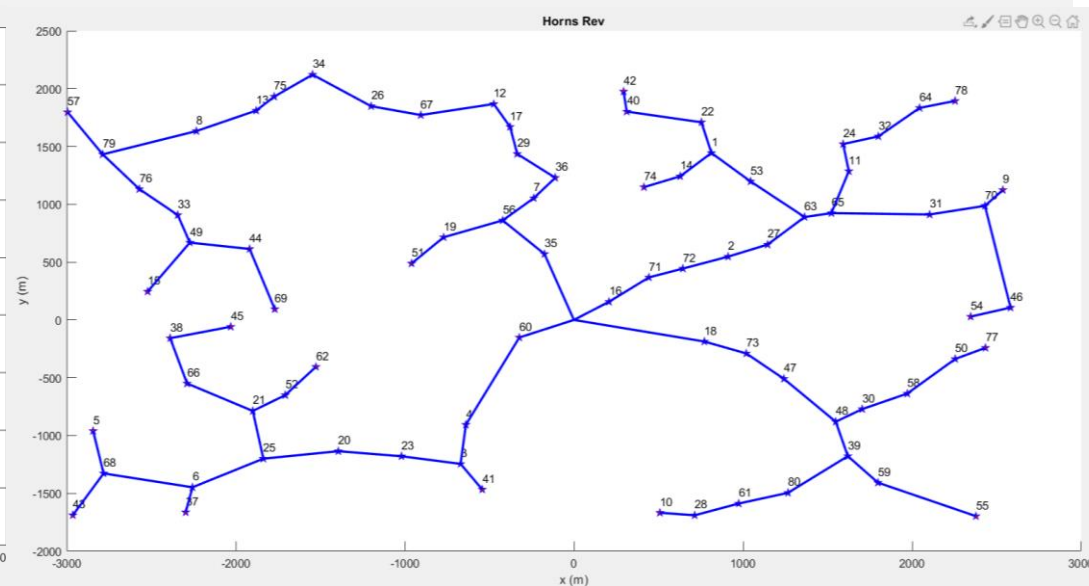
Application: Horns Rev I

The number of WTs and the installation area are fixed so the design optimization aims at **lower LCOE** including fatigue issues due to shading and the cabling

