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 first LiftWEC Project Newsletter. Here you will find an introduction to the LiftWEC project and consortium, as well as some highlights of the ongoing project 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.

LiftWEC

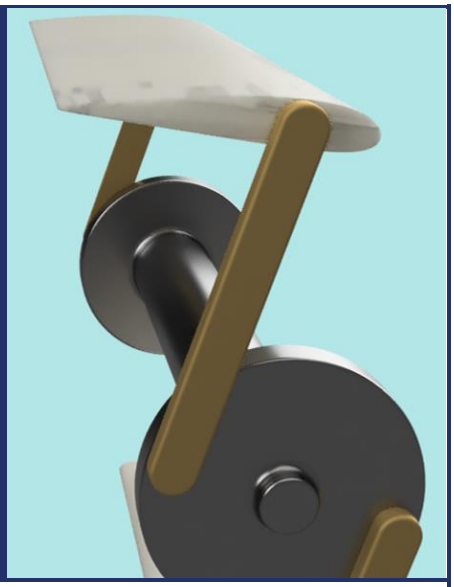
Contact Us!

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.

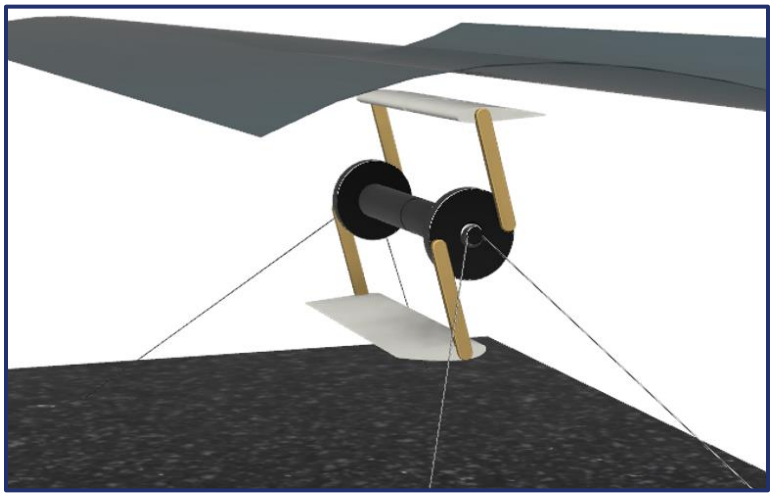
This radically different approach to the design of Wave Energy Converters offers many technical advantages and provides the opportunity of opening up new pathways for the development of Wave Energy as a commercially viable means of energy generation.

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

The entire LiftWEC project is centred around the Concept Design work stream, with all other project activities being directed by, and feeding back into this stream. All project partners contribute to the Concept Design, ensuring that specialist knowledge is acquired from all target areas and equally considered during the design and development of LiftWEC systems.

To provide guidance for the project, Deliverable D2.1 "Preliminary Report on Synthesis of Design Knowledge" has been produced which identifies critical elements of design knowledge which must be generated to develop an understanding of the LiftWEC system's characteristics and design requirements. Deliverable D2.2 "Identification of Evaluation Criteria" has also been produced which outlines the evaluation criteria which are proposed for use during assessment of potential LiftWEC configurations. A literature review of pre-existing lift-based Wave Energy Converters was presented in Deliverable D2.3 "Review of current Lift-based WEC concepts and specification of preliminary configuration" along with a report on the outcomes from the first LiftWEC Project Workshop.

At present, work on the Conceptual Design is focused on the development of a suite of Concept Design and Concept Evaluation support tools which will be used to investigate and evaluate the performance characteristics of lift-based Wave Energy Converters and potential LiftWEC systems.

To access the public deliverables produced visit the LiftWEC website or click on the icons below:

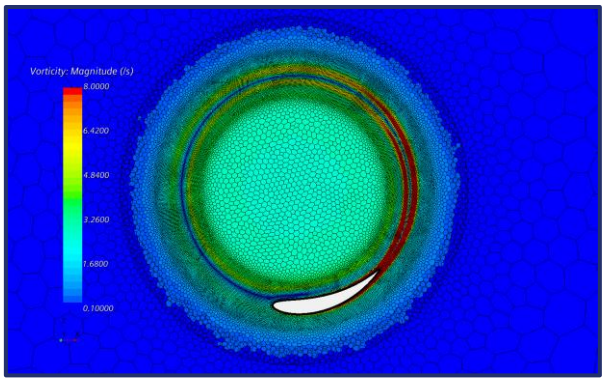
Deliverable D2.1 Deliverable D2.2 Deliverable D2.3

HYDRODYNAMIC MODELLING

Hydrodynamic modelling will be used to investigate the hydrodynamics of lift-based Wave Energy Converters and to analyse the performance of potential LiftWEC systems. A variety of numerical models will be developed to achieve these goals. These will range from low-fidelity, global models which will employ analytical and semi-analytical methods to investigate long term performance, to high-fidelity RANS simulations which will be used to investigate finer details of the fluid-structure interaction.

