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Introduction of Blue Energy in the Mediterranean: The Conceptualization of the Sea as "Space" and Emerging Opportunities for Greece and Mediterranean Countries

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When we think of the term "space," we tend to imagine an onshore area with certain features, such as borders, governing laws and regulations, land uses, geomorphology, materials, and substance. Seldom, however, we will think of the sea as space, despite the fact that it has all the aforementioned characteristics: it covers a certain area, it has specific features and serves different operations. For Mediterranean countries like Greece, the sea has always been a core element of their identity in both geographical and cultural terms. Throughout history, the sea served as a means to boost their economies through trade and other maritime activities and their culture through interaction with other cultures and civilizations. Nowadays, the sea is set to play yet another important role in terms of renewable energy exploitation and energy self-sufficiency. One can therefore easily understand how important this space is. However, the sea's significance in these aspects has not been fully fathomed yet, nor is it considered as a space that needs to follow specific rules for its "healthy" development. This paper tries to identify how the introduction of Blue Energy can function as a driving force for the conceptualization of the Mediterranean Sea as space and, subsequently, for its regulation. Furthermore, it is presenting the opportunities that Blue Energy technologies can bring to Greece and to any Mediterranean country for a prosperous, environmentally friendly and sustainable future.

Keywords: Blue Energy, Blue Energy technologies, Blue Growth, Maritime Spatial Planning, maritime activities

INTRODUCTION

The Mediterranean Sea covers an area of approximately 2.5 million km^2. Its 46,000 km long coastline is divided between 22 countries with a combined population of more than 460 million. One third of this population resides in coastal areas and has become increasingly urban over the last few decades (UNEP/MAP, 2012). The densely inhabited region has been the field of intense human activity for millennia and it remains so. The economies of the surrounding countries are heavily dependent on the sea. Fisheries and aquaculture in the Mediterranean generate a Gross Value Added (GVA) of more than 4 billion euros and almost 353,000 jobs; maritime transport has a

GVA of 27 billion euros, while 550,000 people are directly employed in the sector (Plan Bleu, 2014). Finally, with the Mediterranean being the world's leading tourist destination, attracting one third of International Tourist Arrivals worldwide and almost half of which in coastal zones, it's hardly surprising that coastal tourism is generating a GVA of 135 billion euros and offering employment to 3.2 million people (Plan Bleu, 2014). By being an extremely busy sea, the Mediterranean is inevitably subject to constant environmental and economic pressures, which are expected to intensify in the future. The population of Mediterranean countries is projected to rise to 529 million by 2025 (UNEP/MAP, 2012), while almost all maritime activities are expected to continue to develop resulting in increased conflict for space and resources (Randone, 2017).

Blue Energy, which includes the well-established offshore wind, as well as nascent technologies such as wave, tidal, current, ocean thermal, osmotic power, and biomass production from algae, is an emerging maritime activity, which the EU has set as an additional pathway to achieve its energy and climate change goals. Given the emphasis placed by the EU on renewable energy, it is safe to assume that Blue Energy will develop into an important industry and will therefore lay significant spatial claims into the sea in the near future. This will add to the pressures of already established maritime activities such as tourism, fisheries and aquaculture, maritime transport, etc., whose cumulative impacts are becoming increasingly hard to accommodate under the current regime of sectoral management. However, the highly spatial character of industries like Blue Energy facilitates the shift to more spatial approaches of regulation, like Maritime Spatial Planning (MSP). According to Stephen Jay, with some of the marine activities becoming site-specific, as they need fixed structures, "some marine areas are becoming more clearly defined for specific uses and are being more widely conquered for development—and therefore for planning also" (Jay, 2010a). In essence, Blue Energy can assist in the conceptualization of the Mediterranean as a space that needs a coherent vision for the future, by functioning as a driving force for the adoption of a spatial regulation approach. This in turn will allow Mediterranean countries to reap the multiple benefits from the sustainable development of Blue Energy.

BLUE ENERGY PROSPECTS IN THE EU

The EU has a strong track record of commitment to renewable energy. It has been almost a decade since Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 "on the promotion of the use of energy from renewable sources" (also known as the Renewable Energy Directive) entered into force, setting for the first time and for each member state a binding national target for the share of energy from renewable sources in gross final consumption of energy for 2020. Ranging from 10% for Malta to 49% for Sweden (Annex I), these national targets are consistent with a target of a 20% share of energy from renewable sources in the EU gross final consumption of energy in the same year. Furthermore, the Directive requires that the share of energy from renewable sources in all forms of transport in 2020 is at least 10% of the final consumption of energy in transport. In accordance with Article 4 of the Directive, each member state has compiled and adopted a national renewable energy action plan in order to achieve their respective national obligations.

