Strengthening the wave energy sector - OWWL forecasting for Bombora Wave Energy, Pembrokeshire, Wales

sweep

Impact Summary

Drawing on the success of the first SWEEP Operational Wave and Water Level (OWWL) model developed for the Environment Agency, SWEEP's team - **Professor Gerd Masellink, Dr Tim Poate and Dr Kit Stokes from the University of Plymouth's Coastal Processes Research Group** - have developed a suite of additional bespoke, localised OWWL models for a variety of wider partners. The following impact summaries highlight the benefits being delivered, both for the public and private sector.

Contributing to the operational success of **£20m** wave energy convertor

5-days-in-advance localised wave forecasts enhancing decision-making

Informing delivery of anticipated **5%** of UK's 2050 installed wave energy target

Ways of Working

Innovative Knowledge Provision — **Tailored Decision Support**

Why it mattered?

With global electricity demand expected to double by 2050, and estimates that the sea will deliver 10% of this, Wave Energy Converters (WECs) are set to play a key role in helping to meet this demand. Despite the opportunities for a potential $141.1m market by 2027, progress with wave energy has been slow to date, partly due to poor survivability of wave technologies.

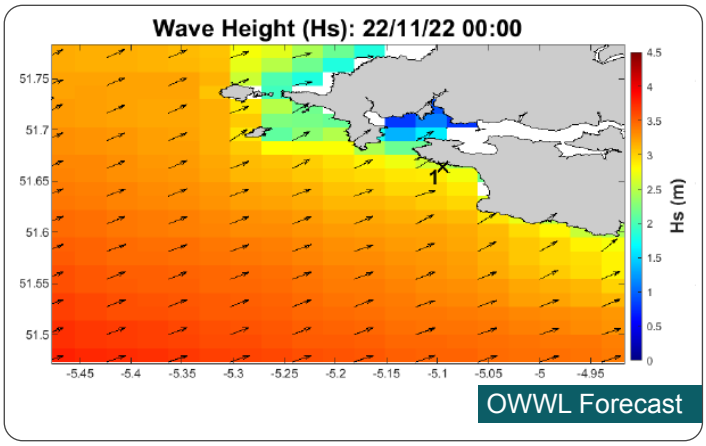
Bombora Wave Energy, is one of only a small number of companies still actively developing WECs. Since 2018 it has been constructing the world's first, full-scale flexible membrane style WEC in Pembrokeshire, Wales; the first WEC ever to be deployed in the SW of the UK. Achieving proof of concept, will lead to a significant breakthrough, and investment opportunity.

With four enormous flexible membranes, worth over £200k each, Bombora's WEC is susceptible to costly damage during high sea states, particularly with waves more than 4.5m in height. Bombora approached SWEEP to develop a version of their Operational Water and Wave Level (OWWL) model to generate bespoke forecast data for the deployment site, enabling more proactive and cost-effective operational decision making.

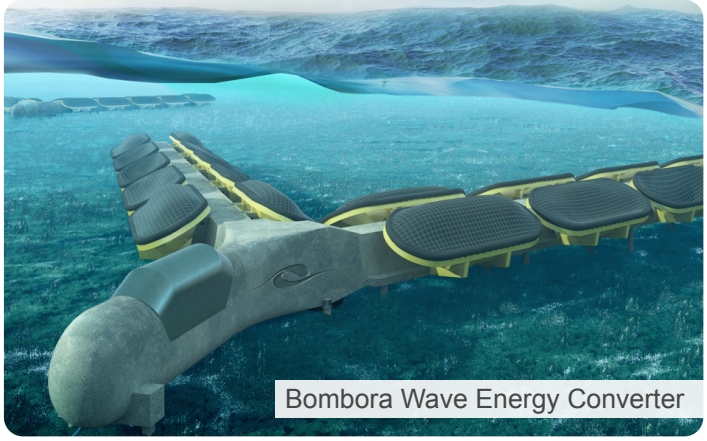
What we did

Working closely with Bombora Wave Power, the SWEEP team delivered:

- **A bespoke OWWL model** for Bombora's deployment site (East Pickford Bay, Freshwater, Pembrokeshire) driven by Copernicus Marine Environment Monitoring Service (CMEMS) data, operating independently in forecast mode and fully calibrated and validated.
- **Daily forecast reports** on hydrodynamic parameters in East Pickford Bay, generated and delivered automatically to Bombora and including wave height, wave power thresholds and alerts.



