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The BLUEMED Italian White Paper:
an overview of relevance, obstacles and proposals
of the key sectors for a Blue Growth

BLUEMED Italian White Paper Working Group

Consiglio Nazionale delle Ricerche

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EXECUTIVE SUMMARY

INTRODUCTORY REMARKS

The Mediterranean Sea has been a crucial crossroad for the history, economy and culture of Europe, Middle East and North African countries. However, until very recently, past and current impacts of human activities on the basin have been largely neglected, nor has a coordinated plan for a coherent and sustainable use of its resources been developed. The concept of sustainable marine and maritime economic development, "Blue Growth", adopted by the European Union (EU) can be expressed as a knowledge driven quantum jump in the exploitation of marine resources, radically different from current practices and fundamentally aimed towards the improvement of the social wellbeing. Blue Growth implies a drastic change from how operators from marine and maritime sectors have traditionally addressed management of marine resources, towards a synergistic, non-conflicting and sustainable use of the sea, still allowing for a significant growth and prosperity. This is now recognized as a global challenge, and believed to be particularly relevant for the Mediterranean region, given its long history of marine resources exploitation and increasing human pressure. Nevertheless, at present the general perception is that the economic growth potential of the Mediterranean Sea is still only partially harnessed and can and should be more effectively exploited without damaging natural resources and their sustainability in the long term. The Mediterranean region is thus an ideal natural laboratory to test the implementation and feasibility of Blue Growth. To verify just how realistic this perception is, a collective effort of joint analysis and strategy design is needed.

When considering the current economic crisis and the evolving political, social and environmental conditions in the Mediterranean Region, it becomes apparent that all the multidisciplinary actors from different countries need to build an ideal environment for constructive dialogue (science diplomacy) and lay the groundwork for conditions that allow societies, economics and policies to attract investments while, reconciling tensions and balancing economic growth, social implications and environmental conservation. Tackling climate change, (the Mediterranean is one of the global hotspots for global warming),understanding ecosystem function, managing sustainability, all require the most effective initiatives and strategies . Hence, the EU Blue Growth initiative represents a long-term strategy to support growth in the maritime sector as a whole by harnessing the untapped potential of Europe's oceans, seas and coasts for the creation of "blue" jobs and economic growth.

To this aim, nine European Countries (Croatia, Cyprus, France, Greece, Italy, Malta, Portugal, Slovenia, Spain) and the European Commission (EC) have been promoting and supporting the BLUEMED Research and Innovation initiative for blue jobs and growth in the Mediterranean area since 2014. Since 2017, BLUEMED has been formally endorsed by all member countries of the European Union (EU) and of the Union for the Mediterranean, including non-EU countries, through the undersigning of the Valletta Declaration.

The EC also funded the BLUEMED project (2016-2020), a Coordination and Support Action (CSA) to promote the implementation of the BLUEMED Strategic Research and Innovation Agenda (SRIA). The BLUEMED SRIA is a shared reference for the Mediterranean countries, that addresses key challenges and identifies the main common priorities to foster Blue Growth. The BLUEMED project involves all the EU Member States supporting the BLUEMED initiative and is coordinated by the Italian National Research Council (CNR). Its success will mostly depend on the ability to involve the relevant actors and stakeholders in the definition of knowledge driven shared strategies, to be implemented at national and international level.

To support the participative process while connecting the top-down and bottom-up approach and stimulating a dialogue among stakeholders, the BLUEMED project established four thematic working groups, so called BLUEMED platforms at Mediterranean level, that reflect the three pillars on knowledge, economy, and technology clustering the SRIA key challenges and including a fourth cross-cutting platform on policy (Tab. 1). The BLUEMED platforms are conceived as fora where national representatives interact to convey the messages from their communities to consolidate the BLUEMED SRIA. The platforms also act as dynamic observatories for monitoring the system. In the long term, platforms are expected to become a transnational network that will continuously and operationally put into effect, monitor, prioritize and update the SRIA's actions in the Mediterranean.