Original layout



Optimal lay-out

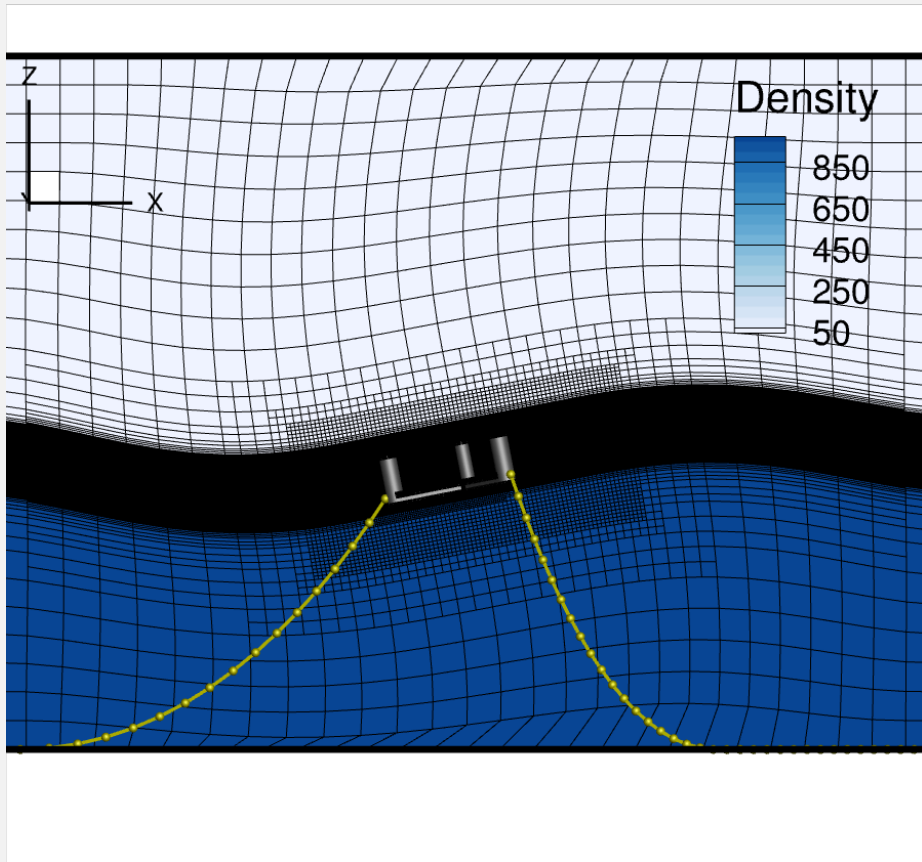


Application: Horns Rev I

	Horns rev initial	Horns rev intermediate	FLOWIND optimized	
CF	0.5756	0.5756	0.5769	
AEP (kWh)	8.0671 E+8	8.0671 E+8	8.086 2 E+8	← 0,2%
Cable length (km)	50.541	44.400	27.546	
Capex €	2.0102 E+8	1.9856 E+8	1.9182 E+8	← -5%
LCOE €	0.056725	0.056459	0.055682	← -2%
Max mean TIA	0.07409	0.07409	0.08014	
Mean mean TIA	0.05950	0.05950	0.06097	
Stdv mean TIA	0.00710	0.00710	0.00831	
Cable cost/CAPEX	10.06%	8.94%	5.74%	← -50%

2 FLOATER DESIGN

Validation: Response to extreme waves

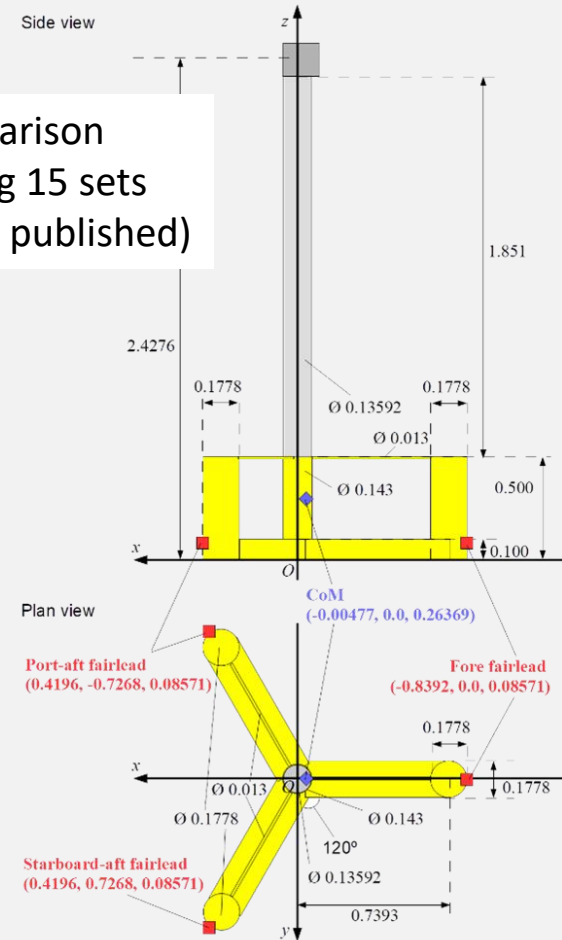


3-dimensional CFD simulation using MaPFlow (two-phase flow solver including air & sea)



