The LiftWEC Newsletter

A HORIZON 2020 PROJECT DEVELOPING A NOVEL LIFT-BASED WAVE ENERGY CONVERTER

Welcome to LiftWEC!

LiftWEC is a Horizon 2020 Research Project focused on the development of a lift-based Wave Energy Converter. This is the second LiftWEC Project Newsletter. Here you will find an introduction to the LiftWEC project and consortium, as well as some highlights of the ongoing research activities.

Find Out More Online!

If you would like to find out more about the LiftWEC project or our research, check out our website at:

https://www.liftwec.com/

Here you will find details about the project and consortium as well as regular news updates, downloads, project data and other interesting things.

Contact Us!

If you are interested in the work of LiftWEC, or if you would like to get involved, get in touch! We would love to hear from you! Email us at:

General@LiftWEC.com

Or click below to find us on social media:

Project Outline

The LiftWEC Project is a Horizon 2020 research project that focuses on the development of a novel type of Wave Energy Converter called 'LiftWEC'. LiftWEC seeks to extract ocean wave energy through the generation of hydrodynamic lift forces on one or more rotating hydrofoils.

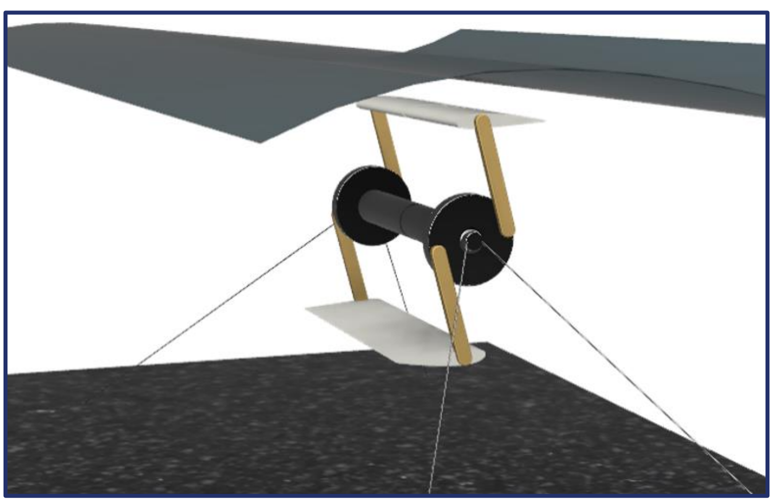
This radically different approach to the design of Wave Energy Converters offers many technical advantages and provides the opportunity of opening up new pathways for the development of Wave Energy as a commercially viable means of energy generation.

For more information visit: https://www.liftwec.com/

Project Approach

The LiftWEC project will develop one or more Wave Energy Converter concepts that extract ocean wave energy through the exploitation of lift forces generated by one or more rotating hydrofoils. This will be achieved through an iterative design process consisting of cyclic knowledge building and re-integration for further refinement of the concept. The LiftWEC project will see the system taken from its initial conception at Technology Readiness Level 1 up to Technology Readiness Level 4.

A co-design approach will be used which will incorporate design knowledge and requirements from a wide variety of perspectives including hydrodynamics, structures, control, operations & maintenance, cost of energy, environmental interactions and social acceptance. Essentially, the project consortium will seek to develop the LiftWEC concept taking a whole-systems approach to design, where representatives from as many stakeholder groups as possible will be sought to feed into the development. In this way, it is hoped that previous lessons learned by the marine renewables industry can be incorporated into the design of LiftWEC from the earliest possible stage and that many of the unforeseen pitfalls experienced by previous developers can be avoided as the system moves towards the prototype testing stage.



During the project it is expected that a large bank of knowledge and data will be produced relating to the design and operation of lift-based Wave Energy Converters. It is intended that as much of this information as possible will be made available in an open-source and open-data format, so please feel free to get involved. Check the website and social media for updates, get in touch with the consortium and feel free to make use of project data as it becomes available.

Project Consortium

If you are reading the digital edition of the newsletter, click on any project partner logo to head directly to their own home page.

Project Work Streams

The following sections introduce the various work streams of the LiftWEC project. For more information see the LiftWEC website or get in touch!

CONCEPTUAL DESIGN

LED BY: QUEEN'S UNIVERSITY BELFAST

The Conceptual Design work stream is intended to ensure the success of the whole-system approach taken to LiftWEC's development through; (1) the generation of specific knowledge required to answer outstanding design questions, and (2) collation of learning from all other work streams to inform best practice design in an interdisciplinary manner.

