COST ACTION CA20109

MODENERLANDS

Modular Energy Islands for Sustainability and Resilience

1st Working Group Meeting
2nd Management Committee Meeting

Coimbra, Portugal | April 11-12, 2022

MEETING BOOKLET

Editors:

- Carlos Rebelo
- Charalampos Baniotopoulos
- Hassan Hemida
- Anina Glumac
- Enzo Marino
- Michaela Gkantou
- Ruben Paul Borg
- José Correia

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Modular Energy Islands for Sustainability and Resilience

Meeting Booklet for the 1st Working Group Meeting and 2nd Management Committee Meeting 2022 (Coimbra, Portugal) of the COST Action CA20109 Modenerlands:

Modular Energy Islands for Sustainability and Resilience

Edited by

Carlos Rebelo, Charalampos Baniotopoulos, Hassan Hemida, Anina Glumac, Enzo Marino, Michaela Gkantou, Ruben Paul Borg and José Correia

This publication is based upon the work from
COST Action CA20109 Modenerlands, supported by COST
(European Cooperation in Science and Technology)

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About CA 20109 Modenerlands

The COST Action MODENERLANDS revisits safe, smart, modular, cost-effective, and socially valuable high performance Energy Islands based on offshore floating platforms. This Action aims at merging and systematizing the efforts of the European Research and Development groups working on Sustainable Energy and the related technologies, in particular wind and wave energy, for the consideration of Floating Energy Islands in the plans, design and development of future infrastructures of renewable energy. During the development of this Action pathways shall be proposed for incorporating and promoting the relevant synergies in Research, Education and Training to allow for the development and future implementation of floating energy islands in oceanic deep-sea waters, thus enhancing sustainability in the energy sector.

The first Working Group (WG) meeting held in the Sciences and Technologies Campus of the University of Coimbra has been thought to last one and half day and to allow as most as possible face-to-face meetings of the WGs members. This first meeting aims to constitute a privileged forum to promote the member interaction and the sharing of past scientific and technical experience and backgrounds, and to allow for the technical discussions within the thematic of the different WGs in order to establish the ways to fulfill the objectives stated in the MoU of the Action.

The technical work to be developed within the Action has been framed within three Working Groups. The WG1 deals with the resources assessment and the future of the renewable energy in view of the climate changes. The WG2 addresses the Modularized Construction of Offshore Floating Platforms aiming at easily extending their size and capacity according to future energy needs, where the concept of Modular Energy Island acts as a platform to maximize collection and conversion of the renewable energy sources. In WG3 the new challenges related to the design and manufacture of new cutting-edge technologies for energy storage/transmission will be addressed including exploitation of Green Hydrogen related technologies for efficient energy storage and grid integration taking into consideration resilience analysis and techno-economic criteria.

Dr Carlos Rebelo
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University of Coimbra, Portugal

Dr Charalampos Baniotopoulos
Vice-Chair
Aristotle University of Thessaloniki, Greece
University of Birmingham, United Kingdom

Committees

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Trayana Tankova, PT	Science Communication Coordinator, University of Coimbra
Georgios Stavroulakis, EL	Grant Awarding Coordinator, Technical University of Crete
Hassan Hemida, UK	WG1 Leader, University of Birmingham
Enzo Marino, IT	WG2 Leader, University of Florence
Ruben Paul Borg, MT	WG3 Leader, University of Malta
Helena Gervásio, PT	Equal Opportunities & WG Membership Officer, University of Coimbra
Panagiotis Alevras, UK	Industry Liaison Officer, University of Birmingham
Anina Glumac, LU	WG1 Vice Leader, University of Luxembourg
Michaela Gkantou, UK	WG2 Vice Leader, Liverpool John Moores University
José Correia, PT	WG3 Vice Leader, University of Porto

Local Organisers of Modenerlands 1st WGs and 2nd MC meetings

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Mariela Mendez Morales, PT	University of Coimbra

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Z. Jiang, NO

Agenda

Meeting 1 - General Timetable of the 1st Meeting

DATE:	11 and 12 April, 2022
Time	Day 1: 09h00 – 18h00 (WET)
	Day 2: 09h00 – 13h00 (WET)
Place	Coimbra, Portugal
Venue	Department of Civil Engineering University of Coimbra – Campus 2 R. Luis Reis Santos 3030-788 Coimbra
Host	Prof. Carlos Rebelo

11th April (Monday)		
9:00 - 9:15	Registration	Secretariat – Building Main Entrance
Plenary Sessions		**AUDITORIO LAGINHA SERAFIM**
9:15 - 9:30	Welcome	Carlos Rebelo & Charalampos Baniotopoulos
9:30 - 9:45	Overview of the COST Action and WGs	Carlos Rebelo
9:45 - 10:15	**Invited Lecture WG1**	**Teresa Simões**
10:15 - 10:25	Introduction to WG1	Hassan Hemida & Anina Glumac
10:25 - 10:50	Coffee-break	
10:50 - 12:30	Presentations from WG1 members	(See detailed list)
12:30 - 13:30	Lunch	University Restaurant
13:30 - 14:00	**Invited Lecture WG2**	**Claudio Lugni**
14:00 - 14:10	Introduction to WG2	Enzo Marino & Michaela Gkantou
14:10 - 15:40	Presentations from WG2 members	(See detailed list)
15:40 - 16:00	Coffee-break	
16:00 - 16:30	**Invited Lecture WG3**	**Luciano Molestano**
16:30 - 16:40	Introduction to WG3	Ruben Paul Borg & José Correia
16:40 - 18:10	Presentations from WG3 members	(See detailed list)
20:30	Dinner	Restaurante O Trovador

12th April (Tuesday)		
Parallel Sessions - presentations and discussion		**Room**
9:00 – 11:00	WG1	CMM
	WG2	SE – 3.4
	WG3	SE – 3.5
11:00 – 11:20	Coffee break	
11:20 – 12:15	WG1	CMM
	WG2	SE – 3.4
	WG3	SE – 3.5
Plenary Session		**AUDITORIO LAGINHA SERAFIM**
12:15 - 13:00	Report by WG leaders, conclusions, and future work	
13:00	End of the Working Groups Meeting	
13:00 - 14:00	Lunch	University Restaurant

COST CA 20109 – Working groups

Meeting 1 - List of Presentations from Working Group members (11th April)

WG 1 - ASSESSMENT OF SUSTAINABLE ENERGIES RESOURCES FOR ENERGY ISLANDS		
Plenary Session		**AUDITORIO LAJINHA SERAFIM**
10:50 - 11:00	Angela Meyer	Renewable Resources, Climate Change, and Intelligent Wind Farm Monitoring to Facilitate the Energy Transition
11:00 - 11:10	Christopher Koroneos	Optimum Energy Systems for Small Islands
11:10 - 11:20	Emilio Muñoz Cerón	Development of a Solar Photovoltaic Map for the Identification of Suitable Locations for Near-Shore and Off-Shore Energy Islands
11:20 - 11:30	Félix Nieto	Assessing the Potential in Wind-Excited Energy Harvesters by Computational Methods
11:30 - 11:40	Nejan Huvaj	Assessment of Offshore Wind and Floating Hybrid Wind and Solar Energy Potential Using Geographic Information System and Multi-Criteria Decision Making Methods: Case for Turkey
11:40 - 11:50	Rumiana Vatseva	Geospatial Technology for Environmental Modeling
11:50 - 12:00	Tamara Bajc	Solar Thermal Energy Current State and Perspectives
12:00 - 12:10	Tareq Abu Hamed	Agrivoltaics: Harvesting the Sun Twice and the Dual-Use of Land
12:10 - 12:20	Anina Šarkić Glumac	Challenges and Opportunities Towards Energy Islands – A Literature Review

