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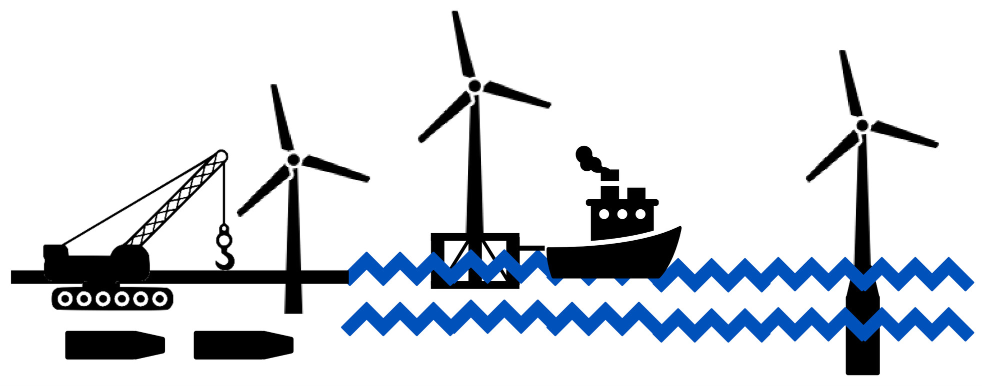
EERA DeepWind CONFERENCE 2025



Relevance of life-cycle trade-offs in substructure concepts selection for floating wind turbines

Research objective

Access to deep waters, currently untapped wind resource is enabled by floating wind turbine substructures

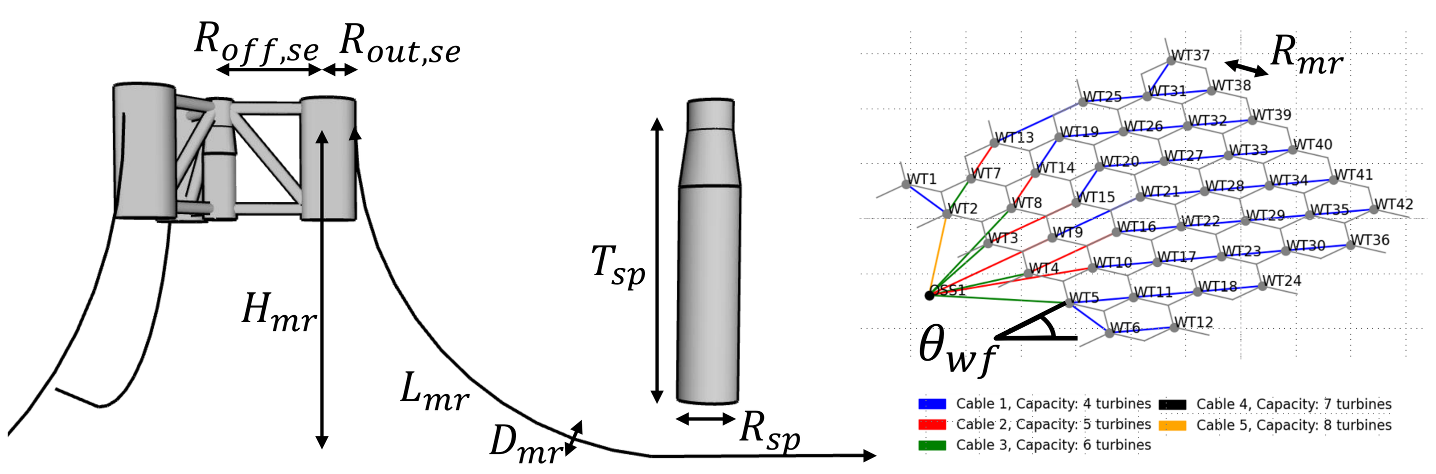
Different substructure concepts have relative benefits and weaknesses related to the various wind farm life-cycle phases, such as lower fabrication costs or ease of installation

Recent research focused on design optimization of floating substructures for production costs reduction, and development of life-cycle cost (LCC) models for floating wind farms

- ❖ Lack of research on the life-cycle trade-offs related to the floating substructure concept selection
- ➢ This research sheds light on the importance of the life-cycle trade-offs involved in selecting spar buoy and semi-submersible substructure for a floating wind farms

