DUBLIN
17 – 19
OCT
2012

4TH INTERNATIONAL
CONFERENCE
ON
OCEAN ENERGY

ICOE 2012
INTERNATIONAL CONFERENCE ON OCEAN ENERGY

CONFERENCE PROGRAMME

Presented by

seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

European Ocean Energy ASSOCIATION

OES OCEAN ENERGY SYSTEMS

Wednesday 17th October

07.00 - 08.30 Registration

08.30 - 10.15

ICOE 2012 Conference Opening Session
Opening: Eoin Sweeney, Chair of the ICOE International Committee

Welcome & Chair: Dr Brian Motherway, CEO of SEAI

Mr Pat Rabbitte, Minister for Communications, Energy and Natural Resources, Irish Government
Mr Bernard Valcourt, Canadian Minister of State (Atlantic Canada Opportunities Agency)
Ms Arlene Foster, Minister for Enterprise, Trade and Investment, Northern Ireland
Mr Colin Imrie, Deputy Director and Head of Energy and International Low Carbon, Scottish Government

10.15 -10.45 Coffee Break & Exhibition

10.45 -11.45

Keynote Addresses - Enabling the Development of Ocean Energy
Chairs: Eoin Sweeney, Chair of the ICOE International Committe

John Mc Sweeney, Head of Innovation, ESB - *Ocean energy, harnessing the potential*
Eddie O'Connor, CEO Mainstream and Founding Member of Friends of the Supergrid - *Offshore Grid: the key enabler for marine renewables*
Sean Kidney, Climate Bonds Initiative - *Financing pathways for the marine renewable sector*

11.50 - 13.00

1.1 Wave Energy Convertors I
Chair: Kim Nielson, Ramboll, Denmark

- Martin McAdam, Aquamarine - *The development of Aquamarine*
- Ali Baghaei, Oceanlinx Ltd - *The world's first 1MW wave energy convertor*
- Jonathan Fievez, Carnegie Wave Energy Ltd - *Progress towards the worldwide deployment of the CETO® Wave Energy Technology*
- Erik Friis-Madsen, WaveDragon - *The development of a Wave Dragon 1.5 MW North Sea Demonstrator*

2.1 Ocean Energy Resource Assessment
Chair: Prof Tony Lewis, HMRC University College Cork

- Helen Smith, University Of Exeter - *Wave resource assessment for the Falmouth Bay wave energy test site (FaBTest)*
- Thomas Adcock, University Of Oxford - *On the tidal resource of the Pentland Firth*
- Shiaw-Yih Tzang, National Taiwan Ocean University - *Wave Energy Resources on Coastal Waters of Northeast Taiwan*
- Takashi Okamoto, Hiroshima University - *Wave Energy Resource in the Western Part of Japan*

3.1 Interactions with other sectors
Chair: Jochen Bard, Fraunhofer Institute, Germany

- Laurent Marquis, Wave Star - *Introduction of Wavestar wave energy converters in the Danish offshore wind power plant Horns Rev 2*
- Alla Weinstein, Principal Power - *WindFloat and WindWaveFloat: A deepwater offshore renewables system*
- James Ryan, Aquavision - *Farming fish, waves and wind in the deep blue*
- Eduardo Quevedo, Plocan - *Modular multi-purpose offshore platforms: TROPOS's approach*

13.00 - 14.30 Lunch & Exhibition

14.30 - 15.45

1.2 Tidal Stream Technologies I
Chair: Peter Fraenkel, Fraenkel Wright Ltd

- James Ives, OpenHydro - *Development of a tidal energy business*
- Oliver Wragg, Atlantis Resources Corporation - *Deployment and testing of the AR1000, a 1MW tidal stream turbine*
- Peter Kracht, Fraunhofer IWES - *Implementation of a Vertical Axis Marine Current Plant for Off-grid Village electrification in Indonesia*
- Sian Wilson, Black and Veatch - *Understanding the interactions of tidal power projects across the UK Continental Shelf*

2.2 Results of Environmental Impact Studies
Chair: Yago Torre-Enciso, EVE, Spain

- Andrea Copping, Pacific Northwest National Laboratory - *Renewable Ocean Energy and the Marine Environment: Filling Gaps in Knowledge*
- Graham Daborn, Acadia Tidal Energy Institute - *Between Scylla and Charybdis : Designing Approaches to Environmental Assessment of In-Stream Tidal Power in High Flow Environments*
- Cuan Boake, Queen's University Belfast - *The Environmental Monitoring Programme related to Wake Effect of the Seagen Tidal Turbine*
- Mérin Broudic, Swansea University - *Long Term Monitoring of Underwater Noise at a Proposed Deployment site of a Tidal Stream Device*