Three separate numerical methods will be developed in the LiftWEC project. These are:

1. A lifting-line model coupled to a panel method (termed the Global Model),
2. A non-linear Rankine-type panel method, and
3. A RANS-based Computational Fluid Dynamics method.

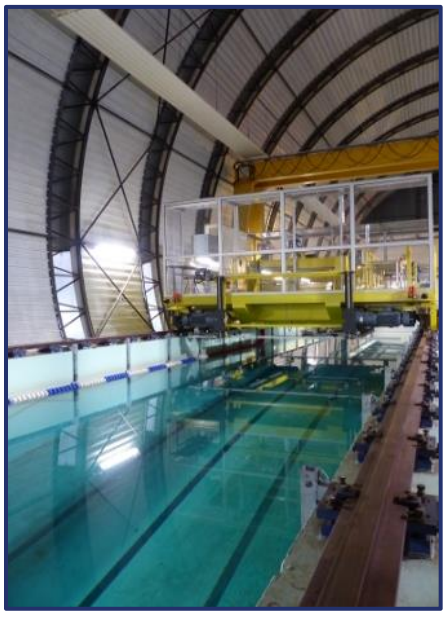


First test runs to assess the capabilities of each tool have been conducted and validation and verification exercises completed using the available literature. The Global Model, which consists of the lifting-line model coupled to a panel method, has been successfully tested in a wide variety of coupled simulations which cover the range of hydrodynamic conditions likely to be encountered by the LiftWEC system. Work is ongoing to extend the functionality of this and the other models.

PHYSICAL MODELLING

Wave tank testing, both 2D and 3D, will be used to inform the design of lift-based Wave Energy Converters and to calibrate/validate the numerical and analytical models developed.

The majority of physical modelling work to date has focused on engaging with other partners working on the hydrodynamic numerical modelling, structural modelling and control system development to ensure that the physical modelling conducted will be capable of providing the necessary data for calibration and validation of the various simulations.

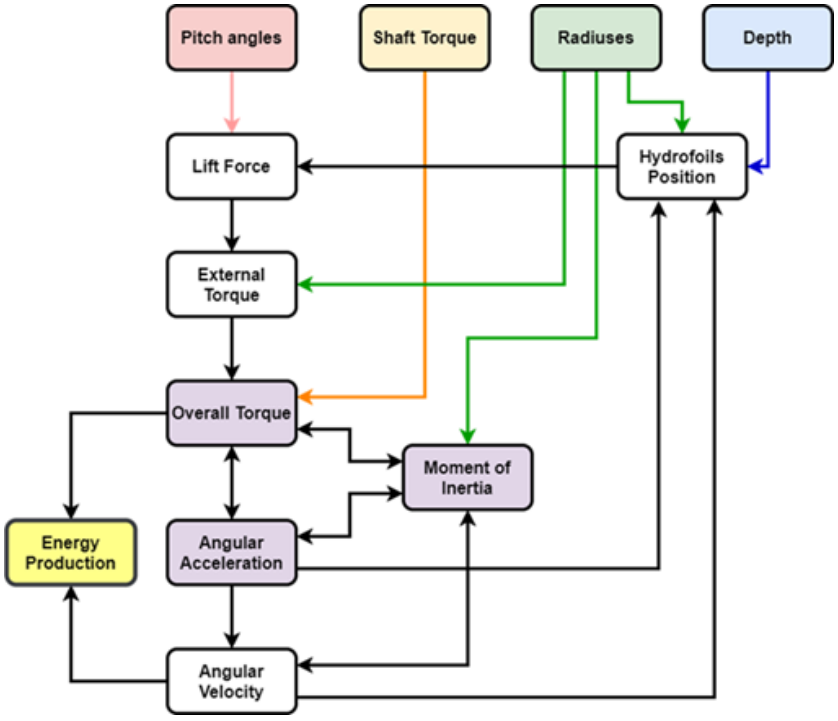


It is anticipated that the 2D experiments will be carried out at the ECN towing tank (see adjacent picture). The size of the facility (140m long by 5m wide and 3m deep) allows the generation of comparatively large waves and associated water particle motions. This should maximise the Reynolds number of the flow around the model foils to minimize the influence of scale effects; although it is anticipated that these will still have to be accounted for in the design of both the physical models and testing programme.

CONTROL SYSTEM DESIGN

The requirements and potential for the use of control in lift-based Wave Energy Converters consisting of a series of rotating hydrofoils will be investigated as part of the LiftWEC Project. This will involve consideration of not only the electro-potential mechanical control elements, but also consideration of the possible goals of control through the development of a suitable Performance Function for the LiftWEC system.

The parametric structure of the Performance Function for potential LiftWEC systems has been produced and is presented in Deliverable D5.1 "Determination of Performance Function Parametric Structure". This parametric structure outlines the components that make up the idealised LiftWEC Performance Function and examines the extent to which such components can be represented as functions of the control inputs for the LiftWEC system.



Control System Design work is currently focused on the development of the control strategy for potential LiftWEC systems using a control-orientated numerical model. These tools will then be used as the basis for control design as outlined in the adjacent figure.