WG 2 - MODULAR OFFSHORE FLOATING ENERGY ISLANDS		
Plenary Session		**AUDITORIO LAJINHA SERAFIM**
14:10 - 14:20	Abdollah Malekjafarian	Vibration-Based Methods for Structural Dynamics and Assessment of Offshore Structures
14:20 - 14:30	Christabelle Vassallo	Ultra High Durability Concrete for Offshore Floating Structures
14:30 - 14:40	Georgios Malliotakis	Floating Wind Energy Converters. Vibration Control Methods.
14:40 - 14:50	Giulio Ferri	Modeling Offshore Floating Energy Platforms
14:50 - 15:00	Mariela Mendez Morales	Achieving Modularity in Large Structures Through Additive Manufacturing
15:00 - 15:10	Evangelos Efthymiou	Advancing Aluminium Deployment in Offshore Floating Wind Energy Concepts
15:10 - 15:20	Stefano Lenci	Some Nonlinear Phenomena in Floating Structures
15:20 - 15:30	Vikram Pakrashi	A Compendium of Natural Frequency Formulae of Offshore Wind Turbine Structures
15:30 - 15:40	Zhiyu Jiang	Mooring System Design Challenges for Modular Floating Energy Islands

WG 3 - NETWORK, ENERGY STORAGE AND RESILIENCE ANALYSIS		
Plenary Session		**AUDITORIO LAJINHA SERAFIM**
16:40 - 16:50	Grzegorz Cempura	Electron Microscopy, Spectroscopy and Tomography for Energy Material's Applications.
16:50 - 17:00	Ivan Todorović	Digital Twinning of Energy Islands
17:00 - 17:10	Maria Tsami	Greening Mobility and Resilience Management Challenges in Island Transportation
17:10 - 17:20	Snezana Cundeva	Grid Integration of the Enabling Technologies Required for Decarbonizing Islands
17:20 - 17:30	Suraj Gupta	Renewable Hydrogen Generation from Direct Electrolysis of Seawater
17:30 - 17:40	Tomasz Bakoń	Phase Change Materials as Energy Storage Alternative
17:40 - 17:50	Yahya Danayiyen	Power Electronic Converters in Renewable Energy Plants
17:50 - 18:00	Yesim Kamile Aktuglu	Offshore Structures from the Point of the Architectural Stability
18:00 - 18:10	Jovan Todorovic	Power Grid Integration Issues of Renewables Within Energy Islands

Videoconference links

11th April (Monday)	
Plenary Sessions	
All participants	https://videoconf-colibri.zoom.us/j/83522490942?pwd=Z2hmdTVzbk5hc0wyZU5vMWtSWGFYUT09 Password: 779781

12th April (Tuesday)	
Parallel Sessions - presentations and discussion	
WG1	https://videoconf-colibri.zoom.us/j/84710679642?pwd=NFpvNjMzbHAxc3B2b3hqaFRNcXJudz09 Password: 763579
WG2	https://videoconf-colibri.zoom.us/j/87487436856?pwd=bkt6ZGlSTDhGM0E4c1JhcVRkK2ttUT09 Password: 017479
WG3	https://videoconf-colibri.zoom.us/j/86398348024?pwd=eERhaFhIVi80aUticzFPc2drNWdMQT09 Password: 099504

Abstracts from Working Group 1: Assessment of Sustainable Energies Resources for Energy Islands

Renewable Resources, Climate Change, and Intelligent Wind Farm Monitoring to Facilitate the Energy Transition

Angela Meyer

My research spans the fields of wind and solar resources, climate science, and wind turbine condition monitoring based on artificial intelligence. My current research projects focus on the short-term forecasting and monitoring of wind and solar energy and are funded by the Swiss National Science Foundation and the Swiss Innovation Agency Innosuisse. My group is investigating renewable resources and renewable resource forecasting using ground sensor systems and satellite-based sensors ([1]; [2] – [5]) and the impact of climate change on the surface climate and renewable operating conditions [6]. I am also researching data-driven approaches to automating the early detection and diagnosis of operation faults in wind turbine drive trains ([7] – [9]; [10]). For our current research, please see https://www.angela-meyer.net.

In the planned presentation, I will give a short overview of my scientific background, my group's research, and our potential contributions to the Working Group activities. I look forward to collaborating with you in this working group.

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Development of a Solar Photovoltaic Map for the Identification of Suitable Locations for Near-shore and Off-shore Energy Islands

Emilio Muñoz Cerón[1], Hassan Hemida[2], Anina Šarkić Glumac[3]

[1] Center for Advanced Studies in Earth Science, Energy and Environment. IDEA Photovoltaic Research Group. University of Jaen, Jaén, Spain, [2] School of Engineering. University of Birmingham, Birmingham, UK, [3] University of Luxembourg, Interdisciplinary Centre for Security, Reliability and Trust (SnT), Esch-sur-Alzette, Luxembourg

As a preliminary step for the design proposal of modular offshore floating energy islands, an appropriate assessment of the sustainable solar energy resource have to be undertaken because photovoltaic based systems are one of the main energy suppliers of such islands.

In the photovoltaic industry the development of solar maps, which gives information about the energy yield of such installations within a certain region, enables the identification of the most suitable locations for the implementation of such solar projects [1], [2].

However, all these studies are referred to inland locations and there is scarce or limited information about the suitability of a certain region for the development of solar floating system. Therefore it is interesting to undertake a preliminary study with the Mediterranean Sea as a base case, where it is identified the best locations for such installations, differentiating between near-shore and off-shore locations.

This study can set the foundations for further ones in other locations, together with further research where other renewables could be also considered (i.e. wind, tidal, etc.)

The IDEA Photovoltaic research team from the University of Jaen (Spain) have the expertise in development potential integration assessments of this technology and the main author have previous experience in the design of PV integration solutions, such as the development of hybrid PV-noise barriers for road infrastructures and the design and installation of floating PV systems on irrigation ponds.

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Assessing the Potential in Wind-Excited Energy Harvesters by Computational Methods

Félix Nieto[1], Antonio J. Álvarez[1]
[1] School of Civil Engineering, University of La Coruna, Spain

The Energy Island concept relies on the synergetic combination of diverse renewable energy sources such as wind, solar, waves or tides for a high-performance energy infrastructure. Wind excited energy harvesters are capable of converting the oscillatory energy induced by aeroelastic excitations into electrical power, and this technology may be considered as an additional contributor for offshore multi-energy farms, remarkably for low-medium wind speeds events. The overall goal of our research is to apply numerical methods for the accurate modelling of the performance of large-scale energy harvesters; and therefore assessing their potential for deployment in real conditions.

Our experience in shape optimization considering aeroelastic performance ([1], for example), allows us to apply advanced multidisciplinary design tools for the improvement of wind energy devices. We have extensive experience in aeroelastic effects, particularly in CFD simulation of fluid-structure interaction problems (see for instance, [2]). Additionally, we have studied experimentally one prototype of wind-excited energy harvester [3]. Furthermore, we have been recipients of one MIT-Spain INDITEX Sustainability Seed Fund for the project entitled "Efficient Wind-Excited Energy Harvesters Based on Nonlinear Cantilever Beams". We have also been active in diffusion activities in this topic, delivering a workshop for High School students on wind-excited energy harvesting technology within the frame of the 2021 European Researchers' Night. We have also developed an early-stage technology for offshore deployment of energy harvesters, which was selected among the "call for technologies" applications of the EMPORIA4KT Blue Economy Technology Transfer Program (Interreg Atlantic Area).