KNOWLEDGE PLATFORM	ECONOMY PLATFORM	TECHNOLOGY PLATFORM
POLICY PLATFORM		

Tab. 1
The three pillars of the BLUEMED SRIA reflected into the BLUEMED Platform and a cross-cutting Policy platform

Based on this framework, and building on the main outcomes of relevant projects and initiatives and on established research and innovation priorities in the Mediterranean, as from relevant common Strategic and Innovation Agendas, this White Paper reviews the present status of the main economic sectors involved in the Blue Growth. It also discerns the main obstacles to the achievement of the identified priorities and proposes possible strategies to overcome them, starting from an Italian perspective.

This contribution is the result of the active engagement of the Italian scientific community and relevant marine and maritime stakeholders. Several approaches and tools were adopted to manage these interactions, as reported below.

- *First national BLUEMED event*
  Preliminary ideas and suggestions were collected at the national workshop "BLUEMED meets Italian Stakeholders" held in Rome, at CNR Headquarters, on the 5th of June 2017. This participatory event gathered more than 100 people and offered the opportunity to launch the national BLUEMED platforms as mirror mechanisms of the Mediterranean ones, and initiate the process of identifying areas of intervention.
- *The survey "Share your view on the Research and Innovation agenda for the Med!"*
  A dedicated online survey was launched to collect suggestions to update the BLUEMED SRIA by examining each goal and action in detail, and proposing additional inputs and/or revisions, identifying barriers and bottlenecks, while stressing the specificity of the Mediterranean basin in relation to a proposal of actions.
- *Consultation with experts*
  Leading experts were invited to contribute to this paper by reviewing the state of the art of "blue" economy sectors, the related cross-

cutting issues and constraints, and to define trajectories towards Blue Growth objectives.
- *An inter-ministerial group on Blue Growth*
  To coordinate and strengthen the Italian position, open and public discussions through regular meetings were organized with decision makers, including representatives from relevant ministries, in order to better align and strengthen national programmes and strategies.

Further improvements will be integrated by creating the necessary links with the National Smart Specialization Strategy (S3) and the Italian Bioeconomy Strategy (BIT). The implementation methods of the National and Regional S3 – definition and execution of strategic plans where national and regional interests and resources can converge – also ensure the involvement of Regions and the variety of productive knowledge expressed by the territories through multi-regional plans approved by the Conference of Regions and by the Autonomous Provinces.

In addition, a collaboration with the National Technology Cluster Blue Italian Growth (CTN-BIG), established according to the Ministry of Education, University and Research 2015-2020 National Research Program – strongly correlated with the National and Regional S3 – and with Italian Law n. 123 of 03 August 2017, was activated and will be pursued. This effort will also serve as a guideline to consolidate the BLUEMED SRIA actions and to design an initial roadmap for their implementation.

The keystone of the work presented here is the recognition that effective steps towards a "blue" economy can only be achieved only by transcending the mere identification of research and innovation challenges and priorities for specific sectors, which inevitably reflect a partial, sectorial view. This means that the main effort must be directed towards an

integrated view of how different activities, often conflicting, might coexist and even develop synergies. An in-depth analysis on how new technologies and new knowledge can overcome conflicts and improve our use of the sea, and/or on the extent to which existing technologies and knowledge might be better exploited for the same scope is therefore considered essential. As a consequence, this document is not intended as a conventional list of pure Research and Innovation (R&I) priorities, but rather focuses on the identification of how the most relevant R&I challenges for Blue Growth can be more efficiently tackled.

The adopted methodology follows a scientific approach, starting from a detailed analysis of relevant activities and objectives for each of the main marine and maritime socio-economic drivers (food, transport, tourism, chemicals and materials, energy, security, ecosystem health). Gaps and barriers to Blue Growth are identified and different approaches to overcome them, with particular focus on cross-cutting high-level priorities as well as pragmatic actions for research and innovation to be shared at national and Mediterranean levels, are proposed.

