Energy from the ocean – predictable, reliable, renewable

There is a huge amount of energy in the ocean to be harvested from waves and currents, tides and swell. According to Ocean Energy Systems (OES), an international initiative under the International Energy Agency, the potential for Ocean Energy Converters (OEC) could be 330 GW by the year 2050, creating 300,000 jobs in the industry. Prototypes are entering the market but cost efficiency is still a challenge. SSPA is acting as a research partner to develop ocean energy systems further. The project development involves the use of SSPA's testing facilities as well as computation and modelling methods.

The increased interest in OEC

The sea covers 72% of earth's surface and is continuously regenerating energy arising from wind and tidal effects. Several sources estimate that it is technically feasible to extract 300–500 GW (approximately 2,500–4,500 TWh/year) by the year 2050 from ocean energy sources. The need for further development and testing to bring down the cost of energy production is still too high for venture capital to become the primary source of investment.

According to Ocean Energy Systems (OES), an international initiative under the International Energy Agency, the currently installed Ocean Energy Conversion (OEC) power worldwide is about 0.5 GW with agreements for another 0.5 GW in place. Compared to wind power, with a total worldwide production of 430 GW, the contribution is very small. However, also according to OES, the potential for OEC could be 330 GW by the year 2050, creating 300,000 jobs in the industry.

There has been a resurgence of interest in OEC in recent years, visible in research and development funding from public agencies. European Commission research programmes are supporting an unprecedented number of OEC projects, and many national funding agencies have similar support in place. In general, the cost of energy from OEC is currently too high compared to other means of renewable energy production, which for now keeps most projects below pre-commercial stage and limits the possibility of securing the necessary venture capital for scaling to a size where supplying the grid is economically viable.

OEC power production does however have unique advantages. Noise or visual impact present in the case of wind power and to some degree solar power is non-existent or low depending on the type of installation. A big issue for transition to a renewable energy system is consistent power production. Here OEC installations can help with a more uniform energy output through more diverse power production.

Current OEC projects

SSPA has acted as a consultant or research partner in several OEC projects over the years and is currently involved in three OEC-related research projects. They are:

- PowerKite (EU research project)
- Cost Efficiency of Marine Energy Conversion (Swedish Energy Agency)
- Marinet II (EU research project)

What all of the above projects have in common is that SSPA's testing facilities are utilised in connection with support within measuring techniques, hydrodynamic design or Computational Fluid Dynamics (CFD). Testing the devices in downscaled but realistic conditions improves the reliability of the performance prediction of the device and can be used to validate simulation models such as CFD or the design in general.

PowerKite

PowerKite covers many aspects of OEC from specific design improvements of Minesto's Deep Green power unit to more general aspects such as environmental effects on the marine environment. SSPA is involved with all work packages in relation to hydrodynamics, with a focus on turbine design. A more extensive description of PowerKite was presented in earlier issues of SSPA Highlights.

Cost Efficiency of Marine Energy Conversion

Cost Efficiency of Marine Energy Conversion is supported by the Swedish Energy Agency, and involves improvements to Minesto's Deep Green OEC unit. A more cost-effective anchoring system is being developed, and SSPA is assisting in improving the rudder and wing design, ¼ scale testing in the SSPA Marine Dynamics Laboratory (MDL) and investigating scale effects using CFD. The project content has been adapted to look at remaining issues for Deep Green that are not investigated in PowerKite.

Marinet II

Marinet II is the successor to Marinet, which ended in 2015. Besides the development of standards, guidelines and best-practice guidelines for the area of OEC, Marinet also provided approximately 700 weeks of testing at the infrastructure facilities funded entirely by Marinet.

Projects for Marinet II under the Transnational Access programme are selected by the selection board of Marinet II, giving access to testing facilities free of charge. SSPA has committed to providing several weeks of testing at our facilities (or similar assistance for the same amount of funding). According to the work programme of Marinet II, applications can be submitted until approximately mid-2017. Application forms will become available at the beginning of 2017 at www.marinet2.eu

Future research and development for OEC

Development from concept to full-scale energy production requires a complicated, expensive, inter-disciplinary process. Hydrodynamic optimisation of the unit is only one step. Electrical systems, shore connection, structural design, cost/benefit analysis, safety, risk, park design, anchoring, installation/service and environmental impact are other important

The unique features of ocean energy make it a very good alternative for the generation of clean, renewable energy with no carbon-dioxide emissions. This pictures shows some examples of the Ocean Energy Converters developed in Sweden. Courtesy of CorPower Ocean, Minesto and Seabased.

issues. Today the main focus worldwide is on decreasing the energy cost of OEC units, whereas issues such as park design with safety and risk in mind and specialised installation and service vessels are largely developments to be investigated further.

SSPA has been in the business of improving the design of vessels to save energy for decades. The leap from hydrodynamic design and testing of vessels to hydrodynamic design and testing of OEC units is not a large one. Besides a general understanding of hydrodynamics, SSPA can offer a wide variety of testing facilities, model construction, advanced measurement methods, CFD, propeller/turbine design, simulation of installation and service and risk/safety assessments. To support this development, SSPA therefore actively seeks projects within the area of OEC both as a research partner and for commercial development.

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