EWTEC 2021 SIDE EVENT

14th EWTEC 2021
European Wave and Tidal Energy Conference Series
PLYMOUTH
5th–9th SEPTEMBER 2021

EPSRC Marine Wave Energy Programme

Monday 6 September 2021

17:00 - 18:30 BST

Hybrid event

Online & at the University of Plymouth

Supergen Offshore Renewable Energy

UKRI Engineering and Physical Sciences Research Council

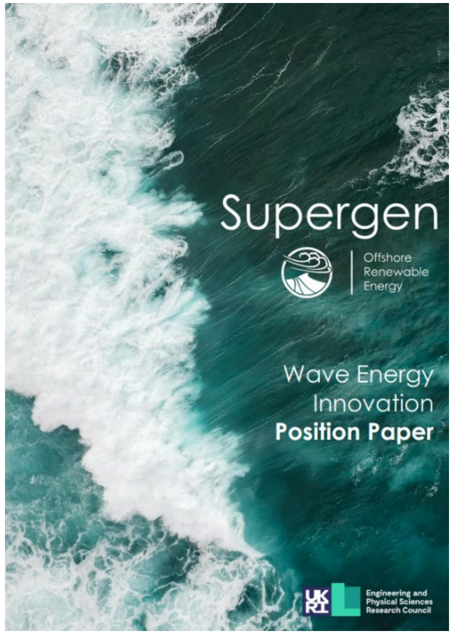
Wave Energy Workshop and Roadmap

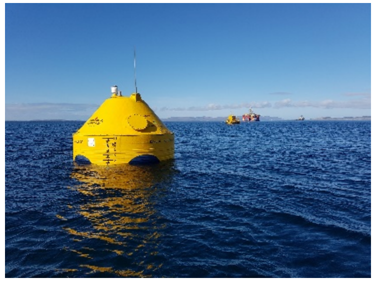
In 2019, we published the Wave Energy Innovation Position Paper and Wave Energy Road Map, which resulted in EPSRC investment in marine wave energy. This work contributed to the POST Parliamentary Briefing on Marine Energy and was carried forward into the September 2020 call for evidence on the potential of marine energy projects in Great Britain and in turn into the Government's Energy white paper.

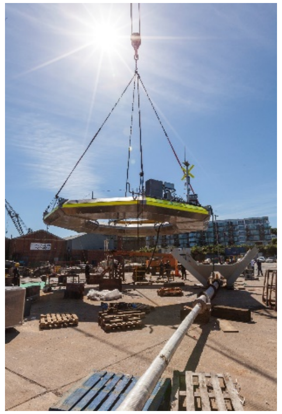
Impact

- Wave Energy Innovation Report
- Wave Energy Road Map - Realising the potential of Wave Energy in the next 10 to 15 years
- Contributing to the EPSRC launch of a £4.5 million Marine Wave Energy Call for proposals
- Contribute to POST Parliamentary Briefing on Marine Energy
- Evidence cited in Energy White Paper and contributed to UK Government 10 point plan for a green industrial revolution benefitting UK marine energy industry