DRIVING BLUE GROWTH

Economic growth in modern societies relies on innovation and exploitation of new resources that may expand the market. Human well-being depends on the fulfilment of basic needs such as food, health, equal opportunities to play an active role in society, e.g., jobs. There is a general consensus that the marine environment has a great potential to improve all the above. In many nations, this realization has triggered a growing interest to explore the potential of marine areas and design strategies that draw on marine resources and services in ways that go beyond their traditional and consolidated uses. On the other hand, it is acknowledged that the exploitation of marine systems need to be increasingly sustainable to allow for long-term use. Initiatives reconciling both requirements fall under the umbrellas of Blue Growth and Blue Economy, as defined by EU (see for example: https://ec.europa.eu/info/sites/info/files/bluegrowth_p4p-report_2017.pdf). Both concepts originate from the need for a holistic approach to a sustainable management of marine systems. These are indeed characterized by the complex interaction of the socio-economical and the ecological components.

This white paper illustrates the Italian position on Blue Growth. It builds on an overview of the status of different sectors and activities of marine and maritime economy, among which those considered pillars for Blue Growth due to their underexploited potential, with the scope to more specifically identify the impediments of sustainability and sketch possible roadmaps and scenarios to foster the Blue Growth in the Mediterranean area. For some sectors the focus is primarily on Italian circumstances and predicaments while

for others the perspective is pan-Mediterranean. This document condenses the results of targeted interactions within the Italian scientific community and several players and stakeholders, including the Italian Ministries involved in marine and maritime affairs (Ministry of Education, University and Research - MIUR; Ministry of Economic Development - MISE; Ministry of Infrastructures and Transport - MIT; Ministry of Agricultural, Food and Forest policies - MIPAAF, Ministry of Foreign Affairs and International Cooperation - MAECI; Ministry of Cultural Heritage and Activities and of Tourism - MIBACT; Ministry of Defence - DIFESA; Ministry of Economics and Finance - MEF) and the Agency for the Cohesion of Territories. The last five ministries have been regularly consulted through a dedicated inter-ministerial group on Blue Growth. The ultimate goal of this analysis is to provide shared visions and to design future trajectories for joint research and innovation priorities in the Mediterranean, as seen from the Italian perspective. As such, it contributes to the BLUEMED Strategic Research and Innovation Agenda challenges and actions and to the design of a roadmap for their implementation.

Since the market does not act as a regulator when it comes to common and shared resources, knowledge of the interactions and potential conflicts that can arise among the different sectors and the development of shared metrics to rank priorities are needed to prevent criticalities and to design sustainable solutions through strong governance practices. Consequently, Blue Growth and Blue Economy involve not only technological innovation and deep knowledge of the dynamics of marine ecosystems but an equally deep knowledge

of the economic, political and social drivers behind them. Only by integrating both kinds of knowledge, a realistic and thus successful strategy can be designed and proper governance tools can be developed. This paper thus also provides a synthetic survey of some juridical and political constraints, the main conclusions of which are as follows:

- A tailored set of rules fine-tuned for the specific morphology and size of the basin has not yet been produced. The main reference document is still the United Nations Convention on the Law of the Sea (UNCLOS, 1982), which was designed for the high seas and is, in several cases, inadequate;
- As a consequence, the need to delimit respective Exclusive Economic Zones (EEZs) has already produced a number of questions and disputes that have contributed to the abstention of the coastal states from the proclamation of their EEZs;
- Some states have established *minoris generis* maritime zones (i.e. fishing protection and/ or exclusive fishing zones and ecological protection zones or both as hybrid zones) based on the principle of *in maior stat minus*;

- Although the coastal states of the Mediterranean Sea seem to interpret the cooperation obligation stated by UNCLOS as a commitment to negotiate rather than as an obligation to reach an agreement, several multilateral agreements have been reached for the protection of the environment and fishery resources;
- Naval and other military forces and Coast Guard-Port Authorities may play a role to support the enforcement of international directive for the protection of the environment (e.g. the EU Marine Strategy Framework Directive, MSFD).

Our main analysis is then structured around five economical drivers which shape the different sectors, namely food, transport, tourism, energy, chemicals and materials. It focuses on the present status and potential, as well as on the related gaps and barriers, sketching possible solutions to overcome them. Specifically, Tab. 2 provides for each driver a synthesis of the main strengths vs. problems at Mediterranean level, of the role that Research and Innovation (R&I) can play to foster Blue Growth, and a practical roadmap to be implemented.

