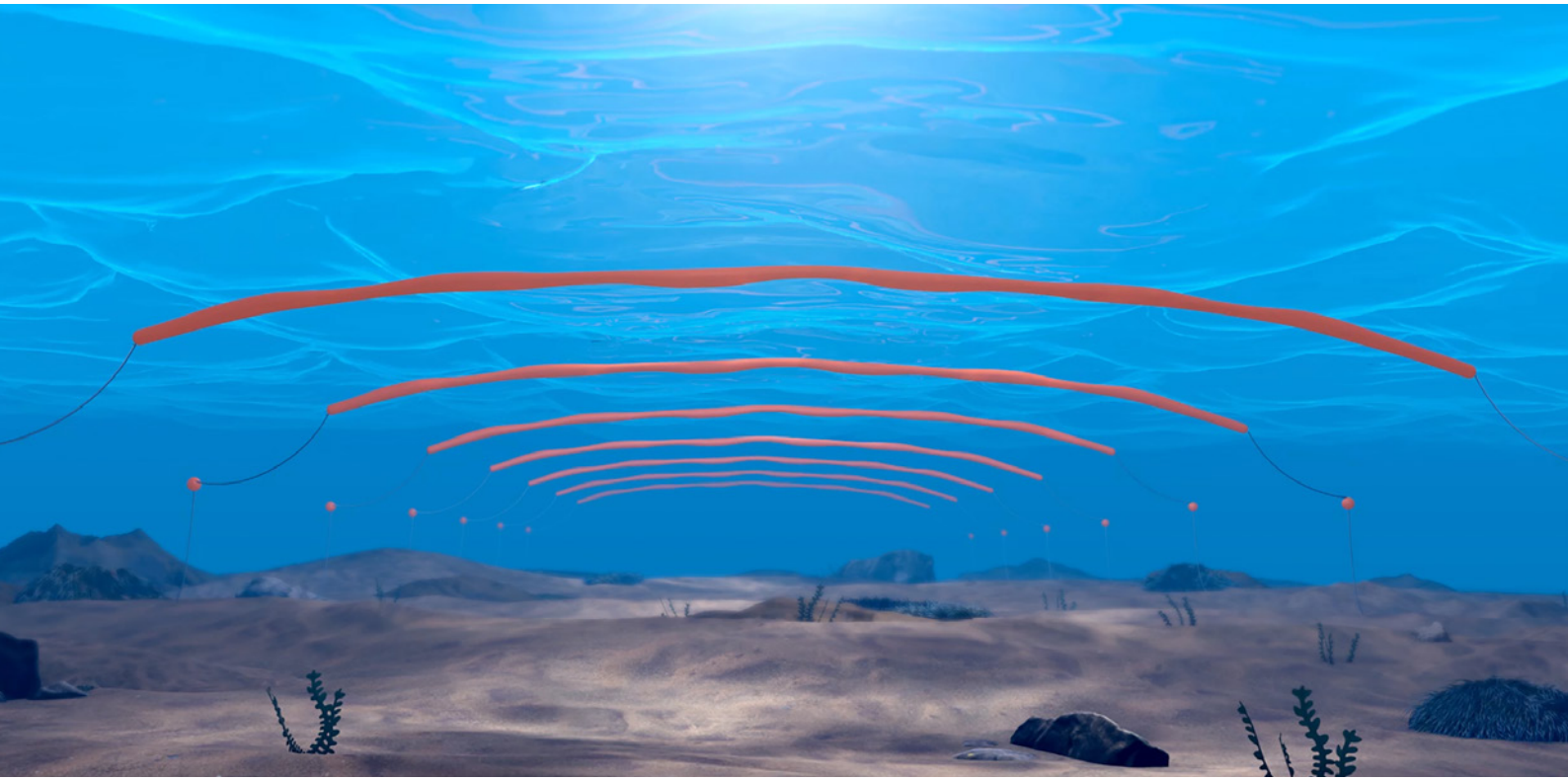
SBM OFFSHORE

ENERGY. COMMITTED.

Project | Discipline | Product Line **Renewable Energy**

WAVE ENERGY CONVERTER



The S3® Wave Energy Converter represents a paradigm shift in wave energy conversion

While the wave power available worldwide would in itself be sufficient to fulfil the planet's electricity needs, successful attempts to harness energy from the ocean waves have remained elusive. Indeed, conventional Wave Energy Converters (WEC) – referred to as Generation 1 devices – have inappropriate and bulky structures combined with complex Power Take-Off (PTO) elements usually involving hydraulics, turbines and gearboxes. These hydraulic-based systems are inefficient and would require significant maintenance, which constrains their technical and economic viability.

Since 2009, SBM has been developing a new generation of breakthrough Wave Energy Converter, the S3, which addresses the limitations identified in Generation 1 Wave Energy devices. The S3 WEC converts the kinetic energy from waves directly into electricity using Electro Active Polymers (EAP), which offers numerous benefits.