Reports can be accessed from
www.supergen-ore.net/impact

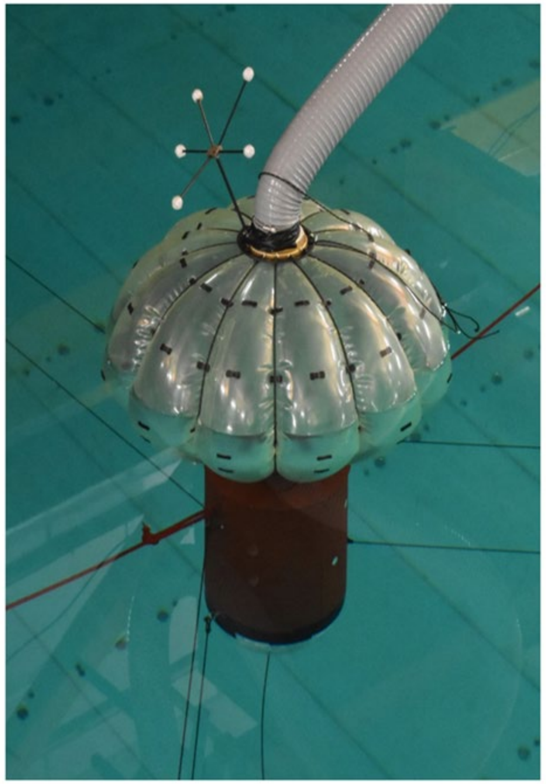


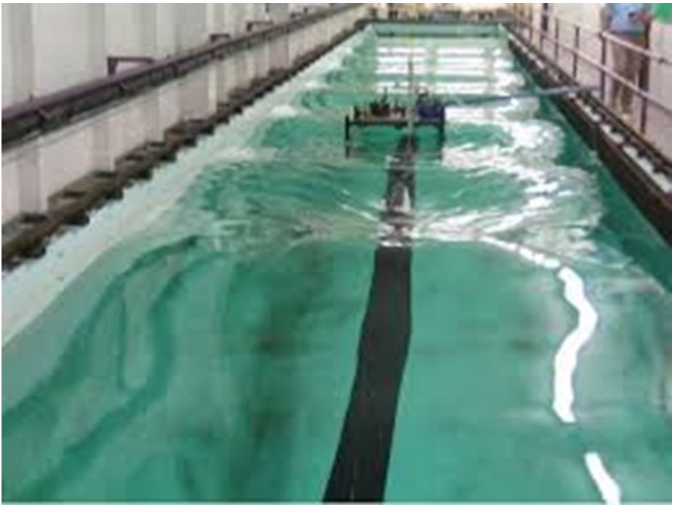




Agenda

17:00	Welcome	Deborah Greaves
17:05	Introduction to the Marine Wave Programme and EPSRC Strategy	Zaffie Cox (EPSRC)
17:15	Flexible Responsive Systems in Wave Energy: FlexWave	Deborah Greaves, Professor of Ocean Engineering (University of Plymouth)
17:20	New Generation Modelling Suite for the Survivability of Wave Energy Convertors in Marine Environments (WavE-Suite)	Qingwei Ma, Professor of Hydrodynamics (City, University of London)
17:25	Holistic Advanced Prototyping and Interfacing for Wave Energy Control	Adam Stock, Knowledge Exchange Fellow in the Wind Energy and Control Centre (University of Strathclyde)
17:30	Mooring analysis and design for offshore WEC survivability and fatigue (MoorWEC)	Peter Stansby, Professor of Hydrodynamics (The University of Manchester)
17:35	MUE-DRIVE: Marinisation and Upscaling of an All Electric Drivetrain for Wave Energy	Nick Baker, Senior Lecturer (Newcastle University)
17:40	Novel High Performance Wave Energy Converters with advanced control, reliability and survivability systems through machine-learning forecasting	George Aggidis, Head of Energy Engineering (Lancaster University)
17:45	Bionic Adaptive Stretchable Materials for WEC (BASM-WEC)	Qing Xiao, Reader in Marine Hydrodynamics (University of Strathclyde)
17:50	System-level Co-design and Control of Large Capacity Wave Energy Converters with Multiple PTOs	Guang Li, Reader in Control Engineering (Queen Mary University of London)
17:55 – 18:30	Q&A Panel Discussion	All





Flexible Responsive Systems in Wave Energy: FlexWave

EPSRC Marine Wave Energy Call 2020 EP/V040367/1, £1.0m, 12 July 2021 – 11 July 2024

Professor Deborah Greaves[1], Dr Martyn Hann[1], Professor Zhong You[2], Professor John Chaplin[3], Dr Shanshan Cheng[1], Dr Maozhou Meng[1], Professor Alistair Borthwick[1], Dr Robert Rawlinson-Smith[1], Dr Edward Ransley[1], Dr Siming Zheng [1]

[1] University of Plymouth, [2] University of Oxford, [3] University of Southampton

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Project partners

CHECKMATE FLEXIBLE ENGINEERING

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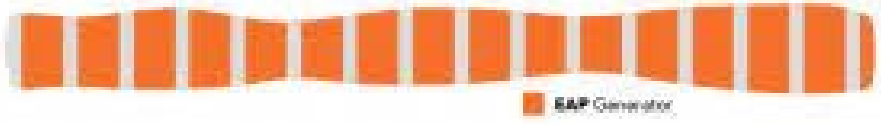
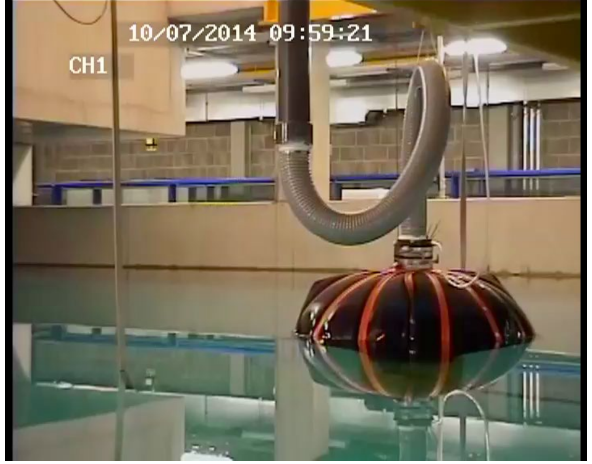
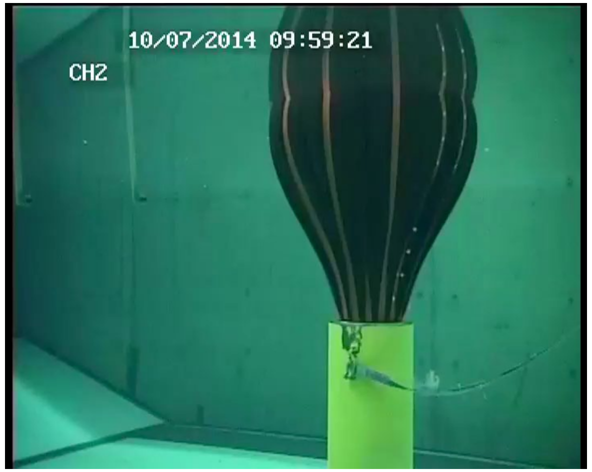
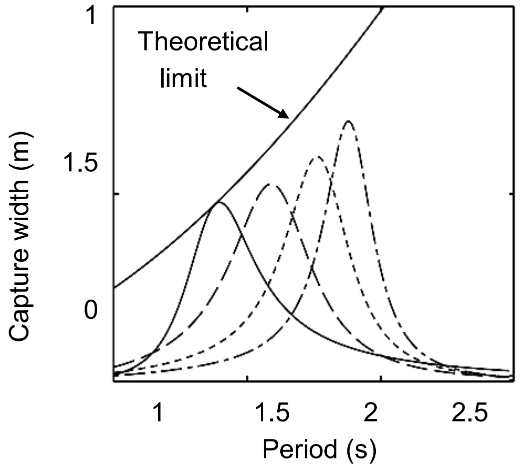


Why FlexWave?

- Flexible fabric WECs can be smaller and lighter than rigid counterparts.
- May be tuned to suit incident wave conditions by controlling internal fluid pressure.
- Controlled non-linear deformation can accommodate or shed high loads without reaching critical stress concentrations, improving survivability and reducing installation and lifetime costs.
- A range of PTO types could be utilised, such as air turbine, electro active polymers or novel distributed embedded energy converters.
- Lightweight flexible structure is unlikely to cause collision damage, so a low risk option for co-location with offshore wind.