We would like to collaborate in multiple aspects associated to the development of the floating Sustainable Energy Islands concept by contributing in the assessment of the potential of energy harvesters, as well as other renewable sources, paying special attention to their combination and interactions. We wish to contribute in the studies, discussions, and dissemination activities organized by the MODENERLANDS network.

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Assessment of Offshore Wind and Floating Hybrid Wind and Solar Energy Potential Using Geographic Information System and Multi-Criteria Decision Making Methods: Case for Turkey

Nejan Huvjaj, Eray Caceoglu

Offshore wind and solar energy development is on an increasing trend, especially in Europe and Asia. Annual and cumulative installed floating photovoltaic (PV) capacity worldwide indicates a significant increase since 2016. Offshore wind turbines that are in deeper waters, which may require floating systems, are even more attractive option in terms of wind resource. Both floating wind and floating PV's are also preferable since they do not occupy land space, which is valuable and has many competing land usage alternatives. Floating PV systems can also reduce water evaporation from water bodies. In addition, the natural cooling effect of water, which increases PV efficiency by up to about 12%, is another advantage of floating PV's. Although floating wind and floating solar energy systems can be installed individually on a water body, a combination of them can also be used in the same location, either on the same platform as a hybrid (combined) system, or as individual-but-connected installations, providing efficiency in terms of energy production. Both options bring cost efficiency benefits together with their own technological challenges. Furthermore, floating hybrid wind and solar systems can share the same infrastructure such as seabed/lakebed cables and onshore substations, therefore they would be more cost-efficient.

Utilization of Geographic Information Systems and multi-criteria decision making methods have been on the rise in site selection for renewable energy. The aim of this study is to evaluate site selection criteria, define no-go zones and buffer distances/limitations and determine the suitable sites for offshore wind and floating solar energy (on water bodies on onland/offshore) using Geographic Information Systems and Analytical Hierarchy Process. More than 17 site selection criteria is considered including commercial fishing activity, distance to shipping routes, length of onshore and offshore cables and a questionnaire is applied to international experts to develop the ranking system.

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Geospatial Technology for Environmental Modelling

Rumiana Vatseva[1]
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Geospatial technology offers considerable potential for sustainable assessment and management of environment. It includes geographical information systems (GIS), remote sensing (RS), and global navigation satellite system (GNSS) technology that supply powerful tools of obtaining and analyzing spatial data for environmental mapping and modelling. RS and GIS are successfully applied in many fields related to natural resources and environmental science, including urban green space modelling [1,2], land cover and land use mapping [3], landscape change assessment [4, 5], forest fragmentation analysis [6] and spatial data infrastructure development [7]. Geospatial tools are also efficiently used in spatio-temporal mapping and monitoring of the size and geographic distribution of the renewable energy resources: the wind and solar energy, biomass and hydropower. Thus, the use of geospatial technology provides a scientific basis for developing and maintaining an environmentally, economically and socially sustainable environment.

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Solar Thermal Energy Current State and Perspectives

Tamara Bajc[1], Milan Gojak[1], Danka Kostadinovic[2], Nikola Mirkov[2]
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Almost 50% of final energy consumption in Europe and worldwide is addressed to thermal energy, which is significantly higher than energy needs for electricity for lighting, electrical appliances and for traffic. About 40 % of total primary energy consumption is used in building sector. Limited amounts of fossil fuels, their negative impact on environment, high and unstable prices and import dependency of fuels caused intensive growth and usage of solar thermal energy worldwide. Solar heating and cooling are the most important solar sectors, where installed solar system power is about 500 GW. This amount is higher than PV system power and also the power of solar thermal plants. Now days, according to the total installed collector capacity, China dominates on first place, then Europe, while United States comes right after, according to the SHC Agency data. Interesting contribution can be achieved through the Floating PV systems (FPV), which can be integrated with other RES techniques. FPV contribution is shown as highly beneficial through the numerous studies, increasing the total production of this hybrid plants and also by making the generation more stable. This research presents a review of different sizes, number, installed power and types of solar collectors and other characteristics of built solar thermal systems worldwide. Potential for possible usage of solar thermal systems was identified and technological and other challenges and perspectives for future growth in the field of solar thermal energy were discussed, having in mind 2050 projections and scenarios.

Acknowledgements

This work was supported by Ministry of education, science and technological development of Republic of Serbia [grant number: 451-03-68/2022-14/200105 from 04.02.2022., sub-contracts TR33047 and TR33048].

Challenges and Opportunities Towards the Energy Islands - Literature Review

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The scarcity of habitable land, growing energy consumption and environmental repercussions of fossil fuels are fostering the development of renewable energy projects in the marine environment. Thus, intensive research has been devoted in recent years in developing offshore marine renewable energy technologies. As for wind energy, offshore farms have been in operation and connected to the grid since 1990 and have experienced a substantial growth in the last decade, especially in Europe. Regarding wave energy, it is considered a significant resource of clean energy with high energy density and good predictability. There exists a number of wave energy farms around the world. The wind and waves are considered two properties of major interest for electricity generation. In addition to these two marine renewable energy resources, solar energy is an alternative source of energy that has been little explored in the marine environment. As oceans and seas receive 70% of sun radiations, offshore solar energy technologies have a high potential for electricity generation. As the concept of combining those three energy sources in a synergic way is quite recent, a detailed review on the use of these three renewable energy resources needs to be performed. Moreover, main advantages and disadvantages of combining the three offshore technologies together in one place, Energy Island, need to be explored in full.

The main author has primarily experience in the exploring wind as the energy resource, using different methodologies such as Computational Fluid Dynamics, wind tunnel experiments, and recently data assimilation and machine learning.

Acknowledgements

The author A.S.G. would like to acknowledge the support of the "Soutenu par le Fonds National de la Recherche, Luxembourg" (FNR) for funding the CORE Junior project DATA4WIND - "Data-Driven Approach for Urban Wind Energy Harvesting", C19/SR/13639741.

Hybrid Power Systems

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Hybrid power systems are power plants that contain two or more technologies that may potentially include WT, PV, CSP, geothermal, hydropower, biomass, natural gas, oil, coal, nuclear power, and storage units. Power systems that do not use fossil fuels and that consist of a combination of renewable energy sources such as wind, solar, and "green" hydrogen energy are also called renewable hybrid power systems. Renewable Hybrid Power Systems are an important solution in terms of energy security, sustainability and flexibility. Hybrid power systems, which will also be used in the MODENERLANDS concept, will constitute a dynamic structure that changes depending on geographical and meteorological conditions due to the combination of renewable energy sources. It is important to know the technical characteristics of hybrid power systems with dynamic and non-linear responses and to define the problems that may occur if the renewable energy systems run together.

In this presentation, small scale hybrid power systems will be explained, and the technical design and considerations will be explained through two sample systems. The first example is a mobile renewable house using PV/wind/fuel cell hybrid power system. Another example is the renewable hybrid power system that can be connected to the grid in case the demand for energy increases while operating independently from the grid.

Figure 1. Stand-alone hybrid mobile renewable house and on-grid hybrid power system.