The EU has taken further steps since then, toward combating climate change and transitioning to a low carbon economy. One of the ten priorities of the EU Commission under President Jean-Claude Juncker, who assumed office in 2014, is "a resilient energy union with a forward looking climate change policy." Indeed, in the 2015 United Nations Climate Change Conference that took place in Paris, EU committed to a binding target of an at least 40% domestic reduction in greenhouse gas emissions by 2030. Within the same context, a "Clean Energy for All Europeans" package consisting of 8 proposed legislative acts, was published by the European Commission on 30 November 2016 (European Commission, 2016). Political agreement has recently been achieved on four of them, including, the Regulation on the Governance of the Energy Union (European Commission, 2018d), the revision of the Energy Efficiency Directive with an energy efficiency target for the EU for 2030 of 32.5% with an upwards revision clause by 2023 (European Commission, 2018a) and the revision of the Renewable Energy Directive with a binding renewable energy target for the EU for 2030 of 32% with an upwards revision clause by 2023 (European Commission, 2018b).

Blue Energy can contribute in meeting the aforementioned targets, while generating economic growth and jobs. According to a recently published EU Commission study, approximately 3 billion euros were invested in ocean energy alone over the last decade and up to 9.4 billion euros more could be invested by 2030, which would lead to a total of 3.9 GW cumulative installed capacity (European Commission, 2018c). The Ocean Energy Strategic Roadmap, produced by the Ocean Energy Forum and submitted to the European Commission in November 2016, estimates that under favorable conditions the installed capacity could reach 100 GW by 2050, thus covering 10% of the EU's power demand (Ocean Energy Forum, 2016). In terms of jobs creation, the sector already accounts for 2,000 high-skilled jobs, primarily in research and development, and according to Ocean Energy Europe it could see up to 20,000 more by 2035 (European Ocean Energy Association, 2013). In short, Blue Energy technologies have the potential of gradually developing into a thriving new industry for the EU and, as such, into a driving force for the regulation of marine space.

BLUE ENERGY AND THE REGULATION OF MARINE SPACE

As a new type of use in the Mediterranean, Blue Energy has to overcome several barriers to realize its full potential. First and foremost, it has to find the space necessary to develop among existing and well-established activities like maritime transport and fisheries. This will surely lead to competition with other

Abbreviations: EU, European Union; GVA, Gross Value Added; MSP, Maritime Spatial Planning; SEM, Southern and Eastern Mediterranean; SMEs, Small and Medium-sized Enterprises.

users of the marine environment, especially given the fact that Blue Energy installations are fixed structures, which inevitably gives them priority over other uses in the space allocated for their deployment. Furthermore, any Blue Energy installation will likely have to face the concern of stakeholders involved in coastal industries that could find themselves affected by it, like tourism. Finally, it has to deal with the uncertainty caused by the current *ad hoc* and sectoral management of maritime activities, which in turn might increase costs and risks of potential investors (Young, 2015). By introducing a coherent vision for the future, Maritime Spatial Planning (MSP) can create the space necessary for the development of Blue Energy in the Mediterranean. As Jay points out while discussing offshore wind, MSP opens up the possibility of well-established activities making space for wind energy—a development less likely to occur under sectoral regimes of regulations—and as a politically—determined process it allows for the prioritization of the latter over the former (Jay, 2010b). This observation can be extended to all types of Blue Energy. Furthermore, MSP will limit competition for space by creating synergies between Blue Energy and other uses, it will increase the level of certainty for investors and thereby, it will reduce costs (European Commission, 2015).

For all the above reasons, the need to develop Blue Energy is functioning as an important driver for the application of MSP (Douvere and Ehler, 2008; Young, 2015). Indeed, the importance of Blue Energy as a driving force for the planning and regulation of marine space is acknowledged in the preamble of Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for Maritime Spatial Planning: "The high and rapidly increasing demand for maritime space for different purposes, such as installations for the production of energy from renewable sources, (…) require an integrated planning and management approach." According to Article 5, member states shall aim through their maritime spatial plans "to contribute to the sustainable development of energy sectors at sea, of maritime transport, and of the fisheries and aquaculture sectors," while taking measures to protect and improve the environment and combat climate change.