3.2 OTEC and Salinity Gradient
Chair: Peter Davies, Ifremer, France

- Paul Dinnisson, OTEC Foundation - *A collaborative effort*
- Frederic Le Lidec, DCNS - *DCNS roadmap on OTEC*
- Franck Rogez, Geocean - *Deep large seawater intakes : a common solution for Floating LNG in oil and gas industry and OTEC in marine renewable energy sector*
- Michael Papapetrou, WIP GmbH & Co Planungs - *Reverse Electrodialysis Power Production - Progress in the development of an innovative system*

15.45 - 16.30 Coffee Break, Poster Session 1 & Exhibition

Modular multi-purpose offshore platforms, the TROPOS project approach

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Abstract

The development of a multi-purpose offshore platform system which could integrate a range of functions from the transport, energy, aquaculture and leisure sectors would help overcome challenges in each of the individual sectors as well as providing additional benefits to society. The FP7 funded TROPOS project approach to this challenge and opportunity is to develop a modular multi-use platform for exploitation in deep waters, with a focus on the Mediterranean, tropical and sub-tropical regions in which this type of structure could be particularly feasible and important.

Keywords: multi-purpose, multi-use, offshore, platform.

1. Introduction

Today more than half of the global population lives within 200 km of the coast, and the number of citizens living within this area is estimated to double by 2025. In Europe, estimates suggest that close to half of the population lives along or near our coasts [1]. Such booming population growth is driven by economic benefits from industrial and urban development, transport links, tourism, energy, and food production. This increasing, non-integrated demand from coastal areas and the concentration of cities along the coast has led to substantial conflict over land and water usage. Thus, space and resources available in the oceans are attracting growing interest, for instance in the use and exploitation of energy and food resources, and in biomass production. Nevertheless, this wide range of resources should be exploited in an organised manner, in accordance with the demand, and following principles of sustainability. In this context, the need for new approaches and integrated solutions for the use of oceanic resources has become increasingly urgent.

There is significant demand in coastal areas for finding innovative methods of production in aquaculture, energy and related transport services. Finally, an integrated approach is critically required to prevent conflicts of use of maritime space and resources. Sharing sites, infrastructures and costs in these diverse activities could therefore present a unique opportunity for improved oceanic exploitation as well as for sustainable economic growth.

Aware of this reality, the European Union has launched "The Ocean of Tomorrow" call for proposals for Multi-use offshore platforms. Through this topic, the EU has provided the scientific and entrepreneurial community with a total funding of €14 M, for up to three projects dedicated to the design of Offshore Multi-use Platforms. The selected projects – TROPOS [2], H2OCEAN [3] and MERMAID [4] – will be able to integrate the exploitation of various oceanic resources, in particular marine renewables, aquaculture and related maritime transport services.

The development of this Multi-use Offshore Platform concept has clearly become one of the EU's most interesting and ambitious projects in order to ensure the integrated, sustainable, and ecological exploitation of oceanic resources.

2. The TROPOS Project approach

The TROPOS project approach is to develop a modular multi-use platform for use in deep waters, with a focus on the Mediterranean, tropical and sub-tropical regions. The development of the multi-use platform system will integrate a range of functions from the transport, energy, aquaculture and leisure sectors and will help overcome challenges in each of these sectors, starting by the shared use of a common infrastructure, among other benefits.

A key to the modular development in the TROPOS approach stems from the old aphorism: "*Think globally, act locally*". Global design generally implies the development of standard solutions; however, the diversity of regional scenarios requires a degree of flexibility and adaptability. In TROPOS, flexibility is achieved through the use of modular units, where

different types of modules can be combined as appropriate in each area (given that each area will have its own unique environment and socio-economic conditions). The TROPOS module concept can be seen graphically in Figure 1 and examples of possible configurations are rendered in Figure 2. A multiuse platform in one given area might combine an energy module, a transport module and an aquaculture module while in another area another combination may prove more viable. The TROPOS modular multi-use platform allows for the combined exploitation of activities in a large number of geographical areas and subsequently provides greater opportunities for profitability. Further, the development of these flexible modular multi-use platforms provides European companies with a strategic competitive advantage in overseas markets with different priorities.

