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

D9.4

Mid-term communication & dissemination report

https://xrotor-project.eu

@XROTORProject

June 2022

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X-ROTOR Consortium

University of Strathclyde

Delft University of Technology

University College Cork – National University of Ireland, Cork

Fundacion Cener

General Electric Renovables España

Norwegian University of Science and Technology

https://xrotor-project.eu

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About X-ROTOR

X-ROTOR: “X-shaped Radical Offshore wind Turbine for Overall cost of energy Reduction” is a Horizon 2020 funded project which aims to develop a disruptive new offshore wind turbine concept.

The X-ROTOR project is led by University of Strathclyde (UK) in partnership with Norwegian University of Science and Technology (Norway), Delft University of Technology (Netherlands), University College Cork (Ireland), Fundacion Cener National Renewable Energy Centre (Spain) and GE Renovables España (Spain).

As the effects of climate change are becoming ever more visible, Europe has raised its target for the amount of energy it consumes from renewable sources from the previous goal of 27% to 32% by 2030. Offshore wind energy can play a key role in achieving the EU target and contribute to the required 40% reduction in CO_2 emissions. However, to achieve the previously mentioned targets the cost of offshore wind must be reduced. The X-ROTOR concept provides a direct route to drastically reducing both capital and operating costs of energy from offshore wind.

The project runs for three years from January 2021, during which time, the concept will be developed through a holistic consideration of technical, cost, environmental and socio-economic impact aspects.

If proven feasible, X-ROTOR will, as a disruptive new offshore wind turbine concept, create new opportunities for the European wind energy industry and play an important role maintaining the EU’s position as global technological leader in renewable energy, reducing greenhouse gas emissions and decarbonising the EU economy.

For more information see **https://xrotor-project.eu**

Description of the deliverable and its purpose

This deliverable reports on communication and dissemination activities from the first half of the project as well as details of communication and dissemination activities for the second half of the project

List of acronyms

AWEA	American Wind Energy Association (now known as American Clear Power Association)
DMS	Double Multiple Streamtube
DoA	Description of Action
DOI	Digital Object Identifier
EAWE	European Academy of Wind Energy
EERA	European Energy Research Alliance
IEA	International Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
IET	Institution of Engineering and Technology
LLT	Lifting Line Theory
MRS	Multi-Rotor System
NAWEA	North American Wind Energy Association
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OREC	Ocean Renewable Energy Coalition
OpEx	Operating Expense
URL	Uniform Resource Locator
UX	User Experience
WESC	Wind Energy Science Conference
WP	Work Package
XRC	X-ROTOR concept

1 Introduction

Communication and dissemination are key activities within research projects. X-ROTOR has a dedicated work package (WP9) focused on such work, the objective of which is to maximise the impact of the project, by achieving the maximum awareness of the project and the dissemination of its results.

This document provides a summary of the communication and dissemination activities over the initial half of the project as well as an overview of the envisaged communication and dissemination activities for the second half of the project.

2 Online Presence

2.1 Website

The X-ROTOR project website was developed at the start of the project and went live on 31 March 2021 on the following URL: https://xrotor-project.eu. As outlined in D9.1 which documented the website, this was planned as a soft launch[1] of the website, with an initial basic layout and design which was intended be enhanced and improved over time as the project progressed.

This soft launch strategy was considered a useful approach for website development, it served as a means of 'testing' a web site, ascertaining preferred features and design elements and facilitating a gradual tweaking of the UX (user experience) and potentially the redesign of components of the site. As a result, over the past number of months, the project website has since been redeveloped and relaunched with a new design sensibility, which is welcoming and open (as illustrated in the figures below). The site includes modern publishing capabilities with the ability to display multi-media assets such as videos, images, infographics and animation as required.

A responsive website design approach was taken, with all development fully responsive catering for all desktop, tablet and mobile devices and degrade gracefully in older browser versions. Care was taken that this responsiveness must be maintained across commonly used browsers *i.e.,* Google Chrome, Safari, Firefox, and Microsoft Edge.

[1] A soft launch is a practice whereby a website (or other product) is released incrementally with minimal publicity and initially to a limited audience. This allows for an opportunity to (re-)consider all aspects of the product and to finetune it before re-launching with publicity.