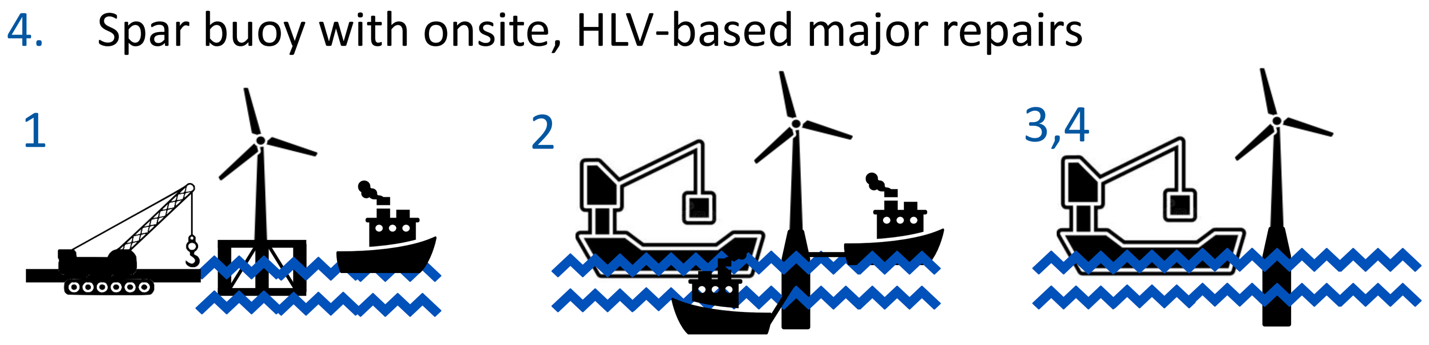
Methodology

Spar buoys and semi-submersibles as substructure concepts with strengths and weaknesses in different life-cycle phases

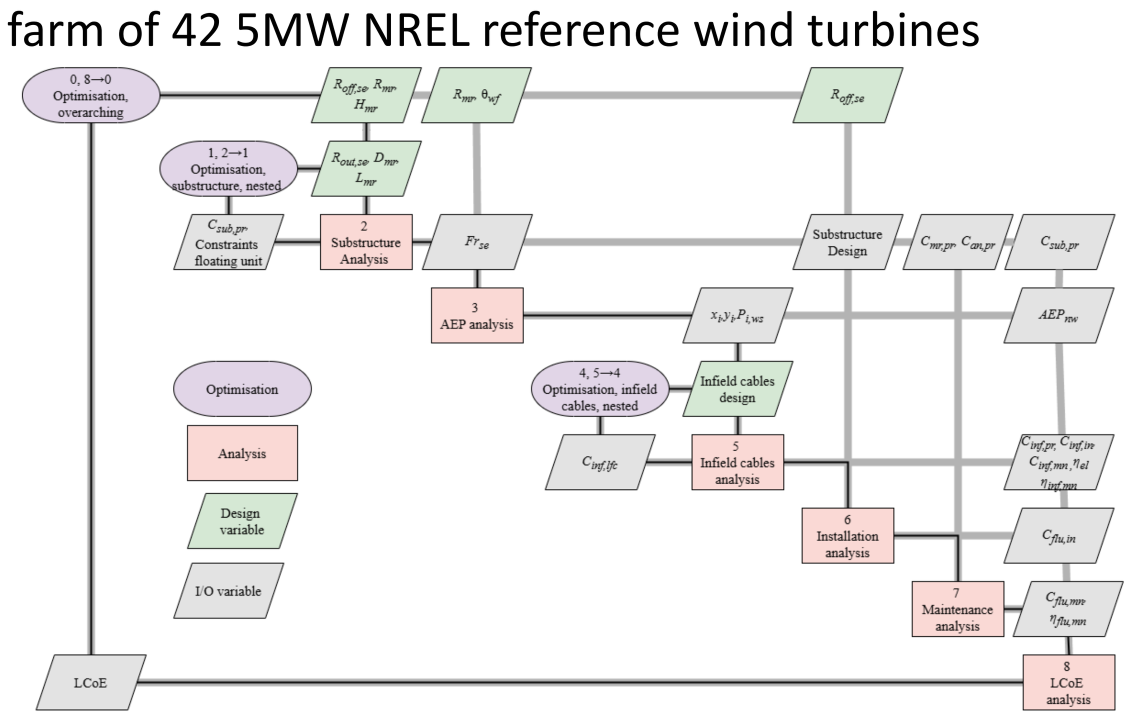


Four alternative options for a floating wind farm are assessed:

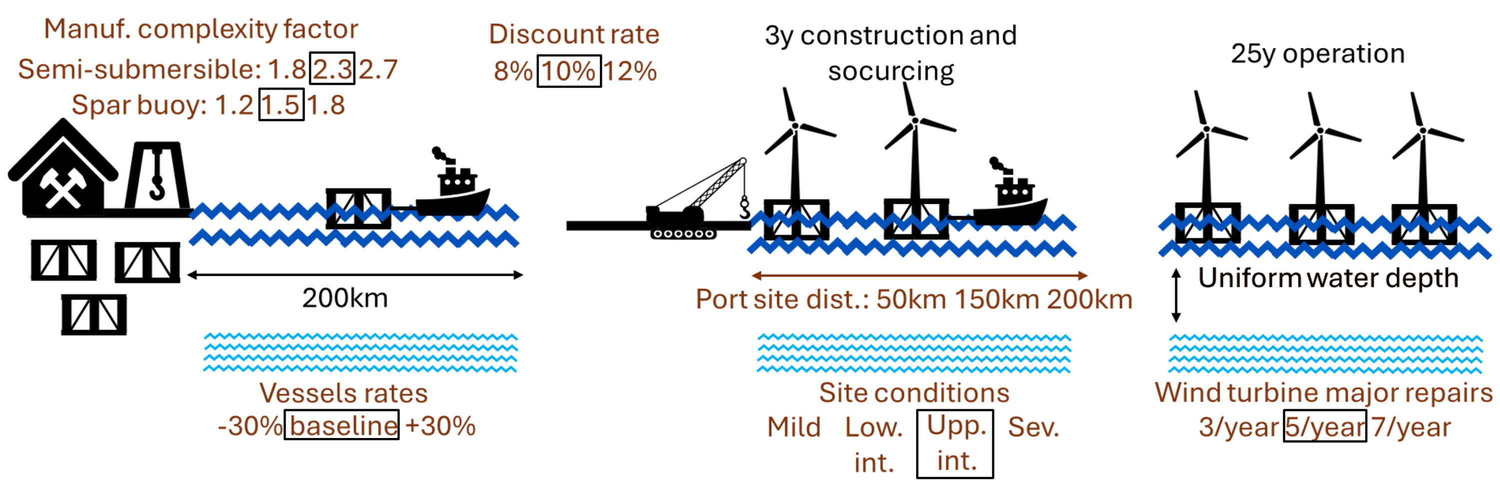
1. Semi-submersible with tow-in, quayside major repair strategy
2. Spar buoy with tow-in, heavy-lift vessel (HLV-based) major repairs
3. Semi-submersible with onsite, HLV-based major repairs
4. Spar buoy with onsite, HLV-based major repairs