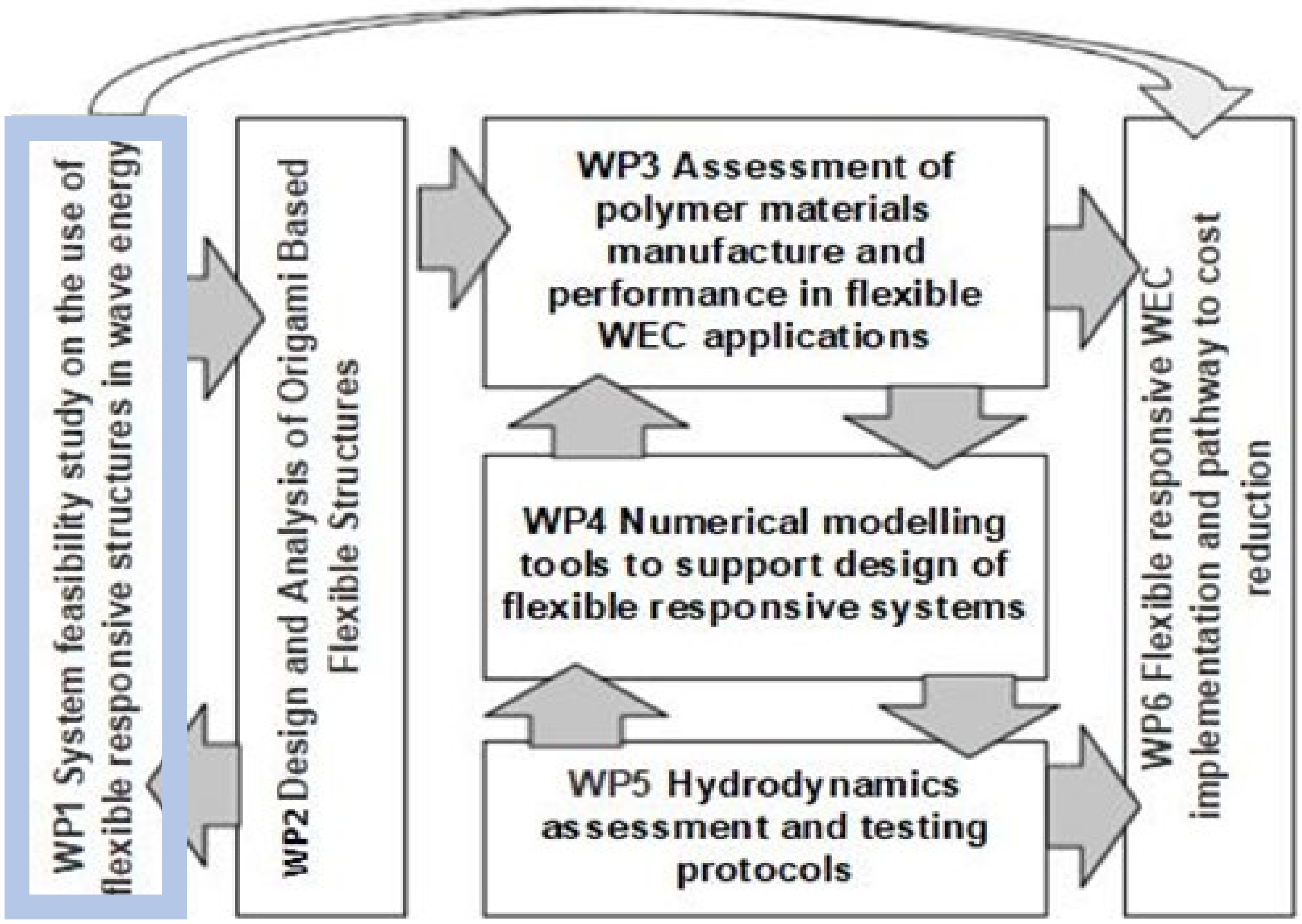
Kurniawan A, Chaplin J, Greaves D, Hann M., and Farley, F. Wave energy absorption by a floating air bag, Journal of Fluid Mechanics 812:294-320 2017.

Aim

- To demonstrate a step change reduction in cost of energy and pathway to utility scale and niche application WEC designs through the use of Flexible Responsive Systems in Wave Energy.
- To develop fundamental knowledge in hydrodynamic performance, structural design, material use and manufacture, alongside new modelling tools, and a novel origami approach to shape selection for resilient WEC designs.