A three-day workshop was held to gather knowledge relating to the design of possible LiftWEC systems. At the culmination of this workshop, 17 separate potential configurations were proposed for further investigation and critical assessment. It was found that each configuration could be broken down into a set of inter-operable sub-systems. It was therefore decided that further work should focus on developing the understanding of the design requirements and implications of decisions made relating to the intended function of each particular sub-system, as opposed to constraining work to focus on the specific mechanical implementations contained within the 17 configurations.

In addition, a set of concept design and evaluation software tools have also been produced. These currently exist in pre-release Beta forms. The concept design tools are intended to permit a first-pass assessment of the hydrodynamics of a given LiftWEC system using first-principle physical representations. The concept evaluation tool is intended to provide a means of ranking LiftWEC configuration and subsystems to identify those with greatest commercial potential. Details of the intended functionality of these tools is presented in LiftWEC Deliverable D2.4 "Specification of Design & Evaluation Support Tools".

Deliverable D2.4

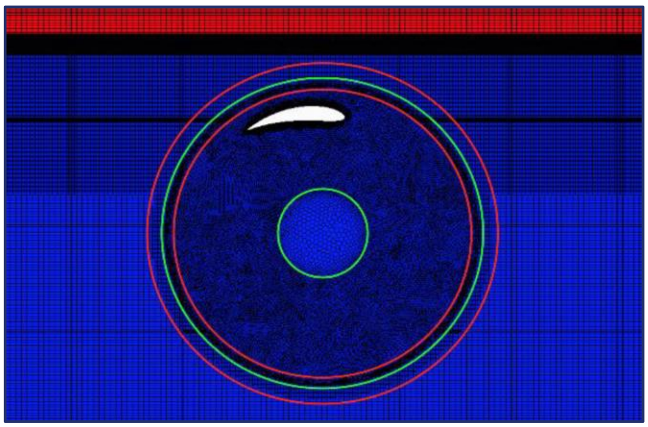
HYDRODYNAMIC MODELLING

LED BY: HAMBURG UNIVERSITY OF TECHNOLOGY

Recent work on hydrodynamic modelling has focused on assessing the computational capabilities of the numerical toolsets developed during the first phase of the project, followed by preliminary validation of the high-fidelity numerical methods. More detail on these works is presented in Deliverable D3.2 "Preliminary Assessment of Computational Capability".

Deliverable D3.2

Results obtained from the first set of validation simulations show excellent agreement with experimental model test data obtained from the literature. It was found that despite the small scale and Reynolds Number of these experiments (1:300, Re < 10e5), the influence of the boundary layer on hydrofoil-free surface interactions remains low. This suggests that potential flow models might prove capable of estimating system performance with reasonable accuracy, even at model scale.



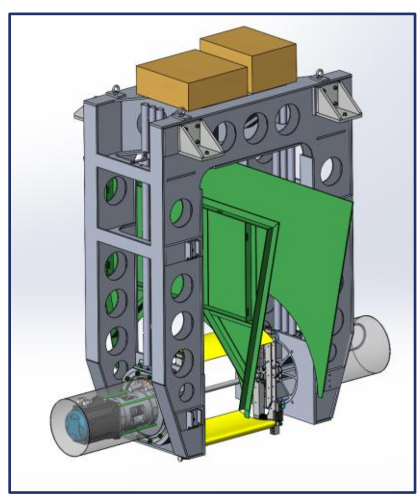
While the high-fidelity models are currently being used for investigation of specific effects such as foil-wake interaction and assisted design of the physical models and test programme, the global model has been further developed towards a holistic consideration of the LiftWEC device. The current goal for development of the global model is to permit the estimation of the annual energy production of the various potential LiftWEC device configurations under consideration.

PHYSICAL MODELLING

LED BY: LHEEA CENTRALE NANTES

Over the last six months the physical modelling work stream has focused on the design of the 2D LiftWEC experimental model and specification of the 2D physical test campaign which will produce experimental data for the validation of the numerical tools developed in the project. The model has been designed to permit testing of configurations with either one or two hydrofoils and allows for user variation of both hydrofoil pitch and operational radius on a per sea-state basis.