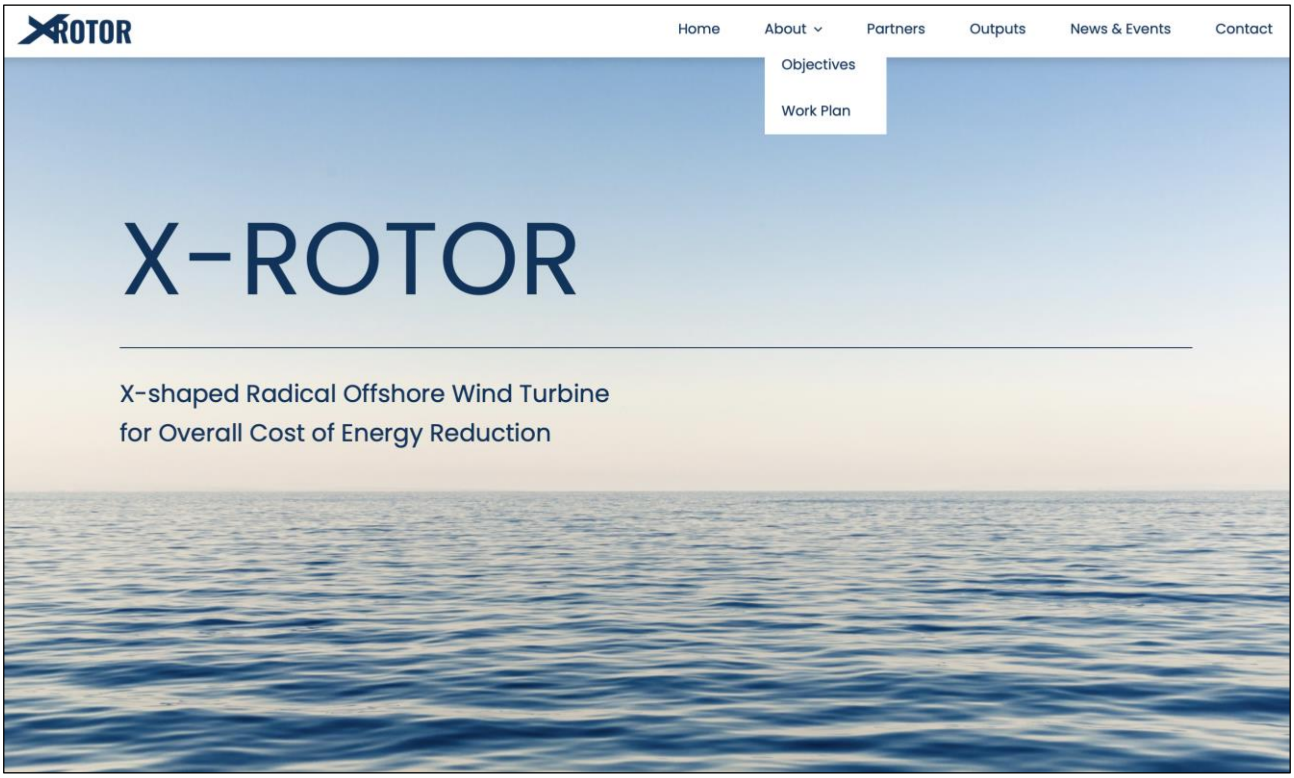


Figure 1: Landing page of the X-ROTOR redesigned website

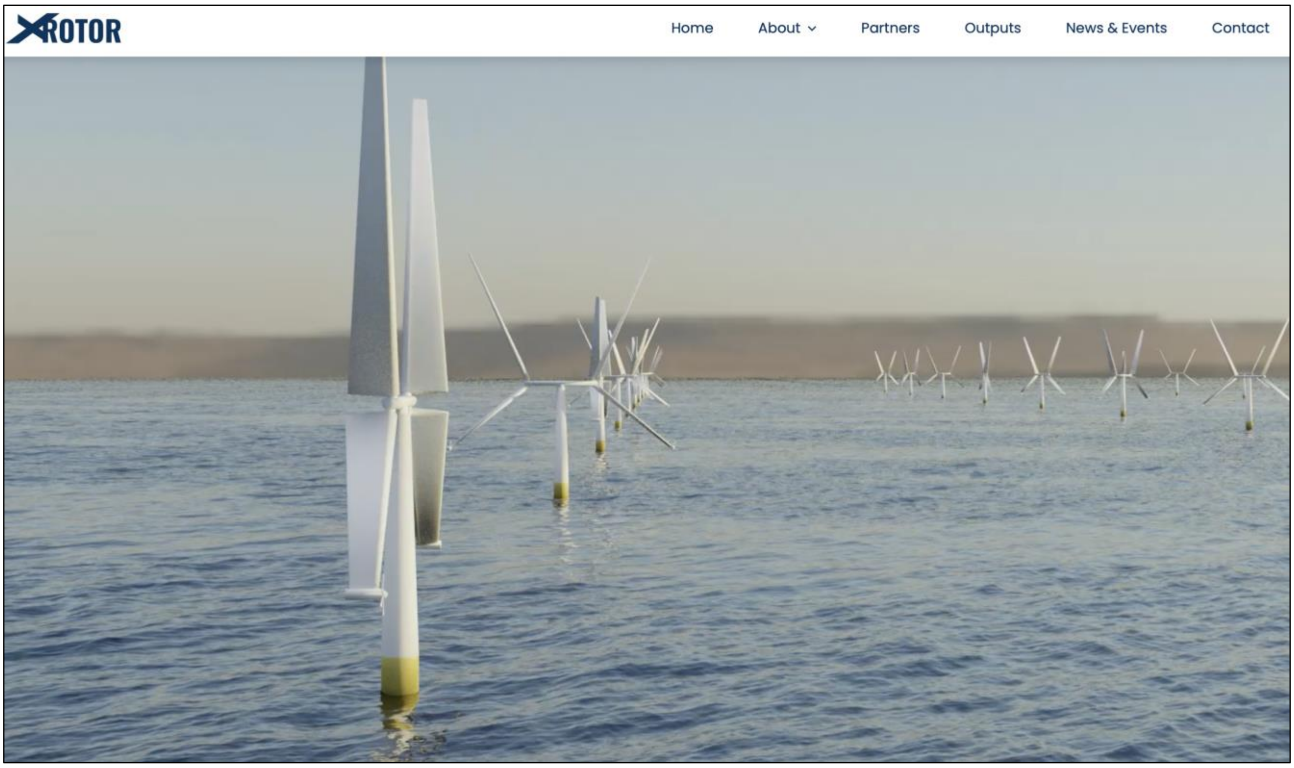


Figure 2: image capture of the video playing on the X-ROTOR home displaying how the new turbine would look and operate

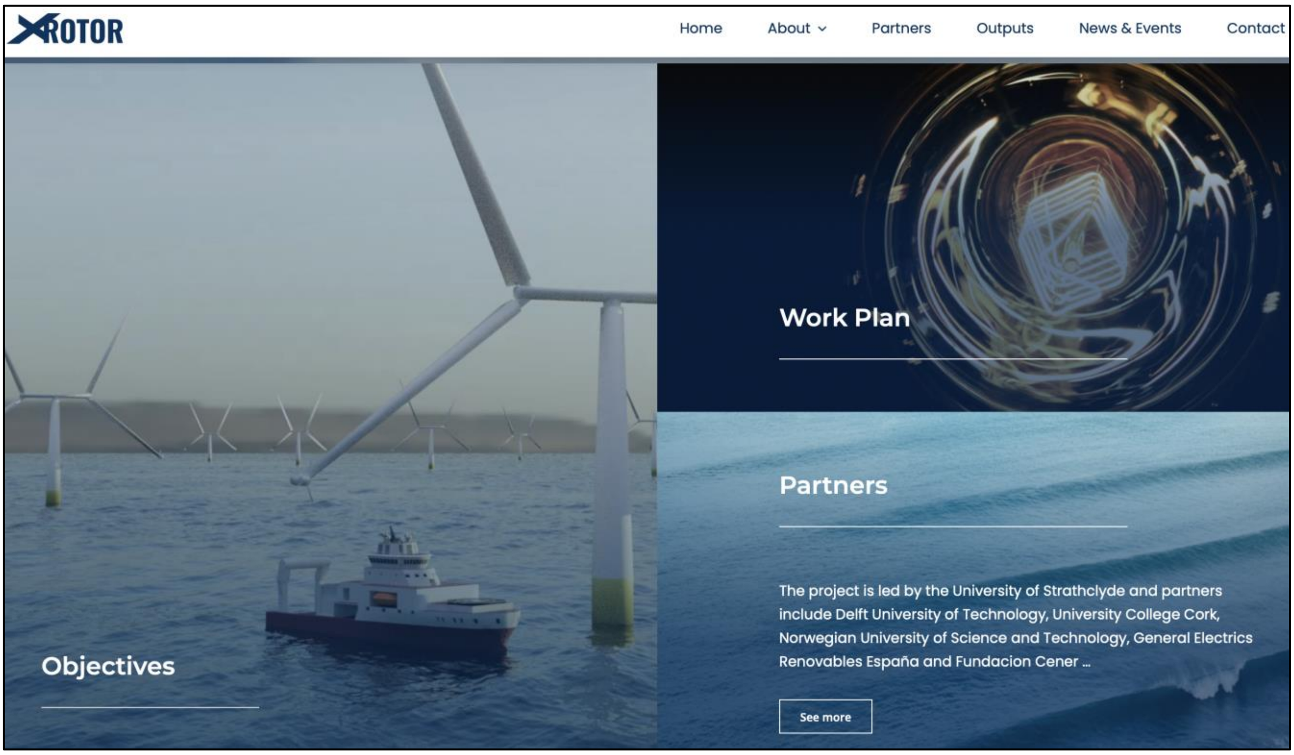


Figure 3: Section of the About page of the X-ROTOR website with links to sections of the website providing information on project objectives, work plan and the consortium partners

Figure 4: News item on the web site announcing the project

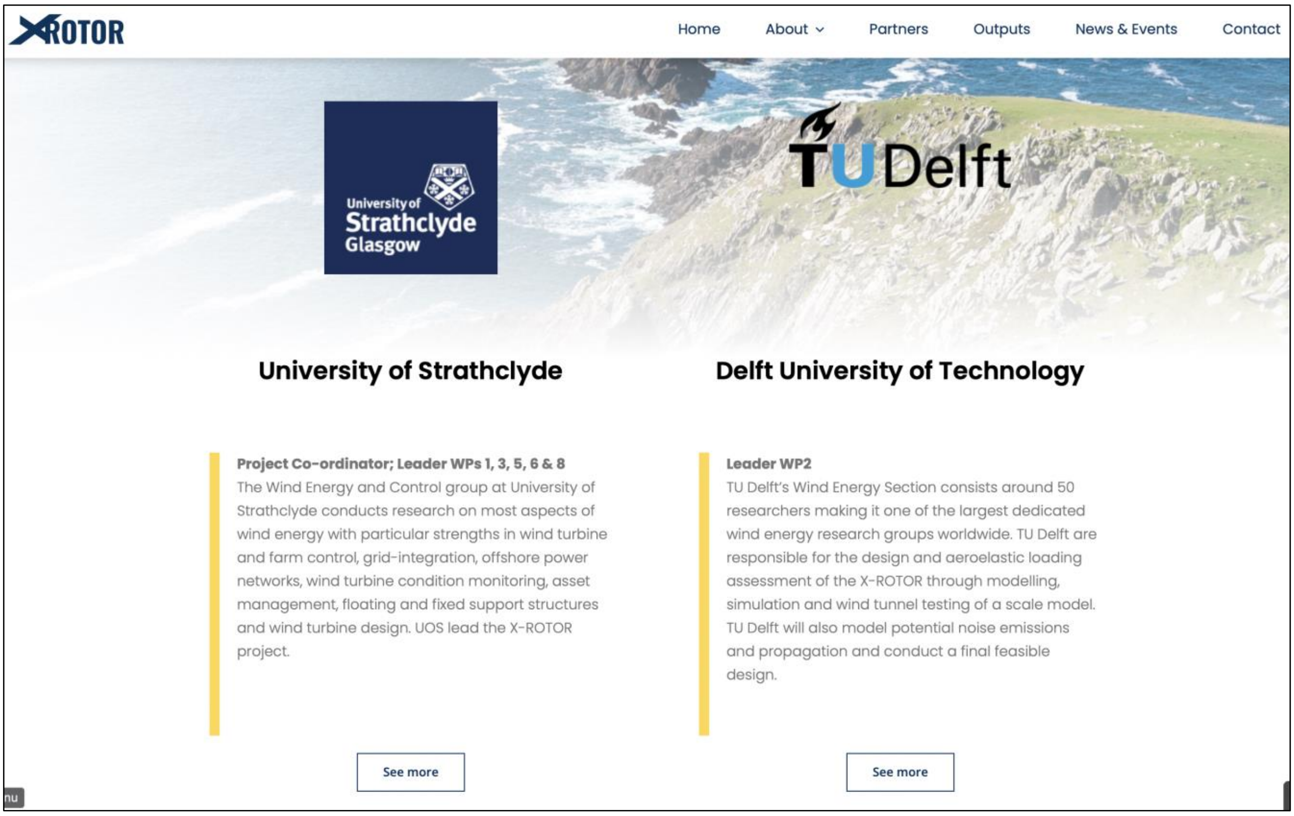


Figure 5: Partner profiles and links to organisation web pages on X-ROTOR website