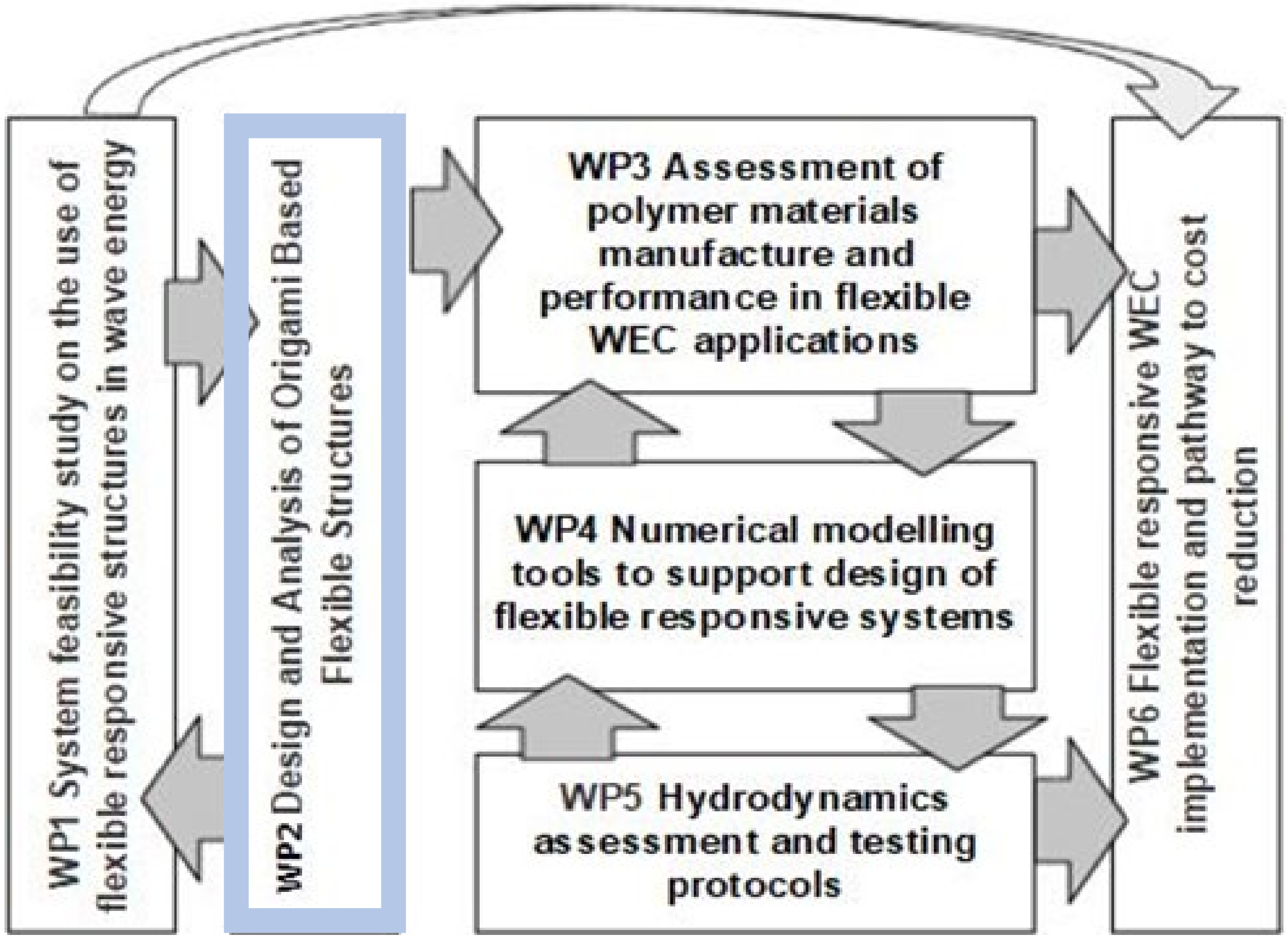
Research programme

- Scoping review and assessment of flexible fabric WEC operating concepts
- Development of efficient numerical models of flexible WECs
- Selection of WEC case studies using different operating concepts



Research programme

- Development of origami-based structures for selected WEC device concepts
- Experimental validation
- Material selection and manufacturing



WP2 Design and Analysis of Origami-Based Flexible Structures

2.1 Development of origami-based structures for selected WEC device concepts

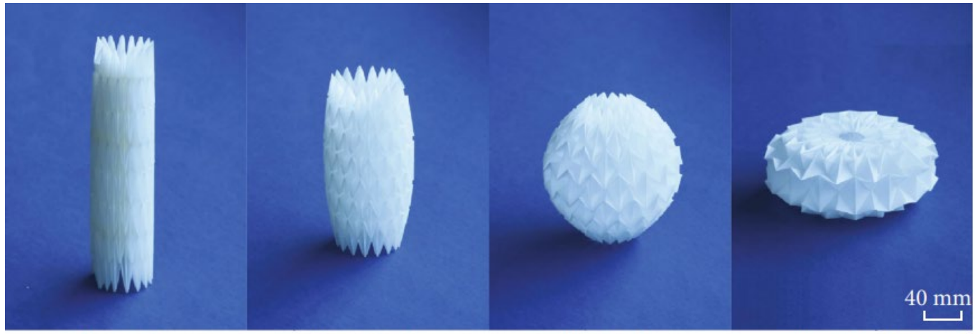
A set of structural concepts that give maximum volumetric change with acceptable strain level (type A), or large surface stretching without formation of aneurysms (type B).

2.2 Experimental validation

- Small scale physical models to validate the folding patterns and deformation modes, and to provide benchmark for FEA of full scale models.
- To assess the strain level for the entire structure, or localised areas where creases occur in type A structures.

2.3 Material selection and manufacturing.

- FEA model to examine the maximum strain at creases for type A, and possible stress/strain concentration in type B
- To provide guidance on the constitutive construction materials



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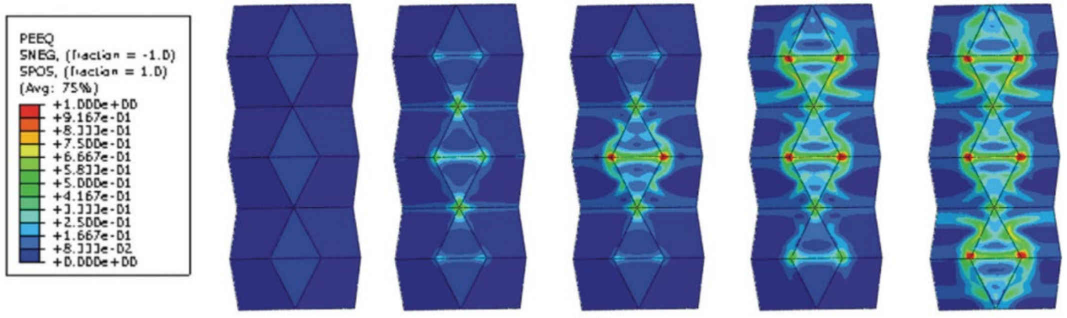
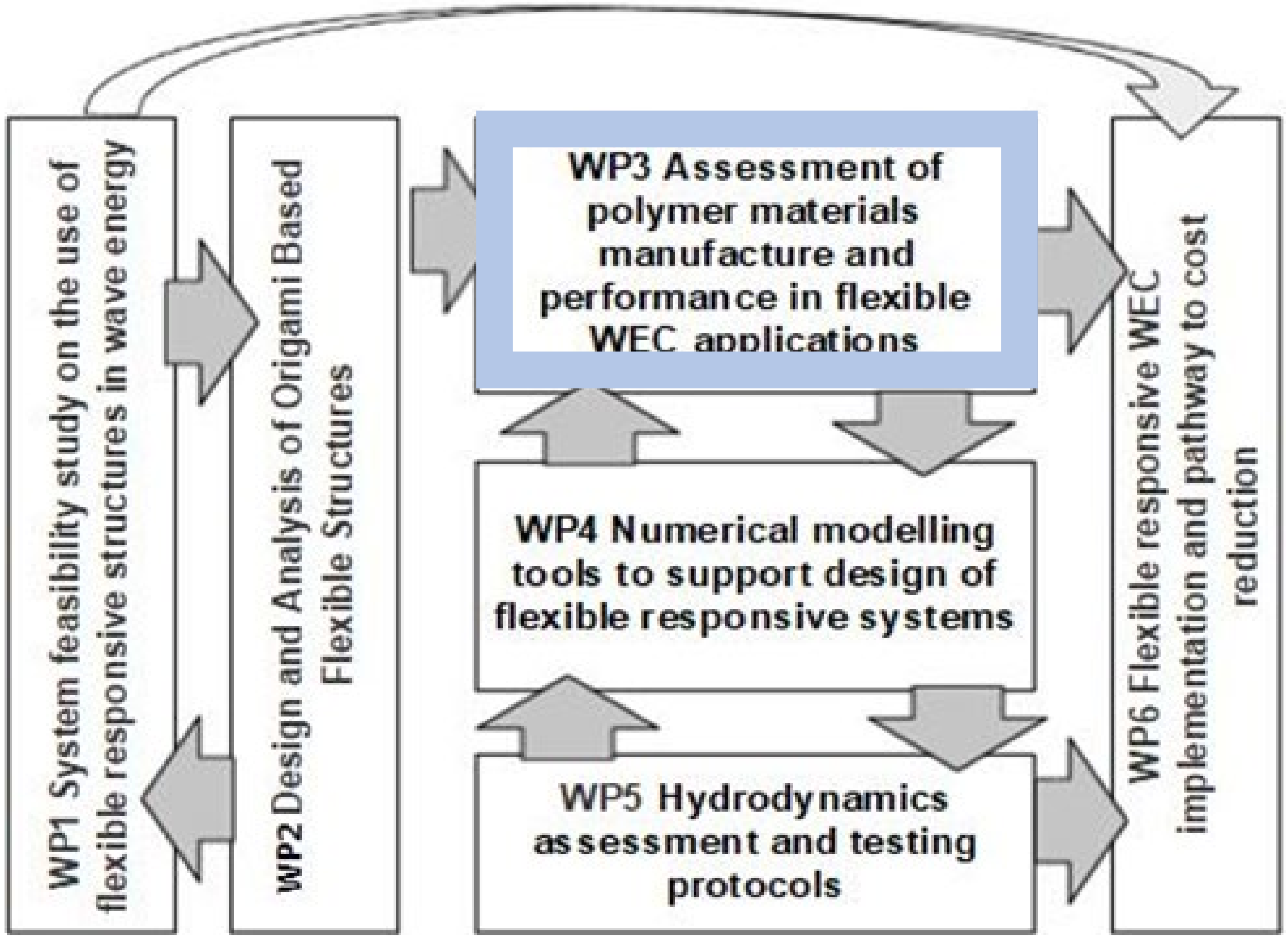


