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Introduction to the Oceans of Tomorrow: The Transition to Sustainability

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Chapter 1

Introduction to the Oceans of Tomorrow:

The Transition to Sustainability

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Abstract

Science and technology offer an opportunity to reconcile the protection of marine ecosystems with the development of sustainable maritime activities, through an integrated maritime policy. In this context, the European Commission has developed a strategy with the aim of proposing means for better integrating marine research with maritime research. To achieve this, the EU increases the integration between established research disciplines and improves cooperation between all the stakeholders concerned with seas and oceans. This book focuses on results of thirteen projects[5] funded by the European Commission. These projects propose concrete measures and mechanisms to improve the efficiency and excellence of marine and maritime research in order to address the challenges and opportunities presented by the oceans and seas. This opening chapter provides an introduction to these projects by first reviewing the goals, partners, methodology and objectives of the each of the projects.

Key words

Marine ecosystems, Maritime activities, Sustainable oceans, Deep Demonstration, Multi-use offshore platforms, Marine Protected Areas

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1.1. Introduction

Seas and oceans affect our daily lives, providing an essential part of our wealth and well-being. They are not only a critical source of food, energy and resources but also provide the majority of Europe's trade routes. Ocean supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen and moderates the Earth's climate, influences our weather and affects human health. It provides foods, medicines, and mineral and energy resources. Moreover, supports jobs and national economies, serves as a highway for the transportation of goods and people and plays a role in national security. A big part of the world's population lives in coastal areas, which are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea-level change, and storm surges) (Costanza R., et al., 1999).

Humans affect the ocean in a variety of ways (Figure 1). Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity lead to pollution (point source, non-point source, and noise pollution), changes to ocean chemistry (ocean acidification) and physical modifications (changes to beaches, shores and rivers). Changes in ocean temperature and pH due to human activities can affect the survival of some organisms and impact biological diversity (coral bleaching due to increased temperature and inhibition of shell formation due to ocean acidification).

Everyone is responsible for caring for the ocean and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

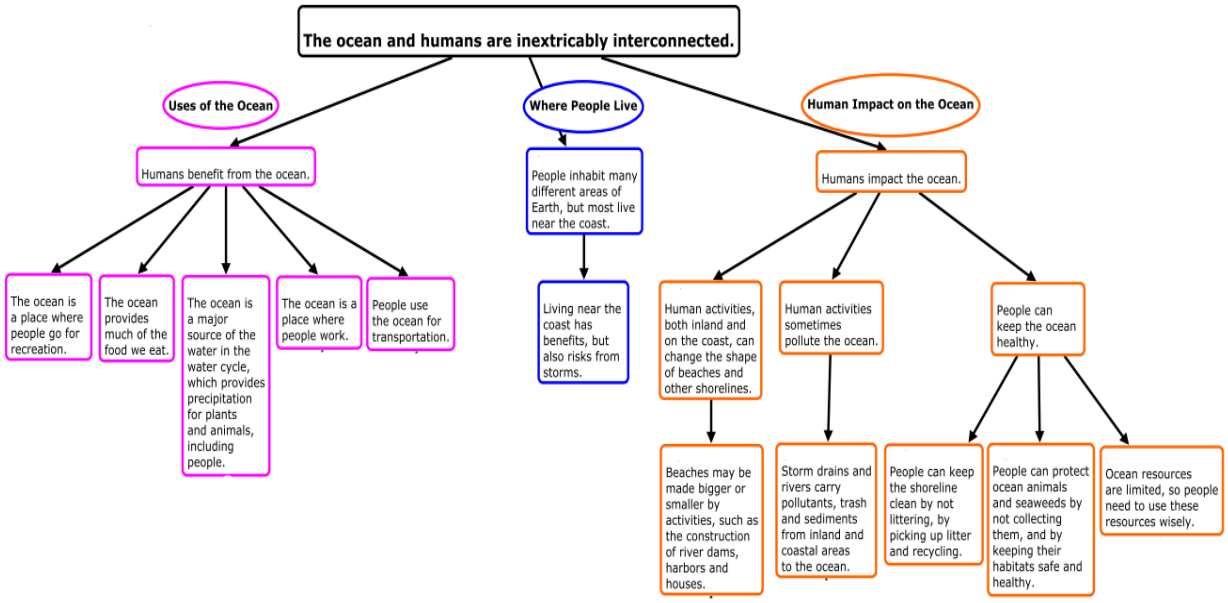

Figure 1 - Fundamental interconnection between humans and oceans (Source: Ocean Literacy Network (2015))

The growing demand for maritime transport, offshore energy, tourism, coastal development, resource extraction, fisheries and aquaculture may have a major impact on the marine environment. United Nations

Conference on Trade and Development is projecting an annual average growth rate of 3,4 per cent for the Maritime Trade the period 2019-2024 (UNCTAD 2019). The European Union has taken up this challenge and established an integrated maritime policy and highlights the importance of integration between established marine and maritime research disciplines, to reinforce excellence in science and to reconcile the growth of sea-based activities with environmental sustainability (European Commission, 2017d). The integrated maritime policy covers five cross cutting policies: Blue growth, which is composed of three components (sustainable jobs and growth, legal certainty and security and cooperation between countries); Marine data and knowledge; Maritime spatial planning; Integrated Maritime Surveillance; and Sea basin regional strategies.

Another growing challenge for both the marine and maritime sector is climate change. International maritime transport faces a dual challenge in respect of climate change: the need to reduce its carbon emissions and, at the same time, adapt to the potentially wide-ranging impacts of climatic changes (UNCTAD, 2020). Ports and Shipping are intrinsically linked – as such, efforts to reduce maritime emissions need to extend beyond seagoing ships alone. IMO's MARPOL Annex VI (2010) regulations on air pollution and energy efficiency are aimed at ships. Nonetheless, it is clear that for port emissions to be reduced, emissions from all port-related emission sources need to be addressed. Besides, climate change is expected to have severe impacts on the marine environment. Increase in water temperatures will contribute to a restructuring of marine ecosystems with implications for ocean circulation, biogeochemical cycling and marine biodiversity.

The IPCC (2018) report explicitly refers to the need for "rapid far-reaching and unprecedented changes in all aspects of society". European Union has put into force several Directives and Regulations aiming to incentivise port and shipping companies to commit to comply with environmental standards. The European Green Deal, the most ambitious action plan of European Union, aims at increasing the EU's greenhouse gas emission reductions target for 2030 to at least 50% compared with 1990 levels, creating the most ambitious package of measures, accompanied with an initial roadmap of key policies in cutting-edge research and innovation, in green technologies and sustainable solutions (European Commission, 2019a).

The main goal of this work has been the contribution to an interdisciplinary and participatory framework of analysis of technical, environmental, economic, social aspects of Blue Growth, which can provide policy recommendations for improved implementation of the Initiative, allied with the relevant Sustainable Development Goals (SDGs), the Marine Strategy Framework Directive (MSFD), the Marine Spatial Planning (MSP) and the Maritime Spatial Planning.

The multidisciplinary team of Professor Phoebe Koundouri joined forced with two well established networks: UN SDSN and EIT Climate-KIC aiming to drive the highly needed change towards a resilient, circular, net-zero carbon and inclusive economy. EIT Climate-KIC is a European knowledge and innovation community, working towards a prosperous, inclusive, climate-resilient society founded on a circular, zero-carbon economy. The EIT Climate-KIC is part of the European Institute of Innovation and Technology (EIT) and the EIT Community, which is a body of the European Union and a global innovation leader, delivering world class solutions to societal problems. It seeks to catalyze the rapid innovation needed across sectors by bringing together the brightest minds to tackle challenges, empowering leaders through capacity building, and financially support the most promising climate-positive businesses (EIT Climate-KIC, 2020a).