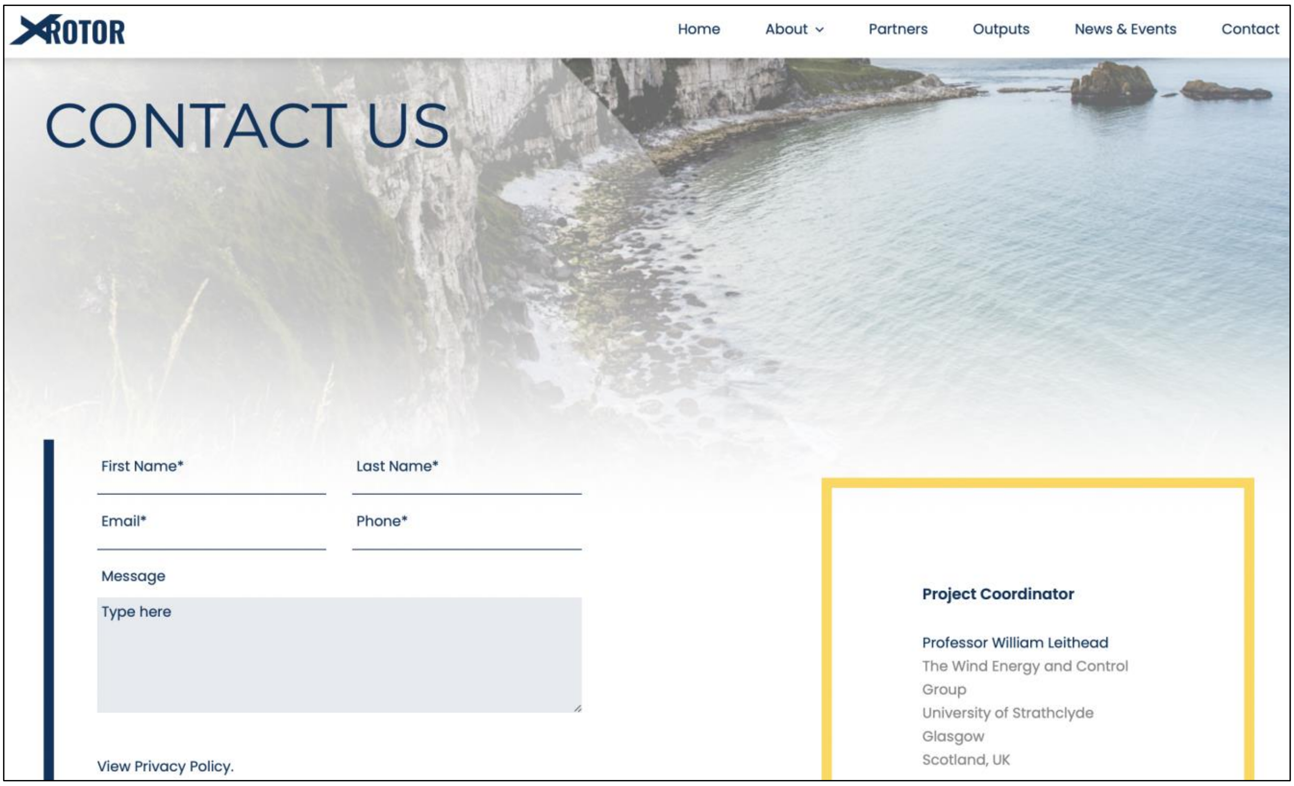


Figure 6: Contact form on X-ROTOR website

2.2 Open access repositories

Open access repositories file will be used for means of both long-term storage and dissemination of public outputs of the project, once they approved. Such use is not intended to replace the project website or similar, rather the aim is to achieve more effective dissemination of the outputs and to provide for continued access after the life of the project.

This will include use of institutional repositories, which can be very useful when prospective readers are searching for the work of particular researchers of research teams (e.g., https://strathprints.strath.ac.uk, https://cora.ucc.ie).

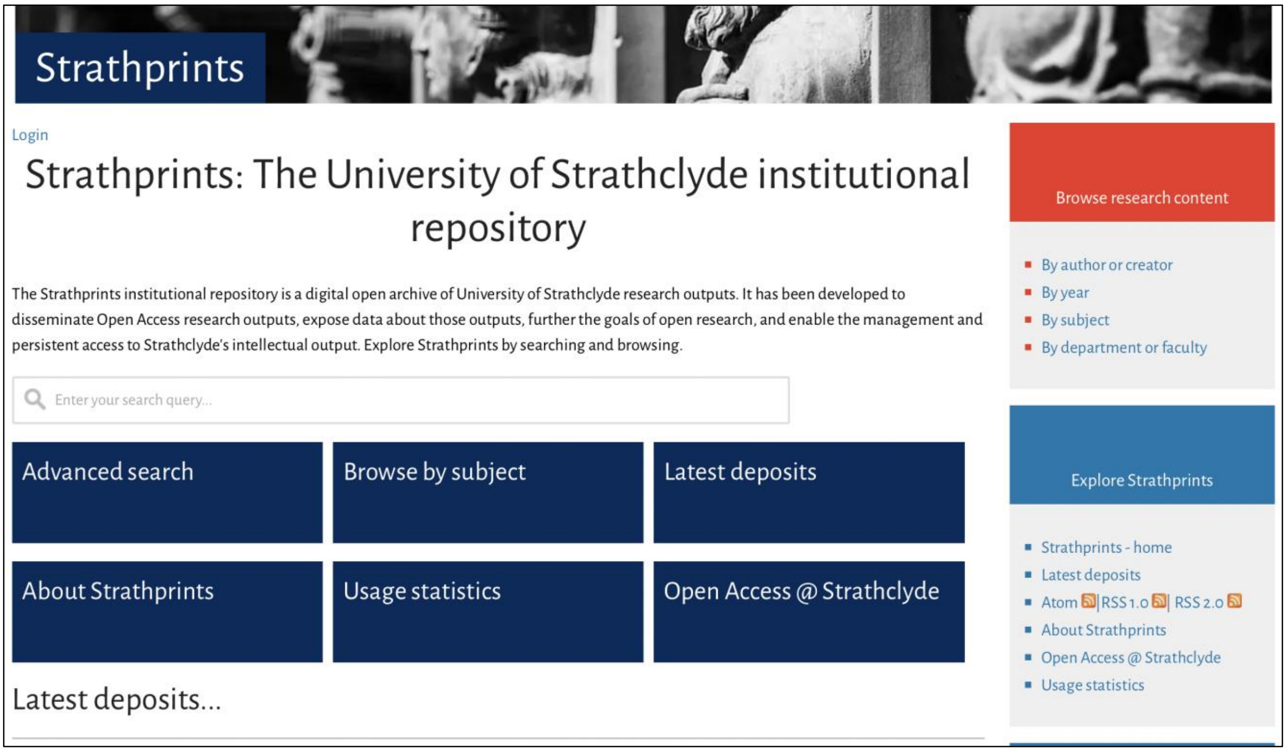


Figure 7: Landing page of the University of Strathcylde's institutional repository Strathprints

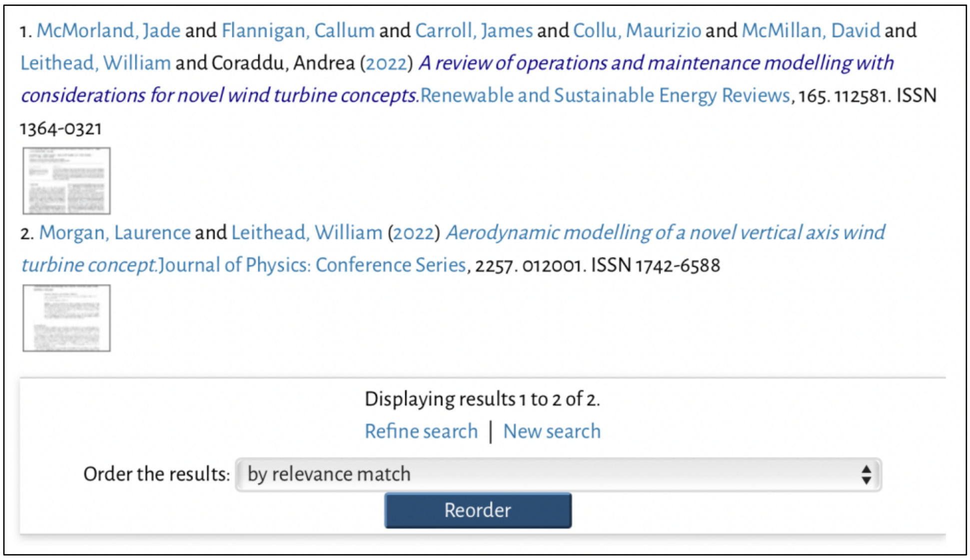


Figure 8: Search results for the term "X-ROTOR" on Strathprints repository

A presence is also being established for project outputs on the Zenado file repository (https://zenodo.org). This general open access repository is provided through the EU OpenAire initiative and maintained by CERN, and will ensure accessibility and publicity of outputs and guarantee the availability of outputs long after the project has concluded.

