



Job offer: Postdoctoral fellow

Project Title: Wind Turbine Generators Technology Screening and Industrial Maturity

Research Fields: Wind energy

Offer type: postdoctoral researcher (short term contract, 12 months)

Workplace: GeePs, CentraleSupélec, University Paris-Saclay

Hiring Institution: CentraleSupélec, University Paris-Saclay

Heads of the Scientific Project: Mattéo CAPALDO (TotalEnergies), Arsim AHMEDI (TotalEnergies), Loïc QUEVAL (GeePs, CentraleSupélec, Université Paris-Saclay)

Application deadline: 12/2022

Job Starting Date: as soon as possible

Mission (scientific project)

Offshore wind is a very active industry in terms of technology, and it is recently exploring several innovations for the conversion of the mechanical energy (rotation of the blades) to the electrical conversion (rotation of the rotor in the stator of the electrical machine).

Generally, the average specific power of offshore wind turbines remains relatively constant between 300 W/m² and 400 W/m², as the technology targets the high wind speed class (IEC I). Since 2013, a continuous increase in drive train configurations using permanent magnets (type D-PM and E-PM) can be observed resulting in market shares above 80% in the last two years (see Figure 1, right). Assuming that this dominance of permanent magnet drive trains will persist, JRC (2020) assumes an EU market share of 95% in its HDS scenario, followed by 68% and 44% based on extrapolating historical time series or the uptake of new innovations in MDS and LDS, respectively. Latest industry innovations in drive train design propose an alternative to fault-prone roller bearings by replacing them with flexible conical journal bearings ('FlexPad' bearing, patent pending) capable to cope with main-shaft deflections during rotation [SCHRO19].

Moreover, the German technology developer Adion Technologies proposes a new hybrid gearbox concept (first patent to be granted in 2020) for next generation wind turbines (up to 20 MW) coping with the increased masses at these turbine ratings with a modular two-stage distributed gearbox [WATSO19]. At the very early stage (TRL 1-2) concepts of tip-rotors would offer the possibility to replace gearbox and generator by a fast-rotating rotor/generator located at the tip of each blade. As

this concept targets weight and cost reduction it might be especially interesting for very large offshore rotors.

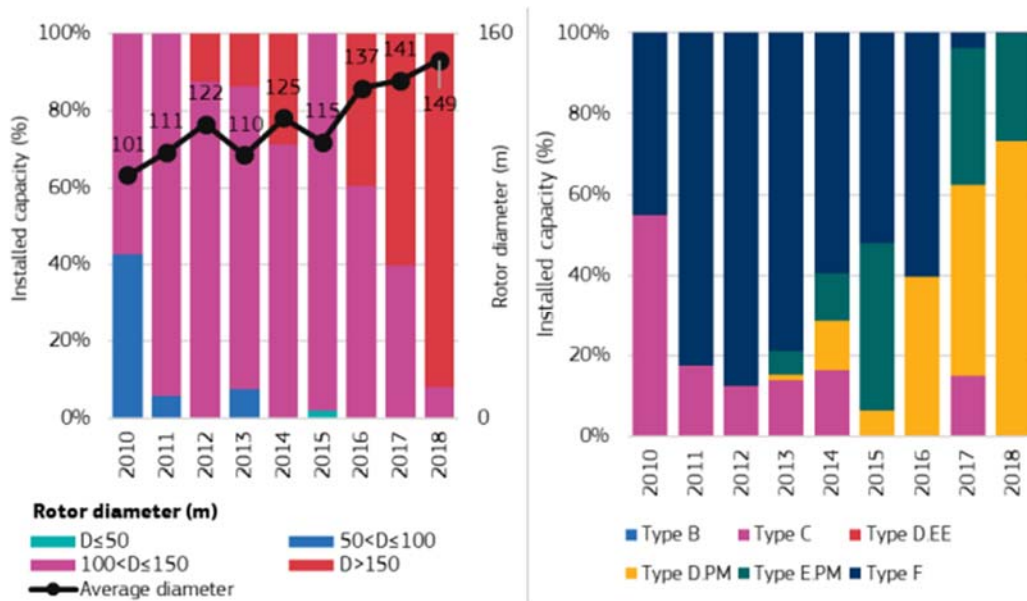


Figure 1: Evolution of rotor diameter of offshore wind turbines (left) and annual market share of installed capacity by train configuration (right) in the EU28 [JRC2019c].

In this context, it is necessary to understand pro and cons of each of those solutions to have a direct impact in terms of levelized cost of energy (LCOE) for wind farms developments.

The limitations and technology developments on the electrical side including the generator and converter combination will have to be considered as well [YARAM2015].

The objective of this project is to clarify the reasons of the different technology developments made by wind turbine manufactures and to understand their impact of the manufacturing, supply chain and to the final cost of the wind farm. To do that, a simple model can be develop with the possibility to adapt it to the different technologies thanks to the definition of a set of input parameters and boundary conditions.

References

- [JRC2019b] Wind Energy Technology Market Report. Luxemburg: European Commission, 2019 b. EUR 29922 EN.
- [SCHRO19] Schröder T, Jacobs G, Rolink A and Bosse D: "FlexPad" - Innovative conical sliding bearing for the main shaft of wind turbines. Journal of Physics: Conference Series 1222 (012026). DOI:10.1088/1742- 6596/1222/1/012026
- [WATSO19] Watson S, et al.: Future emerging technologies in the wind power sector: A European perspective. Renewable and Sustainable Energy Reviews 113 (109270). DOI:10.1016/j.rser.2019.109270
- [YARAM2015] V. Yaramasu, B. Wu, P. C. Sen, S. Kouro and M. Narimani, "High-power wind energy conversion systems: State-of-the-art and emerging technologies," in Proceedings of the IEEE, vol. 103, no. 5, pp. 740-788, May 2015. DOI: 10.1109/JPROC.2014.2378692.

Environment

The work will take place at the laboratory GeePs (Group of Electrical Engineering Paris) and Université Paris-Saclay (ranked 13 th worldwide and 1st in continental Europe in the Academic Ranking of World Universities), in Paris' region.

Required profile

The candidate should hold or is about to complete a PhD in electrical or energy engineering. An experience in techno-economic analyses would be appreciated. The candidate has good oral and written communication skills in English. Prospective candidates need to contact the research team, with their CV, to further discuss about the subject.

How to apply?

Please send the following documents by email to: matteo.capaldo@totalenergies.com, with copy to loic.queval@centralesupelec.fr.

- CV and a cover letter showing your interest
- An exhaustive list of your works: scientific publications, patents and others scientific productions
- Reference letters are not requested but candidates are asked to provide the name and contact of one reference whom it may contact at a later date.
- An English abstract of PhD work (2 pages max.)