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Comparison of the capacity factor of stationary wind turbines & weather-routed energy ships in the far-offshore

A research in progress

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Significance & Motivation





FARWIND project's vision





FARWIND project's vision: Boat Design



Study objectives

1. Investigate how high the capacity factor can be, with optimized routings, depending on the energy ship sailing capabilities and deployment area.

2. Compare this CF to that of hypothetical stationary floating wind turbines





1. WIND SPEED DATA

- 10m wind speed data for years 2015, 2016 and 2017
- ERA-Interim dataset by European Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis.

OFFSHORE WIND TURBINE POWER CURVE BOAT SPEED & POWER POLAR



Data

1. WIND SPEED DATA 2. OFFSHORE STATIONARY WIND TURBINE POWER CURVE



3. BOAT SPEED & POWER POLAR



Data

WIND SPEED DATA OFFSHORE WIND TURBINE POWER CURVE 3. 1MW BOAT SPEED & POWER PRODUCTION POLAR





Optimization using qtVIm software



Dedicated & modified qtVIm version

New optimization criterion:





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Floating wind turbines CF using QtVIm

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Average CF for stationary WT (2015, 2016 & 2017)





Optimization of 1MW FARWINDER capacity factor

Year	-	2015	2016	2017
Annual average CF	%	81	83	81
Best CF over one route	%	95	95	94
Worst CF over one route	%	46	55	60
Average route duration	Day (s)	6	6	6
Longest route duration	Day (s)	15	11	11
Shortest route duration	Day (s)	1	2	2
Longest route distance	NM	7480	6073	5730
Shortest route distance	NM	907	1140	1576
Average filling ratio at the end of the routes	%	68	71	69



Optimized route traces for 1MW energy ship (2015, 2016 & 2107)





Capacity factor at far offshore



Conclusion

Average CF of year 2015, 2016 & 2017					
Energy Ship	Stationary wind turbines				
82%	69%				

- Moving further offshore increase significantly the CF of stationary WT
- With the same resource and over the same geographical area, a mobile device, such as a wind energy ship, may increase even more the CF.
- Capacity factor of energy ships needs to be refined includes sensitivity studies as function of the storage capacity aboard the energy ships and the rated power
- taking into account the effect of sea conditions on energy ships' performance.



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Thank you for your attention