The UN Sustainable Development Solutions Network (SDSN) was set up in 2012 under the auspices of the UN Secretary-General. SDSN mobilizes global scientific and technological expertise to promote practical solutions for sustainable development, including the implementation of the Sustainable Development Goals (SDGs) and the Paris Climate Agreement. SDSN works closely with United Nations agencies, multilateral financing institutions, the private sector, and civil society (UN SDSN, 2020)

The Oceans of Tomorrow call triggered the interest to explore the whole spectrum of the Sustainability concept in the Oceans, with several European funded projects having been developed in the last 10 years aiming to respond to the challenges, which oceans face today. The aim of this chapter is to present ten projects that have been selected from Professor Koundouri scientific portfolio aiming to cover challenges and solutions related to sustainable oceans in a holistic manner. The objective is to build the knowledge base for a sustainable growth of sea-based activities. It will do this in three ways: by improving understanding of marine ecosystems' response to a combination of natural and anthropogenic factors, by interpreting the interdependencies between shipping sector and ports and by providing a scientific foundation for feasible, sustainable management and regulating policies taking into consideration relevant innovative technologies.

1.2. The oceans of tomorrow

The aims of the call are to improve our understanding and the predictive capacity of marine ecosystems' response to a combination of natural and anthropogenic factors, while fostering innovations to make the most of sea resources. The call consists of four topics. Two are of generic nature: Multi-use offshore platforms (MUOPs) and Marine microbial diversity while the other two are of particular relevance to the Mediterranean and the Black Sea regions: (1) natural and human-made pressures in the Mediterranean and Black Sea and (2) marine protected areas (MPAs) and wind energy potential in the Mediterranean and Black Sea.

1.2.1 The MERMAID project

The MERMAID (Innovative multi-purpose offshore platforms: planning, Design and operation) FP7 European Commission project develops concepts for next-generation offshore platforms for multi-use of ocean space for energy extraction, aquaculture and platform-related transport (MERMAID, 2015). The total budget is 7.4 million euro and the European Union has granted a financial contribution of 5.5 million euro for duration of 48-months. The project examines different concepts, such as a combination of structures or completely new structures on representative sites under different conditions. In addition, project development guidelines are produced for stakeholders and end-users, addressing a wide range of issues such as business and technical aspects and spatial socio-economic planning. The MERMAID consortium consists of 28 European partners from Denmark (Coordinator), Germany, Belgium, Italy, Sweden, Spain, Greece, Norway, The Netherlands, Poland, Turkey, Cyprus and United Kingdom bring together expertise from both science and industry (Universities (11), Research institutes (8), Industries (5) and Small and Medium Enterprises (4 SME's)), from many regions in EU. The project considers four offshore study sites for multi-use offshore platforms. Site-specific designs are being developed based on an extensive stakeholder consultation process and the environmental characteristics of each site. MERMAID focuses on specific challenges in: the Baltic Sea, representing a typical estuarine area with fresh water from rivers and

salt water from the North Sea; the trans-boundary area of the North Sea-WaddenSea, representing a typical active morphology site; the Atlantic Ocean, representing a typical deep water site; and the Mediterranean Sea, representing a typical sheltered deep water site (Figure 2).

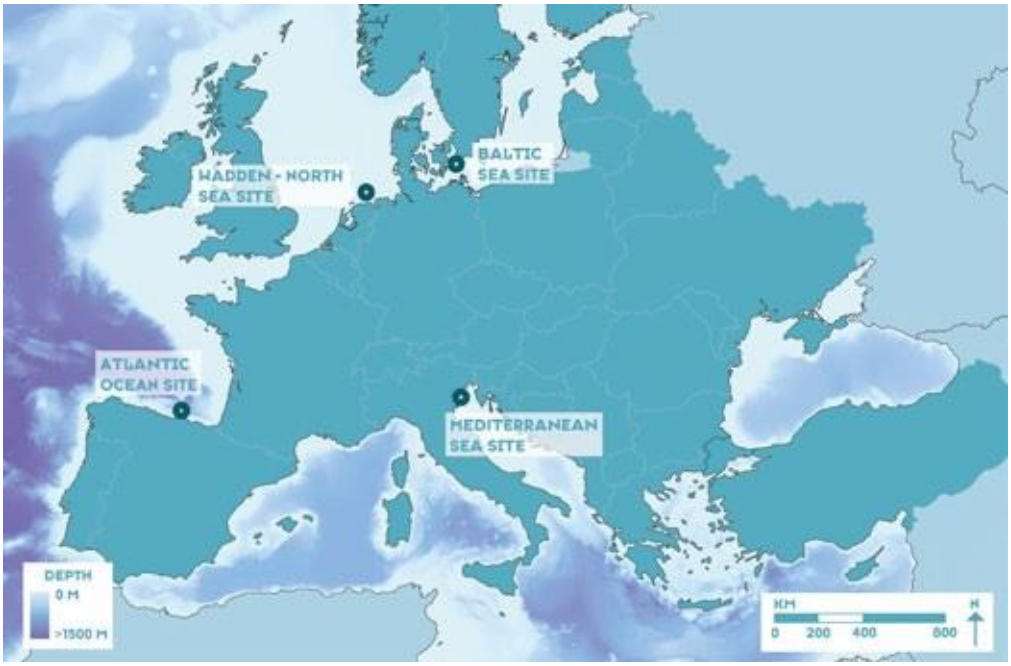

Figure 2 – MERMAID sites map **(**Source: MERMAID (2015))

The objectives of the project concerning the effective management procedures are to address the variations in legislation and policies (institutional acceptance), attract of developers and investors (financial feasibility) and involve the stakeholders (socio-economic and ecological acceptance). The MERMAID project also aims at the development of innovative technology and design through the development of a) integrated concepts for extraction of renewable ocean energy, b) offshore aquaculture technology, c) a large-scale platform design concepts and d) unification of technologies and services. For the achievement of sustainable integration, the project developed a framework of dynamic and spatial environmental, ecological sustainability and socio-economic viability of Multi-use Platforms (MUPs). Moreover, for the integration of management, technology, social economics at the four contrasting test sites, the target is to provide tools, techniques and decision support systems that may be applied, tested and validated and are suitable for immediate use. Finally, test sites are used to ensure that MERMAID deliverables are of real value, practicable and usable (MERMAID, 2019).

The project consists of 9 Work Packages (WPs): WP1-Project management, WP2-Assessment of the policy, planning and management strategies, WP3-Development of renewable energy conversion from wind and waves, WP4-Systems for sustainable aquaculture and ecologically based design, WP5-Interaction of platforms with hydrodynamic conditions and seabed, WP6-Transport and optimization of installation, operation and maintenance, WP7-Innovative platform plan and design, WP8-Economical, technical and environmental feasibility of multi-use platforms and finally, WP9-Project dissemination and outreach activities.