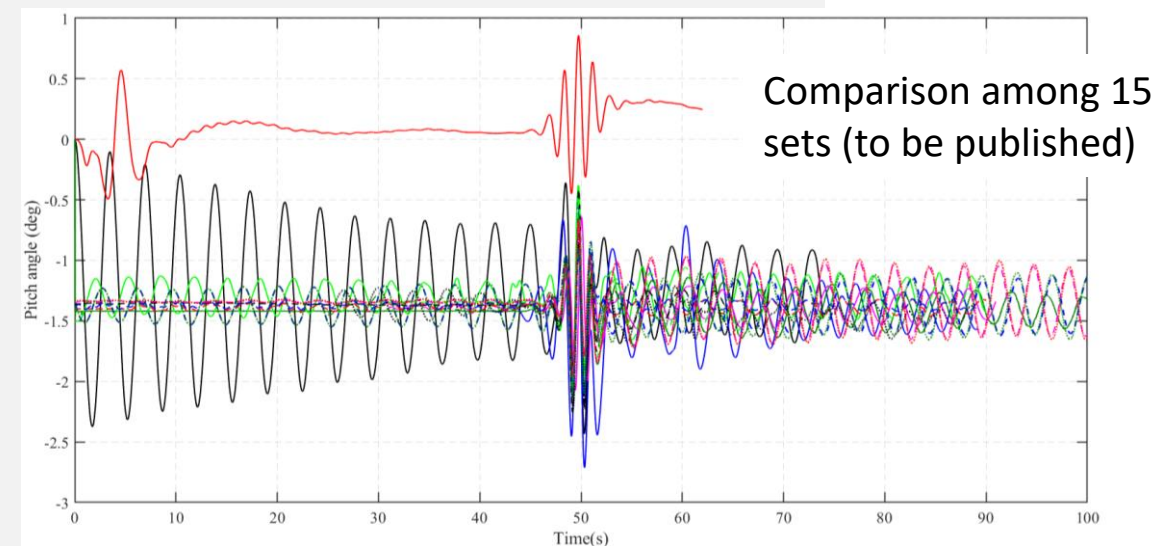
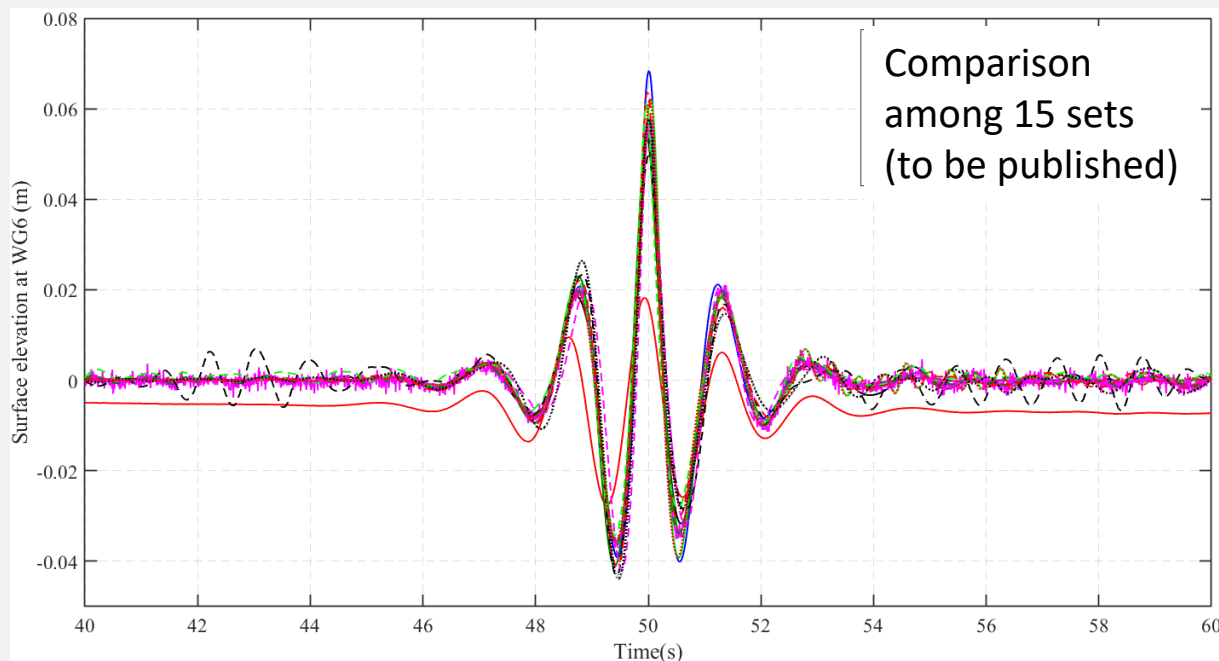
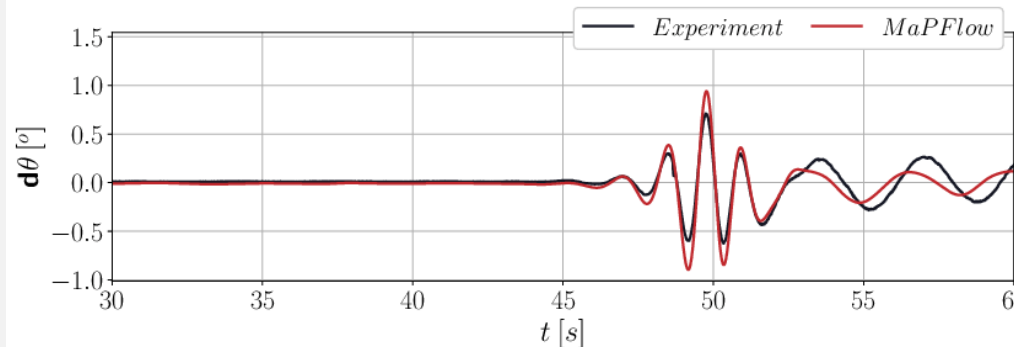