Zenado (optionally) provides Digital Object Identifier (DOIs) for documents, which greatly improves the citability of the project outputs and enables far more effective promotion of the research. A key feature of Zenado is that it allows for differential access level for documents *e.g.,* open access, open access (after a delay), closed access so that all outputs can be stored and/or given a DOI as required.

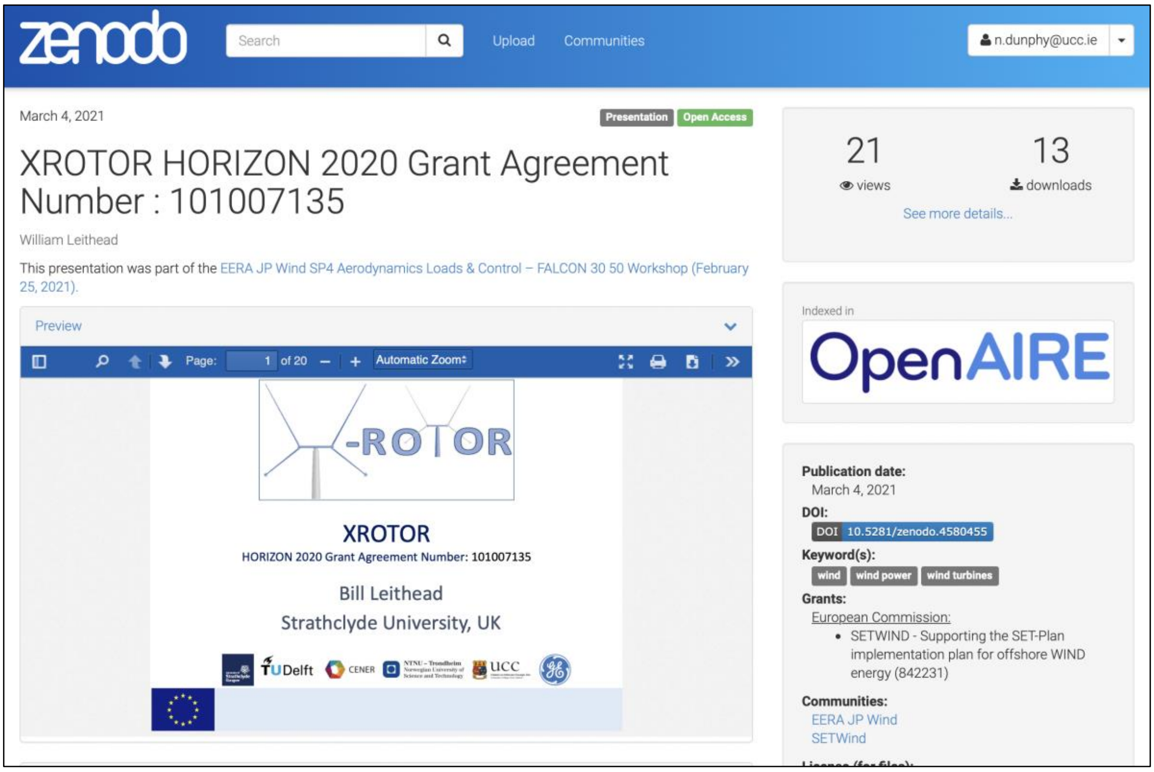


Figure 9: Presentation from the FALCON30/50 workshop stored on the Zenodo open access file repository

2.3 Social media

2.3.1 Twitter

A twitter account (https://twitter.com) was established at the start of the project (@XRotorProject). As foreseen in D9.1, this account was utilised very sparingly over the first part of the project where its principal use envisaged as being the second half of the project, as research outputs and results are beginning to to emerge. To mark the recent relaunch of the website a Tweet mini-campaign is planned during the end June/start of July to (i) mark the relaunch and using the opportunity to reintroduce the project and (ii) calling out each partner and highlighting their contribution to the project.

Figure 10: X-ROTOR Twitter account heading (left) and pinned tweet introducing the project (right)

2.3.2 Linkedin

As the project progresses, and particular as outputs start to emerge and face to face engagements occur, news items and posts will be shared through the personal LinkedIn (https://www.linkedin.com) accounts of the participating researchers. See for example the post displayed in Figure 11 below.

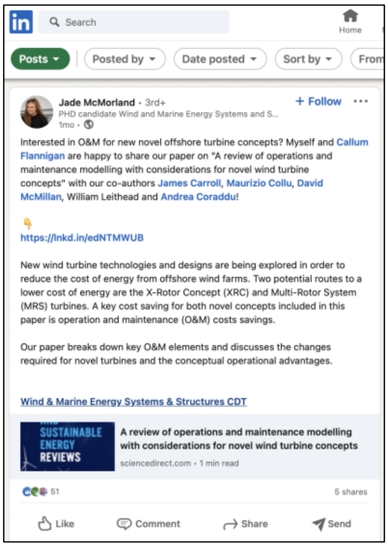


Figure 11: A journal article arising from the X-ROTOR project promoted through LinkedIn

2.3.3 YouTube

Also as explain in D9.1, while the project acknowledged that YouTube (https://www.youtube.com/) can be a good way of reaching an audience, it was not considered appropriate to establish a YouTube channel in the first half of the project. However, just as the project envisages making greater use of Twitter in the second half of the project, A YouTube presence will be established offering an effective means of sharing of short videos and animations which will be emerging from the work of the project.

3 Conference and Journal Contributions

Conference poster presentations

Bensason, D. (2022). ‘A new player in the water: the X-Rotor turbine’. *JM Burgers Symposium*, Lunteren, Netherlands. 8 & 9 June.