Potentials of Polygeneration Systems on Modular Energy Islands

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The challenges of mitigation from fossil fuel dependent energy to 100% renewable are the most important issue in the energy sector today. The Modular energy island approach helps with mitigation towards low carbon, sustainable and renewable energy production, although it is not directly applicable in the continental energy markets. Polygeneration systems are complex energy conversion systems where one or more energy sources are transferred into two or more energy or material outputs. Applicability and effectiveness of a polygeneration system in terms of costs, energy efficiency and environmental impact, strongly depend on energy and material demands near the system location ,available energy sources on the system location, complexity of the system determined by the number of energy transformation technologies applied and the capacity and powers ratings. An optimal mix of energy sources, capacities and power ratings of the system and technologies have to be determined by means of techno-economic optimization, based on the demand side loads, energy market conditions, and sometimes legal market constraints. Generally, conventional energy conversion technology modules for burning fossil fuels can be part of a polygeneration system, as well as renewable energy sources. The optimal configuration of polygeneration systems for sustainable energy islands, should be based completely on renewables (wind, PV, concentrated solar, heat pumps etc.), but the optimal solution will again be affected mostly by the market conditions. The energy planning problem can be solved by modeling and simulation of dynamic performance of modular energy islands during a typical meteorological year, for each location, using (Trnsys or Energy Plan software), with a methodology similar to the one already applied to hybrid (i.e. fossil and renewable based) polygeneration systems [1,2]. Some uncertainties regarding the construction and energy demands near the locations of energy islands should be tackled: (1) energy demands near the island, i.e. heating, cooling, electricity, desalinated water etc; (2) maximum feasible distance from the consumer location according to energy transport losses and construction constraings; (3) energy storage mass and volume constrains on the island; (4) level of automation, reliability and availability of the outputs of a polygeneration system on a modular energy island.

Acknowledgement

This research was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract No. 451-03-68/2022-14/ 200109), and by the COST action CA20109 Modular Energy Islands for Sustainibility and Resilience – MODENERLANDS.

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Fluid Dynamics Research at the von Karman Institute for Development of Energy Islands Planned in the Belgian Part of the Nord Sea

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The von Karman Institute for Fluid Dynamics (VKI) is an international research and educational center located near Brussels. It operates academic and industrial research programs in the field of aeronautics, turbomachinery, environmental and industrial flows.

Fluid dynamics research for offshore renewable projects have seen a large increase in the recent years. The main focus is on analysis and forecasting of wind and wave loading on offshore wind turbines during extreme events as well as for maintenance and operation purposes. Also wind loading on small floating islands with PV panels located in the Belgian part of the North Sea is studied in VKI atmospheric boundary layer wind tunnels in combination with computational fluid dynamics.

The presentation will focus on fluid dynamics research relevant for the development of energy island(s) that are planned in the Belgian part of the Nord Sea in the Belgian offshore wind energy zones.

Abstracts from Working Group 2: Modular Offshore Floating Energy Islands

Vibration-Based Methods for Structural Dynamics and Assessment of Offshore Structures

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Structural Health Monitoring (SHM) is needed on all civil engineering structures to ensure the early detection of any damage, and hence reduce the probability of failure during the structure's operational life. Due to their remote location far out at sea, floating platforms can become inaccessible for visual inspections and so a remote method of condition monitoring is preferred. Our potential contribution will be in WG2, "Modular offshore floating energy islands". Our current research is focused on dynamic coupled modelling of offshore wind turbines including both fixed-base and floating types. We have developed several approaches for modelling of soil-structure interaction for offshore structures. We also have developed several approaches for vibration-based structural health monitoring of offshore wind structures. So, we would like to potentially contribute to the main categories of "Structures", "Anchoring and mooring systems", "Design" and "Monitoring".

Ultra High Durability Concrete for Offshore Floating Structures

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Coastal infrastructure and marine offshore structures are exposed to aggressive action leading to deterioration of reinforced concrete with a high economic impact associated with repair or replacement of structures. Ultra-High performance concrete (UHPC) is developed with improved mechanical and durability properties, for long-term performance when exposed to aggressive environments. The improved performance of UHPC is possible through the use of admixtures and mix design resulting in a self-compacting, self-healing fibre-reinforced concrete with high strength and durability. UHPC has high ductility and strength, together with a significantly lower permeability to aggressive fluids, including lower chloride-ion penetration. These characteristics can promote the exploitation of the materials for highly aggressive environments in green and blue energy infrastructure. The improved performance allows for innovative applications including floating platforms and elements, with improved efficiency in material use and long-term reliability in service conditions (cracked state of the concrete) with reduced maintenance and repair requirements. The paper reviews the characteristics of Ultra High-Performance Concrete and its application for increased service life in highly aggressive environments, with particular reference to floating modular structures and coastal applications.

Floating Wind Energy Converters. Vibration Control Methods

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Our research group emphasizes, among others, on the vibration mitigation of wind turbine towers. Floating wind turbine towers are subjected to strong winds, wave, current and sometimes to seismic loads. The tower and the floating platform should provide enough bearing capacity to withstand to these dynamic loads. Therefore, vibration mitigation plays a key role for the response of the tower. Our recent review article ''Recent advances in Vibration Control Methods for Wind Turbine Towers'' summarizes all the vibration control methods that have already been studied in the literature [1]. There are three main vibration control methods: passive, active and semi-active. Passive seems to be more economical, however, detuning in combination with the required space at the nacelle and high values of mass ration are very common issues. Although active methods are more efficient, they need external power and control algorithms to operate, making them more complex and less attractive. Semi-active methods are new concepts that need to be studied further. Therefore, the main goal our research group is to investigate novel vibration control methods without increasing significantly the overall mass and cost of the system, reducing the impact of the external loads as well. These control configurations will be assessed in terms of structural response for varying loading conditions. Since WG2 focuses on floating wind energy, vibration mitigation is crucial for a sustainable and resilient structure. Our research group is willing to share its findings in regards to optimal design of floating wind turbines providing useful knowledge and expecting for some valuable feedback.

Acknowledgements

The authors acknowledge with thanks Royal Society for the grant (IES\R1\211087). The third author also acknowledges with thanks the Alexander von Humboldt Stiftung for the continuous support to his research work on Sustainable Energy Systems.

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Modeling Offshore Floating Energy Platforms

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The research group at the Department of Civil and Environmental Engineering (DICEA) of the University of Florence has a consolidated experience in nonlinear hydrodynamic models and in the analysis of Offshore Wind Turbines, both floating and fixed bottom. Currently, the research activities are focused on optimization procedures of platform and mooring system for Floating Offshore Wind Turbines (FOWT) ([1], [2]) and on efficient computational models for fully nonlinear Fluid Structure Interaction (FSI) problems. Recently, an in-house frequency-domain solver for the simulation of a semisubmersible FOWT exposed to turbulent wind and irregular waves has been developed. The hydrodynamic potential flow problem is solved with ANSYS AQWA [3]. Linearized viscous drag forces are modelled with Morison's equation [4]. A quasi-static approach, which neglects the inertia of the cables, is adopted for the mooring lines [5]. Linearized simulation, performed by means of FAST [6], allow to estimate the turbine contributions in terms of aerodynamic loads, mass, damping, and stiffness matrices, leading to a fully coupled frequency domain model. The developed tool consists in a 7-DoF model which accounts for the 6 rigid-body platform motions and the Fore-aft tower top deflection, allowing to reconstruct stresses on both the turbine tower and the mooring lines.
Within the WG2 activities, the research group at DICEA can contribute to the analysis of the floating modular system at various level:

- linear, weakly nonlinear and fully nonlinear waves modeling;
- frequency-domain (linear) simulations of the modular floaters and linear FSI;
- frequency-domain based optimizations focused on the identification of the best shapes (squared barge, moonpool, hexagons);
- analysis of the connections and the hydrodynamic interaction between modules can be performed in a linear setting
- time-domain fully nonlinear simulations of the modular floaters with nonlinear FSI;
- nonlinear analysis of the connections and the hydrodynamic interaction between modules

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Achieving Modularity in Large Structures Through Additive Manufacturing

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Each year, more powerful Wind Energy Converters (WEC) enter the market, facing structural engineering with the task of providing larger, safe, and profitable towers. Larger structures translate into complex logistical needs, often restricting potential installation sites. Furthermore, traditional solutions for supporting WEC are pushing the technical feasibility to its limits by demanding a higher level of precision in the components, frequently requiring specialised and costly manufacturing methods.