Deliverable D5.1

STRUCTURAL DESIGN

This work will provide guidance on the desirable design characteristics of lift-based Wave Energy Converters from a structural design perspective, feeding directly into the Conceptual Design work stream and taking calibration and validation data from numerical and physical modelling works.

Once the structural requirements of a typical LiftWEC system have been established they will be used to develop a best-practice approach to structural design and to hypothesize on beneficial/detrimental system characteristics from a structural perspective. This in turn will feed directly into the development of potential LiftWEC systems. It is intended that this work should identify key structural design drivers and thus inform on preferable structural arrangements and the influence of hydrodynamic decisions on the structural loading expected. The work will be conducted for both operational and extreme conditions and will conduct both Ultimate Limit State and Fatigue assessments of potential LiftWEC systems.

OPERATIONS & MAINTENANCE

With regards to Operations and Maintenance (O&M), the project aim is to identify the device design requirements associated with O&M activities at an early stage such that the need for retrospective changes made at a later date is significantly reduced and thus will hopefully not result in significant unforeseen impacts on system performance or viability.

Deliverable D7.1

All operational phases of the LiftWEC concept will be considered and used to provide feedback to the Conceptual Design work stream. This input will ensure that the LiftWEC concepts developed are feasible from an O&M perspective even at the point of their inception.

To begin this work, a series of interviews have been conducted focusing on acquiring key insights from existing wave energy developers and other offshore industries. The outcomes from these interviews are anonymously reported in Deliverable D7.1 "Operational Design Considerations". To briefly summarise, the following recommendations outline some of what the interviewees felt were the most prevalent points of learning:

- Keep the device as simple as possible,
- Design for redundancy such that there is no single point of failure,
- Try to use conventional vessels in the lifecycle phases, as vessels are the main cost penalty,
- Have a well-planned installation and O&M strategy developed as early as possible.

The next stage of the O&M work will involve investigating preliminary configurations through a more detailed financial analysis and identifying the pros and cons from an operations perspective. This will require an adept O&M tool which is currently in development.

LEVELIZED COST OF ENERGY

Work on the Levelized Cost of Energy seeks to identify and feedback on the most significant potential cost saving measures available to the LiftWEC technology as it progresses through its developmental pathway.

To support the calculation of the Levelized Cost of Energy (LCoE), a cost database for a wave energy farm has been compiled using a literature review which has been completed and is presented in Deliverable D8.1 "Cost Database". This contains data for the different cost centres that comprise a wave energy farm; development and consenting, structure and prime mover, installation and commissioning, operation and maintenance, decommissioning and site lease and insurance.

Deliverable D8.1

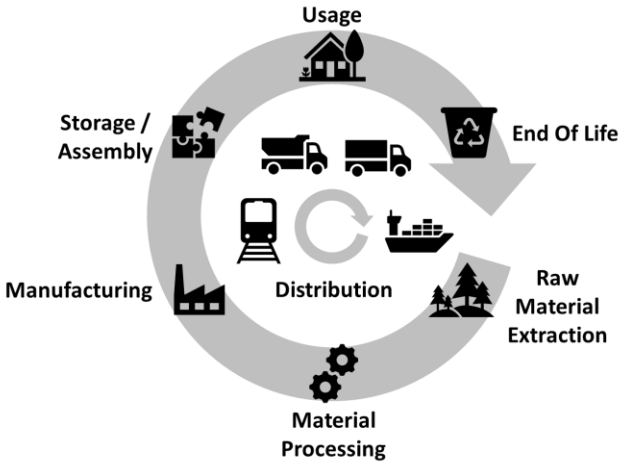
The Cost of Energy tool developed by Julia F. Chozas and AAU[1] has also been used to calculate the LCoE of the Atargis CycWEC device to compare results with what has been stated in the literature. The results were very similar. This exercise was used to validate the tool to be used throughout the LiftWEC project and identify possible refinements.

[1] https://vbn.aau.dk/files/197329239/WECs_COE_Calculation_Tool_ver1.6_4_April_2014.xls

ENVIRONMENTAL & SOCIAL ACCEPTANCE

Development of the LiftWEC technology requires identification of potential environmental and social impacts at the design stage. In this way, relevant findings on the potential Environmental and Social Impact of the system can be considered within the design and attempts made to mitigate or alleviate these concerns before significant spending is already underway or unexpected changes need to be made at a point where they significantly impact the system's viability.

A preliminary literature review has been completed to identify the potential environmental and social concerns arising within other ocean energy projects. This work is feeding into the completion of an Environmental Impact Assessment for a potential LiftWEC system. Combined with the ongoing completion of a Life Cycle Assessment, these works have established the foundations of a catalogue which will identify and detail the potential technology stressors and environmental receptors of potential LiftWEC systems. An outline of the complete lifecycle, or 'cradle-to-grave', approach taken to the assessments is presented in the adjacent figure. Work on the Social Acceptance of the LiftWEC technology will begin in the coming months.



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.

Or if you would like to learn more, feel free to visit our project website:

https://www.liftwec.com/

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