X-ROTOR

X-shaped Radical Offshore Wind Turbine for Overall Cost of Energy Reduction

15th June 2023

Wave and Wind Energy Day, Malin Head

Nicola Baxter, University of Strathclyde

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101007135

Content:

- Background, including introduction to Engineering Team
- Concept
- What will it look like?
- Advantages
- Different from other wind turbines
- Future plans

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Background

- This new design for an offshore wind turbine was first realised by Prof. Bill Leithead, Head of the Wind Energy and Control Centre in the Department of Electronic and Electrical Engineering at the at University of Strathclyde (UoS).
    - Bill took forward a feasibility study with colleagues at UoS, and then applied to the EU for project funding to take forward the research into designing the XROTOR.
- The EU agreed that UoS could have the funding through Horizon 2020 and lead this project. They also agreed on the team of partners across the EU:
    - University College Cork
    - CENER
    - General Electric Renewables
    - Norwegian University of Science and Technology
    - TU Delft

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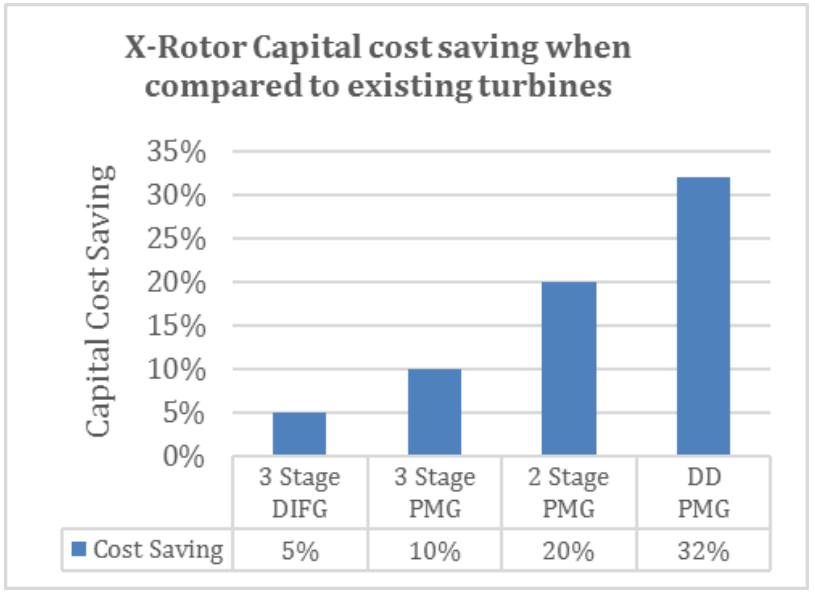
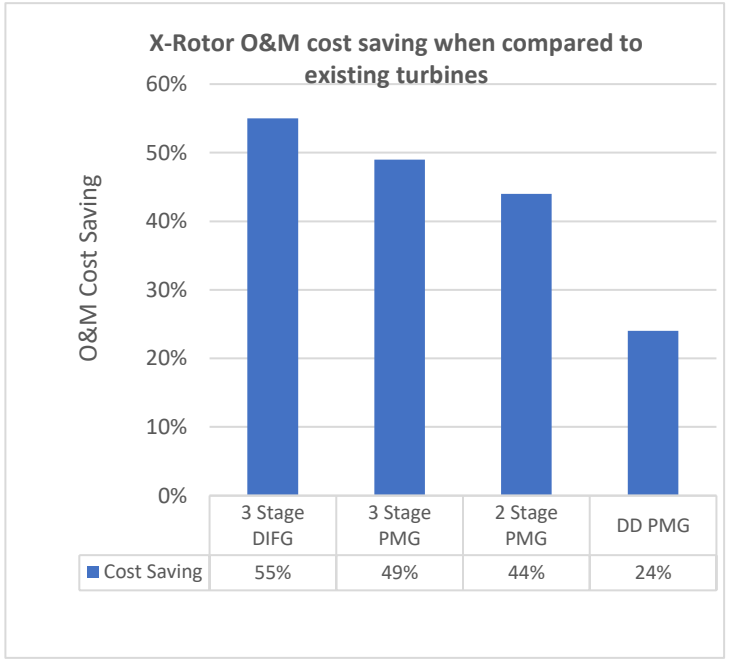
Feasibility Study
CAPEX[1]

- Potential CAPEX (Capital expenditure) savings in comparison to conventional turbines
- O&M costs and OPEX (Operational expenditure) lower than for a comparable HAWT





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Concept

- XROTOR is a X-shaped Radical Offshore wind Turbine for Overall cost of energy Reduction.
- XROTOR has the potential to reduce the cost of energy from offshore wind by up to 20%* compared to what is out there just now.
- Its unique design will change how it can be maintained more easily out at sea than current wind turbines.

*Based on a conservative estimate from early feasibility study work. Citation 1.

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XROTOR: What will it look like?