(b)

Research programme

- Alternative materials assessment
- Materials dynamic fatigue testing
- Materials characterisation assessment



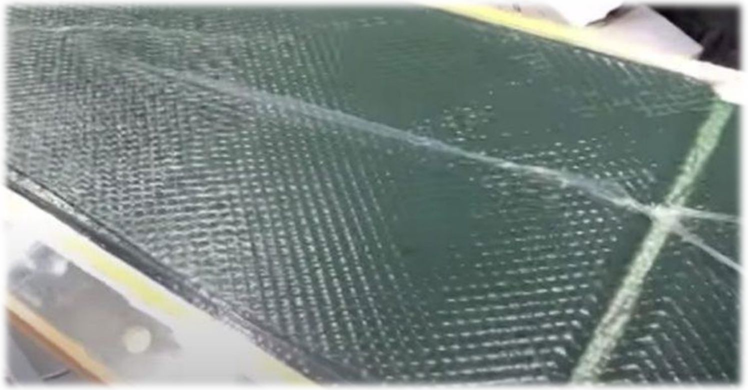
Elastomeric Materials for Flexible Systems in Wave Energy

Conventional approach:

Reinforced rubber moulding using steel tooling, high pressures and high temperatures. Typically used for tyres and shipping fenders. Very high tooling cost for the large sizes required for WECs with significant impact on LCOE numbers.

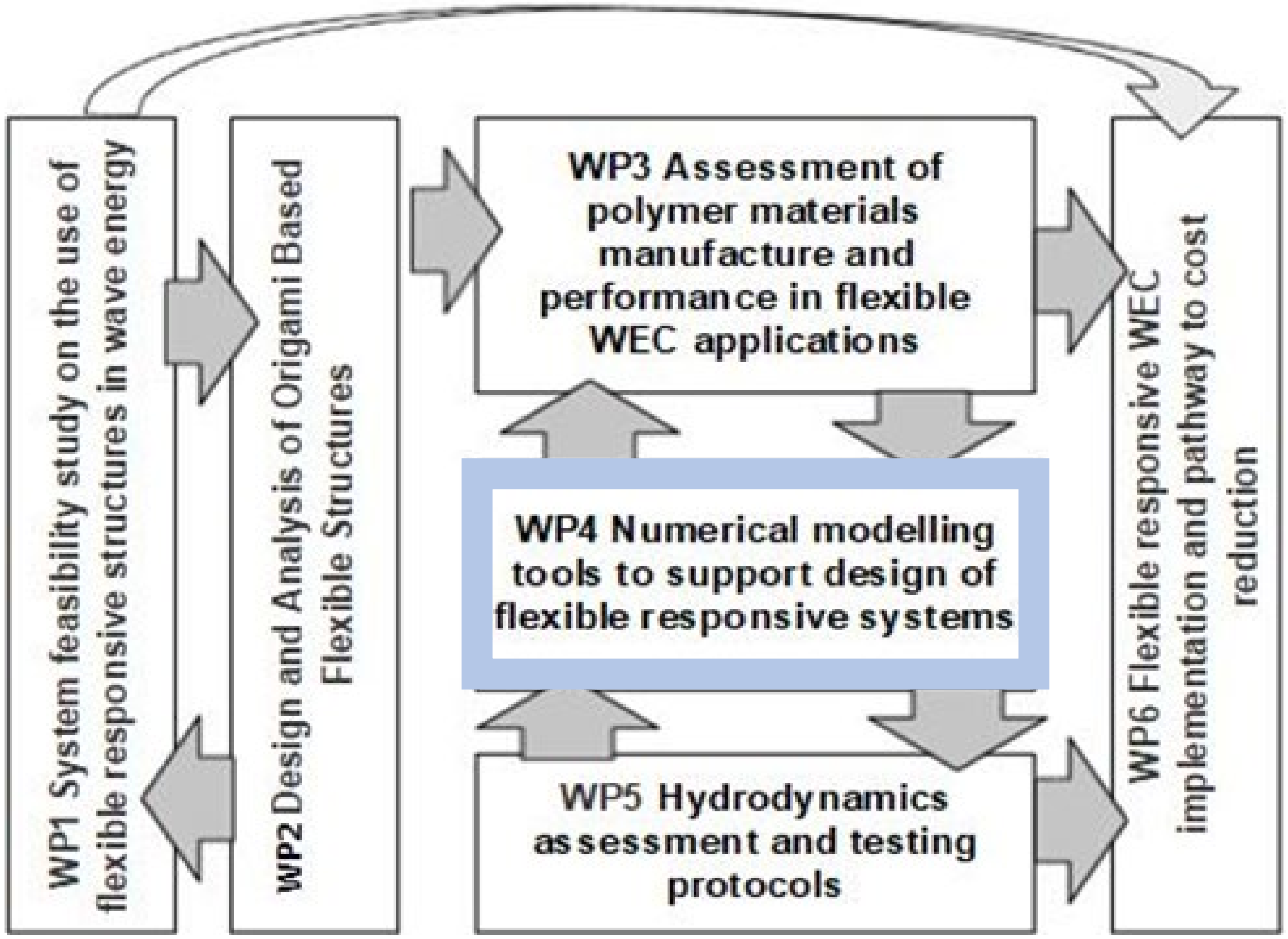
Alternative approaches:

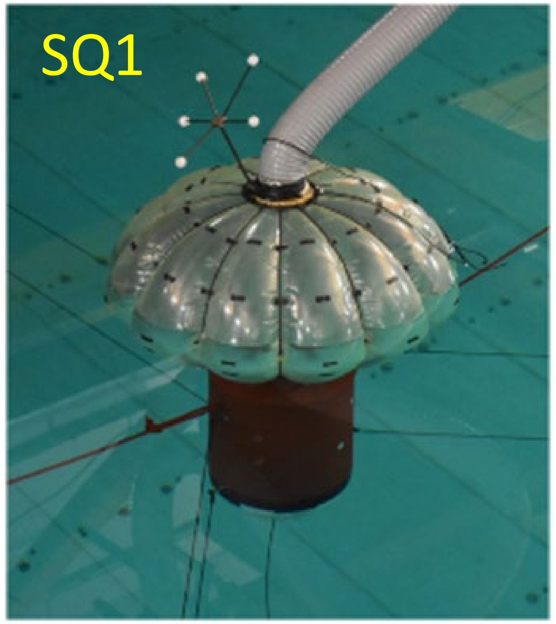
FlexWave to explore moulding of elastomers without high pressures, including rubbers, polyurethanes and the integration of woven reinforcement. Compare with conventionally cured rubber material.

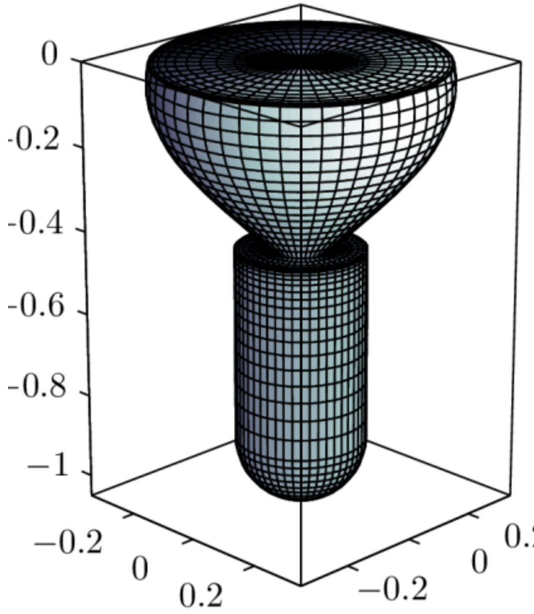


Research programme

- Nonlinear FEA modelling of polymer materials
- Fully coupled fluid-structure numerical model of flexible WECs under extreme environmental conditions







