Feasibility Assessment of an Ocean Wave Energy Converter: The Plug-and-Play 3D Prototype Development

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Poster Summary:

Marine renewable power plants are facing the "Grand Challenge" to incorporate substantial demands on the reliability and built-in redundancy, uptime and safety of the technology for distributing, delivery and control applications. The offshore industry has experienced a clear trend for production facilities to be installed in a water depth and seabed. There are several advantages for installing process equipment close to the source of the product, for instance in wave energy harvesting plants. Currently, each item of process equipment is individually powered from the surface/ shore which is reliable but very costly solution.
As the demand for more reliable and secure marine power systems with greater power quality to be delivered steadily increases, the concepts of Wave Energy Converters (WECs) have become progressively more popular [1, 2].

We present a novel scalable Point-absorbing Ocean Deepwater (POD) energy converter instantaneously transforms power in a wave surge into pneumatic power and further enables the transfer of energy onto a flywheel of sufficient rotational inertia. The stored flywheel energy is extracted as electric power via regenerative braking and conditioned for power delivery to either grid or non-grid applications. The costs associated with a technology for non-grid application are a point of reference in the proposed study.
An exemplary application of the novel and revolutionary POD wave energy converter is illustrated in Figure 1.

Key attributes of the POD energy converter which is bio-inspired by nature are:

a) Demonstrate a proof-of-concept of a wave energy converter, and show the feasibility for designing, fabricating, and testing of 3D prototypes, b) Show by model building experiments aspects of scalable functionality, reliability, and manufacturability using advanced manufacturing techniques, c) Advance the outcomes of the competition to an early college entry program.

Figure 2 presents key features of the studied design concept.

To summarize, the empowerment promise for the topic of interest is consistent with the following blue economy markets:

- Isolated Power Systems: Community Microgrids
- Coastal Resiliency and Disaster Recovery
- Ocean Observation and Navigation
- Offshore Desalination Plant

The intention of this project is to bring Marine Energy, particularly wave energy converter knowledge and industry connections to our university and create an opportunity where students can gain hands-on experience, particularly in emerging marine energy applications.

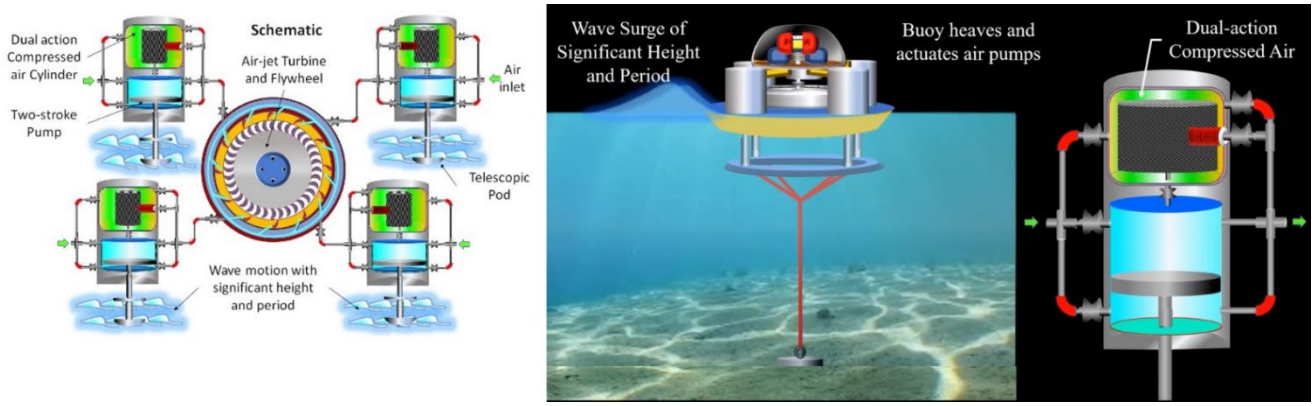

Figure 1: The Schematic, principal components, and perceived operating cycles for the proposed wave energy converter.

The preliminary 3D model is completed and ready to be used for developing a mock-up model of the introduced Wave Energy Converter concept. The plan is to have the complete prototype ready for preliminary experiments using water tank to validate the design concept and perhaps to refine the design variables, dimensions, etc., afterwards.

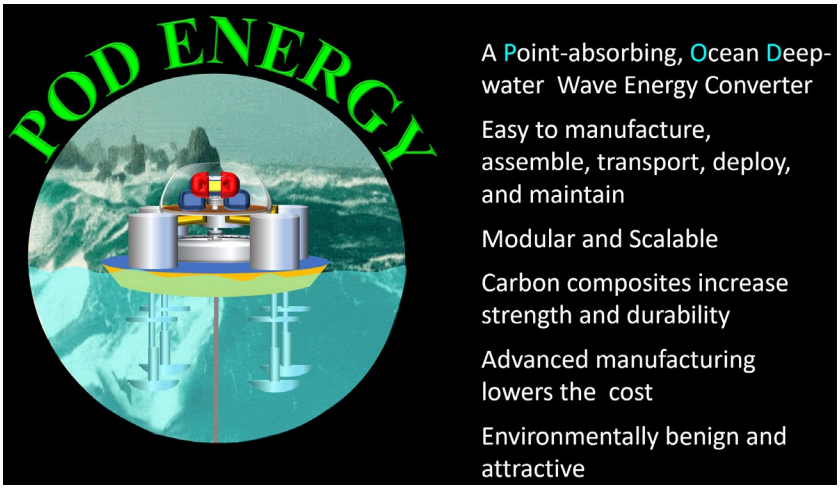

Figure 2: Overview of the envisioned design with its key features.

References:

[1] LiVecchi, A., A. Copping, D. Jenne, A. Gorton, R. Preus, G. Gill, R. Robichaud, R. Green, S. Geerlofs, S. Gore, D. Hume, W. McShane, C. Schmaus, H. Spence. 2019. *Powering the Blue Economy; Exploring Opportunities for Marine Renewable Energy in Maritime Markets*. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Washington, D.C.

[2] Annual Report Ocean Energy Systems. Available online: https://report2016.ocean-energy-systems.org/ (accessed on 14 February 2022).