FOOD	

	FISHERIES
Relevance	Italy is the second largest producer of Mediterranean fisheries with average fish landings of about 15% (249500 tons) and a value of about 29% (about US$ 881 million) of the total Mediterranean and Black Sea catches
Strengths	Fish yield used directly for human consumption Strongly rooted in local culture, diet and cuisine
Problems	85% of stocks are overfished Fleet overcapacity High level of undersized fish in catches Fish demand exceeding national supply
Role of R&I	Ecology of fisheries resources Ecosystem based fisheries management Predictive models on the impact of global changes on ecosystems and fish assemblages Innovative models and methods for stock assessment Socio-economic analysis for more sustainable fisheries
Roadmap	Identifying stock units Improving modelling for Ecosystem Based Approach to Fisheries Reducing discards and improving small scale fisheries Developing participatory management mechanisms and communication/cooperation among stakeholders Implementing spatial based approach to fishery management Advancing in data collection framework Assessing impact of global change on fishery resources and ecosystems

	FARMING
Relevance	25% of consumed fish comes from farms Predicted doubling of weight in a few years
Strengths	It is the only alternative to replace fish from fishery besides synthetic food
Problems	The sector is stagnating Waste production and consequent impact on natural systems At present feed is not sustainable
Role of R&I	Integrated multi-trophic aquaculture New feed Widening of aquaculture of low trophic levels Circular economy to recycle wastes New materials and logistics for offshore aquaculture New strategies against pathogens Exploitation of the deep sea fish stock
Roadmap	Build artificial systems mimicking the natural systems Develop aquaculture in multiple purpose offshore platforms Identify new sources of raw material Envisage alternative preventive and therapeutic measures Select different species to harvest

TRANSPORT	
SHIPBUILDING AND MARINE ROBOTICS	
Relevance	Europe shares 6% of the world shipbuilding activity and controls about 40% of the world fleet The European maritime industry counts 300 shipyards and more than 22000 maritime equipment manufacturers In Italy 40000 companies, distributed over 15 Regions, reach a turnover of 15 billion € and employ over 230000 people AUVs (Autonomous Underwater Vehicles) are a consolidated operational solution for defence, research and hydrocarbon extraction industry
Strengths	In the last five years the turnover of the shipbuilding industry has recorded higher growth than the rest of the economy (+2.1% against +1.9%) due to the positive trend in orders for cruise ships, a sector in which Italy holds a world leadership position The turnover of the yachting industry reached 3.44 billion €, with a growth rate of 18.6% compared to 2015 Two active National Technology Clusters, Trasporti Italia 2020 and Blue Italian Growth
Problems	Lack of mandatory and strict regulations for vessels navigating in the Mediterranean Some Mediterranean fleets are outdated and contribute to high environmental impacts and low safety levels Only few of the maritime sector players are adequately familiar with new technologies Lack of infrastructures to support low carbon technology strategies for ships
Role of R&I	*Shipbuilding* Automation and connectivity (ICT technologies) Innovative ship design and new manufacturing processes Innovative materials Low carbon technology Solutions for safety Low environmental impact solutions *Marine robotics* Sensing and perception Navigation, guidance and control Energy generation, storage and management Propulsion systems, hydrodynamics, mechatronics and materials (also bio-inspired) Marine Internet of Things
Roadmap	Create the legislative, technological and infrastructural conditions to promote a highly connected and automated sea transportation system to improve safety and efficiency of shipping Promote high quality training courses for the workers of the maritime industry to meet the demand for high-tech products using innovative and eco-sustainable production cycles Provide specific funds to improve production technologies Fill the knowledge, technological and regulation gaps for the use of innovative materials Support the design of LNG-fuelled ships and related on-shore facilities as well as the research on batteries and fuel cells, push for new safety regulations and appropriate inland, coastal and offshore infrastructures Promote specific actions, procedures and training for safe operations Promote a joint effort at regional level to create acoustic maps of the polluted areas Promote dual use research programs Define mandatory regulations for ships passing the Mediterranean with respect to chemical and physical emissions Develop Unmanned Autonomous Vehicles and related infrastructure that can extend the area – in the air, on the sea surface and underwater – for different types of operation, reducing the number of support vessels Push for the definition of inspection procedures supported by air, climbing and underwater robots
PORTS	
Relevance	Mediterranean port system features over 100 ports of medium size and a huge number of small and fishing ports, of which 144 are located in Italy
Strengths	20% of the total world's maritime transport and 30% of the oil trades move through the Mediterranean Maritime sector contributes 32.6 billion € to national GDP (2.03%) Maritime sector employs 471000 persons (2% of the workforce)
Problems	The Mediterranean port system is characterized by many ports of medium size while north Europe has fewer but much larger ports, better connected with on-land transport infrastructures Due to infrastructure and management limitations, in the last 10 years the Italian port system has fallen from first to third place in Europe for imports and exports of goods by sea
Role of R&I	Development and application of ICT technologies Digitalization of the logistic chain Innovative solutions for energy generation and storage
Roadmap	Reduce the impact of ports on the surrounding environment (carbon dioxide, CO_2, nitrogen oxides, NO_x and noise emissions) through the electrification of docks and the use of alternative energy sources Improve or build new port infrastructures to provide services to different types of vessels (yachts, ferries, merchant and cruise ships, traditional and LNG fuelled ships) Support the central role of the port system for transport intermodality Promote high level training programmes on central topics for ports and logistics Promote new partnerships among different stakeholders of the logistic chain