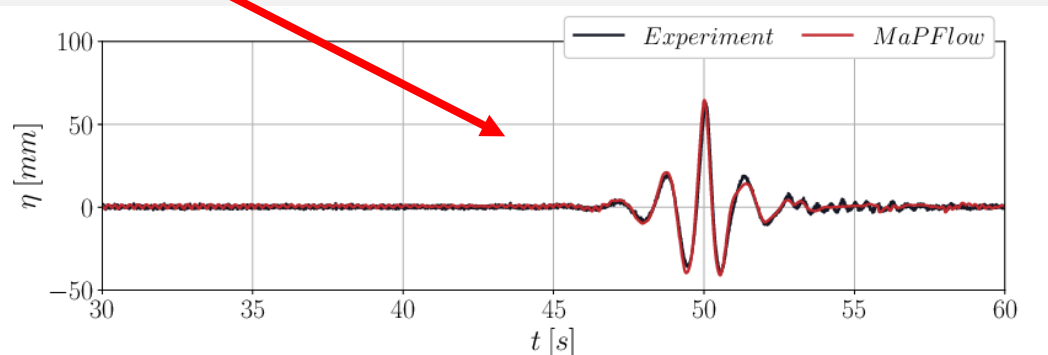
IEA 15MW Floater testing (U Plymouth 2022)