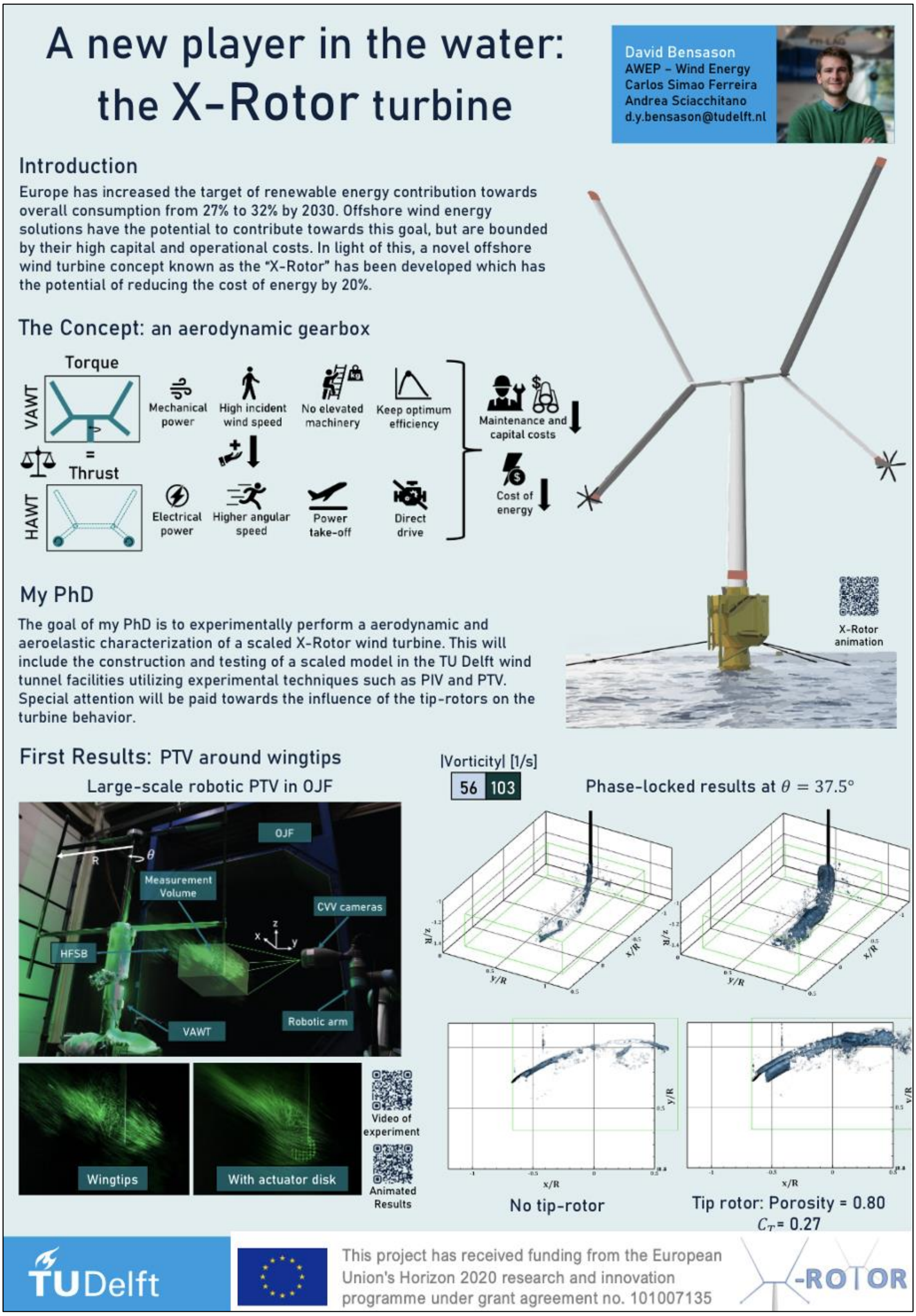


Figure 12: Poster presented by Bensason at the annual *JM Burgers Symposium in the Netherlands*

Giri Ajay, A. (2022). 'The Future of Vertical-Axis Wind Turbines: X-Rotor.' *JM Burgers Symposium*, Lunteren, Netherlands. 8 & 9 June.

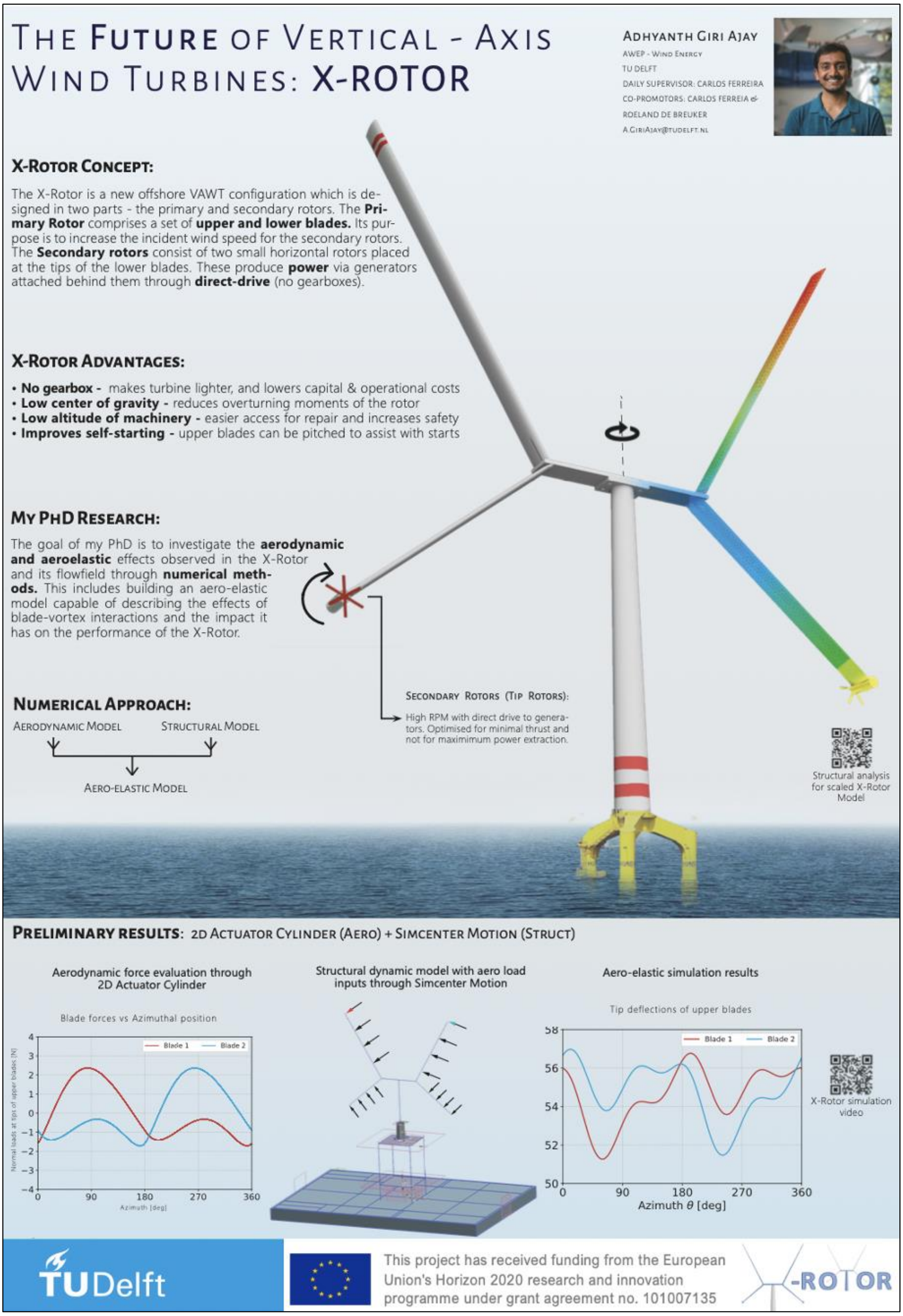


Figure 13: Poster presented by Giri Ajay at the annual *JM Burgers Symposium in the Netherlands*

Deeney, P. and Dunphy N.P. (2022). ‘Stakeholder Engagement for a New Offshore Wind Turbine’, *Wind Energy Ireland,* Dublin. 13 & 14 April.