TOURISM	
Relevance	In Italy the tourism sector added value amounts to about 10% of national GDP, while contributing with employment by 13% Bathing tourism (domestic and international) is the main type of tourism in Italy
Strengths	Continuously growing sector, registering a 42% increase of tourist arrivals between 2000 and 2016, with foreign arrivals up by 58%
Problems	Critical flows require to urgently de-seasonalise and differentiate tourism offering, recognising that de-seasonalised tourism may create additional pressures on coastal systems
Role of R&I	Targeted knowledge based strategy New Information and Communication Technologies (ICT) and services for sustainable tourism Solutions to integrate coast and inland waterways Manage challenges of the coming years, including climate change impacts
Roadmap	Promote collaboration between supply operators through business networks and product clubs Insert products into the local tourist offers and improve promotion/distribution/communication channels Promote product specific valorisation and tourist appreciation of the cultural and natural heritage through new technologies Design a clear and targeted strategy, focusing mainly on new ICT and services, for sustainable tourism, integrating coast and inland waterways Identify the main targets of coastal and inland tourism (nautical tourism, seaside tourism, cruise tourism, urban tourism, experiential tourism) in order to differentiate the offer Integrate the coast and the hinterland with slow inter-mobility Encourage networks of tourism with other economic sectors (agriculture, crafts, culture, fishing) to widen tourism offers Use tourism as a vehicle to educate people, and promote awareness of Italian cultural heritage and of and eno-gastronomic resources Develop new coastal tourism benefits also through a live-learning approach, allowing to discover and experience the destination in a sustainable manner Implement interactive tools based on modern technologies to enhance the visitor's experience Expand the opportunities offered by cruise tourism Better Control and management of tourist flows