Hence, modular supporting structures are becoming increasingly popular due to their advantages regarding transportation and assembling. These structures typically rely on hollow structural sections, typically joined by welding, a process known for its limited fatigue resistance and costly fabrication. As a result, one of the main challenges in the sector is developing connections of simple installation that guarantee high-quality off-site fabrication. All of these while providing adequate fatigue and ultimate limit state resistance.

Additive manufacturing (AM), or 3D printing, is currently creating state-of-the-art components for structural applications, delivering encouraging results. The versatility to produce intricate geometries could facilitate the modularisation of large tubular structures. Thus, the main objective of this work is to conceive a 'plug and play' (PnP) 3D printed system to securely join tubular elements. The geometry of such a device is obtained through mathematical topology optimisation and validated using numerical methods.

The PnP system accommodates the needs of the SeT-Self Erecting Tower project, which presents an innovative composite tower of modular panels, lifted by a built-in internal crane. Such individual panels are constructed using a reticular steel structure of hollow sections, and an external concrete shell. These panels are later joined, mainly through the steel elements. A prototype for this connection is under current development. Finally, the PnP system could be expanded to other areas of structural engineering such as large span roof structures, trusses, offshore platforms, or jacket towers.

Acknowledgments

This work was developed in the framework of the research project SeT-Self Erecting Tower (CENTRO-01-0247-FEDER-070138) co-financed by the European Regional Development Fund, through Portugal 2020 (PT2020), and by the Competitiveness and Internationalization Operational Program (COMPETE 2020) and under the R&D Unit Institute for Sustainability and Innovation in Structural Engineering (ISISE), under reference UIDB/04029/2020, financed by FCT-Foundation for Science and Technology, IP/MCTES through national funds (PIDDAC).

Advancing Aluminium Deployment in Offshore Floating Wind Energy Concepts

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Today, wind generation is largely realized through onshore applications, but it is expected that offshore wind will be an important component in the future energy mix to decarbonize Europe and reach the targets of 60 GW of wind by 2030 and 300 GW of wind by 2050. In this field, floating offshore energy concepts that can operate in deep waters exploiting the respective higher wind speeds, as well as energy of waves and sea currents, are attracting growing interest. The fact is that they have higher flexibility in site selection and lower social and environmental impact as opposed to land-based wind energy production. In pursuit of innovative solutions and design concepts to ensure low-cost installation and maintenance operations, accelerating thus floating wind energy expansion, the use of alternative materials can offer additional advantages in performance. Structural aluminium, as an alternative material, represents a lightweight option with high thermal conductivity, durability, remarkable corrosive resistance and excellent recyclability, comprising important beneficial attributes in offshore wind.

The herein proposed activity aims at investigating further the deployment of aluminium alloys in floating offshore wind energy field towards enhancement of cost-effectiveness, sustainability and modularity of the respective applications. In particular, the research will address the exploitation of extrusion features and joining technologies like the friction stir welding (FSW) and demountable connecting techniques towards developing low maintenance aluminium-based solutions for holistic design and optimisation of floating wind energy concepts. Through computational study the feasibility of aluminium alloys use for the turbines, platforms, moorings, and control systems will be investigated. Moreover, newly introduced usage of thermal spray aluminium for reduction of metal emissions in floating wind energy will be further analysed.

Some Nonlinear Phenomena in Floating Structures

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There are plenty of nonlinear problems in floating structures, and in particular in Modular Energy Island, for example in wind blades, wind turbine-tower interactions, mooring lines, sea-island (fluid-structure) interactions, dynamics of floating platforms (islands), island-island (structure-structure) interactions.

Here we summarize the work we have done in the past on simple models of catenary (e.g. mooring lines) [1], semi-infinite cables resting on a unilateral substrate (e.g. mooring lines) [2,3], nonlinear oscillation of beams (e.g. tower of the wind turbine) [4-7], vertical risers (e.g. in TLP) [8,9] and rotating beam (e.g. turbine blades) [10]. In all work the focus is on investigating in depth the nonlinear phenomena that occur in the considered systems, giving a very rich scenario, that could introduce dangerous effects if not properly addressed but, on the contrary, can give a cornucopia of possibilities if properly exploited.

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A Compendium of Natural Frequency Formulae of Offshore Wind Turbine Structures

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This presentation will present a compendium of natural frequencies for offshore wind turbines for a range of foundation types, in a simplified format [1], for rapid estimates. The presentation provides a synthesis of various works carried out by different groups [2] on this topic globally and examples have been created to illustrate them. Rapid estimates of such natural frequency with reasonable accuracy can provide offshore wind industry stakeholders a clear insight to several engineering options for implementation [3], along with their risks and opportunities [4]. The presented examples can be easily adapted to spreadsheets [5] and consider several aspects of structural demands and exposure conditions to loading, thereby providing a good basis for estimating lifetime performance and cost, including those obtained through scaled testing [6].

Acknowledgements

This research received funding from Enterprise Ireland SEMPRE project DT-2020-0243-A. The authors would also like to acknowledge SFI MaREI centre R2302_2 and UCD Energy Institute.

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Mooring System Design Challenges for Modular Floating Energy Islands

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In this talk, possible mooring system configurations for modular offshore energy islands will be discussed. First, different types of environmental loads acting on a modular energy island will be presented. Then, existing mooring systems applied to offshore wind energy and wave energy systems will be reviewed. Last, novel concepts with potential cost-effectiveness for large modular floating energy islands will be presented. The presenter has been involved in projects related to design and analysis of floating wind turbines, offshore dynamics, metocean conditions, mooring system design, and marine operations.

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Current View of Energy Island and the Hybrid Energy Island

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The modular energy island has a vital role in future energy planning. Although the energy sources increase day by day, the higher energy demand based energy crisis is growing faster. However, governments and unions aim to deal with the high carbon emission rates due to fossil fuels. That is why new solutions with renewable energy sources are very important. One of the few disadvantages of renewable energy sources is the area they occupy on land which may be agricultural lands, animal migration routes, areas suitable for habitation, or locations that may harm natural life. At the same time, water areas (eg. Oceans, seas, lakes, rivers) on earth have a very big potential for renewable energy sources. Because approximately 70 percent of our world surface consists of water areas. It means, there are very large potential areas to use energy producing. In the last years, offshore wind turbines and wave energy converters are so popular energy plants thanks to new technologies. For future sustainable energy infrastructure, offshore applications should be aimed and safe, smart, modular, cost-effective and socially valuable high performance sustainable Energy Islands should be developed.