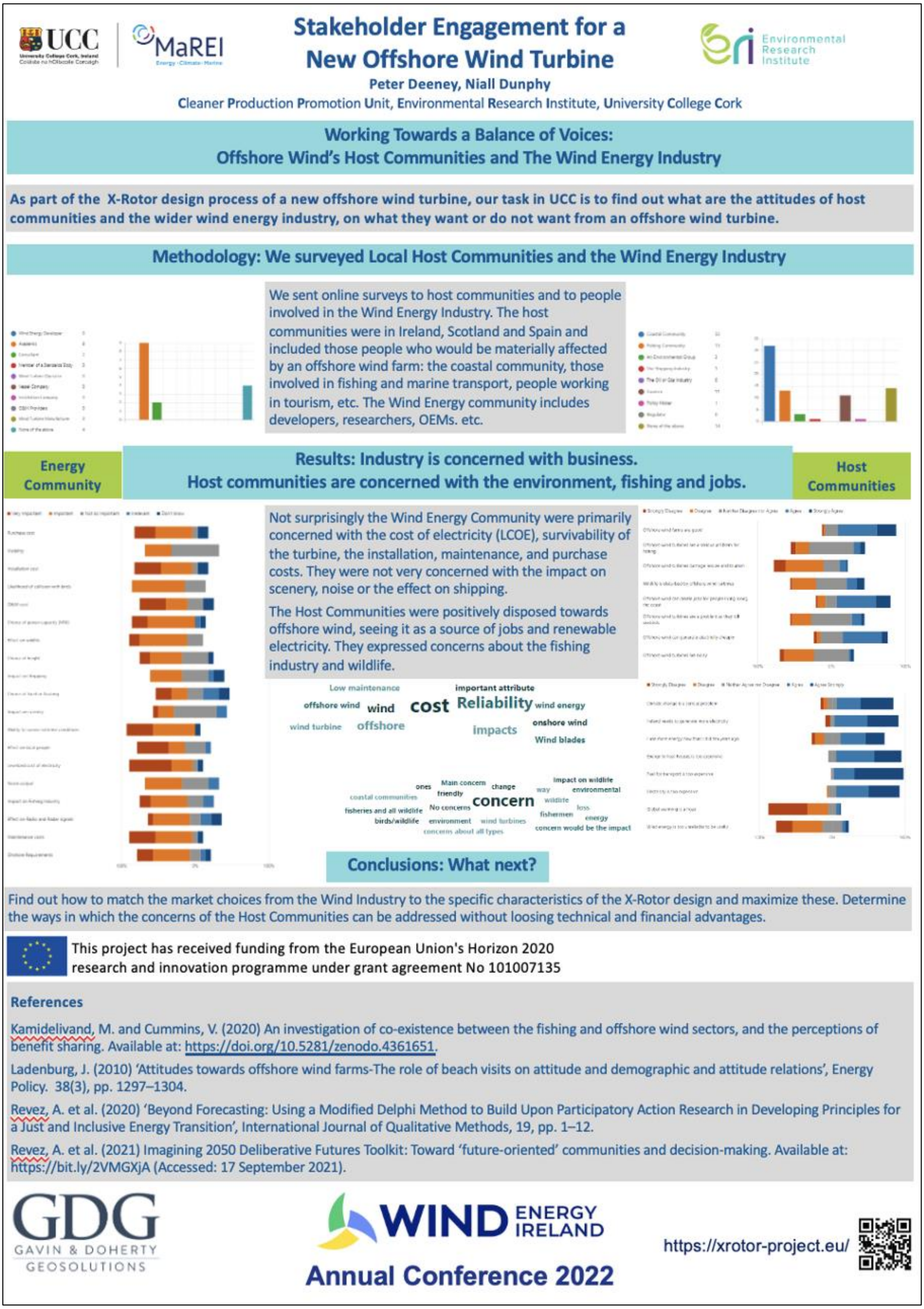


Figure 14: Poster presented by Deeney and Dunphy at the Wind Energy Ireland Annual conference

Conference oral presentations

Leithead, W.E. (2021) ‘X-ROTOR’, *EERA JP Wind-SP4 FALCON 30/50 Workshop: Future of Aerodynamics, Loads and Control 2030-2050*. Online. 25 February.

Leithead, W.E. (2021). ‘X-ROTOR: X-shaped Radical Offshore wind Turbine for Overall cost of energy Reduction’, Low-TRL Renewable Energy Technologies, *Sustainable Places 2021*, Rome, 29 September.

Leithead, W.E. (2021) “What will future wind turbines look like?” University of Texas – Dallas, Distinguished Seminar Series

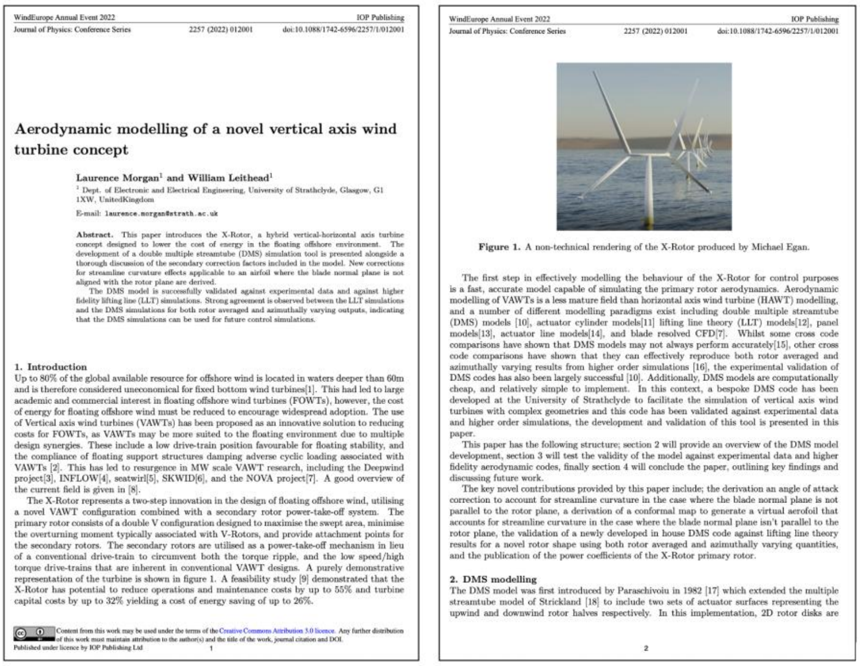
Morgan, L. and Leithead, W.E. (2022). ‘Aerodynamic modelling of a novel vertical axis wind turbine concept’. *Wind Europe*, Bilbao, Spain. 5-7 April. [subsequently published as a journal article]

Flannigan, C., *et al.,* (2022). ‘Operations expenditure modelling of the X-Rotor offshore wind turbine concept’, *The Science of Making Torque from Wind*, Delft, Netherlands. 1-3 Jun [subsequently published as a journal article]

Journal Articles

Morgan, L. and Leithead, W. (2022). ‘Aerodynamic modelling of a novel vertical axis wind turbine concept’ *Journal of Physics: Conference Series.* 2257: 012001 doi:10.1088/1742-6596/2257/1/012001

Abstract: This paper introduces the X-Rotor, a hybrid vertical-horizontal axis turbine concept designed to lower the cost of energy in the floating offshore environment. The development of a double multiple streamtube (DMS) simulation tool is presented alongside a thorough discussion of the secondary correction factors included in the model. New corrections for streamline curvature effects applicable to an airfoil where the blade normal plane is not aligned with the rotor plane are derived. The DMS model is successfully validated against experimental data and against higher fidelity lifting line (LLT) simulations. Strong agreement is observed between the LLT simulations and the DMS simulations for both rotor averaged and azimuthally varying outputs, indicating that the DMS simulations can be used for future control simulations.



WindEurope Annual Event 2022 IOP Publishing
Journal of Physics: Conference Series 2257 (2022) 012001 doi:10.1088/1742-6596/2257/1/012001

Aerodynamic modelling of a novel vertical axis wind turbine concept

Laurence Morgan[1] **and William Leithead**[1]
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Abstract. This paper introduces the X-Rotor, a hybrid vertical-horizontal axis turbine concept designed to lower the cost of energy in the floating offshore environment. The development of a double multiple streamtube (DMS) simulation tool is presented alongside a thorough discussion of the secondary correction factors included in the model. New corrections for streamline curvature effects applicable to an airfoil where the blade normal plane is not aligned with the rotor plane are derived.

The DMS model is successfully validated against experimental data and against higher fidelity lifting line (LLT) simulations. Strong agreement is observed between the LLT simulations and the DMS simulations for both rotor averaged and azimuthally varying outputs, indicating that the DMS simulations can be used for future control simulations.

1. Introduction

Up to 80% of the global available resource for offshore wind is located in waters deeper than 60m and is therefore considered uneconomical for fixed bottom wind turbines[1]. This had led to large academic and commercial interest in floating offshore wind turbines (FOWTs), however, the cost of energy for floating offshore wind must be reduced to encourage widespread adoption. The use of Vertical axis wind turbines (VAWTs) has been proposed as an innovative solution to reducing costs for FOWTs, as VAWTs may be more suited to the floating environment due to multiple design synergies. These include a low drive-train position favourable for floating stability, and the compliance of floating support structures damping adverse cyclic loading associated with VAWTs [2]. This has led to resurgence in MW scale VAWT research, including the Deepwind project[3], INFLOW[4], seatwirl[5], SKWID[6], and the NOVA project[7]. A good overview of the current field is given in [8].

The X-Rotor represents a two-step innovation in the design of floating offshore wind, utilising a novel VAWT configuration combined with a secondary rotor power-take-off system. The primary rotor consists of a double V configuration designed to maximise the swept area, minimise the overturning moment typically associated with V-Rotors, and provide attachment points for the secondary rotors. The secondary rotors are utilised as a power-take-off mechanism in lieu of a conventional drive-train to circumvent both the torque ripple, and the low speed/high torque drive-trains that are inherent in conventional VAWT designs. A purely demonstrative representation of the turbine is shown in figure 1. A feasibility study [9] demonstrated that the X-Rotor has potential to reduce operations and maintenance costs by up to 55% and turbine capital costs by up to 32% yielding a cost of energy saving of up to 26%.

1

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Figure 1. A non-technical rendering of the X-Rotor produced by Michael Egan.