Comparison among 15 sets (to be published)



NOTE: All dimensions in metres

Validation: Response to extreme waves



Free surface elevation close to the floater

Floater pitch response

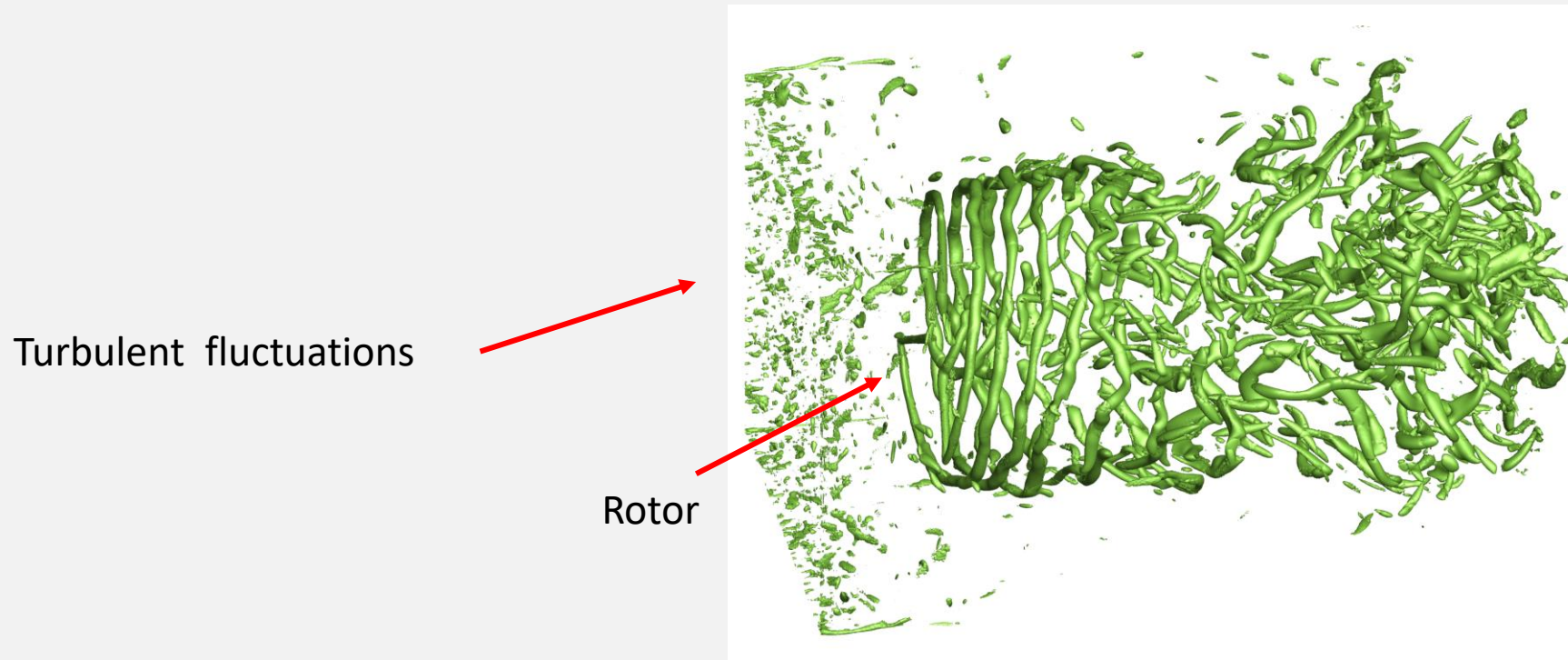
3 HI-FI (HIGH FIDELITY) MODELLING

FSI based on an LES turbulence model



Aeroelastic response to turbulence

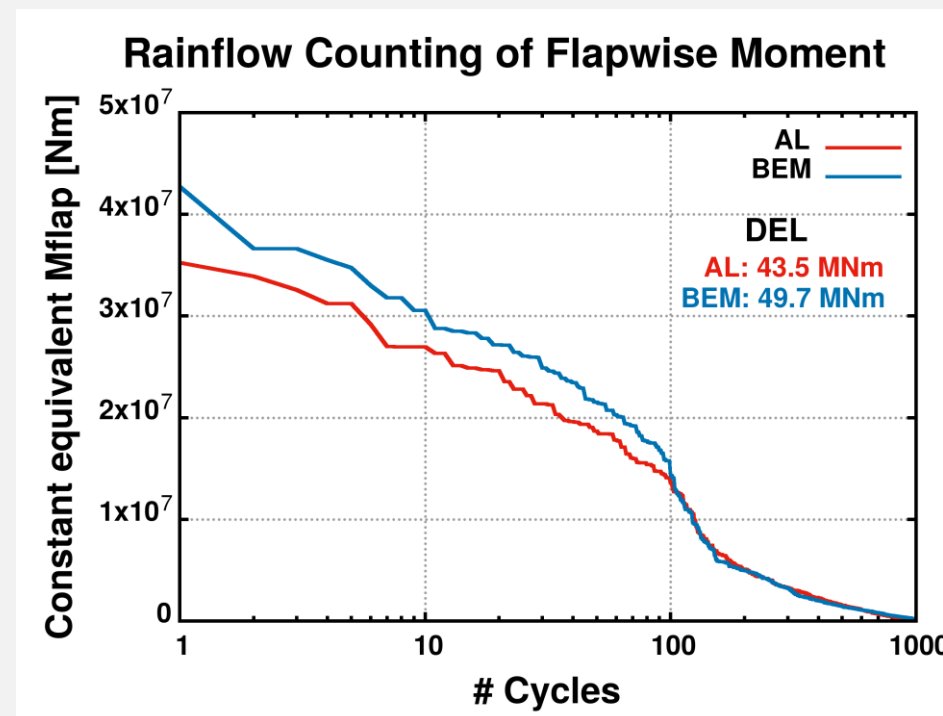
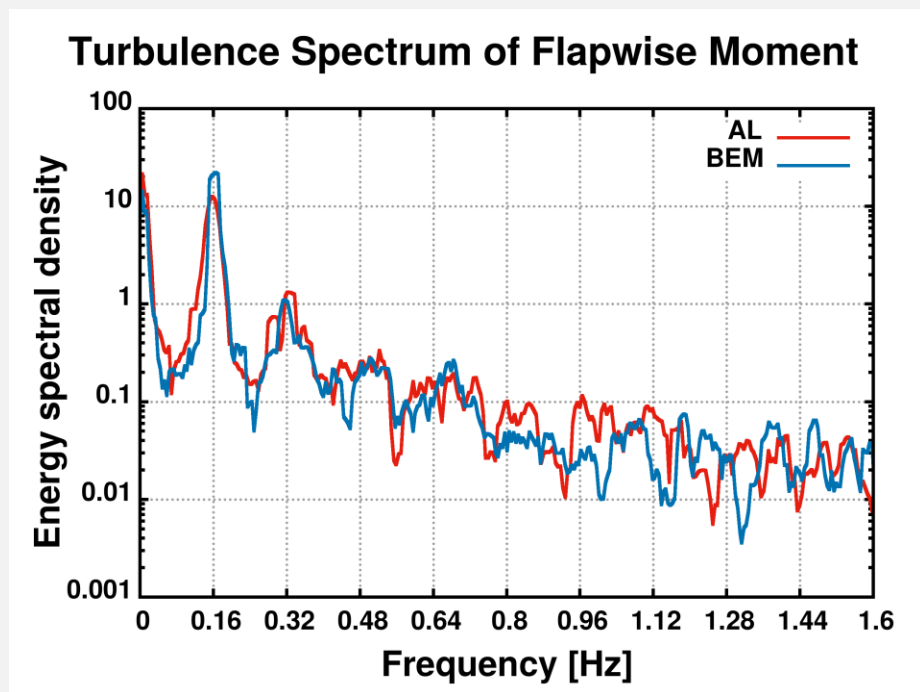
Fully coupled aeroelastic analysis of wind turbines in turbulent winds, represented by active turbulent spots in a Large Eddy Simulation context (LES).



Iso-surface of vorticity

Aeroelastic response to turbulence

Increased accuracy becomes an opportunity to a better design and by that to reduced LCOE



FSI based on LES turbulence model

Why ECC?

We combine...

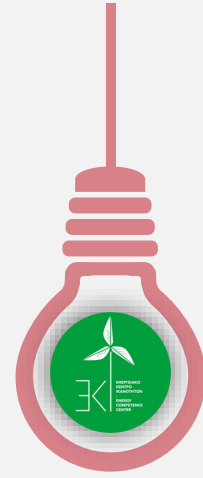
- Broad engineering knowledge in wind energy and maritime technologies
- Long research expertise at European and National level
- Validated High-fidelity computational tools and procedures beyond the state of art

and ...

OFFER ...



Highly specialized services



High Fidelity in design and analysis of floating turbines and parks



Optimised solutions

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THANK YOU