OWWL Forecast



Bombora Wave Energy Converter

Impacts & benefits delivered

Due to delays in Bombora's WEC deployment, much of the expected SWEEP impact has yet to be evidenced, but is still anticipated by our partner.

Knowledge/Capacity

New information, knowledge and capacity building: SWEEP's bespoke OWWL model is providing more site-specific, localised, higher spatial resolution forecasts for the deployment site than was previously available to Bombora. This data forms a key component of the approach to accurately and timely predict, and respond, to wave conditions in East Pickford Bay; critical for the WEC success.

Organisational function

Cost-savings on SWEEP vs an external consultant to produce these forecasts. SWEEP delivered additional value through the provision of ongoing data throughout the deployment period (as opposed to just specific weather windows) and ensuring this arrived in advance and was tailored to Bombora's needs.

Looking to the future

In anticipation of WEC deployment, our partner confirms they expect significant impact will be delivered over the next 6-12months (during 2023).

- **Strengthening decision making and planning** – using SWEEP's forecasts to strengthen planning particularly around:
  - WEC experiments - part of the commissioning process.
  - The WEC launch - as membranes are inflated.
  - The back-up process for WEC shut-down - either in the event of an automatic shut-down failure and/or as a precautionary action when large sea states are expected.
- **Financial and economic benefits** – material and repair costs-savings will be realised by minimising WEC membrane damage. Additionally, greater profits will be delivered by avoiding interruptions to WEC energy production: estimated to be 1 GW per hour, per year. Successful proof of concept is expected to unlock investor confidence in wave energy production machines such as Bombora's WEC, and through their ongoing involvement, SWEEP will contrite to the economic benefits associated with delivering the UK's 2050 target of 22 GW of installed wave energy capacity.
- **Extending benefits to other Bombora projects** – as well as to the wider wave energy industry – Peter Arnold, Head of Loads and Modelling, Bombora Wave Power told us *"SWEEP's approach of developing forecast outputs, fed from publically available CMEMS data and formatted in a way that's useful to a WEC developer, is of great value to the wave energy sector as a whole"*.

> *"SWEEP forecasts allow us to plan experiments on the WEC demonstrator in advance, and react more quickly when we need to shut down the machine in the event of live sea states; two factors key to the success of the project."*
>
> **Peter Arnold, Head of Loads and Modelling, Bombora Wave Power**

> *"The real benefit of SWEEP's work is the cost savings by helping to prevent wave damage to this £20m machine. We can't get that wrong - even if one membrane ruptures, we have to replace the cell module, and if all four membranes are lost, the project will have no value at all. So stopping damage in the first place is really key."*
>
> **Peter Arnold, Head of Loads and Modelling, Bombora Wave Power**

Organisation we worked with

bombora

Underpinning NERC Science

- NE/N015525/1 - Physical and biological dynamic coastal processes and their role in coastal recovery (BLUE-coast)
- NE/M004996/1 - Impact of sequence of extreme storms during 2013/14 winter on South West coast of England
- EP/H040056/1 - New understanding and prediction of storm impacts on gravel beaches (NUPSIG)

About SWEEP

The South West Partnership for Environmental & Economical Prosperity (SWEEP) is a partnership between the University of Exeter, the University of Plymouth, and Plymouth Marine Laboratory. Funded by the Natural Environment Research Council and stakeholders together to solve key challenges faced by those working with our natural resources. **www.sweep.ac.uk**

UKRI Natural Environment Research Council

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