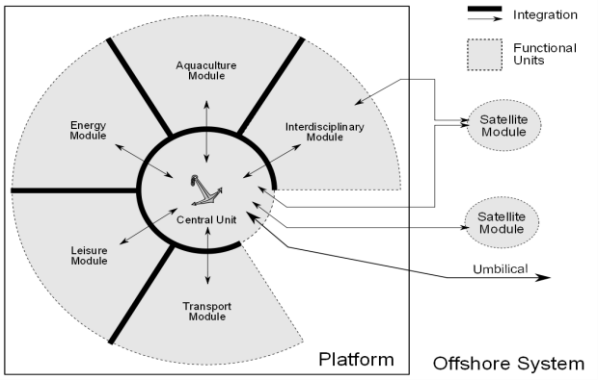

Figure 1: Multi-use offshore platform system functional components

The geographical focus of the TROPOS design will be the Mediterranean Sea, tropical and subtropical areas, generally from -40 to +40 degrees latitude which includes a vast part of the world's oceans where similar characteristics may be found and where European regions exist with specific needs. However, it is anticipated that the proposed focus will not limit the applicability as the TROPOS multi-use platform will be a flexible modular design as described above.

The TROPOS design opens up an immense area of the ocean that would otherwise not be accessible to such use. European seas in the areas of interest show greater depths and have shorter continental shelves (Figure 3); hence floating devices are necessary to harness resources even at relatively short distances from the shore. The multi-use platforms developed from the concept designs will have the potential to provide these coastal regions with appropriate aquaculture systems, innovative transport services as well as leisure and offshore energy solutions. In addition to the European areas of interest, the potential of applications will be explored for non-European waters. Additionally, Europe's outer-most regions, located in tropical and subtropical areas, are highly dependent on fossil energy due to their poor or non-existent connections to central electricity networks. In addition, the EU Outermost Regions (OMRs) – namely the Azores, the Canary Islands, Guadeloupe, Guiana, Madeira, Martinique and Reunion (Figure 4) – represent a specific geographical and economic reality due to their remote location and reduced dimensions. Indeed, contrary to the rest of the European territory, their limited space and resources, added to restricted market dimensions, cannot be compensated by the nearby presence of significant markets. These elements have led the OMRs to consider the surrounding ocean as an outstanding location of resources and available space, which can be exploited and could strengthen both economic growth and job creation. The TROPOS project is thus particularly interesting for the EU OMRs with respect to the energy, aquaculture, transport and tourism sectors. Recent studies [5] have indicated that there is strong interest from these regions in shifting their energy supply to renewable resources. Multi-use platforms could help make this transition a reality.

Providing a solution for the exploitation of Europe's deep coastline would have great potential and market value, including the creation of new local business activities such as shipbuilding, coastal shipping, renewable energy and food production. The development of these multi-use platforms can lead to the economic regeneration of coastal communities, since local jobs are created as a result of the new activity.

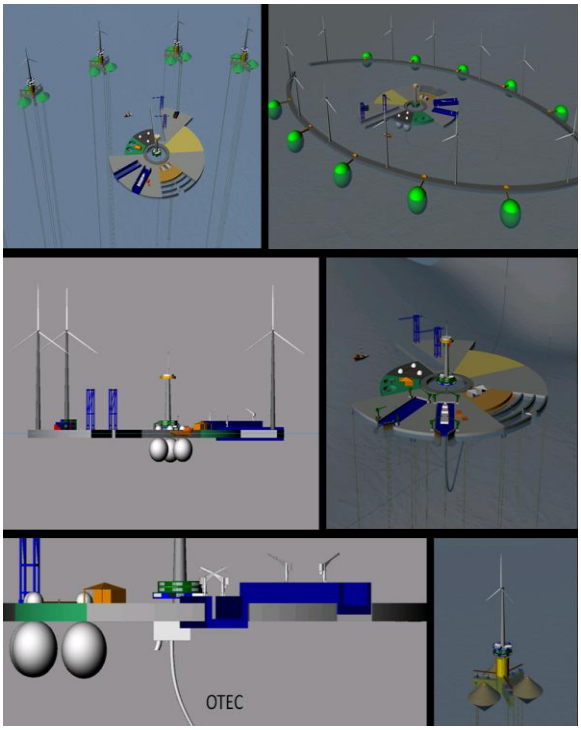

Figure 2: Rendering of possible designs and configurations for multidisciplinary applications of the TROPOS offshore platform system concept