The first step in effectively modelling the behaviour of the X-Rotor for control purposes is a fast, accurate model capable of simulating the primary rotor aerodynamics. Aerodynamic modelling of VAWTs is a less mature field than horizontal axis wind turbine (HAWT) modelling, and a number of different modelling paradigms exist including double multiple streamtube (DMS) models [10], actuator cylinder models[11] lifting line theory (LLT) models[12], panel models[13], actuator line models[14], and blade resolved CFD[7]. Whilst some cross code comparisons have shown that DMS models may not always perform accurately[15], other cross code comparisons have shown that they can effectively reproduce both rotor averaged and azimuthally varying results from higher order simulations [16], the experimental validation of DMS codes has also been largely successful [10]. Additionally, DMS models are computationally cheap, and relatively simple to implement. In this context, a bespoke DMS code has been developed at the University of Strathclyde to facilitate the simulation of vertical axis wind turbines with complex geometries and this code has been validated against experimental data and higher order simulations, the development and validation of this tool is presented in this paper.

This paper has the following structure; section 2 will provide an overview of the DMS model development, section 3 will test the validity of the model against experimental data and higher fidelity aerodynamic codes, finally section 4 will conclude the paper, outlining key findings and discussing future work.

The key novel contributions provided by this paper include; the derivation an angle of attack correction to account for streamline curvature in the case where the blade normal plane is not parallel to the rotor plane, a derivation of a conformal map to generate a virtual aerofoil that accounts for streamline curvature in the case where the blade normal plane isn't parallel to the rotor plane, the validation of a newly developed in house DMS code against lifting line theory results for a novel rotor shape using both rotor averaged and azimuthally varying quantities, and the publication of the power coefficients of the X-Rotor primary rotor.

2. DMS modelling

The DMS model was first introduced by Paraschivoiu in 1982 [17] which extended the multiple streamtube model of Strickland [18] to include two sets of actuator surfaces representing the upwind and downwind rotor halves respectively. In this implementation, 2D rotor disks are

2

Figure 15: Initial pages of the Morgan and Leithead (2022) article

McMorland, J., Flannigan, C., Carroll, J., Collu, M., McMillan, D., and Leithead, W.E., Coraddu, A. (2022) A review of operations and maintenance modelling with considerations for novel wind turbine concepts. *Renewable and Sustainable Energy Reviews*, 165. 112581. doi:10.1016/j.rser.2022.112581

Abstract: New wind turbine technologies and designs are being explored in order to reduce the cost of energy from offshore wind farms. Two potential routes to a lower cost of energy are the X- Rotor Concept (XRC) and Multi-Rotor System (MRS) turbines. A key cost saving for both Novel concepts included in this paper is operation and maintenance (O&M) costs savings. The major component replacement cost for conventional horizontal axis, XRC and MRS turbines are examined and the benefits of the concepts are provided in this paper. A review on existing decision support systems for offshore wind farm O&M planning is presented with a focus on how applicable these previous models are to novel turbine concepts, along with analysis of how the influential factors can be modified to effectively model XRC and MRS.

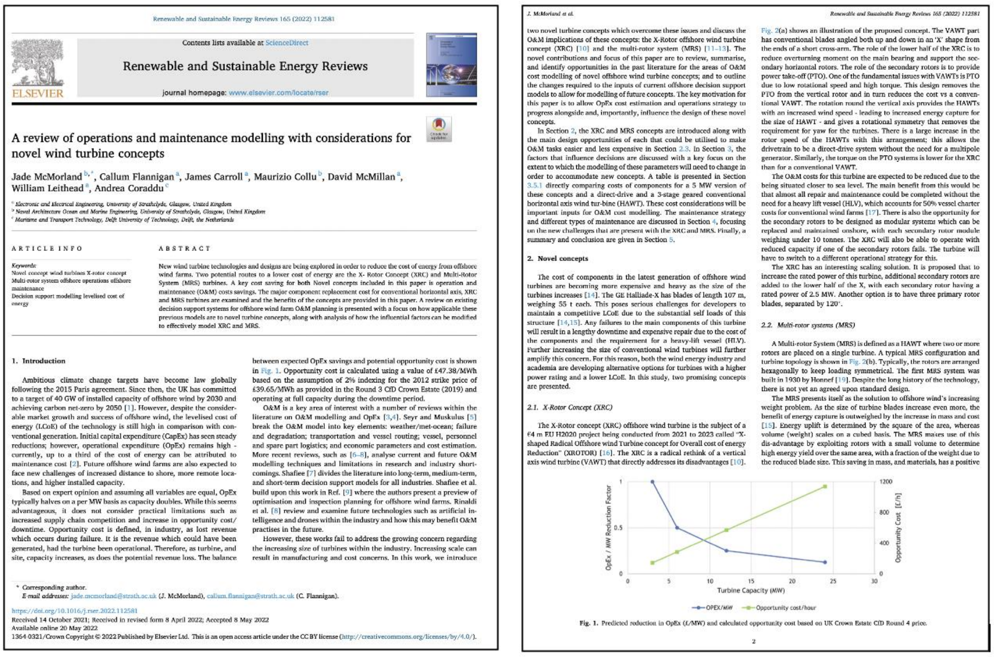
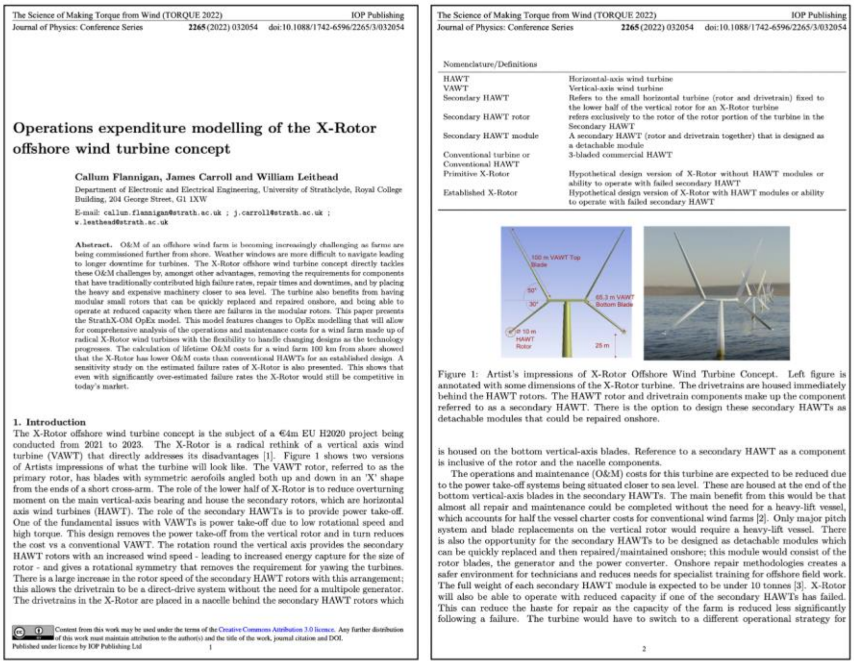


Figure 16: Initial pages of the McMorland *et al.,* (2022) article

Flannigan, C., Carroll, J., Leithead, W.E (2022). 'Operations expenditure modelling of the X-Rotor offshore wind turbine concept'. *Journal of Physics: Conference Series*, 2265: 032054 doi:10.1088/1742-6596/2265/3/032054

Abstract: O&M of an offshore wind farm is becoming increasingly challenging as farms are being commissioned further from shore. Weather windows are more difficult to navigate leading to longer downtime for turbines. The X-Rotor offshore wind turbine concept directly tackles these O&M challenges by, amongst other advantages, removing the requirements for components that have traditionally contributed high failure rates, repair times and downtimes, and by placing the heavy and expensive machinery closer to sea level. The turbine also benefits from having modular small rotors that can be quickly replaced and repaired onshore, and being able to operate at reduced capacity when there are failures in the modular rotors. This paper presents the StrathX-OM OpEx model. This model features changes to OpEx modelling that will allow for comprehensive analysis of the operations and maintenance costs for a wind farm made up of radical X-Rotor wind turbines with the flexibility to handle changing designs as the technology progresses. The calculation of lifetime O&M costs for a wind farm 100 km from shore showed that the X-Rotor has lower O&M costs than conventional HAWTs for an established design. A sensitivity study on the estimated failure rates of X-Rotor is also presented. This shows that even with significantly over-estimated failure rates the X-Rotor would still be competitive in today's market.