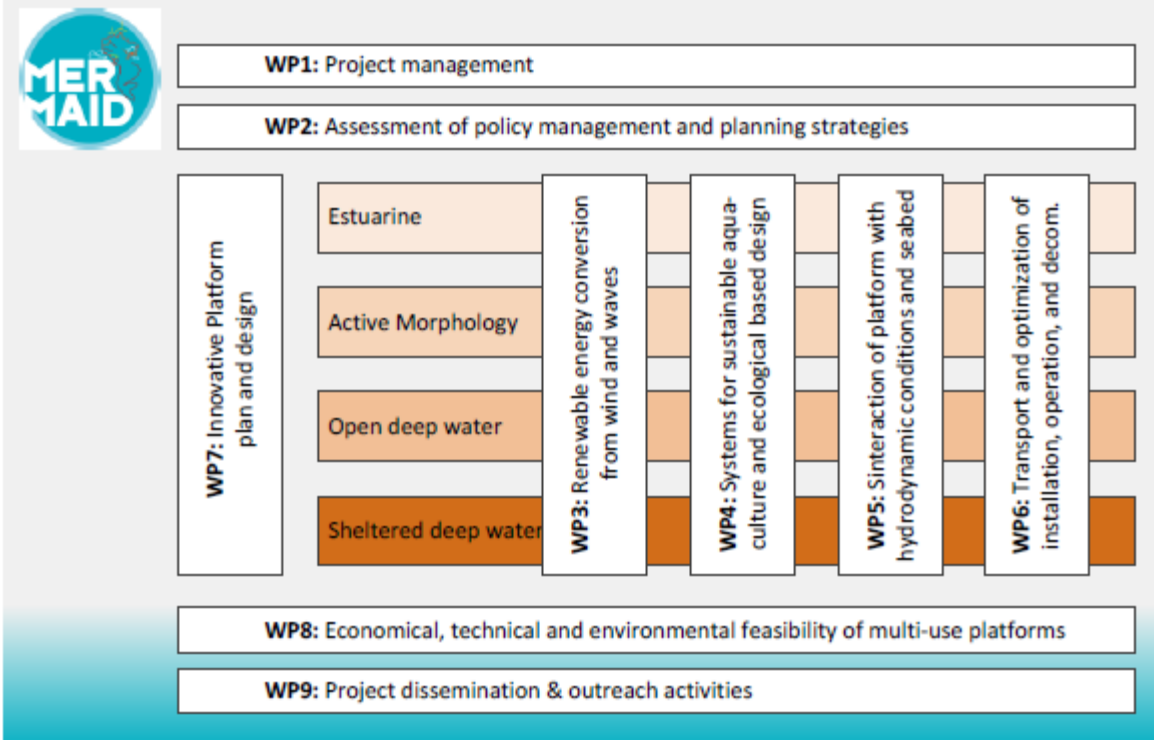

Figure 3 – MERMAID Work Packages breakdown (Source: MERMAID (2015))

The structure of the packages serves the main goal of the project for the development of specific guidelines to assist future stakeholders within the offshore industries in order to plan, establish and operate their businesses in the most optimal way possible.

The final goal of MERMAID is to disseminate project knowledge and procedures into the community of the professionals involved in the planning, installation, operation, maintenance, monitoring and decommissioning of off-shore platforms, the preparation and implementation of policies and strategies for sustainable use of sea resources, low carbon economy and eco-friendly transportation. Moreover, specific activities are also planned for the public and businesses which receive benefits from the sustainable development of the use of marine resources, both energy and food. The main dissemination activities include: i) the participation in international exhibitions: production of materials e.g. posters, leaflets, etc.; ii) the establishment and updating of the project home page on the World Wide Web; iii) the publication of peer-reviewed scientific papers; iv) the active participation of partners in international conferences and publications in the proceedings of these conferences; v) the publication of guidelines, based upon the project findings, that present performance and design of innovative multi-purpose platforms; vi) the results of MERMAID are expected to be used in teaching assignments, lectures and exercises at European universities so that the latest state-of-the-art is given to European students; and vii) the utilization of results in PhD studies in scientific publications and thesis. Through these activities the MERMAID will accomplish to establish an efficacious collaboration and exchange of knowledge, information and experiences between the scientific community, coastal and marine authorities, the industry and potential end users and also to inform the public about the concept of multi-use offshore platforms.

1.2.2. The H2OCEAN and TROPOS project

In addition to MERMAID, the European Commission granted two other research projects under the call Oceans of Tomorrow with regard to multiuse offshore platforms, allocating a total budget of 20 million: The H2OCEAN (2014)) FP7 European Commission project aimed at the development of a wind-wave power open-sea platform equipped for hydrogen generation with support for multiple users of energy; and the TROPOS (2014)) FP7 European Commission project aimed at the development of a floating modular multi-use platform system for use in deep waters (European Commission, 2014a).

The H2OCEAN (Development of a Wind-Wave Power Open-Sea Platform Equipped for Hydrogen Generation with Support for Multiple Users of Energy) project aims at developing an economically and environmentally sustainable multi-use open-sea platform on which wind and wave power will be harvested. Part of the generated energy will be used for multiple applications on-site, including the conversion of energy into hydrogen that can be stored and shipped to shore, and a multi-trophic aquaculture farm. Prof. Phoebe Koundouri and her team have contributed to the integration of the socio-economic research of all three projects under the Oceans of Tomorrow. The socio-economic outcomes of the projects have been published in numerous multidisciplinary top ranked scientific journals, one book Koundouri (2017) (editor) "The Ocean of Tomorrow (Vol. I): Investment Assessment of Multi-Use Offshore Platforms: Methodology and Applications", and an electronic decision support system integrating technical, environmental, financial and socio-economic aspects of off-shore platform design and location.

The TROPOS Project aims at developing a floating modular multi-use platform system for use in deep waters, with an initial geographic focus on the Mediterranean, Tropical and Sub-Tropical regions, in particular on the EU Outer-Most Regions (OMRs), composed by the Azores, the Canary Islands, Guadeloupe, Guiana, Madeira, Martinique and Reunion, but designed to be flexible enough so as to not be limited in geographic scope. TROPOS gathers 20 partners from 9 countries (Spain, the United Kingdom, Germany, Portugal, France, Norway, Denmark, Greece and Taiwan), under the coordination of PLOCAN (Spain). The TROPOS Project is a €7-Million European Project aiming to explore the design of Offshore Multi-use Platforms, in which a mixture of different sectors and specific functions can be performed in a shared location with shared infrastructure (and costs) and could prove to be an important opportunity for improved utilization of the oceans as well as sustainable economic growth (Figure 4). Developing a concept of Multi-use Oceanic Platforms has become one of the EU's most interesting bets to guarantee the use and synergistic exploitation of oceanic resources in a sustainable and eco-friendly manner.

Figure 4 – The TROPOS project (Source: TROPOS (2014))

The TROPOS Project enhances the potential and increases the added value of the integration of the four disciplines of Transport, Energy, Aquaculture and Leisure (TEAL) in the proposed floating platform designs. This is to be achieved by ensuring a maximum level of integration and synergy of the multiple platform uses and studying and proposing how to enhance the potential of TEAL integration. The main objectives of the project are to i) determine suitable locations for the offshore platform system and explore the relations, potential for synergies and integration of a broad range of functions including different marine renewable energy sources, fisheries, aquaculture and related maritime transport aspects. ii) develop innovative designs of MUPs that allows their close spatial integration and study logistics, security, installation, operational, decommissioning and maintenance requirements for MUPs and iii) study the economic viability, socio-economic acceptability and environmental impact of key combinations and address ways to minimize significant negative impacts of floating MUPs and configure the MUPs for the Mediterranean, subtropical and tropical areas.

TROPOS project is divided into 8 Work Packages (WP), completely interdependent and interactive one with another: WP1 – Project Management, WP2 – Geographic and Module Benchmarking and Decision Methodology, WP3 – Conceptual Design of Platform Components and Integration, WP4 – Engineering Specification for Chosen Platform Designs, WP5 – Strategy: Economics, Infrastructure and Logistics, WP6 – Environmental and Socio-Economic Impact, Legal Issues, WP7 – Communication, Dissemination and Technology Transfer and WP8 – Scientific and Technical Coordination. The successful completion of all the work packages (Figure 5) allows reaching the planned objectives of the project.