KEY FACTS

- **2.1 TW** is the average power waves alone can provide around the globe (source Gunn et al. 2012) - approximately equal to global electricity demand
- UN: **50%** of the world's population lives **within 60 km of the sea** – closely matching supply with demand
- Wave energy is **an immense and untapped resource -** Attempts to harness wave energy have suffered from a lack of offshore expertise
- **Over $8 trillion** is forecast to be invested in renewable energy **over the next 25 years**

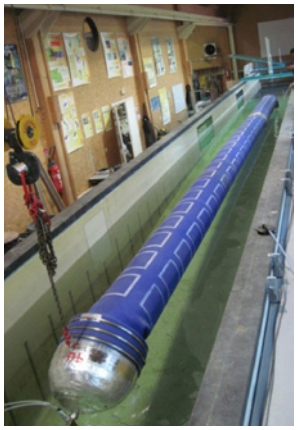
This breakthrough concept builds upon the cost reduction potential of roll-to-roll manufacturing processes and the extensive operational feedback of the high voltage capacitor industry (EAP are similar to high voltage capacitors) to provide a Wave Energy system with reduced Capex and requiring minimum maintenance, resulting in a low LCOE (*Levelized Cost Of Electricity*). The floater and its mooring system have been successfully tested in the basin.

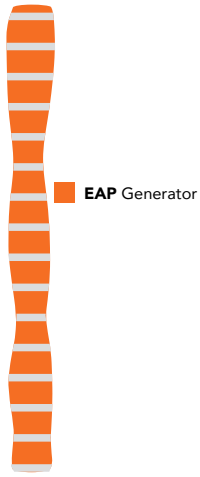
SBM Offshore S3 Concept

- Fully flexible tube containing water, closed at both ends
- Multimodal response (standing waves)
- Energy conversion system = Electro-Active Polymers (EAP)

EAP-based PTO embedded in the structure

- Energy converted DIRECTLY from waves to electricity
- Distributed power generation
- EAP + roll-to-roll process





For Wave Energy Generation 1 devices, conventional (rigid) systems are inherently limited

- High structural costs
- Energy / stress concentration on Power Take-Off elements
- Mechanical Power Take-Off costly O&M
- Narrow & fixed absorption bandwidth

A breakthrough technology is required… SBM S3 WEC – A paradigm shift

- Merged power conversion function and hull structure
- No complex mechanical parts – no hydraulics, no hinges, no gearbox, no turbine, etc.
- No routine maintenance – passive system
- Flexible – can be folded or reeled for installation
- Standing-wave multi-resonance system – higher efficiency
- Distributed energy generation with no stress concentration

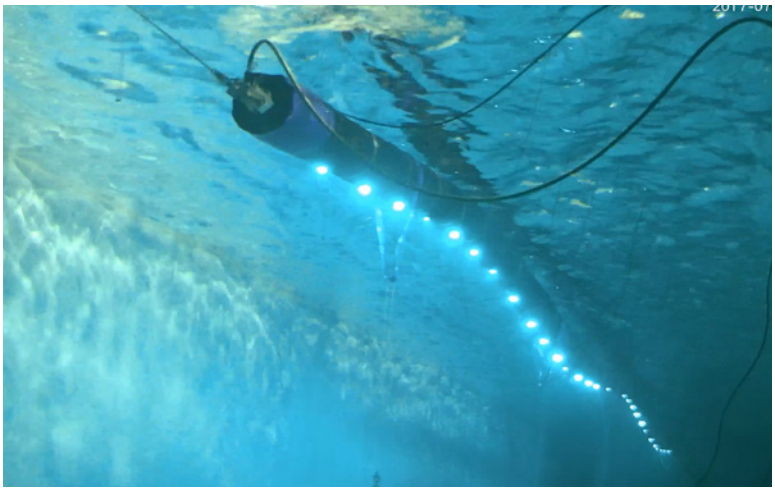
The S3 in practice: Scaled prototype at sea

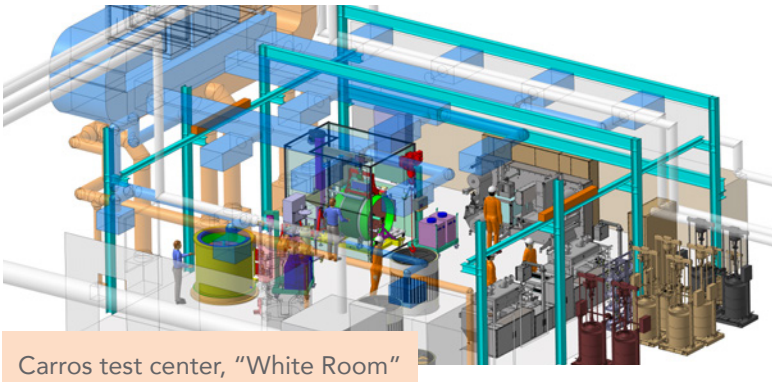
So far, the basin tests have demonstrated the capacity of the S3 to transform wave energy into electricity, with both a high level of efficiency and over a wide range of wave periods.

The next step is to validate the highly-automated manufacturing process through the construction of a scaled prototype* in our Test Center in Carros, France. It will be deployed at sea in 2021 in Monaco waters and grid-connected. This sea trial will test the system in real conditions to assess the system behavior, material ageing and power conversion systems, as well as allowing optimal integration in the marine life environment. At the same time, the prototype will deliver the first kWhs to the grid.

This is in line with SBM Offshore's ambition and vision to support the energy transition through its offshore expertise and innovative spirit.

*executed via France's Strategic Investment Programme (Programme d'investissements d'avenir) entrusted to the French Environment and Energy Management Agency (ADEME)





Carros test center, "White Room"

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