ENERGY	
Relevance	The growth of the marine energy sector has been relatively slow if compared to the onshore industry MRE (Marine Renewable Energy) is a promising resource capable of responding to the energy demand of coastal and insular areas, preserving the marine environment
Strengths	The EU actively promotes the development and exploitation of MRE technologies in the context of the transition to low carbon energy The milder climatic conditions of the Mediterranean allow the affordable testing of devices and stimulate the design of particularly efficient technologies for ocean energy harvesting Italian technologies covering the whole value chain of offshore wind energy are ready for applications Wave and tidal technology is supported by the Italian government, Italy is at the forefront of research in developing and testing prototypal and pre-commercial devices for ocean energy conversion.
Problems	Environmental and technical issues limit the implementation of offshore wind farms in the Mediterranean and scenarios of climate change make it difficult to decide on the best locations for wind farms Lengthy authorization process Traditional maritime sectors (e.g. shipping, fishing activities, tourism) are not always spatially compatible with the development of new maritime industries
Role of R&I	Concentrate efforts on a limited number of promising technologies for energy conversion from tidal streams and waves, targeting a reduction in the Levelized Cost of Energy (LCoE) Develop sustainability assessment studies based on a life cycle thinking approach, embracing the environmental, economic and social dimensions Investigate the possibility of integration of different types of energy production at sea (wind-tidal-wave)
Roadmap	Create and continuously support Blue Economy businesses and high-tech clusters while enhancing connections with the traditional know-how-based industries Strengthen potential synergies between coastal and offshore energy infrastructures and other activities/threats such as aquaculture, protected areas and coastal erosion prevention Share background data and information in the development and consent phase for different types of energy production at sea and jointly planning necessary infrastructures and grid connections Develop larger demonstration projects to sustain MRE development from basic and applied research to final commercial deployment

CHEMICALS AND MATERIALS	
THE DEEP SEA	
Relevance	Not relevant so far
Strengths	Second largest unexplored volume on the Earth Mineral reserves of rare materials and biology
Problems	No easy access or exploitation Scarce knowledge of the impact of goods exploitation on the deep sea environment Jurisdictional access issues
Role of R&I	New materials and new technology Better knowledge of the biota and their contribution to Earth system functioning Evaluate impact and exploitation of gas hydrates
Roadmap	Stronger oil and gas supply chain Implement the Directive 2013/30/EU on safety of offshore oil and gas operations improving environmental monitoring, hazard assessment, and conducting risk analysis Promote scientific research and exploitation on gas hydrates Better understand the deep sea ecosystem functioning Store CO_2 (carbon dioxide) by seafloor microbial communities interacting with specialized fauna Develop bioremediation approaches in the deep sea against pollutants Exploit the deep sea fish stock
BLUE BIOTECHNOLOGIES	
Relevance	Not relevant so far (2% of EU bioeconomy)
Strengths	Presumed great potential of new materials and chemicals High (5%) global annual average growth rate Growing impact on pharmacology, cosmetics, bioremediation
Problems	Fragmentation of the sector in Italy
Role of R&I	New knowledge in fundamental biology Focused -omics based marine technology
Roadmap	Fund new focused research departments Implement specific political actions to support biotech industry Test and promote safe natural products of marine origin Create synergies with other activities, e.g. food, bioremediation Explore preventive healthcare Increase the prominence of Mediterranean companies at global scale

Tab. 2
The Blue Economy sectors in Italy

Our analysis demonstrates that the majority of the objectives related to each of the economic drivers listed above are affected by criticalities and bottlenecks caused by three major factors:

• knowledge and technological gaps;
• missing/inefficient transfer from knowledge into practice;
• competition and conflicts among interests (stakeholders, regions, states, etc.).

Though specific knowledge gaps are identified for each driver, common obstacles arise due to incomplete knowledge of the main physical and biogeochemical processes and cycles of the Earth system on one hand, and, from a completely different perspective, by the complexity of the processes that govern the creation and exchange of knowledge, the transfer of knowledge to innovation and the implementation of knowledge-based policies.

The analysis of the mutual interactions between the human activities and the Earth system functioning unveiled the uncertainties related to the evaluation of the effects of anthropogenic pressures on the marine environment and its vulnerable ecosystem.

This is due to the systematic discharge of traditional and emerging classes of pollutants at sea, as well as the unreliable evaluation of the impact of marine environmental changes on human economic and social structure, through the modification of the ecosystem services. The long-term assessment of the value of natural resources remains uncertain due to the gaps in our basic knowledge of the dynamics of natural systems, which require continuous efforts and innovative approaches.