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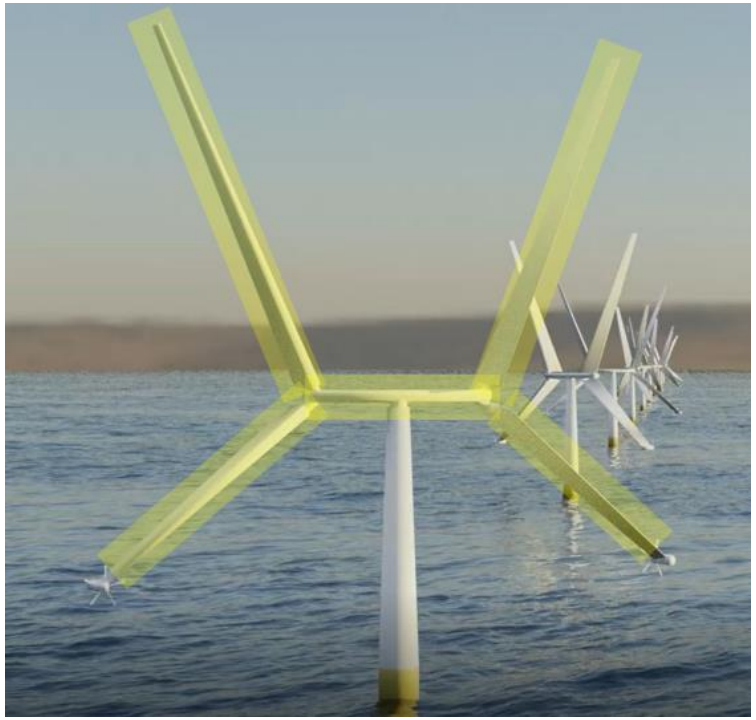
XROTOR: What's different?

- Vertical axis primary rotor freely rotates around the vertical axis



- Horizontal axis secondary rotors:
  - Provide all power take off
  - Control primary rotor speed

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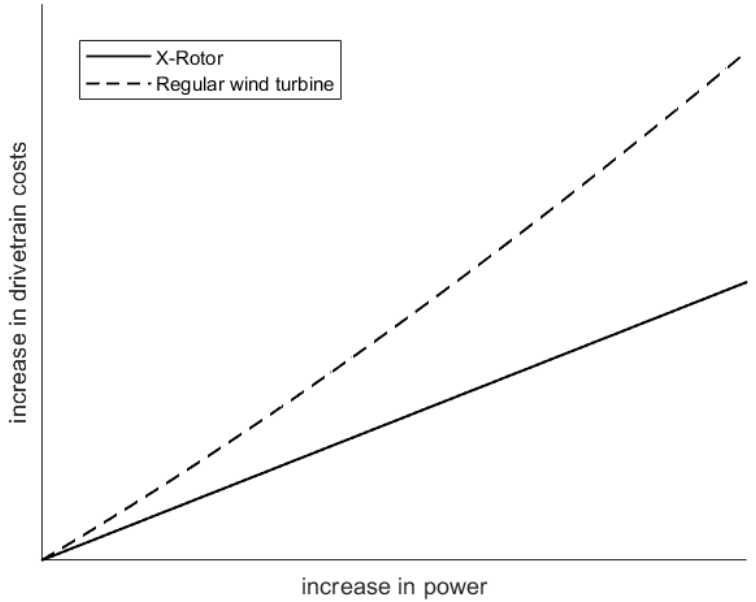
Advantages

- Potential cost of energy reductions of about 20% to 25%
  - In the production, not in what it produces!
- Potential for floating:
  - The overall mass of the XROTOR is less than a conventional HAWT (horizontal axis wind turbine)
  - More of the weight is at lower height
- Improved scalability – making it easier to go bigger!
- Prediction modelling for wakes have shown these turbine can be placed closer together, so less footprint out in the oceans. [2]
- Potential for birds to keep a distance due to noise produced by the XROTOR. This is still being researched with results to follow later this year.



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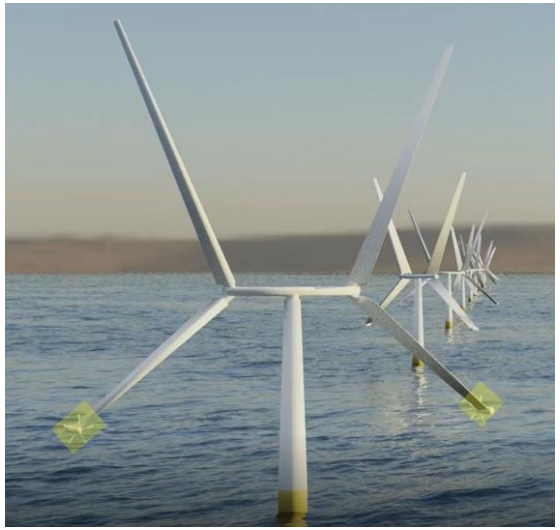
Different from other wind turbines

- Several aspects of the X-rotor concept are advantageous for repair and maintenance.
    - Easier to maintain as this is can be done from a small vessel - the XROTOR turbine is closer to sea level. This allows for easy access to all components with these being easier to remove and replace.
    - Option for generator and rotor to be detachable for transfer to shore for repair/maintenance
- Components are low height and light in weight.
- Generator and rotor are highly reliable since no gearbox or multipole generator.
- Potential for operation to continue with one generator, and rotor not operating.



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Future of XROTOR

- This part of the project will be completed by the end of 2023, with all results sent to the EU Horizon 2020 Project officer for validation .
- Most of the results are looking positive across the project, which means it's worth taking forward for further research and prototyping.
- There are a couple of 'irons in the fire' regarding future funding...

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References

1. Leithead et al., "The X-Rotor Offshore Wind Turbine", Journal of Physics, Vol. 1356, October 2019
2. Huang, M., Sciacchitano, A., and Ferreira, C., “On the wake deflection of vertical axis wind turbines by pitched blades,” Wind Energy, 2023

[5,6] Leithead et al., The X-Rotor Offshore Wind Turbine, Journal of Physics, Vol. 1356, October 2019

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Thank you for your time!

Nicola Baxter, University of Strathclyde

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