In this abstract, the general overview of the energy island, necessity of it and the hybrid energy island are shortly given. Even though there are wide application areas on the water for energy islands, authorities must take into account these areas are not unlimited. Also, habitats and ship roads must be protected on the water and under the water. So, the hybrid energy island can solve these issues. Since the wind, wave, hydrogen and solar energy production systems could be located on the island using hybrid and neighbor strategies. An offshore wind turbine can generate hydrogen, can carry solar panels on it and can give a suitable space for a wave energy converter. At the same time, this hybrid island can create a suitable environment for shipping, touristic facilities and submarine works. Thus, the hybrid structure and created environment of the energy island may decrease CAPEX and OPEX costs for sustainability and scalability.

Acknowledgements

The author also acknowledges SCU MOBILERS Team.

Study of Aluminium Structures at the Faculty of Civil Engineering, University of Montenegro

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An overview of aluminium structures research pieces conducted and/or ongoing at the Faculty of Civil Engineering, University of Montenegro (FCE UoM), is presented. Performed (as well as those planned for ongoing studies) analyses, obtained results and drawn conclusions are briefly described. For less than one decade, considerable achievements have been accomplished.

Generally, aluminium may be considered competitive and economically viable when/where its main positive characteristics - lightness, corrosion resistance and almost unlimited choice of cross-section shapes - represent important advantage over other materials, primarily steel. However, this material, being relatively young in structural engineering, has not yet been used up to its full potential. Further scientific researches and considerations are needed to enable that.

EN 1999 is closely linked with the EN 1993. Being significantly less comprehensive, EN 1999 often refers to EN 1993 for certain calculation or detailing procedures. However, having in mind differences between two metals, it is not always easy to adjust rules of EN 1993 for application in aluminium structures. Consequently, common everyday use of EN 1999 demands its further analyses, clarifications and amendments.

Having in mind above stated, researchers from the FCE UoM, 10 years ago initiated a series of research studies of aluminium structures. The experimental, numerical and theoretical analyses realised (or ongoing) within the scientific project "Latticed aluminium towers for overhead electrical lines" (IRSALPEE, 2012-2015) and within three doctoral researches are presented, together with the engagement of the FCE UoM research team in the process of standardisation regarding aluminium structures design.

Gained experience may be useful in activities of CA 20109 / WG 2 - MODULAR OFFSHORE FLOATING ENERGY ISLANDS, having in mind that aluminium is recognised as suitable material for offshore structures.

Acknowledgements

Presented researches were mainly supported through different programmes of Montenegrin Ministry of Science (co-financing national scientific-research projects in period 2011-2014; grants for PhD researches in period 2018-2023).

Investigation Innovator Flow Control Techniques at Wind Turbine Blades for More Energy Output and Less Vibration-Noise

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Recently, wind energy has had great popularity due to its historical background. But critical lack of information especially in terms of technical cases puts a barrier in some fields of wind energy applications even though it has a reputation. It can be said that aerodynamically understanding of flow characteristics formed over blades which is the most important part of marine current/offshore/wind turbines might be between these technical cases. For instance, the influence of transition to turbulence and laminar separation bubble (LSB) on the performance of turbines is not fully understood, which acquires more attention. Investigations in this field are in priority because these flow phenomena directly affect the aerodynamic performance of turbines and their structural design. Thus, it is essential to accurately understand and solve the unsteady flow structures in the LSB. Investigation of flow phenomena such as boundary layer separation or formation of laminar separation bubble giving negative effects in terms of aerodynamic performance over different floating wind turbine blades running at low Reynolds number regimes are being programmed. After detailed investigation experimentally and numerically, flow control techniques are being planned in order to enhance aerodynamic performance, decrease to flow induced vibrations and noises. This implied that the stochastic vibrations such as flap-wise and edge-wise vibrations at the blade may be prevented. Also, this causes the stochastic fatigue loads to decrease and the lifespan of floating wind turbine blades to increase.

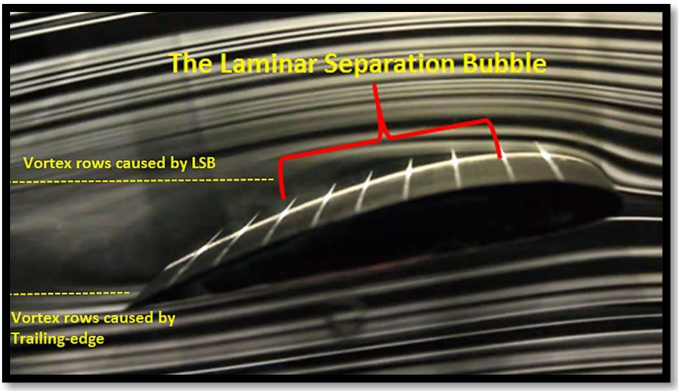

Figure 1. The formation of laminar separation bubble over suction surface of aerofoil.

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Funded by the European Union

Energy Methods in Applied Structural Dynamics for Island Structures

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A published study on wind turbine tower collapse incidences recorded throughout the past 40 years has revealed various types of buckling failure, being the collapse of tubular tower shell structures the most catastrophic one [1]. The construction for modern wind energy infrastructure on floating islands are subjected to winds, wave, tidal, and additional cyclic loading induced by rotors, which acting in isolation or simultaneously impose additional challenges to onshore and offshore structures. The authors have also disseminated buckling failure studies of wind turbine towers by means of an enhanced energy method that scrutinises energy-curvature relations of turbine tower shell structures during buckling events [2,3]. The proposed method enables the scrutiny of tower shell elements under axial load and bending moment induced by dynamic loads imposed to infrastructure sitting on energy islands. According to it, the energy stored within an imperfect tower shell structure can be modelled and quantified through a sequence conformed by pre-buckling transient and post-buckling stages that precede the bifurcation point. As WG2 (Modular Offshore Floating Energy Islands), embeds in the COST Action 20109 Modenerlands, becomes essential for the sustainability and resilience of the island structures to inform engineering practice accordingly. Our research group is willing to share our findings regarding dynamic analysis of floating wind turbines while looking forward to a mutually inspiring cooperation.

Acknowledgements

The authors acknowledge with thanks Royal Society for the grant (IES\R1\211087). The third author also acknowledges the Alexander von Humboldt Stiftung for the continuous support to his research work on Sustainable Energy Systems.

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Structural Health Monitoring for Wind Energy Infrastructure

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In this talk, we introduce a framework for wind energy infrastructure monitoring, developed at the Chair of Structural Mechanics and Monitoring at ETH Zurich. The framework couples data-driven simulation tools with state-of the-art structural monitoring methodologies for intelligent and data-driven diagnostics of wind turbine structures, with the goal of providing actionable tools able to guide operators and engineers in the management of their assets.

We develop both purely data driven [1,2] and hybrid [3] monitoring methods and tools for wind turbines and their components. Under the term hybrid, we refer to the combined use of physics-based models with monitoring data, for building digital twins and virtualizations of the operating system. We place particular emphasis on running these hybrid models online, or in near real-time, i.e., as data is attained. The work presented forms part of the recently completed ERC Starting Grant WINDMIL on the topic of "Smart Monitoring, Inspection and Life-Cycle Assessment of Wind Turbines", awarded by the European Research Council.

Acknowledgements

The authors would like to acknowledge the funding support of Albert Lück Foundation at ETH-Zürich, the European Research Council via the ERC Starting Grant WINDMIL (ERC-2015-StG#679843).