The Directive indicates that all coastal member states had to designate the competent authority or authorities for the implementation of the Directive and transpose the latter into national legislation by 18 September 2016. MSP should be implemented and respective maritime spatial plans established as soon as possible and by 31 March 2021 at the latest. The majority of Mediterranean EU member states have indeed completed the transposition process, but have not yet developed legally binding plans. Therefore, maritime activities are still managed on a sectoral basis and, in the case of Blue Energy, sometimes even this is lacking. In Greece, for instance, there is no specific legislation or rules for Blue Energy. As is the case with most Mediterranean EU member states, there is legislation pertinent to renewable energy in general, but for the time being it doesn't include any provisions regarding Blue Energy. The adoption of the first maritime spatial plans by 2021 will hopefully open the way for Blue Energy ventures and allow Mediterranean EU member states to benefit from the opportunities that Blue Energy presents.

OPPORTUNITIES FROM BLUE ENERGY AND THE CORRESPONDING TECHNOLOGIES

The more methodical and meticulous maritime legislation and the various Blue Energy technologies that have been implemented more systematically in the northern countries of the EU, already provided evidence of their great benefits, both in terms of energy preservation and economic growth. Countries like Sweden, where national MSP has been in place since September 2014 (NorthSEE, 2018) together with a National Maritime Strategy and the corresponding environmental legislation, have succeeded in the correct and successful use of Blue Energy. Producing the energy by various Blue Energy plants which at the same time created new areas of expertise and research for their Small and Medium-sized Enterprises (SMEs), while leading the country to further economic prosperity, energy self-sufficiency and CO_2 emissions reduction.

The example of Sweden, describes in fact, the two basic opportunities or benefits that the use of Blue Energy technologies can offer to the Mediterranean and European countries in general. On one hand, it is all the advantages that the use of Renewable Energy Sources can address: environmentally friendly energy production, minimization of CO_2 emissions, energy self-sufficiency, boost of economy by eliminating expenses spent for the purchase of typical and gradually depleting sources of energy. On the other hand, it is the establishment of new job opportunities and fields for Research and Development in the Blue sector. To this adds, the new inventions and final products related to Blue Energy products that are created by Start-Ups, SMEs etc. and are introduced into the market. Given the fact that Blue Energy is still at an infant stage for the Mediterranean, the opportunities for development in various sectors related to Blue Energy are high. The possibilities of evolving Blue Energy production through viable economical implementations of all technologies become more and more realistic, even more so that all the Blue Energy technologies, beyond the already commercially and economically deployable technology of offshore wind (Union for the Mediterranean Secretariat, 2017), are developing rapidly in terms of commercialization.

However, in the case of Mediterranean and possibly in comparison to the North and Baltic Seas, the production of Blue Energy and the installations of the corresponding technologies, need to be performed in connection with, in respect to and in parallel with the rest of maritime activities, e.g., coastal tourism, as suggested in various points throughout the reports of DG MARE on the "Blue Growth potential in the Mediterranean and the Black Sea." A study for maritime economic activities conducted for the Mediterranean countries and in particular for Albania, Bosnia and Herzegovina, Croatia, Cyprus, France, Greece, Italy, Montenegro, Malta, Slovenia, Spain, and Turkey in 2010, has shown that the total GVA generated by all 12 countries exceeded the 63 billion EUR, which is more than three times the total GVA generated by all maritime economic activities in the Baltic Sea. Additionally, three of the aforementioned countries—Italy, Greece and Spain—represented the 81% of this activity" (European Commission- EUNETMAR, 2014a).

The high value figures obtained by the study, clearly state the importance of maritime activities to the economy of the said countries. At the same time they lead to the conclusion that any decision related to Blue Energy installations for the Mediterranean, needs to be taken under careful consideration considering that they might affect the rest of maritime activities. Especially in the case of the coastal areas of certain countries such as Italy, Spain, Turkey, Greece and France where most of the maritime activities take place (e.g., tourism), analysis has shown the large economic importance of the specific areas, by exhibiting a GVA of over EUR 150 billion (European Commission- EUNETMAR, 2014a). This demonstrates that the economy of these countries depends highly on their coastal activities and any choice of alteration or addition in the activities of the area, need to safeguard the existing operations or even further promote the economic growth.