The rotor can be controlled using either speed or torque control and can be driven if required. Quantities measured will include the power take off torque, radial and tangential loads on each foil, angular position of the rotor and wave elevation upstream and downstream of the model.



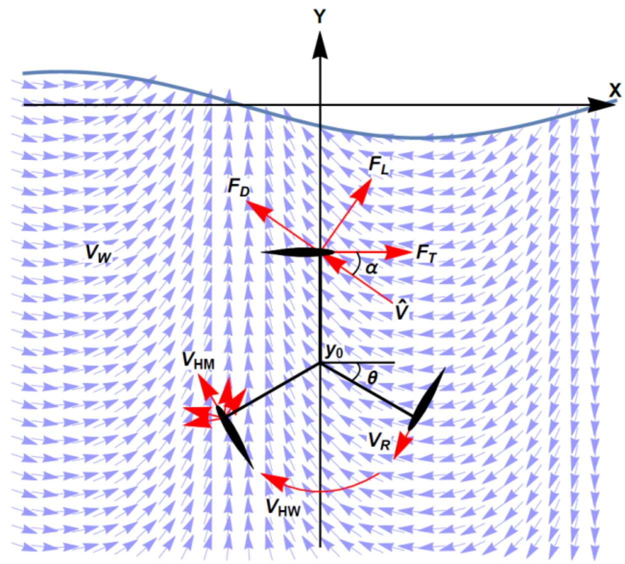
The physical testing will be conducted in the ECN towing tank within a narrow "sub-channel" made of partition walls, which will locally reduce the flume width. The idea behind this approach is to allow the use of a tank capable of generating large waves while keeping the width of the device, and hence the loads experienced, more manageable, thus reducing complexity and costs.

CONTROL SYSTEM DESIGN

LED BY: NUI MAYNOOTH

Work on the control system design has focused on the development of a new analytical model which can be used to develop model-based control systems for the LiftWEC device. The mechanical model is based on Newton's second law for rotation. Rotation is considered in two-dimensional potential flow for both monochromatic and panchromatic waves, including waves generated by the rotating rotor, and including accountancy for viscous losses.

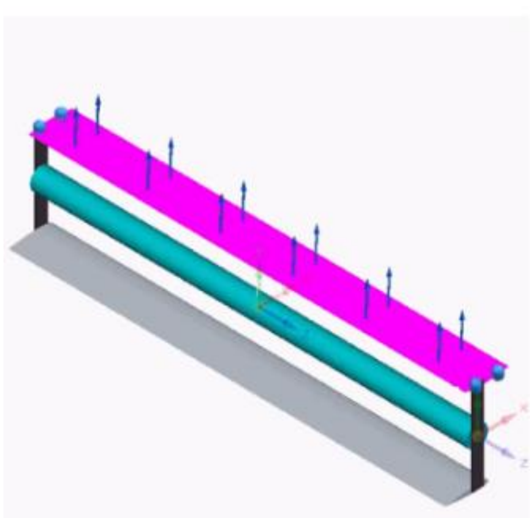
In developing this model, a set of new, exact analytic functions have been derived which give the free surface perturbation and induced fluid velocity field caused by hydrofoil rotation. These new formulae significantly decrease model calculation time and increase the accuracy of results compared to earlier approximations. The new equations have been successfully validated against both physical and numerical results published by two independent research groups. The potential representation of hydrofoils as both point sources and thin chords has been investigated during this work. A number of academic articles detailing these works are currently under review for publication.



LED BY: UNIVERSITY OF STRATHCLYDE

STRUCTURAL DESIGN

Recent work on structural design includes the Ultimate Limit State (ULS) analysis of LiftWEC subject to operational and non-operational loads. Results have been presented in both Deliverable D6.1 "Extreme Event LiftWEC ULS Assessment" and Deliverable D6.2 "Transportation and Maintenance LiftWEC ULS Assessment". One notable highlight is the development of the first documented coupled structural-hydrodynamic model for wave bladed cyclorotors. The model outputs the instantaneous bending stresses and deformations of the LiftWEC hydrofoils subject to different sea-states. Secondly, a pioneering analysis completed in collaboration with Innosea details the types of loads that could be encountered during transportation and maintenance operations. The coupled results suggest that the design of LiftWEC should be governed by operational requirements, rather than by transportation and maintenance requirements.



