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#### Technology related R&D:

- Modelling & field measurement of tidal currents and waves
- Incl. current profile, WCI, turbulence
- Velocity field analysis near the device (2D/3D actuator disc)
- Contribution to overall concept dev.
- Subsystem development and testing: PTO, control (HIL)
- Technology specific water to wire models (Matlab Simulink)
- Control engineering development tool
- Dynamic load analysis (waves & turbulence, fatigue & extremes, DELs)
- Operational control development and implementation (hard and soft)
- Commissioning and monitoring of full scale prototypes and commercial-demonstrators: monitoring concept (data, sensors), test protocols
- Analysis of field data: resource characterisation, device performance

## MARINE ENERGY RESEARCH & DEVELOPMENT

### Marine Power Utilisation

Marine power, in the form of waves and tidal currents, has the potential to provide significant contributions to sustainable power supply. Different technologies are being developed at present. The Marine Energy Group of the Department Energy Converters and Storage Systems supports companies in developing competitive technologies: from concept phase, tests and trials at laboratory level up to demonstration and pilot projects in the megawatt scale, the group carries out potential and feasibility studies and develops market-entry strategies.

### Focal Points

Marine power technology commercialisation demands the exact knowledge of economically viable resources, the development of reliable and competitive technologies and the implementation of market-entry strategies and instruments. The central challenges in the utilisation

of wave and tidal current energy are the improved assessment of available resources, their characterization by means of field measurements as well as improved dynamic simulation models. The development of marine energy technologies proceeds step by step from the concept phase, model trials, up to small-scale field trials and finally demonstration projects in the megawatt scale. In this process, experience, concepts and models from the development and realisation of other technologies, in particular hydro-power and wind energy, are used and adapted to specific marine energy system requirements. In regard to norms and international harmonisation, projects are carried out in cooperation with the IEA-OES, IEC and other networks and organisations.

- 1 *SEAFLow: World's first marine current turbine*
- 2 *SEAGEN: 1.2 MW twin rotor tidal turbine*
- 3 *CORES: Irish OWC ocean energy buoy*
- 4 *In-situ tidal turbulence measurements*
- 5 *SDWED: Danish Wavestar wave energy device*



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## SELECTED MARINE ENERGY PROJECTS

### SEAFLOW

Control and operating control of variable speed marine current turbines. Our focus: Dynamic simulation of the device, development of the drive train and the electrical concept, control and operation, realisation of the autonomous onboard power supply, testing of the generator with the frequency converter, blade pitching drives and the onboard grid, monitoring and data analysis.

### SEAGEN

Exploitation of marine currents using twin rotor turbines in the MW range. Our focus: Conceptual investigations and simulation, deployment and testing of the pitch system, implementation of the near-hardware software and communication testing, commissioning, local testing, monitoring, realisation of a fully automatic speed controlled operation, verification of the simulation models.

### Kobold I

Energetic use of tidal currents in the Strait of Messina, Italy. Our focus: Installation and test of a controller unit for automatic operation of a floating 60 kW vertical axis marine current turbine.

### Kobold II

Energetic use of tidal currents in the Lombok Strait, Indonesia. Our focus: Investigation on drive train concepts in connection with island grids. Development of operation and control system of a floating 150 kW vertical axis marine current turbine, system testing, staff training, commissioning and field testing for a village electrification scheme in Indonesia.

### Pulse Stream 1200

Our focus: Modelling and dynamic simulation of a 1.2 MW device utilising oscillating hydrofoils, development, implementation and testing of operation and control.

### CORES - Components for Ocean Renewable Energy Systems

Our focus: Investigation of the generator frequency converter system, controls and grid connection, device concept development and downscaled field test version, HIL test of the whole PTO including the control, commissioning.

### SDWED - Structural Design of Wave Energy Devices

Our focus: Investigation of electrical and hydraulic PTO systems and energy storage solutions for wave energy converters.

### TidalSense Demo

Our focus: Cost comparison between the new system and classic CMS approaches using strain and/or acceleration measurements with frequency domain data processing. Integration of the developed hardware into the communication infrastructure of tidal energy converters.

### Study work

Our focus: Waves and tidal energy resource assessment for specific regions worldwide, multi-renewable energy platform concepts and market analyses, concept development for a tidal turbine.

### ORECCA - Offshore Renewable Energy Conversion platforms – Coordination Action

Our focus: Project lead and -coordination, development of a R&D roadmap, investigations regarding offshore platform technologies and installation infrastructure.

### MARINA Platform - Marine Renewable Integrated Application Platform

Our focus: Project Liaison Board member in the role of the ORECCA project leader. Simulation of a wind and tidal turbine hybrid concept.

### TROPOS

Modular Multi-use Deep Water Offshore Platform Harnessing and Servicing Mediterranean, Subtropical and Tropical Marine and Maritime Resources. Our focus: Project coordination, investigation of oceanic activities and technologies on such platforms, development of platform designs, investigations regarding economics, lifecycle assessment, infrastructure & logistics and deployment strategy

### MaRINET - Marine Renewables Infrastructure Network for Emerging Energy Technologies

Our focus: Coordination of research activities; development of innovative methods to measure turbulence and wave current interaction in marine currents; standardisation and harmonisation for marine renewable energy research methods (PTO), improvement of facilities, operational techniques and instrumentation with a focus on tidal energy and PTOs.