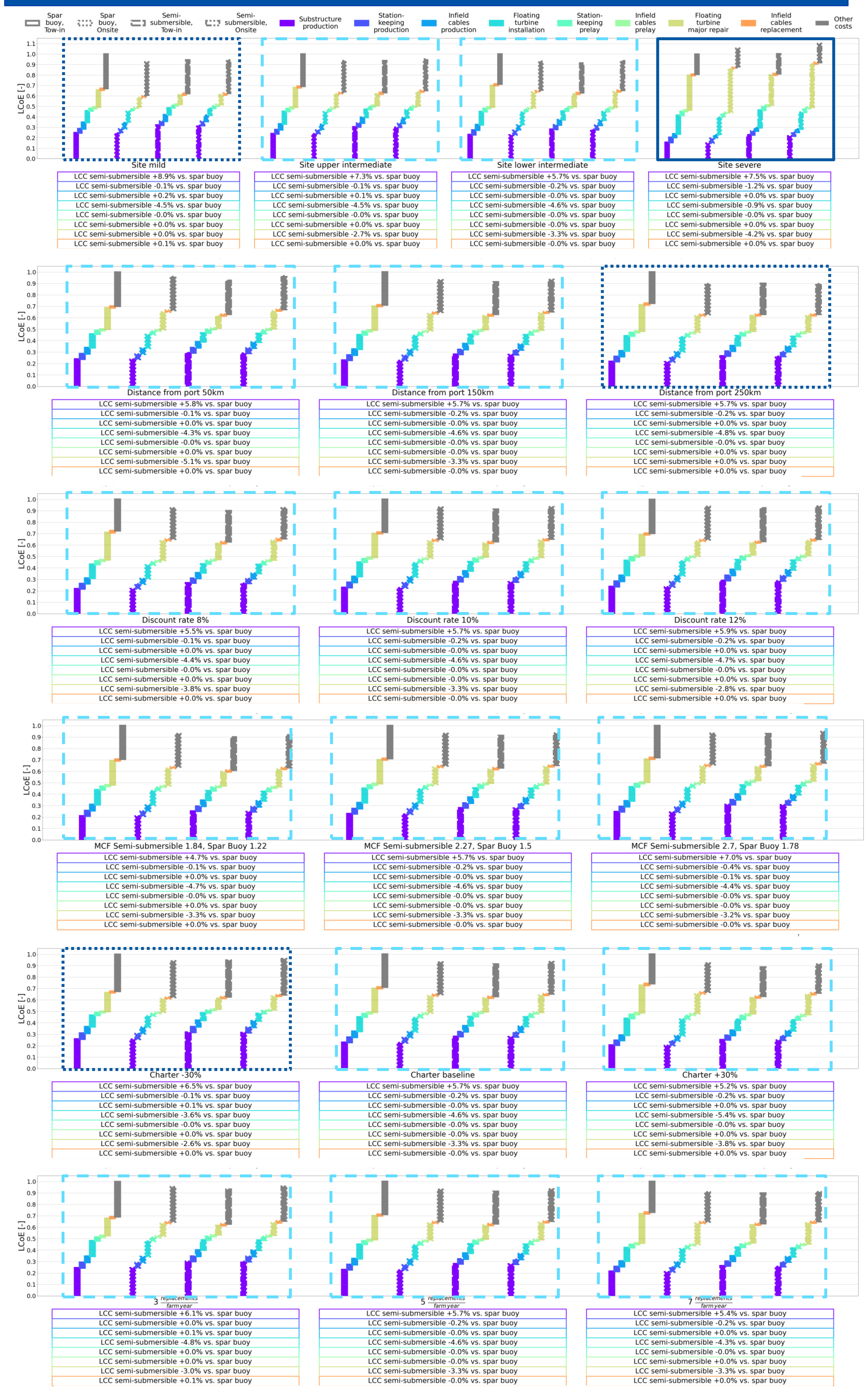
MDAO to optimally size spar buoy and semi-submersibles for a wind farm of 42 5MW NREL reference wind turbines



For each design driver variation, results of the MDAO workflow obtained for each farm configurations 1 to 4 are compared



Results



LCoE "best" semi-submersible scenario - LCoE "best" spar buoy scenario [€/MWh]				
Site conditions	3.44	-0.14	-1.57	0.35
Distance from port	-2.92	-1.57	0.05	
Discount rate	-1.83	-1.57	-1.41	
MCF	-2.56	-1.57	-0.39	
Vessels rates	0.43	-1.57	-3.53	
Major repairs	-1.68	-1.57	-0.94	

Baseline

Conclusions

- ✓ There is no 'best concept' a prioti: life-cycle trade-offs in floating substructure concept selection are important and should be accounted for in the depvelopment of a wind farm
- ✓ Variations in design drivers have a significant impact on the trade-offs and can make one or another floating substructure concept more cost-competitive
- ✓ Semi-submersibles with tow-in maintenance strategies and spar buoys combined with an onsite major replacement approach show a higher cost-competitiveness among the combinations of floating substructures and major repair strategies assessed

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 860737.