Deliverable D6.1

Deliverable D6.2

OPERATIONS & MAINTENANCE

LED BY: UNIVERSITY COLLEGE CORK

Deliverable D7.2

Work on the Operations & Maintenance (O&M) of LiftWEC systems to date has been centred on developing the O&M simulation tool, OM Expert. OM Expert is a cloud-based application coded under the Microsoft .NET framework which can be used to assess the O&M requirements of a given system. A detailed description of the implementation of OM Expert for the LiftWEC system can be found in LiftWEC Deliverable 7.2 "Operations & Maintenance Model Development". The model takes as main inputs the number of WECs in a farm, power capture characteristics, met-ocean data, failure rates and available vessel fleet and technicians. The model calculates expected downtime, average energy yield as well as costs associated with repairs.

Deliverable D7.3

A broad assessment of the O&M requirements of various possible LiftWEC implementations is given in LiftWEC Deliverable D7.3 "Operations & Maintenance Assessment of Preliminary Configurations". Preliminary investigations on the proposed deployment site used for viability assessment reveal that the site is quite energetic. An exposed Atlantic site is promising for raw energy potential but more restrictive in terms of available weather windows for offshore work. It was found that using conventional vessels, utilising quick "plug and play" installation techniques was more cost effective than utilising expensive heavy lift vessels. Future work will tie this and other findings into the recommended design criteria for LiftWEC systems.

LED BY: AALBORG UNIVERSITY

LEVELIZED COST OF ENERGY

The latest work on the Levelised Cost of Energy (LCoE) has focused on identifying and facilitating discussions on the most significant potential cost saving measures available to the LiftWEC technology. This analysis will continue throughout the LiftWEC development pathway. To assess the economic performance of the different LiftWEC concepts - or any concept at low TRL level - is not trivial. A guide has been developed in order to approach this problem. Technology agnostic cost centre breakdowns for both CAPEX and OPEX have been derived from the cost database compiled within the project. This cost database has been made publicly available for use and can be found on the LiftWEC Project repository[1]. By using common figures for the discount rate and capacity factor, cost ranges for different cost centres can be defined in order to reach a target LCoE. This approach is expected to assist decision-making during evaluating of different LiftWEC concepts.

The System Lifetime tool from the DTOceanPlus project[2] has also been used to calculate the LCoE of the Atargis CycWEC device and results compared both with what has been stated in the literature and what was previously calculated using the Cost of Energy Calculation Tool developed within the LiftWEC project[3]. The results were very similar, suggesting the tool developed within the LiftWEC project provides meaningful and accurate results.

[1] https://zenodo.org/record/4442080#.YH7iHuhKiCg
[2] https://www.dtoceanplus.eu/content/download/4457/file/DTOceanPlus_D6.4_System_Lifetime_Costs_WavEC_20191219_v1.0.pdf
[3] https://vbn.aau.dk/files/197329239/WECs_COE_Calculation_Tool_ver1.6_4_April_2014.xls

ENVIRONMENTAL & SOCIAL ACCEPTANCE

LED BY: WAVEC

Deliverable D9.1

Work on the environmental and social acceptance of LiftWEC has continued to seek and assess relevant environmental and social influences on LiftWEC design criteria as outlined in Deliverable 9.1: "Identification of potential technology stressors and environmental receptors of the LiftWEC technology". This report identifies potential wave energy technology stressors on environmental and socioeconomic receptors and suggests possible mitigation measures to address those impacts.

In addition, work has also begun on completing an Environmental Impact Assessment scoping exercise for the LiftWEC technology, which will include identification of potential environmental impacts to be considered, a list of possible mitigation measures to be implemented during all project phases and the main type of monitoring activities to be undertaken during a prototype and pre-commercial testing phase of the LiftWEC device.

Work is also ongoing on completion of a literature review on the latest Life Cycle Assessment (LCA) studies carried out in the marine renewable energy sector, and the development of a template to request data from partners on the LiftWEC configuration (life cycle stages, components and sub-components, materials, processes, transport) for the LCA methodology.

Get Involved!

Do you have an idea for a lift-based Wave Energy Converter that you would like to explore? Do you have any thoughts on the potential viability of a lift-based system? Do you have experience that you think would help the development of this type of device? If so, get in touch – we would love to hear from you!

Email us at:

General@LiftWEC.com

Alternatively, you can follow us on social media by clicking on the icons to the right.

If you would like to learn more about the LiftWEC project, visit our project website at:

https://www.liftwec.com/

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