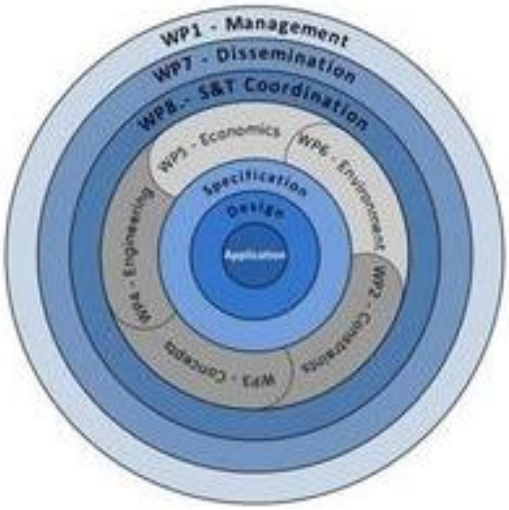

Figure 5 – TROPOS Work Packages breakdown (Source: TROPOS 2014))

Over the course of the project, the TROPOS consortium will be disseminating the results of the project to multiple audiences, via different channels, at different intervals, etc. This is necessary throughout the project for the purposes of raising awareness and inviting debate and comment on the scientific work which is being undertaken, while it is in progress; as well as for the dissemination of the projects deliverables and results to promote uptake and increase impact of the project, visibility and credibility as possible. The project's dissemination strategy uses the internet, presentations, workshops, publications and the online project site. The open access project deliverables, results, documentation, scientific publications and newsletters ensure the awareness of the public.

1.3 Blue Growth and Maritime Spatial Planning

The European Commission has initiated a program called Blue Growth, which is the EU's long-term strategy to support sustainable growth in the marine and maritime sectors. Marine space will become a delicate issue to future Blue Growth plans in European seas, challenging creative and innovative contributions which at the same time can ensure environmental sustainability. One such creative and innovative possibility is multi-use, i.e. making use of marine space in a more efficient effective way when two or more sectors join activities in same area (European Commission, 2017a). Whereas this is not fully new, as we used to combine, for instance, shipping and fishing, the approach is now expanded to cover typical Blue Growth sectors, such as wind and aquaculture combinations. While the multi-use arrangement increasingly is accepted as a valuable contribution to Blue Growth, it is not clear how to practically implement it in European seas.

1.3.1 The THAL-CHOR project

THAL-CHOR (Cross border cooperation for Maritime Spatial Planning Development) Interreg project seekes the development of a methodology for Maritime Spatial Planning and then the adoption of this methodology for pilot application in selected areas in Cyprus (Limassol area) and Greece (Islands of Lesvos and Rhodes). Spatial conflicts of the sea, better coordination between stakeholders and strengthening cross-border cooperation were also project's objectives. The consortium is composed of six partners from Cyprus

and Greece including the Ministry of Transport, Communication and Works (CY), who is the Lead Partner, the Ministry of Interior (CY) and the Ministry of Shipping and Island Policy (EL).

The work packages were composed of the following actions, namely analysis of main features of the marine environment and its benefits for human activities; development of a Web-GIS to display all collected data; overview of the legal framework and recommendations for its improvement; definition of future priorities and analysis of the future state in terms of evolution of existing activities and development of new ones; pilot implementation of Maritime Spatial Planning in selected areas and drafting of pilot maritime spatial plans; and evaluation of the methodology followed for implementing Maritime Spatial Planning and identification of good practices.

1.3.2 The BlueBRIDGE project

BlueBRIDGE (Building Research environments fostering Innovation, Decision making, Governance and Education to support Blue growth) H2020 project supports capacity building in interdisciplinary research communities actively involved in increasing scientific knowledge about resource overexploitation, degraded environment and ecosystem with the aim of providing a more solid ground for informed advice to competent authorities and to enlarge the spectrum of growth opportunities as addressed by the Blue Growth Societal Challenge (BlueBRIDGE, 2020). BlueBRIDGE bundles forces from intergovernmental organizations, research institutes, industry and SMEs establishing a network with a proven track in VREs & e-Infrastructures, computer science, marine, aquaculture, environmental & fisheries science & economy.

The project consists of 10 WPs: WP1 - Project Management, WP2 - Project Governance, Exploitation and Sustainability, WP3 - Communication, Stakeholder Engagement and Knowledge transfer, WP4 - VREs Deployment and Operation, WP5 - Supporting Blue Assessment: VREs Development FAO Anton Ellenbroek, WP6 - Supporting Blue Economy: VREs Development, WP7 - Supporting Blue Environment: VREs Development, WP8 - Supporting Blue Skills: VREs Development, WP9 - VRE Commons Development and WP10 - Interfacing Infrastructures.

BlueBRIDGE has developed innovative services, the so-called Virtual Research Environements (VREs), in four major areas. Fisheries through an ecosystem approach, where services for stock assessment and for the generation of unique identifiers for global stocks are developed; Aquaculture, where services supporting the analysis of socio-economic performance in aquaculture are provided (Tsani and Koundouri, 2018); Maritime Spatial Planning, where spatial planning services are available to identify aquaculture and fisheries infrastructures from satellite imagery and tools to visualize, analyze and report on a range of ecologically important seafloor features within marine protected areas (MPAs)); and Education, where tools to set up and deliver training courses in a cost-effective way are developed.

1.4 Cultural Ecosystem Services and Marine Protected Areas management

Marine Protected Areas (MPAs) are vital for the conservation of the Mediterranean Sea, due to their role in managing several pressures like fishery. Nonetheless, many species and habitats in MPAs are still exposed to a variety of stressors. In most MPAs human activities are not spatially managed considering their cumulative effects, while monitoring and protection are not coordinated. Additionally, limited effort has been carried out to address the environmental challenges, measure the consequences of human impacts and to provide management recommendations.

1.4.1 The AMAre project

The AMAre (Actions for Marine Protected Areas) Interreg project aims to improve the management and protection measures in order to maintain the biodiversity and to increase the resilience of the MPAs for current purposes and upcoming challenges, strengthening the sustainable use of the resources. The AMAre consortium consists of 10 European partners from Italy (coordinator), Malta, Spain, Greece and France with the pilot activities being developed in four MPAs, tailored on the specific human uses. The pilot cases will be in Spain (The Freus d'Eivissa i Formentera Marine Reserve), Malta (Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet), Italy (Porto Cesareo MPA and Torre Guaceto MPA) and Greece (National Marine Park of Alonissos Northern Sporades).

MPAs are exposed to a variety of stressors, related to human activities. Unsustainable use of resources leading to habitat loss, lack of knowledge of the mismanagement economic loss, lack of coordination and monitoring of biological and environmental changes in MPAs and lack of integration of the interdependencies among human activities and MPAs in the future (e.g. coastal tourism, aquaculture, offshore wind farms are some of the reasons why environmental accounting of the MPAs is needed.

The focus of the project was concentrated on those human uses considered a concrete threat (fishery, touristic frequentation, yachting) including those possibly increasing in the future (e.g. marine litter), which are difficult to be managed both at local and at transnational scale. The pilot activities are replicated by different partners using the same scheme but considering different preferences to ensure great applicability of the project results. Local and regional stakeholders (e.g. Management bodies of protected areas, MPA managers) will benefits from these pilot activities since they consist the first concrete example of coordinated application of marine spatial planning (MSP) in the Mediterranean Sea able to significantly improve the management and the monitoring of biodiversity and the ecosystem services provided by MPAs.

Its main objectives are the refinement of a general framework, the development of shared methodologies (spatial planning and monitoring) and geospatial tools for multiple stressors assessment, the environmental monitoring and stakeholders engagement seeking to structure and exchange information among MPAs on biodiversity status, environmental variables, distribution and intensity of human pressures focusing on vulnerable habitats of EU importance (e.g. coralligenous outcrops and Posidonia meadows) (AMAre, 2020).