Especially for Greece, having the second largest coastal zone in the EU (within a range of 10 km from the coast) covering 49.442 km^2 (13.3% of the EUs coastal area) and an extensive coastline of 15.021 km (representing 11% of the total EU-22), all the aforementioned seem to have a higher importance. Greece is characterized by a high degree of insularity, composed of an estimated number of more than 6,000 islands and islets (European Commission, 2014). Reports from EU and DG MARE in 2012 about the socio-economic features prove that the GVA of the coastal area is EUR 181.8 billion, in other words the 93.1% of country's total, while the people employed in coastal areas reach the 91.3% of country total. The same report mentions that "the large dependence on maritime activities of Greece is due to the fact that the main economic areas are coastal." The 7 largest marine and maritime activities as identified in this report for Greece are: Coastal tourism, Deep Sea and Short Sea Shipping, Fishing for human consumption, Passenger ferry services, Cruise tourism, Yachting and marinas (European Commission- EUNETMAR, 2014b). Therefore, any implementations of Blue Energy should be done with precaution. The positive however in this case is that for most of these activities, any installations of Blue Energy can work as a helping hand to the development and growth of the sector.

Being a popular touristic destination, Greece receives annually a large number of visitors especially during summer. In the case of some islands and in certain periods, this number can reach almost twice or triple as the number of the local inhabitants, multiplying the energy demands. This creates a periodical load or peak points on the grid that can cause instability of the power supply and can lead even to the failure of the energy operation system. Given the fact that the islands in their majority, if not all, have on site energy production of certain capacity, the environmental, economic and social impact in such periods of overload can be quite high. Blue Energy installations can address this problem and can provide the islands with an environmental solution, by procuring self-sufficiency for the islands in terms of energy throughout the whole year. By selecting a combination of 2 or 3 different types of Blue Energy technologies that could supplement each other during their operation, according to the local characteristics and energy potential of the sea, these installations could achieve the minimization of the CO_2 emissions while relieving the islands' economy and the satisfactory supply of energy to cover the demands. At the same time, these installations could go beyond their primary usage and become a touristic attraction to a certain public interest in ecotourism while combined with activities, such as diving. With a proper design of the Blue Energy installation e.g., in their foundations to facilitate the biodiversity and the fish inhabitation, like in an artificial reef, these technologies can introduce an innovative way, not only to succeed in the production of clean energy and to create places of interest for "new tourist flows" (European Commission, 2014), but as well to promote the continuous enrichment and development of aquatic life, since fishing boats are not allowed to approach the areas around the installations for safety reasons.

CONCLUSION

All the aforementioned applications of Blue Energy, its technologies and the possible corresponding areas of research, are not only applicable for Greece; they could be of use in any of the Mediterranean countries. Besides, the described combinations of Blue Energy installations with the maritime activities are not restricted to the ones described above. In general any maritime activity that demands energy can be directly connected with Blue Energy technologies. And all these manifest the big opportunities that those technologies can bring to Greece and to every Mediterranean country. What is, however, needed in all cases and before planning any viable scenario for Blue Energy implantation, is an in depth analysis of the country's seas energy potential, together with the various environmental parameters and the analysis of the local maritime activities. For the case of Greece, for example, in the search of appropriate areas for the implementation of such technologies, an analysis has to be performed while taking into consideration, beyond the energy potential of the seas: (a) the transport from the mainland to the islands and from island to island for touristic or trade purposes which form a complicated maritime traffic pattern, (b) all the environmentally protected areas, (c) the shipwrecks, (d) the sea bathymetry, (e) touristic destinations, (f) optical disturbance, etc. The result of such an analysis and for the case of Greece has shown that smaller in size installations but more in quantity could be the key for reaching the full capacity of the Greek Blue Energy Potential (MAESTRALE, 2018). However, it should not be overseen that an important factor for the realization of any Blue Energy scenario is the existence of a detailed and clear supporting legislation and MSP. Otherwise none of the intended implementations, no matter how promising, can come into feasible realization. Similar problems, like the ones that evolved during the green growth and green energy production, such as for example public protests against installations of wind turbines, will once again appear causing the same negative chain reactions. When the scenarios can be clearly defined, simultaneously and diligently organized at a legal, environmental, economic and social level, only then the Blue Energy technologies can reach their full potentials. Under well-balanced decisions, Blue Energy concept and technologies could bloom to their full growth and offer to Greece and to every Mediterranean country a prosperous, environmentally friendly and sustainable future.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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