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Abstracts from Working Group 3: Network, Energy Storage and Resilience Analysis

Electron Microscopy, Spectroscopy and Tomography for Energy Material's Applications.

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To increase the efficiency of existing systems and develop new materials for power generation systems it is crucial to know the material's structure-properties relationship.

Novel architectures of materials comprising complex system moieties are emerging to face the inevitable challenges of more efficient usage of raw materials, critical for the state of the art technologies that help to support environmental protection, green production of chemicals, and cleaner energy sources. Understanding the structural and chemical nature, including electronic states, at the atomic level of these materials and the interactions that create the synergies between these components requires pushing the limits of microstructural characterization methodologies.

Electron microscopy (HR-SEM, HRTEM, HAADF) and state-of-the-art spectroscopy techniques (EELS, EDX) can help to characterize various Materials for Energy fully.

Advanced TEM can characterize the bulk, the interfaces, the surface, and the structural and electronic interaction of complex material systems. Thermoelectric generators need a high figure of merit (ZT) to perform with high thermal to electric conversion efficiency. Since ZT is determined by the electrical and thermal conductivity and the Seebeck coefficient, and as these properties are inherently interrelated, it is essential to understand the correlation between these physical properties and the underlying structure of these devices. Materials for advanced energy systems such as steam generation, low footprint, and "zero-emission" conventional power plants with increased efficiency need to incorporate new materials capable of operation at ultra-supercritical or advanced ultra-supercritical steam conditions in a temperature range up to 750°C for 100000 hours. The development of new materials with improved creep- and oxidation resistance focuses on martensitic 9-12% Cr steels, which combine the strength of the 9% Cr steels and the steam oxidation resistance of 12% Cr steels, austenitic steels, and Ni-based superalloys.

Digital Twinning of Energy Islands

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Research and development activities regarding the utilization of energy islands, and pertaining vertical and horizontal integration processes of developed devices and concepts, are conducted utilizing increasingly complex and diverse tools.

With respect to electric energy aspects of energy islands, several platforms can be considered during different development and integration stages. Namely, studies regarding energy islands can be conducted using offline simulation platforms that are based on Model in the loop (MIL), Software in the loop (SIL), Processor in the loop (PIL) or Controller model in the loop (CMIL) approaches. Next, real-time simulation platforms, based on Controller hardware in the loop (C-HIL) or Power hardware in the loop (P-HIL) concepts, may be used. Finally, emerging platforms such as Co-simulation or Cloud emulation and simulation platforms can be employed. All these platforms are adopting digital twinning concepts, but bring different advantages and features.

In the context of MODENERLANDS, and particular Working Group 3 research, dissemination and coordination activities, digital twinning platforms can be used for studies addressing the integration of power electronics devices with power systems, mechanisms for power system disturbances handling and mitigation, networks' power management and control frameworks, technological and economical resilience aspects and studies analyzing the interaction of different electric energy sources and storage systems.

Greening Mobility and Resilience Management Challenges in Island Transportation

Maria Tsami

The presentation will provide an overview of greening mobility and resilience management solutions in the transport sector based on a bibliographic review, considering pros and cons of different applications and strategies and discussing their current and future potential impacts. Gaps, needs and challenges will be presented aiming to identify the focus needed to be given to fill in current gaps and meet future needs and challenges. Conditions and requirements of applications will be discussed. Finally, focus will be given to islands, considering their special characteristics, conditions and needs in terms of transport infrastructure, network design and coverage, energy resources and storage issues. All the above will support formulating a sustainability frame-path to meet island transportation challenges under a resilient transport management perspective.

Grid Integration of the Enabling Technologies Required for Decarbonizing Islands

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Faculty of Electrical Engineering and Information Technologies, North Macedonia

Within the energy transition, the deployment of enabling technologies, such as renewable energy generators on the supply side, or electric vehicles on the demand side, has been rapidly accelerated in the last years, mainly due to the large investment cost reductions. While these technologies are key to meeting the carbon reduction targets of islands, their variable and stochastic nature poses significant challenges for the safe and reliable operation of the power grid. My past research has addressed these issues from multiple viewpoints. From the electricity grid viewpoint, I have studied the hosting capacity of power grids for wind energy without energy storage and electric vehicles that charge without specific coordination [1]. To enable larger shares of renewable energy, I have also explored the possibility of using electric vehicles to regulate the frequency in microgrids and the possibility of using residential energy storage to reduce the impacts of buildings with PV on the distribution grid [2]. From the viewpoint of energy consumers, I have explored methods of energy sharing in energy communities, which ensure that all energy community members benefit from the energy sharing [3, 4]. This line of research should be complementary to the WP3 Network, energy storage and resilience analysis, since it can additionally be adapted to islanded systems, where energy system flexibility is crucial.

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Renewable Hydrogen Generation from Direct Electrolysis of Seawater

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A vast majority of the wind installations are located on coastal regions of the world where freshwater reserves are limited but have abundance of seawater [1,2]. A water electrolyzer technology that can directly process seawater to produce green hydrogen (H_2) can be integrated with the wind (and solar) installations to create a virtually perpetual source of clean energy, satiating the local energy demands of such offshore regions, aligning well with the objectives of MODENERLANDS. Our group's research is oriented towards developing new strategies to rationalise H_2 generation by direct seawater electrolysis. Direct electrolysis of seawater is highly challenging owing to the presence of contaminant ions, especially Cl^- ion, which competes with oxygen evolution reaction (OER) at the anode [1,2]. With a motivation to develop new electrode materials that can inhibit Cl^- oxidation and selectively produce oxygen from seawater, we have been working on transition-metal boride-based catalysts, as reported in our recent article [3]. Ideally, metal oxide-based materials show better stability for electrochemical reactions, but their lower catalytic performance limits their application. To overcome this challenge, we transformed the surface of Fe-doped Co-oxide through chemical boronation and obtained CoFeOB catalyst with a core-shell morphology. The boron-rich shell provided ample number of surface-active sites, thus promoting the OER, while the oxide core provided the desired stability to the catalyst. Owing to this unique core-shell assembly, the CoFeOB catalyst could achieve high catalytic rates in alkali pure as well as saline water electrolytes, with 100% selectivity for OER. This report was the first attempt ever made to rationalise the use of transition-metal boride-based electrocatalysts for saline water electrolysis and it paved way for more research in this class of materials for direct seawater electrolysis. We are also working on integration of such low-cost catalysts to form membrane electrode assemblies, that can function in extreme seawater electrolytes.

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Phase Change Materials as Energy Storage Alternative

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The current inability of electricity store in large amounts is the basic reason for shaping the electricity sector in its centralized current form. Communication will present technologies used in energy storage and the use of energy storage in on-grid and off-grid applications. The focus was mainly placed on technologies that use energy storage in the form of electricity and heat.

The main accent will be given to phase change materials (PCM) - substances with specific heat that varies in response to the temperature changes and increases rapidly in temperature of phase transition. It means that heat capacity of PCM tank compared to heat capacity of water tank at the same volume is several times higher. This gives the possibility for long-term heat and cold storage. Number of deep charge and discharge cycles – number of phase changes from solid to liquid – is one of the limitation of phase change materials. Therefore, the best solution is to charge and consume energy stored in PCM tank as PCM is in transition phase. This requires developing an adaptive control system enabling evaluation of charge and discharge rate of PCM storage tank.

Acknowledgements

Research was partially funded from the TESSe^{2}b project, that is financially supported by the Horizon 2020 Research Innovation Action (RIA) of the European Commission, call EeB-Energy-efficient Buildings (Grant Agreement 680555).