As such, the foundations of sustainable exploitation plans and successful management strategies must rely on an increased knowledge and effective protection of the ecosystems health. The tools proposed here to develop this new knowledge and to mitigate human pressure on the marine environment include:

• the set-up of innovative networks of marine protected areas, better identified as "cells of ecosystem functioning", taking into account the connectivity among sites and the overall functioning of the system;
• the optimization and sustainment of existing observing systems and the design of future augmented observing systems, measuring new variables (e.g. -omics) and developing new sensors and platforms;
• a better and long-term comprehension of the impacts, single and cumulative, of historical, ongoing and future sea uses and their pressures on marine ecosystems and biotic/abiotic resources, supporting an ecosystem-based management approach;
• the development of short and medium-term actions for the environmental/ecosystem recovery and consequent re-launching of economic/industrial activity in polluted marine and coastal areas, as well as the definition of safe and sustainable decommissioning of previous installations no longer in use such as, e.g., offshore platforms.

Be that as it may, the different perception of economic priorities and environmental issues among the various stakeholders (scientists, industries, public authorities, civil society), as well as the distinct innovation priorities among nations and sectors, call for new conceptual and methodological approaches and frameworks to foster the harmonization among policies and reduce potential conflicts, improving the maritime spatial planning implementation process and promoting the maritime domain awareness (i.e. the effective understanding of anything associated with the global maritime domain that could impact the security, safety, economy or environment). This should include the exploitation of innovative tools to promote appropriate investments (e.g. based on smart technologies, big data analytics, etc.), homogeneous legislation and capacity building throughout the Mediterranean and to enhance awareness at civil and political levels of the degradation of the marine environment and the critical impacts in terms of potential disruption of local economies, loss of resources and jobs, which can lead to an overall reduction of social well-being and safety of the entire Mediterranean area.

The definition of efficient knowledge-to-Blue-Growth trajectories, then, extends to the high-level policies governing knowledge creation and exchange (including pan-Mediterranean training networks of student exchange) and favouring the immediate transfer of knowledge to innovation. These are the processes ultimately responsible for the sustainable growth.

Recognizing that the slow emergence of the knowledge economy in the European area played a major role in lowering productivity levels with respect to the United States, the analysis evidenced that successful high-level research and innovation strategies should primarily aim at fostering new knowledge generation and efficient and fair transfer of information among all stakeholders, identifying the following main knowledge-to-Blue Growth strategic objectives:

address the complexity of the interactions between research, stakeholders and policy makers and develop a scientific approach towards effective negotiation and knowledge-based decision processes	overcome knowledge fragmentation and promote cooperation and quality research enhancing competitiveness	extend knowledge frontiers including basic science and support innovative solutions

To address these objectives, the following practical actions have been identified and proposed:

- the development of innovative training and exchange frameworks to increase the efficiency in the interaction between scientists, stakeholders and policy makers, one example being represented by the BLUEMED Mediterranean working platforms on knowledge, technology, economy, policy and by their national counterparts, which in Italy led to the establishment of a permanent inter-ministerial group focused on Blue Growth, co-chaired by MIUR and CNR;
- the definition/strengthening of dedicated technological clusters/districts, which play a key role in transforming scientific results into socio-economic benefits. The National Technology Cluster Blue Italian Growth (CTN-BIG) has been set up to generate the critical mass for innovative economic activities and initiatives also as test beds for the implementation of innovative science-to-policy approaches;

- the consolidation of open data policies by fostering data rescue/re-use, strengthening and enforcing policies for the harmonization and open access to data, supporting the evolution of ocean observing systems;
- the promotion of open science policies by consolidating knowledge sharing initiatives and tools, such as scientific networks, open workshops, open access literature, ocean literacy, citizen science, educational and social outreach;
- the exploitation of new multi-disciplinary data-driven opportunities by applying big data analytics tools in support of basic science applications and decision support systems, by also taking advantage of the opportunities provided by the explosive growth in the number of devices connected to the Internet of Things (IoT);
- The revision of public funding schemes and opportunities to enhance the adoption of open science practices, proposing also a partial shift of funds towards small-scale/Principal-Investigator-driven funding schemes, alongside on going large-scale collaborative projects.

This Executive Summary synthetizes the content of the *BLUEMED Italian White Paper: an overview of relevance, obstacles and proposals of the key sectors for a Blue Growth*, the extended version of which can be accessed at: http://doi.org/10.5281/zenodo.1306490.

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BLUEMED Italian White Paper contents:

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