- Kurniawan et al., 2014, PRSA
- Kurniawan et al., 2016, JFM
- Kurniawan & Greaves, 2016 IET RPG
- Kurniawan et al., 2017, PRSA
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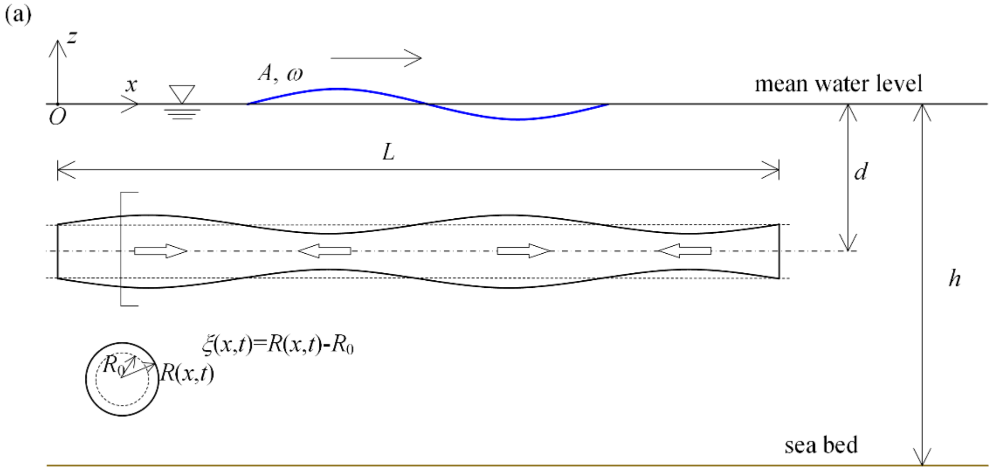
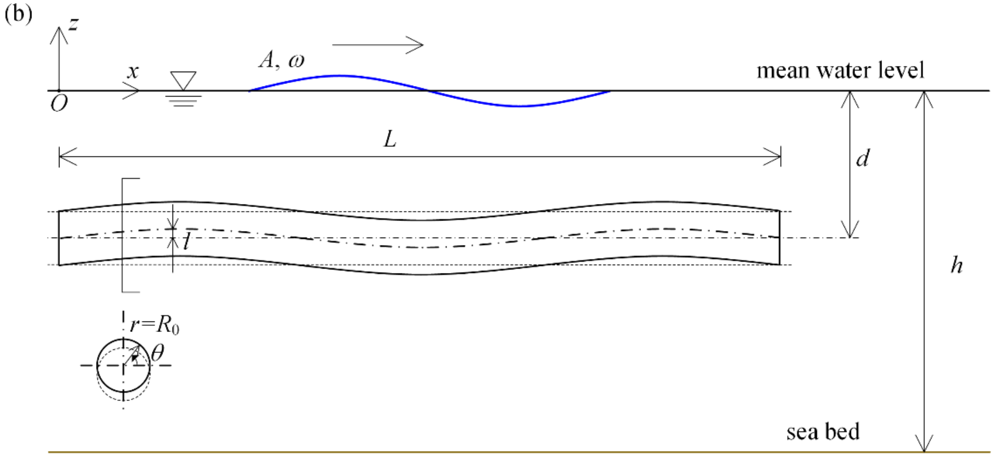
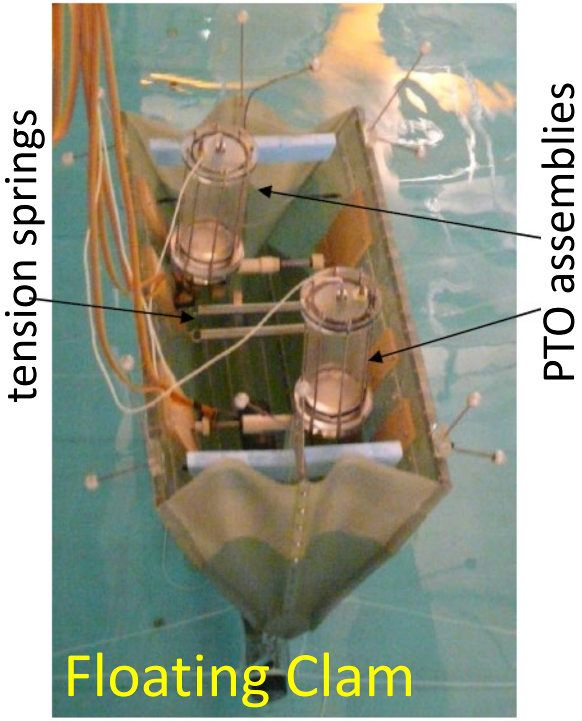
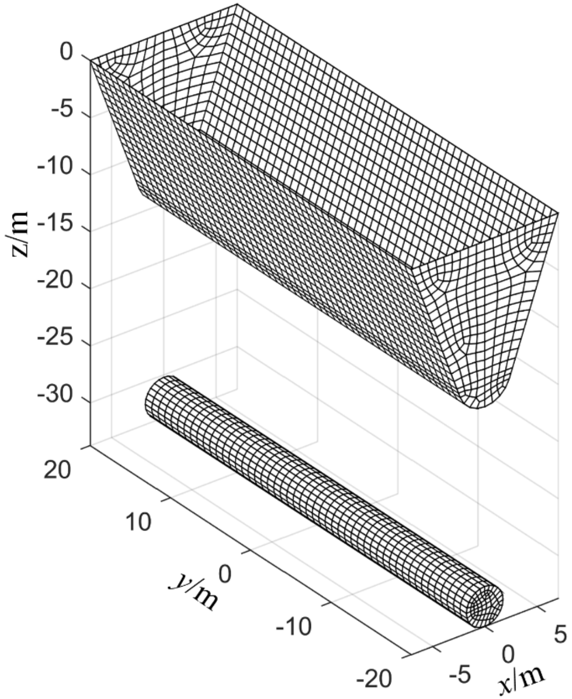