Among the project priorities were the redistributions of human activities reducing conflicts and increasing synergies; the implementation of a well-designed monitoring activities shared and comparable across MPAs and habitats, allowing the objective to comparative assess the performance of single MPAs versus an MPA network; the investigation the potential to individuate early warning indicators of changes; and the development of common trans frontier regulations and best practices to deal with present and future drivers of changes. The final aim of AMAre is to scale up strategies and recommendations at transnational level adopting an ecosystem-based approach considering the goals of the Marine Strategy Framework Directive (MSFD) across MPAs.

The AMAre WebGIS (https://amare.interreg-med.eu/toolbox/geoportal/) created by the project is web-based portal for interactive visualization of the spatial data collected in the study areas, organized in a common spatial infrastructure. The portal combines data relevant for the management of the MPA such as

administrative, biodiversity, elevation, geology, habitats and biotopes, hydrography, monitoring, oceanography, socioeconomic threats.

1.4.2 The RECONNECT project

The RECONNECT (Regional Cooperation for the transnational ecosystem sustainable development) Interreg project studies four Marine Protected Areas and Natura 2000 sites, each of them belonging to a different country, meaning Greece, Cyprus, Bulgaria and Albania (RECONNECT, 2020). The NATURA 2000 is the ecological network for the conservation of wild animals and plant species and natural habitats of Community importance within the Union. It consists of sites classified under the Birds Directive and the Habitats Directive (the Nature Directives). While the MPAs are areas designated to protect marine ecosystems, processes, habitats, and species, which can contribute to the restoration and replenishment of resources for social, economic, and cultural enrichment. The targeted ecosystems are understudied in the Eastern Mediterranean and Black Sea regarding the rest of Europe, and many of the field measurements and estimations are performed for first time in all study areas. Let aside their economic evaluation with the most state-of-art socio-economic methodology. The project's overall objective is the development of management scenarios and can be of use for the policy makers in order to make informed decisions that can maximize the society's well-being based on the services they receive from those MPAs.

Essential Socio-economic and Cultural Variables offered by the Posidonia oceanic habitats were identified in the regional marine park of northern Karpathos Saria and Astakidonision (Greece); the MPA of Kavo Gkreko (Cyprus); the protected area of Ksamil Bay and islands - Stillo Cape - Togo Island (Albania); the Zostera marina in the Natura 2000 of Gradina-Zlatna Ribka (Bulgaria).

The four study areas face similar threats and pressures based on underwater field studies. Their current ecological status necessitated a choice of Ecosystem Services (ES) to be researched that are both site specific in order to provide the local policy makers with information for decisions able to maximize local well-being and important at a regional level in order to provide with conclusions regarding regional development

In RECONNECT the use of Choice Experiment (CE) was considered the most state-of-the-art method for the ES from these specific species (Vassilopoulos and Koundouri, 2017). The ES evaluated are fish abundance, sea water clarity, aesthetic benefits, carbon sequestration, protection from erosion and preservation of underwater cultural heritage. An extra aspect was included as the most common pressure in all areas which was the overfishing, while in the case of Cyprus the impact from massive tourism was incorporated as well.

The project's innovation relies on the expansion of the existing socio-economic technique for the evaluation of a category of ES that is not studied to date due to the lack of standardized methodology and its difficulty to be captured. This is the Cultural Ecosystem Services (CES) referring to the physical and intellectual interactions, the sense of belonging or collective identity that people experience when they snorkel or dive in areas with Posidonia seabed. It is also the ocean literacy, research, and promotion of education on the marine environment that accrues from its conservation and protection. The two CES studied in RECONNECT are the "aesthetic benefits" related to the enjoyment of sea wildlife that offers a sense of unimpacted nature when people come in contact with the iconic or non-iconic species hosted in Posidonia habitats with some of them being emblematic (f.e. monk seals); and the protection of underwater cultural

heritage related to Posidonia's ability to provide a protective matt above archaeological treasures. It buries deeper sediments and provides the right conditions needed to preserve underwater remains by locking out oxygen that otherwise degrades them.

1.4.3 Cultural heritage protection from anthropogenic climate change

Natural and cultural heritage represent a key socio-economic capital and offer many different benefits to citizens. Extreme weather conditions and the adverse effects of climate change are able to significantly damage cultural and natural heritage. If we do not act immediately, the damage may be irreversible. A Greek Emblematic Initiative for the protection of monuments of cultural heritage from anthropogenic climate change launched in 2019 at «Climate Change Impacts on Cultural Heritage: Facing the Challenge» international conference. The aim of this initiative is to track the effects of climate change on these monuments, as well as to assess the social and economic values at stake. It will also address critical challenges to be faced by decision-makers, who are managing these monuments.

1.5 Sustainable coastal and rural areas

1.5.1 The COASTAL project

Rural development in the EU is affected by several environmental, economic and social pressures, such as changing market developments, decreasing population densities, lack of employment, desertification and other. However, coastal areas provide appealing business opportunities, while they are influenced by economic activities in the hinterland (European Commission, 2017b). To analyse the environmental, economic, and social interactions of rural and coastal areas, multi-actor approaches need to be combined with System Dynamics in a holistic manner.

The COASTAL (Collaborative Land-Sea Integration Platform) H2020 project aims to improve the rural-coastal synergies in strategic business and policy decision making and collaboration between coastal and rural actors. A generic toolset and performance indicators are being developed, demonstrated and applied by combining a multi-actor approach with system dynamics modelling, which enables the understanding of the interactions with market, demographic, environmental and climate forecasts, and the quantification of the positive and negative externalities (COASTAL, 2020).

COASTAL is a unique collaboration of 29 partners from 8 EU Member States, representing coastal and rural business entrepreneurs, administrations, and scientific experts. The project core consortium includes: 11 research institutes and 3 universities active in the field of marine science and innovation, hydrology, rural development, agriculture and integrated systems modelling; 3 NGOs active in the field of regional development and economics, agriculture, tourism, and coastal development; 2 farming advisory organisations; 4 administrations involved in regional and rural development, port development, and environmental management; 2 SMEs with expertise in knowledge dissemination, blue growth, industrial and coastal development; and 2 development agencies and 2 partners representing the business sector.

The process followed in COASTAL (2020) projects can be grouped in the following steps, as presented in Figure 6. Local actors and experts participate in collaborative exercises to analyse the underlying causes, propose and discuss solutions, and validate and interpret the impacts of simulated business and policy decisions. Qualitative and quantitative techniques are combined in this co-creation process supported by graphical tools to gain in-depth understanding of the systemic transitions underlying the land-sea

interactions. These systemic transitions are synthesized and analyzed with system dynamic models to produce multiple transition scenarios for key business and policy indicators. From these practical business roadmaps and policy solutions are derived, which are easily updated in the models used to support the analyses.