The Science of Making Torque from Wind (TORQUE 2022) IOP Publishing
Journal of Physics: Conference Series **2265** (2022) 032054 doi:10.1088/1742-6596/2265/3/032054

Operations expenditure modelling of the X-Rotor offshore wind turbine concept

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Abstract. O&M of an offshore wind farm is becoming increasingly challenging as farms are being commissioned further from shore. Weather windows are more difficult to navigate leading to longer downtime for turbines. The X-Rotor offshore wind turbine concept directly tackles these O&M challenges by, amongst other advantages, removing the requirements for components that have traditionally contributed high failure rates, repair times and downtimes, and by placing the heavy and expensive machinery closer to sea level. The turbine also benefits from having modular small rotors that can be quickly replaced and repaired onshore, and being able to operate at reduced capacity when there are failures in the modular rotors. This paper presents the StrathX-OM OpEx model. This model features changes to OpEx modelling that will allow for comprehensive analysis of the operations and maintenance costs for a wind farm made up of radical X-Rotor wind turbines with the flexibility to handle changing designs as the technology progresses. The calculation of lifetime O&M costs for a wind farm 100 km from shore showed that the X-Rotor has lower O&M costs than conventional HAWTs for an established design. A sensitivity study on the estimated failure rates of X-Rotor is also presented. This shows that even with significantly over-estimated failure rates the X-Rotor would still be competitive in today's market.

1. Introduction

The X-Rotor offshore wind turbine concept is the subject of a €4m EU H2020 project being conducted from 2021 to 2023. The X-Rotor is a radical rethink of a vertical axis wind turbine (VAWT) that directly addresses its disadvantages [1]. Figure 1 shows two versions of Artists impressions of what the turbine will look like. The VAWT rotor, referred to as the primary rotor, has blades with symmetric aerofoils angled both up and down in an 'X' shape from the ends of a short cross-arm. The role of the lower half of X-Rotor is to reduce overturning moment on the main vertical-axis bearing and house the secondary rotors, which are horizontal axis wind turbines (HAWT). The role of the secondary HAWTs is to provide power take-off. One of the fundamental issues with VAWTs is power take-off due to low rotational speed and high torque. This design removes the power take-off from the vertical rotor and in turn reduces the cost vs a conventional VAWT. The rotation round the vertical axis provides the secondary HAWT rotors with an increased wind speed - leading to increased energy capture for the size of rotor - and gives a rotational symmetry that removes the requirement for yawing the turbines. There is a large increase in the rotor speed of the secondary HAWT rotors with this arrangement; this allows the drivetrain to be a direct-drive system without the need for a multipole generator. The drivetrains in the X-Rotor are placed in a nacelle behind the secondary HAWT rotors which

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Journal of Physics: Conference Series **2265** (2022) 032054 doi:10.1088/1742-6596/2265/3/032054

Nomenclature/Definitions	
HAWT	Horizontal-axis wind turbine
VAWT	Vertical-axis wind turbine
Secondary HAWT	Refers to the small horizontal turbine (rotor and drivetrain) fixed to the lower half of the vertical rotor for an X-Rotor turbine
Secondary HAWT rotor	refers exclusively to the rotor of the rotor portion of the turbine in the Secondary HAWT
Secondary HAWT module	A secondary HAWT (rotor and drivetrain together) that is designed as a detachable module
Conventional turbine or Conventional HAWT	3-bladed commercial HAWT
Primitive X-Rotor	Hypothetical design version of X-Rotor without HAWT modules or ability to operate with failed secondary HAWT
Established X-Rotor	Hypothetical design version of X-Rotor with HAWT modules or ability to operate with failed secondary HAWT

Figure 1: Artist's impressions of X-Rotor Offshore Wind Turbine Concept. Left figure is annotated with some dimensions of the X-Rotor turbine. The drivetrains are housed immediately behind the HAWT rotors. The HAWT rotor and drivetrain components make up the component referred to as a secondary HAWT. There is the option to design these secondary HAWTs as detachable modules that could be repaired onshore.

is housed on the bottom vertical-axis blades. Reference to a secondary HAWT as a component is inclusive of the rotor and the nacelle components.

The operations and maintenance (O&M) costs for this turbine are expected to be reduced due to the power take-off systems being situated closer to sea level. These are housed at the end of the bottom vertical-axis blades in the secondary HAWTs. The main benefit from this would be that almost all repair and maintenance could be completed without the need for a heavy-lift vessel, which accounts for half the vessel charter costs for conventional wind farms [2]. Only major pitch system and blade replacements on the vertical rotor would require a heavy-lift vessel. There is also the opportunity for the secondary HAWTs to be designed as detachable modules which can be quickly replaced and then repaired/maintained onshore; this module would consist of the rotor blades, the generator and the power converter. Onshore repair methodologies creates a safer environment for technicians and reduces needs for specialist training for offshore field work. The full weight of each secondary HAWT module is expected to be under 10 tonnes [3]. X-Rotor will also be able to operate with reduced capacity if one of the secondary HAWTs has failed. This can reduce the haste for repair as the capacity of the farm is reduced less significantly following a failure. The turbine would have to switch to a different operational strategy for

2

Figure 17: Initial pages of the Flannigan *et al.,* (2022) article

4 Accepted abstracts – upcoming conference contributions

<u>Oral presentations</u>

Bensason, D., van Kan, F., Sciacchitano, A., Ferreira, C. (2022) 'Actuator disks on a vertical-axis wind turbine: a step towards the X-ROTOR' NAWEA/WindTech Conference, University of Delaware, USA. 20-22 September.

Giri Ajay, A., Ferreira, C., de Breuker, R. (2022). Aeroelastic analysis of an X-shaped vertical axis wind turbine. NAWEA*/WindTech Conference,* University of Delaware, USA. 20-22 September.

5 Looking Forward – communication and dissemination activities

As we move into the second half of the project communication and dissemination activities will be intensified as results emerge from the research and outputs are produced by the project. The overall strategy for these activities remains that outlined in earlier deliverables (D9.2 Definition of Dissemination activities, D9.3 General Comms. Material Development), key elements of which are presented below.

Communication

- Maintenance and regular updating of website https://xrotor-project.eu. Development of YouTube channel to promote the project and disseminate outcomes in conjunction with the website.
- Intensification of social media activities – Twitter (@XRotorProject) and researcher LinkedIn accounts – in particular to link in with the participation at events and publishing of project outputs.
- Distribution of project newsletter disseminating news from the project and the project participants.
- Prepare and distribute at least three media communications, providing an overview of project and information on key project results to be disseminated to news outlets and general public.
- Beneficiaries will also continue to use their own communication portals and tools to point out relevant public project results and to announce upcoming events (*e.g.* conferences) where the X-ROTOR project will be represented.

Conferences

X-ROTOR project outputs and findings will be disseminated at international and national conferences. The aim is to widen the environment in which the proposed solutions are conceived, developed and promoted during the project and beyond, increasing the outreach potential of project results to ultimately increase the rapid commercialisation of the technology. Target events include:

- WindEurope Annual Event Conference & Exhibition. Leading onshore and offshore wind conference for the wind energy industry.
- European Academy of Wind Energy (EAWE) Wind energy Science Conference (WESC). Leading scientific conference for wind energy research.
- EAWE Torque. Leading scientific conference for wind energy drive train research.
- American Wind Energy Association (AWEA) annual conference. Leading onshore and offshore conference in the USA.
- Institution of Engineering and Technology (IET) Renewable Power Generation (RPG) annual conference. Leading Wind Energy Conference in EU and China.
- RenewableUK Offshore Wind Energy. Focus on UK offshore wind the world's largest market.
- AllEnergy. Focus on UK renewable energy.

Journal publications

Dissemination of scientific findings will be an important part of the project. Scientific publications and presentations will be targeted in relevant journals. The aim is to have an average of three journal articles per partner by the end of the project. Target journals include:

- Wiley Wind Energy
- Elsevier Renewable Energy
- Renewable and Sustainable Energy Reviews
- IEEE Transactions on Sustainable Energy
- IEEE Transactions on Energy Conversion
- IEEE Transactions on Power Systems
- IET Renewable Power Generation Journal
- Wind Energy Science
- Journal of Energy and Power Engineering
- Energy Research and Social Science

Workshops

End User Technical workshop will be a platform for the project team to present the project's annual results and take recommendations & guidance from industry on project methodology, results and next steps. This activity is to ensure that the X-ROTOR concept is aligned with industry standards and will provide a wider industrial view supplementing the regular industry engagement and ratification work done in this area throughout the project with GE, as detailed in WP8. In addition, it is envisaged that joint workshops will be held with other related and cross-sector projects to disseminate experiences, knowledge and results. Some will focus on academic interests and others on business and industrial stakeholders.

Participation in Events

Links to relevant industry associations and technology platforms will be used for dissemination, these will be links to associations and organisations such as EERA JP WIND, EAWE, and IEA) and Technology Transfer Institutions such as SINTEF, OREC, *etc*.

Final Project Event

The coordinator will organise a final dissemination event, presenting the key project results at the European level. All project stakeholders will be invited to this event with an emphasis being placed on stakeholders necessary for further and accelerated development of the X-Rotor, specifically existing wind turbine OEM's and investors.