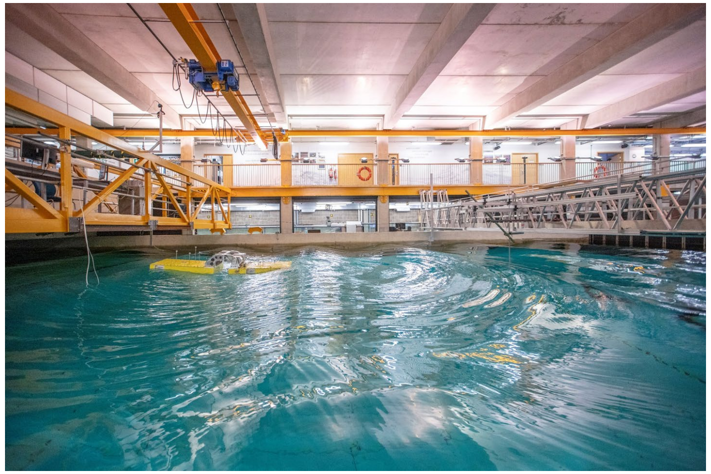


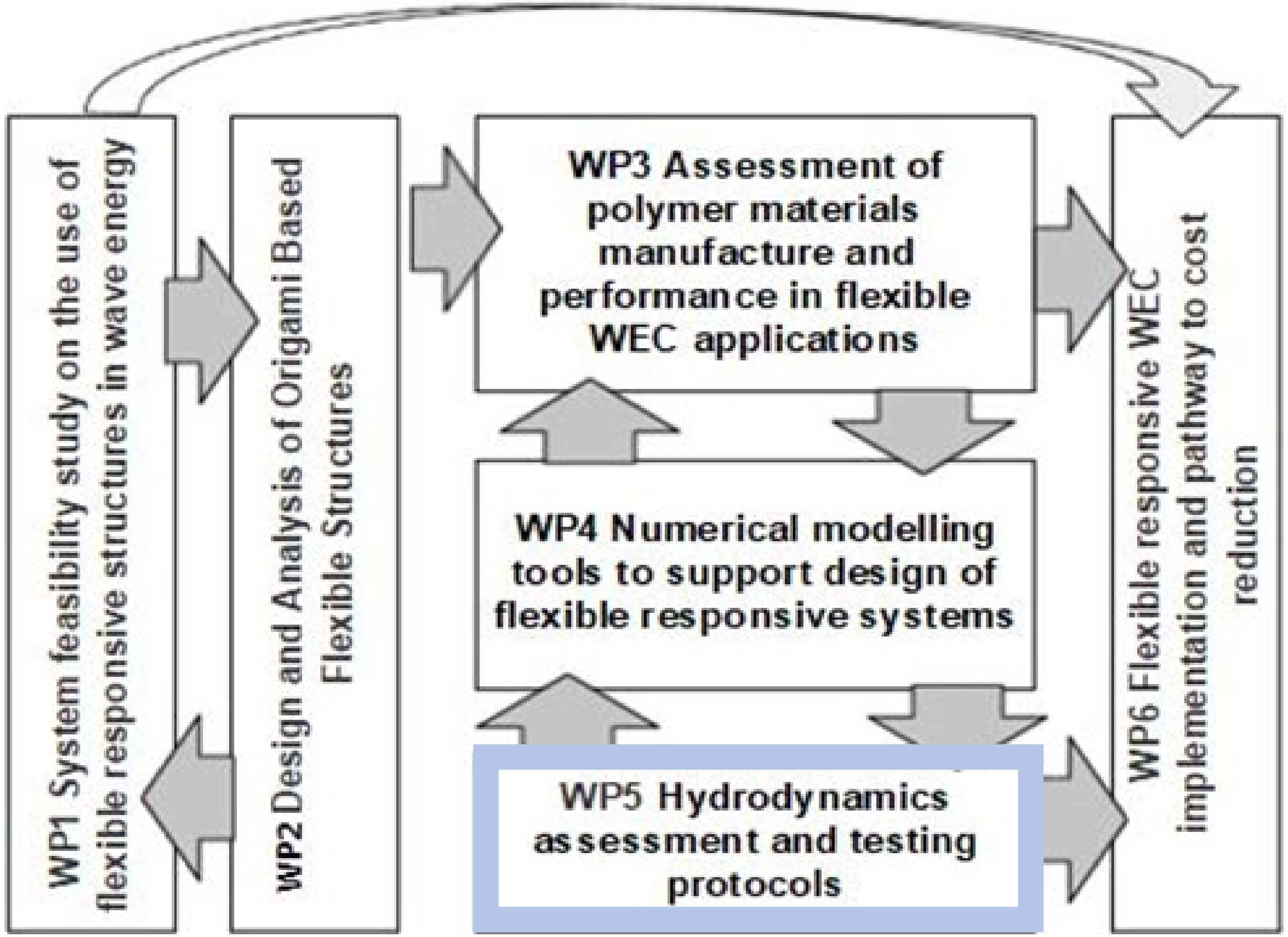




Research programme

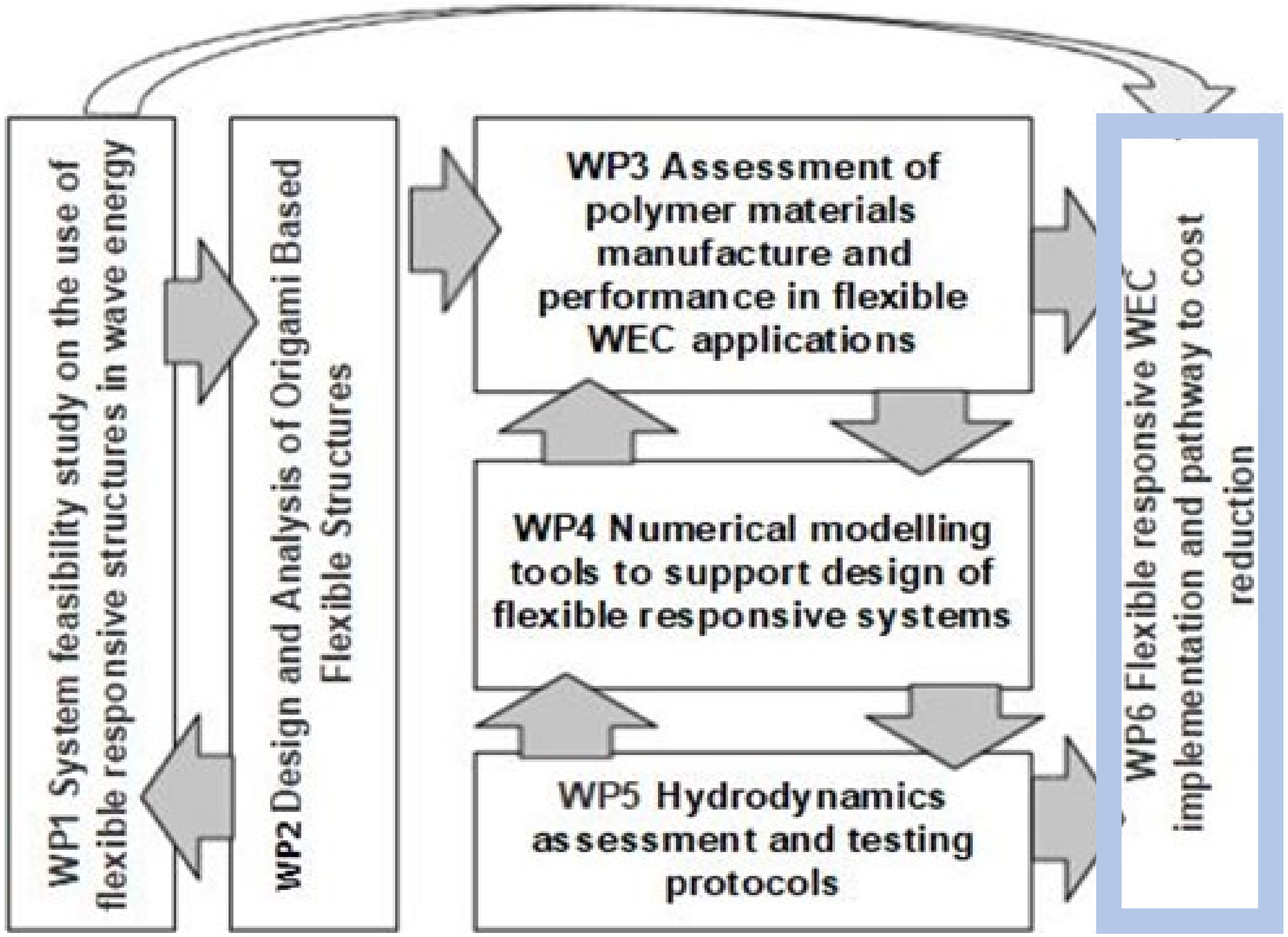
- Hydro-elastic experiments
- Wave-basin testing of novel flexible WECs under operational and extreme conditions





Research programme

- Hydrodynamic performance assessment and design specification for case study WECs
- Value analysis and recommendations for implementation of flexible responsive systems in niche and grid scale wave energy applications



Thank you