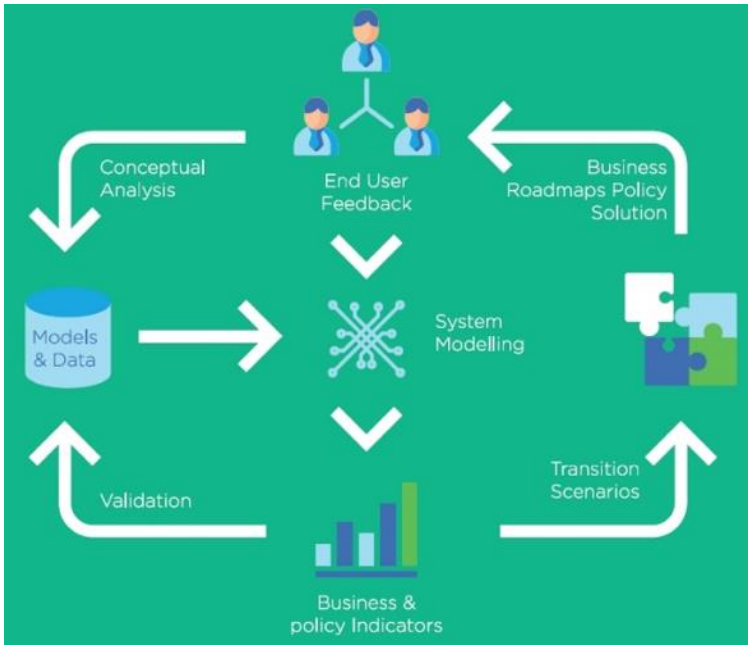

Figure 6 - The COASTAL process (source: COASTAL (H2020))

In a nutshell, the project seeks to contribute to the long-term improvement of sea water quality while creating added value and jobs in coastal areas and the hinterland; develop a transferable set of tools and indicators allowing qualitative and quantitative analysis of land-sea interactions for evidence-based policy making; and provide thorough understanding of the barriers and motivators affecting behaviour and solutions enabling joint actions. Meanwhile, it aims at increasing the job potential and creating added value in coastal areas resulting from new business opportunities and improved collaboration between land- and sea-based operators; reducing externalities from land-based on sea-based activities by improving economic collaboration and integrated governance; and creating durable relationships between coastal areas, serving as flagships for coastal-rural synergy.

1.5.2 The marine plastic litter challenge

The Mediterranean Sea is a top tourism destination in the world hosting nearly 314 million international tourists a year , with European Mediterranean countries attracting most of the tourists, but it is also one of the most affected areas by marine litter worldwide, polluting its shores and pristine coastal waters (UNEPMAP, 2020). The plastic litter problem in seas and oceans has several environmental impacts associated. Besides the direct effect on the marine environment, marine littering is often related to socioeconomic characteristics degradation (e.g. the food chain unsettling, public health threatening, loss of jobs and property devaluation).

EIT Climate-KIC is a Knowledge and Innovation Community (KIC), working to accelerate the transition to a zero-carbon economy. Supported by the European Institute of Innovation and Technology, EIT

Climate-KIC identifies and supports innovation that helps society mitigate and adapt to climate change. They bring together partners in the worlds of business, academia, and the public and non-profit sectors to create networks of expertise, through which innovative products, services and systems can be developed, brought to market and scaled-up for impact. Through their convening power, EIT Climate-KIC brings together the most effective groups to create the innovation that can lead to systemic change (EIT Climate-KIC, 2020a).

WEF (2016) reports that the circular economy is gaining growing attention as a potential way for our society to increase prosperity, while reducing demands on finite raw materials and minimizing negative externalities. Such a transition requires a systemic approach, which entails moving beyond incremental improvements to the existing model as well as developing new collaboration mechanisms. BL.EU Climate (Climate Innovation in Southern Waters) funded by EIT Climate-KIC BL.EU seeks to address the challenge of plastic marine littering in southern European waters by building capacity for innovation to address the issue at the very beginning of its life cycle, on the prevention side and plastic waste reduction with significant climate change mitigation potential from the reduction in the collected and handled plastic waste. Greece, Portugal and Croatia gathered around this problem and identified three pillars around ports (commerce, fishing, tourism) working closely with local problem owners: in Croatia, islands Cres Zlarin; in Greece, the port of Piraeus, islands of Milos and Andros and in Portugal, the port of Lisbon (BL.EU. Climate, 2020).

The project enhances plastic litter reduction through a systems innovation approach, where stakeholders are involved through participatory workshops in solutions identification. Stakeholder mapping, validation interviews and surveys were performed targeting tourists and fishermen only. The results of the questionnaires were analyzed and presented at different workshops conducted in the project sites. The main objective of the workshops was to trigger a discussion among the participants (mostly stakeholders identified at the mapping exercise) on potential solutions to prevent, reduce and collect marine litter, focusing on plastics. All the above led to the design of a strategic roadmap by all three countries, identifying steps to reduce the negative effects caused by plastic waste in the future, supporting not only Governments, but also regions, municipalities, industries, consumers and civil society to improve the awareness campaigns, systems design, replacement, refuse, recycling and reuse of plastic.

BL.EU Climate project is followed by another project supported by EIT Climate-KIC, MEDfreeSUP (tacking single-use-plastic item uses in the Easter Mediterranean Sea), which is based on the plastic waste prevention (PWP) approach and aims to enable local ecosystems to move towards reusables materials. The project focuses on the East Mediterranean coast, targeting the three biggest coastal countries: Italy, Croatia and Greece. The main objective of the project is to set a replicable voluntary protocol for free single-use plastics food packaging adoption for cafes, restaurants, foods stores, hotel, beach facilities, but also for public events and places to provide support and guidance to local business in order to comply to the EU SUP Directive, and go beyond the law to engage Mediterranean islands and cities in the transition toward a free single use plastic environment.

1.6 Sustainable shipping and ports

Sustainable shipping refers to the broad set of challenges, governance rules and regulations, management patterns and corporate behaviours, stakeholders' engagement, and industrial activity forms that should come to define a maritime transport industry that is shaped by the broader societal goals of sustainable

development. The port industry together with the shipping industry constitute a key node in the international supply chain considering that over 80% of volume (70% of value) of world's merchandise trade is carried by sea (UNCTAD, 2019).

Environmental challenges relating to shipping sector and ports are twofold, namely the effects of maritime transport on the environment (e.g. pollution, CO2 emissions) and conversely the environmental impact on maritime transport (e.g. water level, floods, storms, precipitation and extreme weather events) (Asariotis, Benamara & Mohos-Naray, 2017). Shipping and Ports are intrinsically linked – as such, in order to reduce maritime emissions joint efforts by ports, shipping companies, regulating authorities and key stakeholders need to be aligned and orchestrated. IMO's MARPOL Annex VI (2010) regulations on air pollution and energy efficiency in alignment with several European regulations and directives (as presented further in Chapter 11) can be a starting point of implementation and behavior change if addressed appropriately.

Ports role in enforcing the International and European policy and so, drive the emissions reduction, comes down to adopting measures such as introducing differentiated port dues, providing onshore power supply (e.g. 'cold ironing'), switching to low-sulphur fuels and setting speed limits in ports. Ports are increasingly expected to align their performance with sustainability expectations, i.e. to deliver optimum economic and social gains while causing minimum environmental damage. In view of this challenge, ports and consequently the shipping sector need to understand the interdependences between maritime, marine and urban activities (e.g. port areas).

A systematic approach to aligning the expectations and needs of key stakeholders into an environmental management system would enable the continuous identification of an individual port's priorities while it introduces a functional organizational structure that sets respective targets, implements measures, monitors impact, evaluates, reviews and takes corrective actions when and where necessary. In a phased way, EIT Climate-KIC works with a consortium of high-ambition port authorities in Valencia (Spain) and Piraeus (Greece) and Cyprus Ministry of Shipping to demonstrate how ambitious maritime hubs can be catalysts for reversing the fast-growing emissions from international shipping and trade using Systems Innovation approach.

Deep Demonstrations funded by EIT Climate-KIC start with a demand-led approach, working with organisations willing to take on the responsibility of acting as 'problem owners' – in Greece Piraeus Port Authority - committed to zero-net emissions, resilient futures (EIT Climate-KIC, 2020b). Deep demonstrations (Figure 8) progress in tightly designed, iterative phases - steps of rolling out systems innovation-as-a-service, aiming at the identification of the key actors to be involved, current status, vision, innovation needs, sustainable financial planning and ultimately at the alignment of all actors able to drive systems transition to a low-carbon emissions future. Deep Demonstration is a circular approach in innovation implementation with final goal the holistic change of the port to Sustainability.