Figure 3: Relief of the ocean floor and water depths

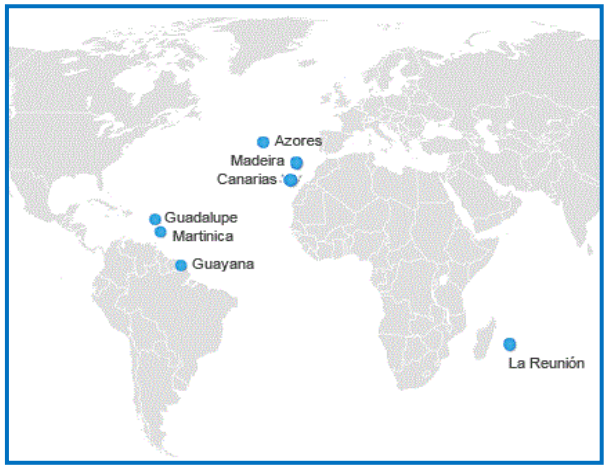

Figure 4: European Union Outer-Most Regions

Project Objectives

The specific objectives of the project are the following:

1. To determine, based on both numerical and physical modelling, including field validations, the optimal locations for multi-use offshore platforms in Mediterranean, subtropical and tropical latitudes. The platform activities and services are expected to include and relate to: novel transport solutions and applications, offshore wind and ocean energy conversion, aquaculture facilities and services as well as offshore tourism and leisure activities.
2. To define and establish integrative and synergic relationships between the following oceanic activities and technologies: renewable energy harvesting and offshore wind in particular, innovative systems for optimal offshore aquaculture and CO_2 sequestration, developing transport solutions for optimised installation and maintenance of the platform, operation and services to shipping and other innovative and integrated services, including offshore tourism activities and ocean environmental monitoring.
3. To develop novel, cost-efficient and modular multi-use platform designs that enable optimal coupling of offshore wind and ocean energy, aquaculture, offshore transport facilities, tourism activities and ocean environmental monitoring.
4. To determine the logistical requirements, including safety, construction, efficient installation, operation, maintenance, monitoring, specialised transportation, supply chain management and decommissioning of the novel platform.
5. To assess the economic feasibility and viability of the multi-use platform as a novel way to deliver new sources of growth and sustainable jobs, including the comparison to non-multi-use platforms in the areas of interest.
6. To develop a comprehensive environmental impact methodology and assessment, including a comparison to non-multi-use platforms.
7. To configure three complete solutions, i.e. at least one for each of the Mediterranean, subtropical and tropical case-scenarios.

Project Benefits

The TROPOS project will contribute directly or indirectly to:

1. Increase the knowledge and efficiency regarding the exploitation of oceanic resources in Mediterranean, tropical and subtropical regions;
2. Diversify the use of marine resources, notably through improving the knowledge related to energy resources exploitation, aquaculture, transport and recreational activities;
3. Extend the sustainable exploitation of oceanic resources to low latitudes areas. These regions are much more abundant and gather a great potential of oceanic resources, even more so than in high latitudes;
4. Promote the development of knowledge and appropriate technologies for the integrated, sustainable and eco-friendly exploitation of oceanic resources.

An interdisciplinary approach

The TROPOS project includes an Interdisciplinary Cohesion Subcommittee (ICS), the aim of which is to enhance the potential and increase the added value of the integration of the four disciplines: Transport, Energy, Aquaculture and Leisure (the so-called TEAL components); on a single floating platform system. As specified in [6], this will be achieved by

- Defining in sufficient detail the phases of the platform design process
- Ensuring a maximum level of integration and synergy of the multiple uses of the platform
- Studying and proposing how to enhance the potential of TEAL integration, i.e. proposing how to optimize the shared use of common structural and functional elements and identifying conflicts as well as identifying and promoting beneficial synergies of the different activities and modules.
- Identifying project tasks where specific expertise is missing ("gaps").
- Participating in the mediation of the information flow between the Work Packages in general.

Impacts

We hereby introduce each TEAL component and the related impact of the project.

Transport Component

Marine transportation provides increasing critical services to society ranging from building commercial and leisure ships, and shipping goods and fuel around the world to servicing offshore structures. Currently, 80 to 90% of all goods imported and exported by Europe are transported by sea.

The exploitation of maritime transportation activities and of service-driven infrastructures will be integrated to the TROPOS platform. The project will notably explore potential synergistic and limiting factors regarding the exploitation of the TROPOS platform as an offshore port and as a basis of logistic services.

Energy Component

The energy sector in the OMRs is characterized by the total isolation of the overall system, by a restricted supply dimension as well as by a strong dependency on a single source of non-renewable energy. In parallel, climate change will undeniably lead to an increased cost of this traditional energy production and to a growing insecurity regarding supply conditions.

The TROPOS platform concept foresees the analysis of synergies, potential limitations and the economic viability of different technologies available for the conversion of offshore wind, ocean thermal gradient, tidal current, solar and wave energy. Depending on the location, related meteo-oceanographic conditions, the expected energy production target, the resulting environmental impacts and, last but not least, the cost, energy conversion technologies may vary substantially from one platform/location to another. Like in other TEAL components, another critical aspect of the Energy component is storage and/or transport issues, which will need to be addressed.

Aquaculture Component

Aquaculture is the fastest growing economic sector in the food industry (FAO, 2009). To reduce fishing pressure on the oceans and supply the increasing demand, aquaculture producers will have to double their production in the coming years. This need is driving producers to move from coastal areas to offshore waters, such evolution involving important technological challenges.

The TROPOS concept, focused on the integrated exploitation of resources, will provide offshore aquaculture with significant synergies for energy exploitation, cages protection, mooring, logistics and transport.

Leisure Component

The tourism industry generates more than 10% of EU's GDP and represents 12% of the total employment. OMRs and the EU Mediterranean area are regions of intense touristic pressure on their coastlines, and there is a constant demand for space for the development of new activities. Used as a service-driven platform for nautical and tourist activities, the TROPOS concept is an innovative approach to the space problem concerning these areas, through contributing to reduce the pressure on coastal regions while creating new business and offshore tourist attraction opportunities.

Figure 5: The TEAL (Transport, Energy, Aquaculture and Leisure) Strategy

Other proposed disciplines, such as Economics or Environmental, should be seen as a basis to justify every TEAL component. In this way all the components are interrelated in a common strategy as is shown in Figure 5.

The TROPOS Consortium

This ambitious project, with a total budget of €6.7 M including €4.9 M of EC funding, requires effective collaboration of a multidisciplinary and highly specialized team in areas such as offshore structures, energy, aquaculture, tourism, maritime transport, socio-economics and environment. Its strong innovative character and the project's key conditions have raised the interest of 18 partners, including European, non-European public research institutions, large companies and small and medium-sized enterprises that excel in the research and expertise in these sectors. The TROPOS Project partners are presented in Table 1.

Nº	Partners	Country
1	Oceanic Platform of the Canary Islands – Project Coordinator	Spain
2	University of Edinburgh	UK
3	University of Bremen-MARUM	Germany
4	Wave Energy Centre	Portugal
5	Universidad Politécnica de Madrid	Spain
6	Fraunhofer Institute-IWES	Germany
7	Toulon Var Technologies	France
8	Norsk Institutt for Vannforskning	Norway
9	Danmarks Tekniske Universitet	Denmark
10	Instalaciones Inabensa S.A.	Spain
11	Phytolutions GmbH	Germany
12	Hellenic Centre for Marine Research	Greece
13	National Sun Yat Sen University - Taiwan	Taiwan
14	Advance Intelligent Development S.L.	Spain
15	Bureau Veritas	France
16	École Centrale de Nantes	France
17	EnerOcean S.L.	Spain
18	University of Strathclyde	UK

Table 1: TROPOS Project partners

Acknowledgements

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[2] FP7 funded TROPOS Project (2012) [Online] Available: http://www.troposplatform.eu/

[3] FP7 funded H2OCEAN Project (2012) [Online] Available: http://www.h2ocean-project.eu

[4] FP7 funded MERMAID Project (2012) [Online] Available: http://www.mermaidproject.eu

[5] European Commission (2007): Étude de modélisation pour l'exploitation des ressources marines pour la production d'électricité dans les régions ultrapériphériques,– INTERREG IIIC – EC/FEDER, BCEOM Report.

[6] The TROPOS Consortium (2011): TROPOS Project Description of Work (DoW) document.