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Power Electronic Converters in Renewable Energy Plants

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I am a university lecturer at the Department of Electrical and Electronics Engineering in Karadeniz Technical Technical University, Trabzon, Turkey. I got my PhD degree at the same university. I study on control of power electronics converters, with a special focus on uninterruptible power supplies.

It is very important to design a hybrid renewable energy plant such as wind-solar-hydropower, wind-wave-solar, and the other combination of these energy types since there are plenty of parameters that should be considered, especially due to their intermittent behaviours. The most important problem of the hybrid systems is that the produced energy cannot be fully predicted. For example, in a solar plant, the energy produced depends on the sunshine time, in a wind farm, it depends on the wind speed. Another most important, the produced energy should match the grid conditions such as frequency and voltage amplitude. In addition to these, the produced energy may not catch the grid conditions such as voltage amplitude and grid frequency since the parameters (wind speed, sunshine, ocean current speed, etc.) are not constant in the renewable energy plants. Therefore, all these disturbances should be considered and a control system that overcomes these disturbances must be designed and implemented on the power electronics converters so that the generated energy can be transferred to the grid in a harmonious manner.

Offshore Structures from The Point of the Architectural Stability

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As it is explained in the Contents of OFFSHORE STRUCTURE- Volume I, edited by D.V.Reddy and M.Arockiasamy, in 1991, published by Krieger Publishing Company, Malabar, Florida:

1. Introduction
2. Wave theories, Wave statistics, and Hydrodynamic Loads
3. Seismological Considerations
4. Ice Forces
5. Brief Review of Offshore Structural Dynamics
6. Behaviour of Freely-Floating and Restrained Ocean Structures
7. Framed and Gravity Offshore Drilling and Production Platforms
8. External Pressure Shell Structures Including Submersibles

It is clear that Offshore Structures are in need of a very logical foundation design, through the light of Architectural Stability in design.

Through the books:

1. Port engineering,v.1
2. Port engineering,v.2
3. HIDY The Waves
4. Coastal structures 79
5. Offshore structure modelling
6. Tides, surges mean sea-level, A handbook for engineers and scientists
7. Foundation design and construction
8. Ocean wave climate, marine science 8
9. Kıyı Mühendisliği
10. Waves, tides and shallow-water processes,

Listed above, entrance gate may be opened for the pathway towards modular energy floating island design with a functional and aesthetical architectural design.

I may try to manage this.

Power Grid Integration Issues of Renewables Within Energy Islands

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Power generation from Renewables (Wind and PV Plants) are implied to be main power sources within an energy island concept. An energy island power grid is assumed to operate either separate or connected to large and stiff power grid.

Renewable generation has already reached significant level in some EU countries, so electricity produced from these renewable sources can't be negligible either in steady state or during transient periods. That is one of the reasons why many National Grid Codes impose technical requirements from Renewables same as for conventional generators.

In order to simulate real operation conditions within power system, small power system is modeled with hydro, steam and PV generation, so the results obtained in the analyze represent PV Plant responses connected to power grid.

The power flow calculations and voltage profiles are obtained by Newton-Raphson iterative procedure for the purpose of steady state operation conditions in the software package PSS/E 34 version.

This paper presents simulation results of PV plant dynamics modeled, also. PV Generic Wind Model is used as PV Plant model, available in PSS/E 34 library with belonging modules.

Dynamics calculations are performed simulating sun irradiance variation, PV Plant responses on various command signals, and influence onto small power system frequency, bus voltages and overall system and PV Plant stability.

Phase-Change Materials and their Application to Wood Material for Energy Conservation in Buildings

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Energy demands in the industrial, residential, utility, and commercial sectors fluctuate daily and/or seasonally. New technologies are needed to control these changes and to use energy efficiently. Efficient use of energy has gained importance in recent years, along with the importance of capturing and storing the energy obtained. Thermal energy storage (TES) technology is based on the logic of facilitating the storage of energy under certain conditions, capturing it when energy demand is low, and releasing it in conditions when energy demand is high [1-2]. In recent years, studies on phase-change materials (PCMs) have expanded [3-5]. The PCMs are divided into three groups according to their chemical structures: organic (kinds of paraffin or non-paraffins), inorganic (metals, but mainly salt hydrates and alloys), and eutectics (mixtures of PCMs, either inorganic-inorganic, organic-organic, or organic-inorganic) [6]. Paraffin-based PCMs are widely used. However, the fact that these products are fossil fuel-based raises the question of geopolitical consequences. Bio-based phase-change materials (BPCMs) are more environmentally friendly and focused on sustainable development and consequently, they are suitable alternative PCMs for use in TES.

This study aimed to investigate the cycling thermal reliability, thermal degradation stability, and TES properties of PCM-modified shellac-impregnated solid wood. Spruce wood was chosen for this study because it is widely available in most countries, easily processed into engineered wood products such as cross-laminated wood and glulam, and is a low-cost and environmentally friendly element for buildings. Fourier-transform infrared (FT-IR) spectroscopy and scanning electron microscopy (SEM) were performed to characterize the chemical content and morphology of the impregnated wood. The thermal degradation stability and thermal energy storage (TES) properties of the modified wood were determined by thermogravimetry (TG/DTA) and differential scanning calorimetry (DSC) techniques. The modified wood samples PA, PASh2, and PASh3 had phase transition temperatures of 59.33 °C, 58.37 °C, and 58.76 °C, and high latent heat of 27.54 J g−1, 10.73 J g−1, and 14.73 J g−1, respectively. The modified wood exhibited high thermal stability because the working temperature was much lower than the decomposition temperature. The SEM analysis showed that the wood microscale pores were filled with PA/Sh. The results obtained determined that the property of storing and releasing solar thermal energy of the modified wood rendered it suitable for practical applications.

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The Performance of the Renewable Energy Sources in the Power Distribution Systems – Case Study

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Renewable energy resources, among other things, play a significant role in the safe and clean supply of electricity consumers. Also, their impacts are reflected in the proper functioning of the transmission, generating, and distributing system. Their integration into the topology of power systems and balance between production and consumption, also planning requires a detailed analysis so that the energy balance to be under allowed limits and has no consequences in impairing the safety margin of the power system parameters. For this, analysis and study coincide with the analysis of the indicators and their performance in the integration of these resources into a power system by building a structure and combining the hybrid variety of these resources. Thus, the study deals with some aspects of the analysis of the parameters of these sources in the power system, respectively in the one substation and performances of the electrical parameters.

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The Role of End-Consumers in Decarbonizing Energy Islands

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In recent years, the investment costs of photovoltaic (PV) generation and battery storage has notably declined, making these technologies economically very lucrative for end-consumers. Our research is related to the integration of PVs and batteries in the residential sector and their coordination in groups of prosumers, known as energy communities. More specifically, our previous research has addressed issues related to (i) the fair sharing of costs, benefits and energy in energy communities and (ii) the quantification of impacts that residential generation and storage have of the distribution grid. With that in mind, this research is synergistic and should potentially contribute to the activities of WP3 Network, energy storage and resilience analysis. The main points of intersection, and potential contribution, are seen in addressing research questions related to: the optimal share of residential PV generation in islands that utilize wind and wave energy, the techno-economic viability of integrating residential or community-owned battery storage and management of battery storage to best deal with the variability of renewable energy. These questions can be suitably addressed using dedicated models, coupled with optimization algorithms, game theory and statistical analysis of large data sets.

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