The aim of Deep Demonstration in Maritime Hubs is to drive the decarbonisation of the three European ports considering all major aspects and conflict points, bringing the key stakeholders in a consortium where impactful discussions take place, co-creating a common vision and working together towards meeting the Sustainability needs of the port through innovation and synergies. Deep Demonstration is part of a bigger UN SDSN Initiative, namely Global Roundtable for Sustainable Shipping[6] aims at bringing together

[6] http://unsdsn.gr/global-roundtable-for-sustainable-shipping-2

shipowners, shipbuilders, technology developers and researchers, ports and policy makers from across the globe. The main goal of the initiative is to develop zero-emission shipping innovations, having as a target net-zero emissions by 2050.

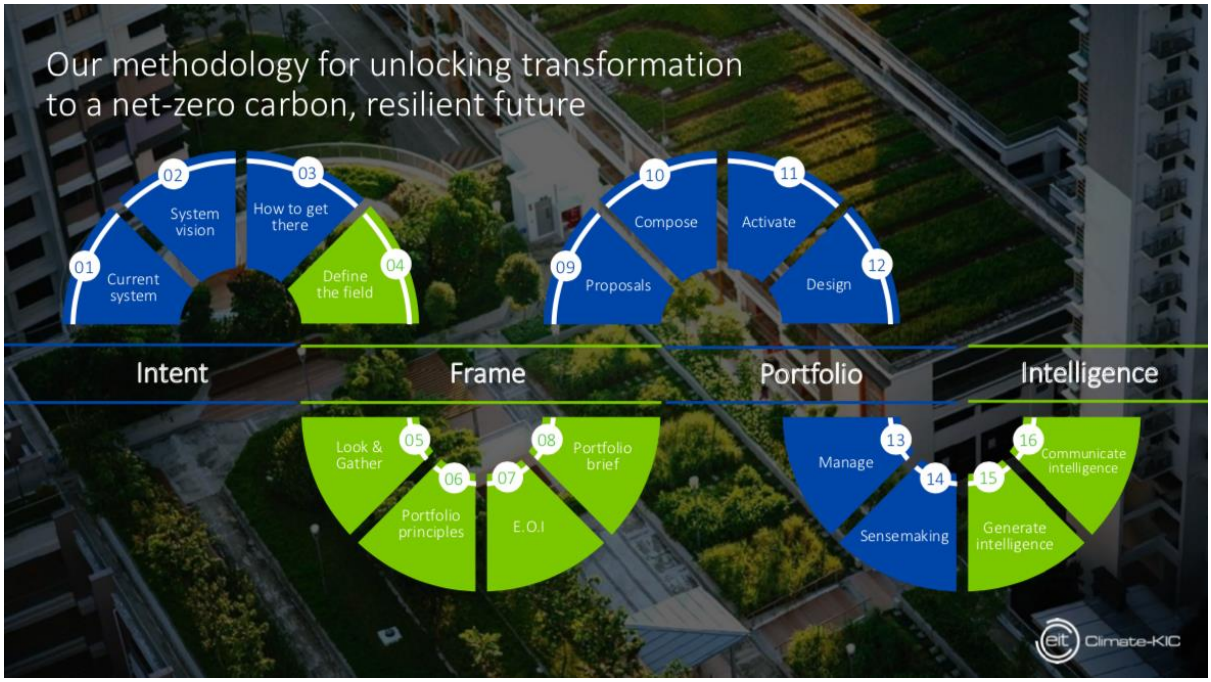

Figure 7 - Deep Demonstration methodology (source: EIT Climate-KIC (2020))

1.7 Circular Economy and Decision making

Despite the growing alarms over climate change threat and the need for financial tools and resources to be mobilized, limited action has been noted in most European Countries in the last decade. The EU has set an ambitious plan for the adoption and implementation of the circular economy (CE). The Plan estimates that by 2030 the integration of CE will result in savings of over 600 bil. euros for EU businesses, will create 580,000 new jobs and will contribute to the reduction of 450 mil. tons greenhouse gases. Member States are key players in Europe's transition to a circular economy. Three EIT Climate-KIC projects seek the implementation of circular approaches in critical public and private institutions.

Adopting Circular Economy in each country should be aligned with its strategic documents and identified sectoral strengths and needs, set in the individual country's Smart Specialization Strategies. CE in S3 (Circular Economy Transition in Smart Specialization Strategy) project aimed at piloting the adoption of CE in their respective S3s, working together with the responsible authorities in two European countries, Greece and Bulgaria. Specific approaches to implementation and supporting funding instruments were discussed and shared with participants. The end goal of the project was to stimulate the timely and systemic adoption of the CE in S3s for the 2020-2027 programming period in EU Member States.

Circular Learning Hub (A learning hub for the engagement and ecosystem transition towards circular thinking) works on an awareness-intention-action path fostering problem-owners to a deeper understanding of circular thinking. Two Lab experiments will be performed by the end of 2020 to empirically confirm the impact of ambiguity on decision maker's (e.g. investors and entrepreneurs) prior probability function and posterior distribution. The experiments will aim to estimate a parametric model of attitudes toward risk/ambiguity and time preferences considering also the impact of climate change (through VR) on decision making process.

In a choice experiment, individuals are in a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set. Each alternative is described by a number of attributes or characteristics. Thus, individuals implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set. Usually, a monetary value is included as one of the attributes when describing the profile of the alternative presented. Virtual Reality Laboratory Experiments are described in three-dimensional topographies containing virtual objects obeying simulated physical laws. The information collected during the experiment will allow for the co-creation of innovative learning initiative on circular thinking. The pan-European extension of this project (Italy, Greece and Bulgaria) will also allow for a more effective co-creation of scaled nudging and learning solutions based on the experiences of the different geographical contexts involved.

The outcomes of Circular Learning Hub will be further exploited by CE Beacons (Western Balkan Circular and Climate Innovation Beacons). The goal of this project is to build an eco-system for circular, climate-related innovation that catalyzes systems transition. The project tackles the following objectives, namely the establishment and empowerment of a network of actors in the Balkans and other countries for developing and implementing circular innovation in business and policy; the creation of partnerships among EU countries through shared circular vision, information, resources and experience on both strategic and operational level; the nurture shared learning amongst "Beacons" to raise capacity of places for systems circular change and climate action; and the reduction of the total negative impacts from current market design through establishing circular markets.

1.8 Mobilizing Science Driven Sustainable Blue Growth

As response to the climate crisis and its effect on Marine Ecosystems and Coastal Populations, a Euro-Asian Initiative has been launched by the SDSN Mediterranean and the Black Sea regional networks together with the national SDSN networks in Greece, Italy, Spain, France, Turkey and Russia under the auspices of the Global SDSN network IN 2019. The goal of the 4-Seas Initiative[7] is to accelerate science-driven blue growth and the implementation of the United Nations Sustainable Development Goals (Agenda 2030) in the following 4-seas: the Mediterranean, the Black Sea, the Caspian and Aral. It follows a 'source-to-sea' approach initiating from river basins and proceeding to coastal and marine ecosystems, as well as the societies whose livelihoods depend on these ecosystems.

The initiative focuses on five areas, namely research, education, data management, innovation and policy, while it brings together all relevant stakeholders in co-designing a systems innovation pathway for the transition to socially, culturally, economically, environmentally and geopolitically sustainable development in the Euro-Asia Region embracing the 4-seas. Categorically, it aims at the development of Sustainable

[7] http://unsdsn.gr/un-sdsn-4-seas-initiative-mobilizing-science-drive

Blue Growth Transformation Pathways in urban and rural areas that depend on the 4-seas and creation of networks of protected marine and coastal ecosystems of cultural and natural interest; the creation of educational programs with an emphasis on understanding and implementing the SDGs, while enriching them with Euro-Asian intellectual tradition, the development and support of open access databases with the data, models, results and policy recommendations relevant to the Sustainability Transition of the 4-seas; the incubation and acceleration of technological and social innovation for the sustainability transition in the region, combining the protection of the natural and cultural environment; and at policy recommendations for the support of sustainable blue growth in the region.

1.9 Conclusions

The cross-thematic "Oceans of Tomorrow" book seeks to implement this commitment. The book falls within the activities launched under European calls (e.g. FP7, H2020) to implement the European strategy for marine and maritime research and to address marine sciences and technologies as a challenge that cut across themes. This book aims to foster multidisciplinary approaches and cross-fertilization between various scientific disciplines and economic sectors on key cross-cutting marine and maritime challenges. Research projects presented in the next chapters bring together scientists, technology providers, industrial partners (including Small and Medium Enterprises-SMEs) and end-users.

There is no doubt that the Earth's survival will depend on the protection and sustainable management of our seas and oceans and the resources they provide. This is recognized by the Joint Communication on International Ocean Governance, which is an integral part of the EU's response to the United Nations' 2030 Agenda for Sustainable Development, and in particular to the targets set out by Sustainable Development Goal 14 (SDG 14) to "conserve and sustainably use the oceans, seas and marine resources". The EU's Seventh Framework Programme for Research and Development (FP7) and Horizon 2020 have funded over 1200 Blue-Economy-related projects European Commission (2014b; 2020). In addition to the political priorities, the challenges of the protection and sustainable management of our seas and oceans are directly linked to the EU Bioeconomy Strategy and Blue Growth Strategy (European Commission, 2017c; 2019b).

References

AMAre (2020). Interreg European Commission project. Actions for Marine Protected Areas. Online Platform. https://amare.interreg-med.eu. Accessed on 18 March 2020

Asariotis R., Benamara, H., Mohos-Naray, V. (2018) UNCTAD Research Paper No. 18 UNCTAD/SER.RP/2018/2018/Rev.1 United Nations Conference on Trade and Development (2018) file:///E:/all%20docs%20and%20files/Article%20on%20Sustainable%20ports/Unctad%20survey%20on%20ports_ser-rp-2017d18_en.pdf

BlueBRIDGE (2020). Horizon 2020 European Commission project. Building Research environments fostering Innovation, Decision making, Governance and Education to support Blue growth. https://www.bluebridge-vres.eu/about-bluebridge. Accessed on 11 February 2020

BL.EU. Climate (2020). EIT Climate-KIC project. Climate Innovation in Southern Waters. https://www.athenarc.gr/el/climate-innovation-southern-european-waters-bleu-climate

COASTAL (2020). Horizon 2020 European Commission project. Collaborative Land-Sea Integration Platform. https://h2020-coastal.eu

Costanza R., et al. (1999), Ecological economics and sustainable governance of the oceans, Ecological economics, 31(2), 171-187.

EIT Climate-KIC (2020a). Europe's leading climate innovation initiative. https://www.climate-kic.org/who-we-are/what-is-climate-kic/

EIT Climate-KIC (2020b). Deep Demonstrations. https://www.climate-kic.org/programmes/deep-demonstrations/. Accessed on 12 April 2020

European Commission (2014a). The ocean of tomorrow projects (2010-2013). https://publications.europa.eu/en/publication-detail/-/publication/95d22319-ce5e-4a60-889b-5620104610b2/language-en/format-PDF/source-search

European Commission (2014b). Selected projects in marine research. https://publications.europa.eu/en/publication-detail/-/publication/b522116e-af4d-427f-8c15-92d732c2595c/language-en/format-PDF/source-71778581

European Commission (2017a). Sustainable blue economy. https://publications.europa.eu/en/publication-detail/-/publication/ada65c0f-aef9-11e7-837e-01aa75ed71a1/language-en/format-PDF/source-71790365

European Commission (2017b). Common organization of agricultural markets (COM). https://publications.europa.eu/en/publication-detail/-/publication/5e3053c2-d6cb-11e7-a506-01aa75ed71a1/language-en/format-HTML/source-72100476

European Commission (2017c). Blue Growth – shaping the next five years together. https://ec.europa.eu/maritimeaffairs/content/blue-growth-–-shaping-next-five-years-together_en

European Commission (2017d). Integrated maritime policy. https://ec.europa.eu/maritimeaffairs/policy_en

European Commission (2019a) The European Green Deal, Brussels, 11.12.2019 COM. Final Communication from the commission to the European Parliament, the European Council, the council, the European Economic and Social committee and the committee of the regions. https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

European Commission (2019b). Bioeconomy policy. https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=strategy

European Commission (2020). Horizon 2020 Programme: Funding & tender opportunities. http://ec.europa.eu/research/participants/portal/desktop/en/home.html

H2OCEAN (2012). FP7 European Commission project. Online platform. https://cordis.europa.eu/project/id/288145. Accessed 18 April 2018

IMO MARPOL Annex VI (2010). Prevention of Air Pollution from Ships. http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Air-Pollution.aspx

Koundouri, P. (2017). The Ocean of Tomorrow, Investment Assessment of Multi-Use Offshore Platforms: Methodology and Applications - Volume 1. Springer International Publishing. eBook ISBN: 978-3-319-55772-4, Hardcover ISBN: 978-3-319-55770-0. DOI: 10.1007/978-3-319-55772-4

Marine Strategy Framework Directive (MSFD) (2008). Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy. Official Journal of the European Union, L 164, 25.6.2008, pp. 19-40.

MERMAID (2015). Online platform. http://www.vliz.be/projects/mermaidproject/. Accessed 18 April 2018

MERMAID (2019). Public Documents. http://www.vliz.be/projects/mermaidproject/docmanager/public/. Accessed 18 April 2018

IPCC (2018). Special Report: Global Warming of 1.5 ºC. https://www.ipcc.ch/sr15/. Accessed 18 April 2018

Ocean Literacy Network (2015). Ocean Literacy Principle #6. http://oceanliteracy.wp2.coexploration.org/ocean-literacy-framework/principle-6-v2/

RECONNECT (2020). Interreg European Commission project. Regional cooperation for the transnational ecosystem sustainable development. Online platform. https://reconnect.hcmr.gr

THAL-CHOR (2015). Cross border cooperation for Maritime Spatial Planning Development. Interreg A: Cross-Border Cooperation Programme "Greece-Cyprus 2007-2013. https://www.msp-platform.eu/projects/cross-border-cooperation-maritime-spatial-planning-development

TROPOS (2012). FP7 European Commission project. Online platform. http://www.troposplatform.eu/

Tsani, S. and P. Koundouri (2018). "A methodological note for the development of integrated aquaculture production models". Frontiers in Marine Science, Vol 4, 2018. DOI: 10.3389/fmars.2017.00406, ISSN: 2296-7745.

UNCTAD (2019). Review of Maritime Transport 2019. https://unctad.org/en/PublicationsLibrary/rmt2019_en.pdf

UNCTAD (2020). Climate Change and Maritime Transport. https://unctad.org/en/Pages/DTL/TTL/Legal/Climate-Change-and-Maritime-Transport.aspx

UNEPMAP (2020). Mediterranean 2017 Quality Status Report. https://www.medqsr.org. Accessed on 5 April 2020.

UN SDSN (2020). United Nations Sustainable Development Solutions Network. https://www.unsdsn.org/. Accessed on 13 March 2020

Vassilopoulos A., Koundouri, P., (2017). Valuation of Marine Ecosystems. In Oxford Research Encyclopedia of Environmental Science. Oxford University Press. e-ISBN: 9780199389414, DOI: 10.1093/acrefore/9780199389414.013.529

WEF (2016). The New Plastics Economy. Rethinking the future of plastics. http://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf