Recommendations to enhance Offshore Wind Energy in the Mediterranean Sea

Policy brief

Introduction

The world continues to advance towards sustainable energy targets – but not fast enough. The 2030 Agenda for Sustainable Development adopted by all United Nations Member States in 2015 includes the Sustainable Development Goal (SDG) 17 of "affordable and clean energy". To ensure access to energy for all by 2030, policy actions must be taken to accelerate electrification, increase investments in renewable energy, improve energy efficiency and develop enabling regulatory frameworks[1].

Offshore Wind Energy (OWE) is currently the only marine renewable technology widely deployed commercially in Europe. At the end of 2022, European sea basins were hosting around 50% of the world's total installed capacity. The need for alternative energy systems like OWE to move towards the Green Deal objectives is undeniable[2]. The targets set at least 60GW of installed offshore wind and 1GW of installed ocean energy in 2030; and 300GW of installed offshore wind and 40GW of ocean energy in 2050. This requires an approximate 30-fold increase in Marine Renewable Energy (MRE) capacity by 2050, broken down into a 25-fold increase in wind energy capacity, and over 3000-fold increase in ocean energy capacity. In fact, the ambition of the EU Members States, stated in the National Energy and Climate Plans, is to achieve 111 GW of offshore renewables by 2030 which is nearly twice as high as the ambition set out by the European Commission[3][4].

The 'Energy Transition Scenario to 2040' formulated by the Mediterranean Energy Observatory, has suggested that renewable energy uptake in the region will triple its current performance by 2040, hence reaching about 27% of overall energy consumption. In this scenario, which assesses all types of renewable sources, the majority of the increase is expected to be delivered by wind and solar[5].
The Mediterranean Sea is characterized by high wind potential, but its deep waters have so far limited the development of OWE – which presents an opportunity for floating offshore wind. Wind capacity could reach up to 12GW by 2030 and close to 40GW by 2050 for the Mediterranean EU countries[6].
OWE will play a critical role in decarbonizing the Mediterranean's energy infrastructure. Nevertheless, the investment risk associated with OWE remains higher than that of onshore wind or solar photovoltaics[7]. Offshore wind supply is facing challenges across several fronts, including increasing raw material prices, supply chain bottlenecks, technological issues, environmental impacts, interference with other marine activities, uncertainties in the licencing process, lack of a regulatory framework and limited social acceptance, among others. Policies will be critical in navigating the current investment risks and ensuring OWE rollout remains on track.

Plan Bleu is a Regional Activity Centre of the Mediterranean Action Plan (MAP) of United Nations Environment Programme (UNEP) responsible for monitoring the implementation of the Mediterranean Strategy for Sustainable Development and the development of blue economy, including OWE, in the Mediterranean Sea basin.

1 United Nations (2023) The Sustainable Development Goals Report. Special edition.
2 The European Green Deal. More information at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
3 Soukissian et al. (2023) Future Science Brief No. 9 of the European Marine Board: European offshore renewable energy: Towards a sustainable future.
4 European Commission (2023) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, "Delivering on the EU offshore renewable energy ambitions", COM (2023) 668 final, from 24 October 2023
5 MEDENER (2016) Executive Summary: Mediterranean Energy Transition: 2040 Scenario.
6 UfM (2021) Towards a Sustainable Blue Economy in the Mediterranean región. 2021 Edition.
7 Dukan et al. (2023) The role of policies in reducing the cost of capital for offshore wind iScience, 26.

Fig.1 *Renewable Marine Energies Offshore Wind Turbines*
Credit : ShutterStock

Overview of Marine Renewable Energy in the Mediterranean, with a special focus on Offshore Wind

Several countries in the Mediterranean region have demonstrated **significant advancements in the development of MRE** in recent years. More specifically, the analysis of various national plans indicates that the focus of **offshore wind development in the Mediterranean will predominantly centre on floating offshore wind.** This emphasis is driven by the predominant deep waters in the Mediterranean, unlike the North Sea, where shallow waters permit the use of bottom-fixed offshore wind technologies. An offshore grid potential assessment encompassing EU member states such as Croatia, Cyprus, France, Greece, Italy, Malta, Portugal, Slovenia and Spain underscored that floating offshore wind exhibits the highest technical potential. In contrast, the technical potential for **bottom-fixed offshore wind is constrained due to water depth limitations. Wave energy presents a comparable potential to floating offshore wind.** However, wave energy presents **higher costs** and the technology requires further development. In comparison to wind and wave, **tidal energy's technical potential in the Mediterranean is notably limited**[8]**.**

Moreover, a recent study examining wind resources, ocean depth, and environmental restrictions in the whole Mediterranean region identified **Greece and Italy, as well as Libya and Tunisia, as being best suited for the deployment of offshore wind energy**[9]**.** The floating/bottom-fixed potential capacities of Libya and Tunisia are projected by the African Development Bank to be 287/52 GW and 169/90 GW, respectively[10].

The **availability of grid interconnection** to export the electricity generated and the presence of **suitable harbour facilities** that may also integrate the **infrastructure needed** to produce and store hydrogen using the electricity generated by offshore wind farms, are important considerations for the large-scale deployment of offshore wind in the Mediterranean[11].

As of early 2024, Taranto, **Italy** is home of the **first operational 30 MW offshore wind farm in the Mediterranean**[12]. In 2023, the European Investment Bank, with the support of the European Commission, co-financed three **offshore wind farms deployed in France** for a total of 210M€. It consists of 3 wind turbines of 8.4 MW located 17 km from the Gulf of Fos-sur-Mer and providing electricity for 45.000 inhabitants[13]. Moreover, the shores of the northern Mediterranean countries are home to more than fifty planned and ongoing commercial offshore wind projects, as well as open sea test locations[14] [15]. Some of these initiatives integrate **hydrogen production**[16]. Notably, **Spain** unveiled a comprehensive roadmap for

8 K. Staschus et al., (2020) Study on the offshore grid potential in the Mediterranean region.
9 D. Pantusa and G. R. Tomasicchio, (2019). Large-scale offshore wind production in the Mediterranean Sea
10 African Development Bank (2021). Assessing the potential of Offshore Renewable Energy in Africa.
11 Wind Europe (2021) A 2030 Vision for European Offshore Wind Ports.
12 A. Buljan (2022) "First Mediterranean Offshore Wind Farm Up and Running in Italy," OffshoreWIND.biz.
13 European Investment Bank (2022). Press release: 'France: The EIB, with the support of the European Commission, is co-financing three floating offshore wind farms for a total of €210 million'.
14 European Commission (2021) Locations of wind farms.
15 European Investment Bank (2022) Eolmed Floating Offshore (Port-La-Nouvelle)
16 A. Memija (2022) "Aquaterra, Seawind working on 1 GW offshore floating wind-to-hydrogen project," Offshore Energy.

the development of offshore wind and marine energy in 2022. The objective of this initiative is to achieve 3 GW of floating wind and 60 MW of marine energy capacity by 2030. To support research and innovation, as well as the testing of offshore projects, Spain has allocated €200 million in grant funding[17 18].

Progress is also achieved in eastern and southern Mediterranean regions by carrying out pre-development initiatives. For instance, in **Tunisia**, feasibility studies for offshore wind projects that incorporate energy storage in two coastal zones are being funded by the Africa Energy Transition Catalyst Programme[19]. Furthermore, countries such as Greece and Türkiye have identified suitable locations for the development of OWE, while others like Algeria and Lebanon have commenced wind resource assessments as an initial step.

Regarding the MRE technologies, **floating offshore wind turbines are in the pre-commercial stage**, whereas **bottom-fixed offshore wind turbines are currently operating commercially.** Technologies related to **wave and tidal energy are now undergoing prototype testing** and pilot project demonstration phases[20]. Specifically on **floating offshore wind**, there are at present two platform technologies deployed at European continental waters at pilot farm stage: Equinor's Hywind Spar, installed in 2017 in the United Kingdom; and Principle Power's WindFloat, deployed in Portugal and United Kingdom in 2019 and 2021 respectively. There are currently 20 floating offshore wind platform designs tested at sea and over 80 platforms at earlier stages of development. Some examples of floating offshore wind technologies being demonstrated are Eolink, SATH, TetraSpar and Floating Power Plant. The latest is an interesting hybrid platform that combines wave and wind energy generation[21].There have been several **deployments of wave energy technologies in the Mediterranean** in the past few years, including, for example, 2022 Sigma Energy's 30kW device deployment in the Adriatic Sea in Slovenia, and Eco Wave Power 100 kW pilot project at the Port of Jaffa in Tel Aviv, Israel, connected to the grid in 2023[22]. For **tidal energy and ocean currents**, ADAG and SeaPower are working towards the installation of a 300 kW in the Strait of Messina in Italy[23].

After fundamental and technological research linked to the development of prototypes, **sea trials play a major role in experimental development.** Spain is the European Union country with the highest number of R&D&I facilities for marine energy with three open sea test centres (BIMEP, PLOCAN, Punta Langosteira Test Site). Additionally, Spain is in the process of identification of new testing sites that can foster the sector's development, especially around the islands' waters and deep waters[24]. However, none of them are located in the Mediterranean side. France will host soon the European's largest offshore testing facility dedicated to floating offshore wind turbines and marine energies, through the recently created Fondation OPEN-C. Five offshore sites will be designed to test the most innovative prototypes, including one in the Mediterranean off the coast of Port-Saint-Louis-du-Rhône, which is currently in the construction phase[25].

In terms of upcoming projects development, the company Renexia is projecting now the Med Wind project located in the Strait of Sicily, which consists of 190 floating turbines with an installed capacity of 2.8 GW and an estimated annual production of almost 9TWh[26]. Similarly, France has taken concrete steps by identifying the locations for two 250 MW floating wind projects. These projects will be subject to a competitive bidding process, with commissioning for 2031[27].

Mediterranean Policy Framework to further Develop the Marine Renewable Energy in the region, with a special focus on Offshore Wind

Policy for marine renewable technology in the **European Union is driven by the European Green Deal and its objective to reach carbon neutrality by 2050**. The **Offshore Renewable Energy Strategy**[28], which is part of the Green Deal, outlines what the EU considers to be realistic and achievable objectives to contribute to its climate neutrality vision.

In addition, the European Union has several policy instruments that specifically concern the impact of human activities on the state of coastal and marine environments, and thus, are particularly related to the development of MRE, such as the Birds Directive

17 IEA-OES (2023) Annual Report: An Overview of Ocean Energy Activities in 2022.
18 A. Garanovic (2022) "Spain adopts regulatory framework for €200M grant program for marine renewables," Offshore Energy.
19 African Development Bank (2023) "African Development Bank's SEFA provides $7.88 million grant for African Just Energy Transition programme".
20 Ibid., p.1
21 E. C. Edwards, et al., (2023) Evolution of floating offshore wind platforms: A review of at-sea devices.
22 Ocean Energy Europe (2023) Ocean Energy : Key Trends and Statistics 2022.
23 Ibid., p.2
24 Ministry for Ecological Transition and the Demographic Challenge (2022). Roadmap for the development of offshore wind and marine energy in Spain.
25 More information about the Fondation OPEN-C: https://fondation-open-c.org/
26 More information at: https://medwind.it/en/med-wind-park/
27 A. Memija (2023) "France Pinpoints Location of Floating Offshore Wind Farms in the Mediterranean Sea," OffshoreWIND.biz.
28 European Commission (2020). Communication from the Commission: Strategy to harness the potential of offshore renewable energy for a climate neutral future. COM/2020/741 final

(1979), the Habitats Directive (1992), the Water Framework Directive (2000), the European Strategic Energy Technology Plan (SET Plan) (2007), the Marine Strategy Framework Directive (2008), the Marine Spatial Planning Directive (2014), the Common Fisheries Policy (2014) and the Nature Restoration Law (2022).

At the **Mediterranean level**, the **Barcelona Convention and its seven Protocols adopted in the framework of the Mediterranean Action Plan (MAP)** constitute the main legally binding Multilateral Environmental Agreement in the region. Under the Barcelona Convention, the Naples Ministerial Declaration was signed by the Contracting Parties in 2019[29], who committed to 'ensuring sustainable and integrated uses of marine and coastal areas and resources, as well as circular economy and innovative tourism products and services, sharing experiences and information at all levels between institutions and projects **including marine renewable energies'.**

In particular, the **'Integrated Coastal Zone Management in the Mediterranean'**[30] protocol is a reference for **'energy facilities'** and where Parties agree on minimising the potential negative impact on coastal ecosystems, landscapes and geomorphology or, where appropriate, compensating by non-financial measures.

Additionally, the **Mediterranean Strategy for Sustainable Development (2016-2025)**[31] provides an integrative policy framework for all stakeholders, including MAP partners, to translate the 2030 Agenda for Sustainable Development and the SDGs at the regional, sub-regional, national and local levels in the Mediterranean region. Blue Economy is included as a key means to achieve development in the region.

The **Union for the Mediterranean (UfM)** is an intergovernmental institution **bringing together 42 countries of the Mediterranean region to promote dialogue and cooperation.** Under the **UfM Working Group on Sustainable Blue Economy**, the Ministers recognised in 2021[32] that **MRE plays a crucial role to reach the reduction targets in greenhouse gas emissions and to tackle climate change.**

In addition, they could have a positive impact on the sustainable development of the economies of the coastal areas and islands.

Under the **WestMED Initiative for the Sustainable Development of Blue Economy in the Western Mediterranean,** funded by the European Commission, the Members States also recognised the **importance of MRE,** as an emerging maritime sector in the Mediterranean[33], and the associated added value towards meeting the reduction targets in greenhouse gas emissions to address climate change, fostering job creation and unlocking entrepreneurial opportunities. This has been especially highlighted under the recently adopted WestMED Ministerial Declaration[34].

At national level, governments have adopted a variety of approaches to support this development, including the establishment of national funding programs, formulation of new regulatory frameworks for permitting, the setting of deployment targets, the creation of test zones, and the implementation of marine spatial planning policies that include dedicated areas for marine energy. Plan Bleu has undertaken a study on the state-of-the-art of the national regulations plans and strategies for the development of OWE in the Mediterranean countries[35].

Some countries are leading ahead towards the development of policy frameworks to promote and regulate the development of MRE projects. **Spain** has approved the Roadmap for the Development of Offshore Wind and Marine Energy which focuses on OWE and aims to strengthen offshore testing platforms, deploying a "plug & play" enabling framework with the goal to be the most agile in Europe to test new prototypes[36]. Additionally, Spain approved a plan to upgrade the national electricity grid that will enable the integration of higher shares of renewable generation for the period 2021–2026[37]. In 2019, **France** established an innovative 'experimentation contract' for renewable energies, especially for MRE and OWE, which simplifies and accelerates the attribution of a feed-in tariff for small projects[38]. MRE are fully embedded in the French National Energy & Climate Plan (2023)[39] and in the French Blue Economy Strategy[40].

29 21st Meeting of the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols (Naples, 2019). Naples Ministerial Declaration
30 UNEP, Barcelona Convention. Integrated Coastal Zone Management in the Mediterranean Protocol.
31 Mediterranean Strategy for Sustainable Development (MSSD). More information at: https://www.unep.org/unepmap/what-we-do/mediterranean-strategy-sustainable-development-mssd
32 UfM (2021) UfM Ministerial Declaration on Sustainable Blue Economy.
33 WestMED (2018) Declaration of the Meeting of the Ministers of the Countries Participating in the Initiative for the Sustainable Development of the Blue Economy in the Western Mediterranean
34 WestMED (2023) WestMED Ministerial Declaration
35 Plan Bleu (2024). State of the Art of national regulations plans and strategies for the development of offshore wind power for the Mediterranean countries.
36 Ibid., p.3
37 Redeia (2022). Transmission Grid Development Plan 2021-2026.
38 Ibid., p.2
39 European Commission (2023) National Energy Climate Plan of France (Draft update – October 2023)
40 Secretariat général de la mer (2022) Les énergies marines renouvelables.

Italy is also an example of the inclusion of MRE in the national strategies, setting up a target of 900 MW of offshore wind power capacity by 2030[41] [42].

Southern and Eastern Mediterranean countries outside of EU **are at a comparative disadvantage regarding national policies for ocean energies** but some of the countries have already include them as a priority in the medium-long term plans. For example, Croatia[43], Greece[44], Malta[45], Tunisia[46] and Türkiye[47] lack specific targets for offshore renewable energy but have already identified suitable locations for the development of OWE. Other Mediterranean countries such as Albania[48], Algeria[49], Egypt[50], Israel[51], Lebanon[52] [53] and Morocco[54] have shown their interest for offshore wind and have initiated energy resource assessment as an initial step.

Policy Recommendations to Promote Marine Renewable energy, with a special focus on Offshore Wind, in the Present and Future context

In 2022, Plan Bleu identified key challenges hindering the development of OWE in the Mediterranean[55].This analysis, enriched by insights from a comprehensive literature review, categorizes obstacles and barriers into five dimensions: environmental, socio-political, policy framework and regulations, technology and infrastructure, and economic-financial.

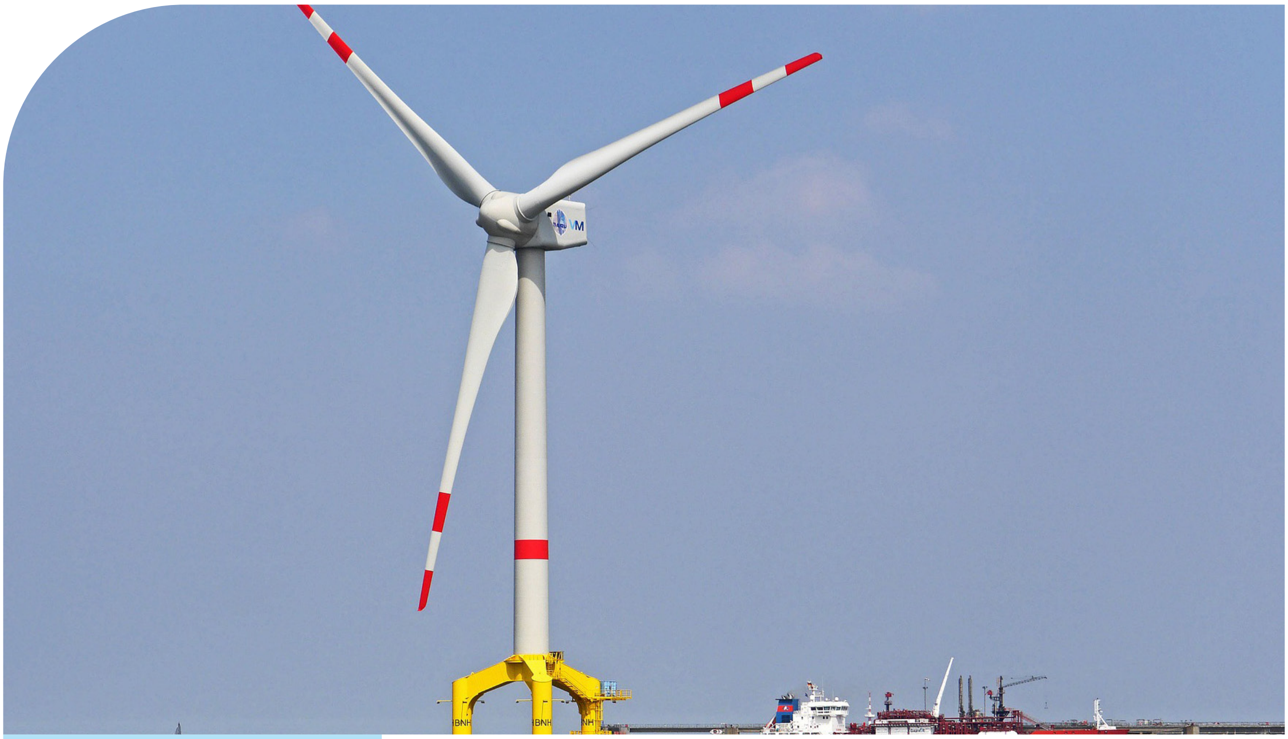

Fig.2 *Pinwheel*
Credit : PixaBay

41 Gazzetta Ufficiale (2023) Approvazione del Piano del mare per il triennio 2023-2025.
42 European Commission (2023) National Plan Integrated for Energy and Climate in Italy.
43 University of Zagreb (2023) Action plan for the uptake of offshore renewable energy sources in Croatia.
44 HEREMA (2023) Press release: The Draft National Programme for Offshore Wind Energy, unlocking a natural wealth for clean energy and billions of euros investments.
45 A. Buljan (2023) "Malta months away from first offshore wind tender, deems floating wind and solar best suited for EEZ areas," Offshore Energy.
46 Ibid., p. 4
47 Balkan Green Energy News (2023) Turkey selects its first offshore wind power zones.
48 Balkan Green Energy News (2022) Albania launches works on offshore wind project.
49 Mostafa Mahdy (2018) Multi criteria decision analysis for offshore wind energy potential in Egypt.
50 New & Renewable Energy Authority Egypt (2022) Annual Report
51 Planning Administration (2020) Maritime Policy for Israel's Mediterranean Waters.
52 UNDP (2013) The National Wind Atlas of Lebanon
53 Ibarra-Berastegi et al. (2019) Evaluation of Lebanon's Offshore-Wind-Energy Potential.
54 European Investment Bank (2022) Morocco: EIB supports Masen in assessing Morocco's offshore wind energy potential.
55 Plan Bleu (2022) Towards Sustainable Development of Marine Renewable Energies in the Mediterranean, Interreg MED Blue Growth Community project.

Challenges and barriers for the development of OWE
Environmental
• Lack of a comprehensive method to assess environmental impacts • Lack of collaboration among countries to measure cumulative effects • Lack of a harmonised environmental impact assessment requirement and procedure at regional level
Socio-Political
• Overcome conflicts among sea users (fishing, aquaculture, maritime transport, tourism, marine protected areas, etc) • Public acceptance and Not-In-My-Backyard (NIMBY) phenomenon • Insufficient cooperation among countries and stakeholders in the Mediterranean • Gaps in skills of the workforce and lack of attractiveness of maritime careers
Policy framework and regulations
• Lack of a specific regulatory framework for OWE and unclear national targets • Lack of international and common standards for offshore renewable energy • Overlapping of authorities' responsibilities and lack of centralised body for offshore renewable energy • Uncertainties and complexity in the consenting process
Technology and infrastructure
• Deficient grid integration, and port and energy storage infrastructures • Insufficient experience with OWE decommissioning • Limited number of offshore demonstration sites
Economic and financial
• Insufficiency of financial support at regional and national level • Attaining competitiveness and commercial viability

Environmental

Challenge: Lack of a comprehensive method to assess environmental impacts.

OWE in the Mediterranean Sea pose serious environmental risks to the seabed and the biodiversity due to the particular ecological and socioeconomic characteristics and vulnerability of this semi-enclosed sea. The potential impacts may include habitat loss and/or degradation, underwater noise, pollution, physical damage, displacement, collision, etc.

Marine protected areas (MPA) in the Mediterranean, often occupy sites exposed to harsh weather conditions and serve as effective buffers against human pressures, overlap of these MPA sites with the selection criteria for thus maintaining environmental integrity. Yet, the OWE projects, reliant on high wind resources, presents a challenge for large-scale OWE implementation in the region[56].

Monitoring of the potential environmental effects of human activities is required by environmental legislation across many countries and it is addressed at EU level in the amended Environmental Impact Assessment Directive of 2014[57].

The key environmental challenges observed in the Mediterranean are the lack of a comprehensive and harmonised method to assess the environmental impacts along with limited collaboration among countries to measure cumulative impacts.

56 Loret et al. (2022) Unravelling the ecological impacts of large-scale offshore wind farms in the Mediterranean Sea

57 European Commission (2014) Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

Recommended actions:

- **Improve cumulative impact assessments.** Develop and implement methodologies that evaluate the cumulative environmental impacts of human activities, including OWE, on marine ecosystems. This approach should transition from reductionist (single-impact) assessments to holistic analyses that consider all human activities as an interconnected whole.
- **Enhance collaborative monitoring.** Establish collaborative frameworks for monitoring basin-wide cumulative effects, involving cross-border cooperation among scientists, policymakers, and administrators. This necessitates the creation of regional and transboundary data-sharing platforms (e.g., EMODnet[58]) and the utilization of Virtual Research Environments and Big Data analytics to synthesize and analyse environmental data comprehensively[59].
- **Adopt Ecosystem-based Maritime Spatial Planning.** Integrate ecosystem-based management (EBM) principles into maritime spatial planning (MSP) and adaptive project management to identify optimal sites for OWE installations and cable routes. This strategy aims to minimize impacts on marine habitats and benthic communities by making informed, environmentally sensitive site selection decisions[60].
- **Harmonise Environmental Impact assessment (EIA) procedures.** Work towards the harmonization of EIA requirements and procedures at least at a regional level. Establishing a common database for potential impacts, mitigation measures, and relevant parameters specific to MRE technologies will streamline the environmental assessment process, reduce project delays, and lower risks for investors[61].
- **Apply the Precautionary Principle.** Policy makers should apply the Precautionary Principle to maintain the collective impact of all marine activities at levels that ensure the preservation of marine ecosystems. This involves preventive decision-making in the face of risk and conducting independent environmental, social, and economic impact assessments for OWE projects, including considerations of seascape and cultural impacts, from pre-construction through to decommissioning[62].
- **Utilize sensitivity mapping.** Leverage sensitivity mapping as a tool to guide early decision-making in OWE planning. By identifying areas of ecological sensitivity, developers and regulators can avoid regions where negative impacts on the marine environment are most likely, thereby reducing investment risks and promoting sustainable development practices[63]. Spain and France have already elaborated sensitivity maps to identify suitable MRE deployment areas, balancing economic interests with environmental protection[64] [65].

Socio-political

Challenge: Overcome conflicts among sea users through Maritime Spatial Planning (MSP)

The use of marine energy will result in an increasing use of sea space. Potential conflicts between marine energies and other sectors (e.g. coastal tourism, fisheries and aquaculture, MPAs and issues on how to regulate these interactions while ensuring environmental sustainability are significant challenges.

Recommended actions:

- **Implement comprehensive MSP:** Adopt MSP as a strategic framework to harmonize the integration of OWE projects with existing sea uses, such as coastal tourism, fisheries, aquaculture, and Marine Protected Areas (MPAs). MSP should aim to balance sectoral interests with environmental sustainability.
- **Facilitate transparent communication:** Use MSP processes to ensure transparent and clear communication regarding the planning, development, and visual impact of OWE projects. This transparency will help in managing stakeholders' expectations and concerns.
- **Encourage co-location of marine activities:** Promote the co-location of OWE with other sea uses (such as tourism, aquaculture, etc.) where feasible, to optimize the use of maritime space. For example, in Belgium, Germany and UK, there are boat tours to visit the wind farms, respecting the 500 m safety zone[66]. The hybrid exploitation of offshore wind

58 European Marine Observation and Data Network (EMODnet). More information at: https://emodnet.ec.europa.eu/en
59 Ibid., p.1
60 Plan Bleu (2021) Using Ecological Sensitivity to guide Marine Renewable Energy Potentials in the Mediterranean region.
61 IRENA (2021) Offshore renewables: An action agenda for deployment, International Renewable Energy Agency, Abu Dhabi.
62 Ibid., p.6
63 WWF-France (2019) Safeguarding marine protected areas in the growing Mediterranean blue economy.
Recommendations for the offshore wind energy sector. PHAROS4MPAs project.
64 MITECO (2023) Plan de Ordenación del Espacio Marítimo, (Spain)
65 Mer Littoral (2030) Plan d'action du DSF de Méditerranée, (France)
66 Schultz-Zehden A. et al., (2018) Ocean Multi-use Action Plan.

and solar energy in the Mediterranean Sea seems promising, particularly in the Aegean and Alboran Seas [67].

- **Expand cross-border MSP cooperation:** Foster cross-border collaboration to ensure that MSP plans are coherent and coordinated across the Mediterranean. This includes leveraging existing policy frameworks and initiatives, such as the EU MSP Directive, and engaging in regional and sub-regional partnerships like the MED-MSP-CoP[68].

Challenge: Public acceptance

The planning and development of OWE projects often overlook the requirement to assess socioeconomic impacts, with the EIA process only partially addressing this, depending on the project's nature and location. Additionally, public acceptance issues can hinder the authorization and commercial development of OWE projects. Local resistance, notably observed along the Italian Adriatic shores and the Catalan coast in the Gulf of Lion, stems from the Not-In-My-Backyard (NIMBY) phenomenon, where individuals support renewable projects in principle but oppose them when proposed within their own communities. A survey across 12 Mediterranean sites found that while marine renewable energy remains relatively unknown (42% awareness), 70% expressed willingness to host installations in their areas[69].

Recommended actions:

- **Integrate socioeconomic impacts in Environmental Impact Assessments:** Ensure socioeconomic factors are considered at all stages of OWE project development, as part of the EIA process. This holistic approach should account for both the environmental and socioeconomic impacts, enhancing the project's acceptance and sustainability.
- **Promote local employment and engagement:** Governments and developers should implement policies that prioritize local employment opportunities and engage local businesses in OWE projects. Drawing inspiration from the UK's approach, gradually increasing the proportion of 'local content' in offshore wind farms can foster community support and economic growth[70].
- **Conduct impartial and inclusive socioeconomic surveys:** At the planning stage, carry out socioeconomic valuation surveys conducted by impartial, academic researchers and addressed to all stakeholders and general public. These surveys should include explicit plans for follow-up monitoring. Portugal, through the survey on the Marine Renewable Energy Allocation Plan, is an example of involvement of key actors in the decision-making process[71].
- **Establish community benefit schemes:** Create frameworks for community benefits that allow local communities to share in the economic benefits derived from OWE projects. This could include job creation, contributions to local organizations, environmental and cultural improvements, educational support, and local electricity discounts, as exemplified by the Carbon Trust's recommendations in the UK[72].

Challenge: Insufficient cooperation among countries and stakeholders in the Mediterranean

In the MRE sector, nations are embarking on collaborative ventures through joint initiatives to avoid conflicts, shift the focus from national borders to shared basins, and leverage cooperation platforms for knowledge and insight exchange. Regional cooperation is essential for achieving offshore objectives. Within the EU, Member States have committed to enhancing political cooperation and promoting cross-border MRE projects[73]. However, in the Mediterranean, existing regional cooperation frameworks lack the dynamism and coherence required to match the pace of innovation in the Blue Economy sectors[74] [75].

Recommended actions:

- **Enhance cooperation among countries:** collaboration among countries will facilitate the exchange of lessons learnt, promote pioneering innovations and advocate for policymakers. For instance, through the North Seas Energy Cooperation (NSEC), nine countries together with the European Commission, signed a 2023 declaration to enhance energy cooperation to develop interconnections and build subsea cables

67 Soukissian, Takvor H., & Karathanasi, F. E. (2021) Joint Modelling of Wave Energy Flux and Wave Direction. Processes.
68 Community of Practice on MSP in the Mediterranean Sea. More information at: https://westmed-initiative.ec.europa.eu/maritime-spatial-planning/
69 Betti G et al. (2022) Perceptions and attitudes toward blue energy and technologies in the Mediterranean area.
70 The Carbon Trust (2020) Harnessing our potential: Investment and jobs in Ireland's offshore wind industry.
71 Plano de Afetação para Energias Renováveis Offshore – PAER (2023) More information at: https://participa.pt/pt/consulta/plano-de-afetacao-para-energias-renovaveis-offshore-paer
72 Ibid., p.7
73 Directorate-General for Energy (2022) "President von der Leyen participates in high-level summit focused on energy security, energy partnerships and green energy development".
74 Offshore Coalition for Energy and Nature – Mediterranean Sea (2023). Press Release.
75 Comité Maghrébin de l'électricité (2023) "Sonelgaz appointed head of the Maghreb Electricity Committee (COMELEC)", Maghreb Emergent.

for OWE[76].

- **Strengthen partnerships with industry-led stakeholder platforms:** the European Technology Innovations Platforms (ETIPs) are recognised as key actors for driving innovation, knowledge transfer and European competitiveness in their sector[77].
- **Engage all relevant stakeholders:** including NGOs, local industry and supply chain industry. At the Mediterranean level, the Offshore Coalition for Energy and Nature – Mediterranean Sea (Med OCEaN) aims to cooperate on the sustainable deployment of offshore wind and electricity grid, while safeguarding nature and healthy marine ecosystems in the region[78].
- **Strengthen regional and subregional energy frameworks** that promote dialogue and explore synergies on OWE, such as MEDENER[79], Med-Reg[80], RCREEE[81], OMEC[82], COMELEC[83]). These frameworks also promote the inclusion of the topic of MRE development under their portfolio. The neighbour's sea basin serves as an example of regional cooperation, establishing a focus (pillar) on MRE to increase the investments in MRE capacity and infrastructure[84].

Challenge: Gaps in skills of the workforce and lack of attractiveness of maritime careers

The International Renewable Energy Agency's (IRENA) energy transition modelling suggests that the onshore and offshore wind industry alone may employ globally 3.7 million people by 2030 and more than 6 million people by 2050 .However, many sectors in the Blue Economy, including MRE, have difficulties finding adequately qualified and skilled professionals, which hampers their growth, and are also facing the so-called "brain drain"[86] [87].

Recommended actions:

- **Match education offer with labour market needs** by promoting up-skilling and re-skilling schemes (specially in SMEs) and improving the communication and cooperation between academia and industry.
- **Adapt and modernise learning schemes:** adapt training and education in view of the latest technological developments and climate-related commitments. By adapting the learning methods, the attractiveness of maritime careers and jobs will increase among the younger generations. New training tools include for example the use of gamification, training simulators, virtual reality and augmented reality, digital tools, e-learning and hybrid solutions[88].
- **Foster sectoral partnership in OWE skills:** such as the Pact for skills- Offshore Renewable Energy (P4S-ORE)[89], focused on stimulating a dedicated training offer, promoting re-skilling and up-skilling of the workforce, training itineraries, and providing suitable preparation for new staff and measures for attracting talent.

Policy framework and regulations

Developers and regulators have a key role to play in building public trust, ensuring the protection and sustainability of public natural resources. Five principles should be applied to reform regulatory MRE processes: 1) clear regulatory objectives; 2) transparent regulatory approval processes; 3) clear ways to appeal and review; 4) early and inclusive collaborative consultation processes; and 5) independence of decision-making bodies[90].

76 North Sea Energy Cooperation (2023) Political Declaration on energy cooperation between the North Seas Countries and the European Commission on behalf of the Union.
77 More information on ETIP Wind at: https://etipwind.eu/ and ETIP Ocean: https://www.etipocean.eu/
78 IRENA (2021) Offshore renewables: An action agenda for deployment, International Renewable Energy Agency, Abu Dhabi.
79 Ibid., p.8.
80 Association of Mediterranean Energy Regulators. More information at: https://www.medreg-regulators.org/
81 Regional Center for Renewable Energy and Energy Efficiency. More information at: https://rcreee.org/
82 Organisation Méditerranéenne de L'energie et du Climat. More information at: https://www.ome.org/
83 Comité Maghrébin de l'électricité. More information at: https://maghrebemergent.net/sonelgaz-designe-a-la-tete-du-comite-maghrebin-de-lelectricite-comelac/
84 Atlantic Action Plan. Pillar III: Marine Renewable Energy.
85 IRENA (2019) Future of wind: Deployment, investment, technology, grid integration and socio-economic aspects (A Global Energy Transformation paper).
86 EUROMESCO (2024) A sustainable blue economy for the Mediterranean: challenges, opportunities and policy pathways.
87 FLORES (2024) Guidelines to promote innovative approaches in LLL for ORE.
88 IEMED (2023) Policy report: Blue economy as an opportunity for enhancing youth and women's employment in the Mediterranean. Cluster project.
89 Skills Partnership for Offshore Renewable Energy (2021) Position Paper: Towards a Pact for skills in the ORE.
90 Van Putten et al. (2018) The emergence of social licence necessitates reforms in environmental regulation.

Challenge: Lack of a specific regulatory framework for offshore renewables

The European Union demanded that each Member State develop an Integrated National Energy and Climate Plan for the period between 2021 and 2030. While some countries have already included offshore renewables in their plans, others (EU and non-EU nations) lack of a clear regulatory framework for MRE development[91]. Additionally, these national plans need to be adapted to the regional//local context.

Recommended actions:

- **Include MRE targets in national Plans:** when feasible, include MRE as a policy action to constitute a clear legal framework. This is the case of Spain, who has published in 2021 a national Roadmap for the Development of Offshore Wind and Marine Energy, constituting a new legal framework for the licensing of renewable marine energy projects[30].
- **Adapt MRE targets and regulations to the local context:** energy targets are established at national level and not by regions. In this context, it is crucial to outline how each region can collaborate to reach this shared national goal. For example, the regional government of the Canary Islands has developed a strategy to develop MRE in the islands and to become a 'Living Lab' for testing MRE technologies and projects[92]. Additionally, cooperation with local authorities and experts to improve the governance and build consensus around decisions is key[93].
- **Integrate maritime and terrestrial Planning:** to avoid creating conflicts at the coastline between planning systems, whose competences are usually differentiated in terms of institutional responsibility and scale.
- **Update international standards for OWE:** policy makers need to ensure that an adequate Quality Infrastructure (QI) includes testing laboratories, certification, accreditation and inspection bodies at the national level. International bodies such as the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) need to develop and update international standards for offshore renewables to incorporate risks of extreme weather associated to climate change and climate variability. For example, no standards have been developed yet specifically for floating solar PV[94].

Challenge: Overlapping of authorities' responsibilities and lack of centralised body for offshore renewable energy

There are no competent bodies that bring together responsibilities related to maritime sectors, so management responsibilities for marine space and its uses are divided into different departments. This creates complex institutional frameworks that hinder decision-making processes and finally translate into confusing and inefficient authorization procedures.

Recommended actions:

- **Establish a centralized coordination body:** implement a «one-stop shop» approach to simplify the regulatory landscape, reduce bureaucratic hurdles, and foster a more cohesive strategy for marine environment management. This central body would be tasked with overseeing all aspects of OWE projects, from planning to execution, ensuring seamless interaction among various authorities and stakeholders.
- **Engage in value chain and community building:** encourage the central coordination body to actively participate in the offshore wind value chain, organize awareness campaigns, facilitate industry events, and streamline the procedural aspects of setting up OWE projects. This approach would foster a supportive ecosystem for offshore wind development, enhancing project viability and success rates. For instance, the UK's successful offshore wind model, led by The Crown Estate, serves as a collaboration hub for renewable energy stakeholders. The entity streamlines procedures for establishing offshore wind farms, emphasizing the importance of a dedicated public entity for project success[95].

Challenge: Uncertainties and complexity in the consenting process

Renewable energy projects are in principle required to receive an authorisation so that they are able to perform their intended activity. Permit-granting procedures help to ensure that the projects are safe and secure. However, the complexity, variety and prolonged duration of those procedures constitutes a major barrier to the swift and necessary deployment of renewable energy. Furthermore, there is an overall lack of knowledge about regulatory processes to be followed to obtain

91 Ibid., p.4
92 Instituto Tecnológico de Canarias, S.A (2022) Estrategia de las energías renovables marinas de Canarias v1
93 Pulselli et at. (2022) Integrating Blue Energy in Maritime Spatial Planning of Mediterranean Regions. Energy Research.
94 IRENA (2021) Offshore renewables: An action agenda for deployment, International Renewable Energy Agency, Abu Dhabi.
95 Ibid., p.9

authorization to develop an MRE project. Consenting bottlenecks in renewable energy projects include delays in obtaining permits, multiple consent applications, unclear processes, repeated environmental impact assessments, extensive monitoring requirements, and limited post-consent design flexibility. Addressing these issues requires substantial national investment and support[96]

Recommended actions:

- **Take lessons learnt from Successful Strategies:** several Northern European governments are adopting a proactive approach to renewable energy project consenting. They identify suitable sites beforehand, conduct preliminary surveys, and engage with stakeholders early on. This process reduces risks for developers, who can then submit proposals in response to centralized tenders. Upon selection, developers are responsible for obtaining necessary licenses and permissions, including environmental assessments and grid connection authorization[97].
- **Simplify the licensing process:** licensing should be tailored to the needs of MRE generation activities. A single online system for project developers, following the example of Scotland, could be introduced. The best designation methods for specific MRE zones should be selected according to national marine area characteristics and energy targets. "Open door" procedures for large marine areas allow industry to develop their own business (e.g. UK) and "calls for tenders" for short term marine energy developments in smaller sea spaces with high concentration of uses (e.g. The Netherlands)[98].
- **Facilitate the licensing process through guidelines:** in addition to the legislative measures, the European Commission has published guidance[99], accompanying the recommendation[100] on speeding up permit-granting procedure, which includes good practice examples that can support the deployment of offshore renewable energy, such as multiple use of space and environmental pre-assessments of offshore wind sites.

Technology and infrastructure

Challenge: Deficient grid integration and port and energy storage infrastructures

With the on-going implementation of the TEN-E Regulation (aiming at specifically include onshore and offshore grid projects across European seas)[101], the European Commission has been addressing grid related challenges. Nevertheless, there are several remaining obstacles, such as the need to promote anticipatory investment in grids and solving cost-sharing issues in relation to offshore grids, energy islands and offshore hubs, as well as its capacity necessary to integrate offshore renewables [102]. The existing grid infrastructure has not been tailored to support Marine Renewable Energy (MRE) and lacks optimization, thus necessitating further development. Even if Europe has rules on grid connections, transnational electric grid expansion (or strengthening) lacks strategic policy mechanisms, government plans and international coordination, all of which will be needed, at least at sea-basin scale, to support MRE expansion [103].

Recommended actions:

- **Implement offshore wind interconnectors:** existing interconnections facilitate electricity transport between the Netherlands and UK, and between Norway and Denmark. However, so-called WindConnectors (i.e. interconnection between offshore windfarms rather than shorelines) are yet to be implemented. WindConnectors are positioned as a more economically attractive alternative (saving up to 5-10% of costs) but ongoing regulations compromise its economic feasibility[104]. In the Mediterranean, the Maghreb region's immediate plans (COMELEC - Comité Maghrébin d'électricité) are mainly focused on expanding energy trade and transmission lines with Europe[105].
- **Upgrade port Infrastructures:** the lack of ports equipped with adapted infrastructures (including lack of specialized vessels for installation and maintenance) and located in the vicinity of deployment sites, also limits optimal exploitation of sites with a good level of resource.

96 Ibid., p.1
97 Ibid., p.1
98 García et al. (2020) Blue energy and marine spatial planning in Southern Europe.
99 European Commission (2022) Speeding up permit-granting and PPAs SWD
100 European Commission (2022) Commission Recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements of 18 May 2022.
101 Regulation (EU) No 347/2013 of 17 April 2013, TransEuropean Networks for Energy (TEN-E) regulation
102 Ibid., p.9
103 Ibid., p.1
104 Kusters et al. (2023) Exploring the agenda-setting of offshore energy innovations: Niche-regime interactions in Dutch Marine Spatial Planning processes.
105 Plan Bleu (2022) Towards Sustainable Development of Marine Renewable Energies in the Mediterranean, Interreg MED Blue Growth Community project.

- **Facilitate grid integration of energy storage systems:** this includes for example the removal of legislative barriers for energy storage projects, and innovations on the supporting policy, regulatory and market frameworks. The variability in power generation embedded to all ORE sources occurs at different timescales. This leads to an intermittent power delivered to the electricity grid, which is challenging for grid stability and operation in the short-term. Energy storage can be a key asset in stabilising the electrical power delivered by MRE converters, compensating supply and consumption imbalances, while ensuring efficient operation of the system[106].
- **Develop super grid and energy hubs:** constructing individual connections for each offshore wind farm could be inefficient and a significant delivery barrier due to environmental and local impacts, particularly when accounting for the required onshore infrastructure. To maximize the use of wind resources on a large scale, it is essential to integrate individual wind farms into cross-country power interconnectors. This integration is vital for ensuring the security of the energy supply and for facilitating efficient electricity trading. Such an integration will serve as an intermediate step towards the development of a multi-terminal and eventually a fully meshed offshore grid, also known as a Super Grid. This Super Grid will feature energy hubs or energy islands among its components. Eventually, energy hubs are envisaged using 100% renewable electricity and allowing OWE to be harvested, rerouted to land and traded on different markets, or converted into other energy forms for final use[107].
- **Develop international standards for High-Voltage Direct Current (HVDC) Systems:** future multi-terminal and large-scale, multi-vendor HVDC systems are expected to incorporate components from various manufacturers. To guarantee seamless operation of diverse equipment and continuous power transmission, multi-vendor interoperability will be essential. International standards would reduce interoperability issues and avoid a potential bottleneck in the development of energy infrastructure[108].
- **Assessment of the potential of Offshore-Wind-to-Hydrogen solution:** hydrogen has historically been used as a resource for industrial processes, when produced with natural gas. Connecting hydrogen production facilities to OWE enables the production of 'green hydrogen'. However, no shared conviction exists yet on the utility of hydrogen as an energy carrier for OWE. Current policy foresees green hydrogen to become economically feasible offshore only post-2030 and the harsh offshore environment presents additional technical difficulties. Additionally, no supporting regulatory framework, market structure or reliable and long-term financial support mechanism presently exists that incentivizes developments of large-scale offshore electrolysers[109] [110].

Challenge: Insufficient experience with OWE decommissioning

Decommissioning of offshore wind farms is still a relatively new exercise, with limited data and/or experience available, which can lead to many uncertainties, increased assumptions, and less accurate estimates of the overall cost and environmental impacts. Offshore removal operations may account for up to 58% of the overall cost and 67% of overall lifetime emissions[111]. Uncertainty in estimates of cost and impact of the later life cycle stages of offshore wind farms need to be addressed.

Recommended actions:

- **Incorporate decommissioning and recycling into the design phase:** Ensure that the design of new generation MRE device components not only considers the technical, economic, and environmental aspects of OWE decommissioning from the outset but also emphasizes their design for decommissioning and recycling. This approach should aim for compatibility with various lifespan extension methods, such as reuse, repowering, and repurposing[112], thereby facilitating more efficient and cost-effective decommissioning stages.
- **Facilitate cross-sectoral knowledge transfer:** encourage the sharing of knowledge and skills between the offshore wind sector and other offshore industries, notably the oil and gas sector. Given the latter's extensive experience in operating and decommissioning projects in challenging marine environments, there is a wealth of insights and practices that can be adapted and applied to OWE decommissioning[113].

106 Ibid., p.1
107 Cutululis, et al. (2021) The Energy Islands: A Mars Mission for the Energy system.
108 Ibid., p.1
109 Ibid., p.11
110 Ibid., p. 6
111 Milne, C., Jalili, S., & Maheri, A. (2021). Decommissioning cost modelling for offshore wind farms: A bottom-up approach. Sustainable Energy Technologies and Assessments, 48.
112 Ibid., p.1
113 Ibid., p.6

- **Promote industry-wide standards for decommissioning:** Work towards establishing comprehensive standards and guidelines for OWE decommissioning that address all facets of the process, from environmental impact assessments to the economic viability of recycling materials. These standards should aim to ensure that decommissioning activities are carried out in a responsible, sustainable, and cost-effective manner[114].

Challenge: Limited number of offshore demonstration site

There is a gap on Research & Innovation projects on MRE in the Mediterranean Sea basin, and especially in the southern countries[115]. Demonstration of devices at sea is costly and risky and SMEs are often short of the necessary resources to deploy their prototypes[116]. Open sea testing facilities enables practical experience of installation, operation, maintenance and decommissioning activities for prototypes and farms. Thus, the offshore sites allow the acceleration of technological innovation in real conditions for projects between the laboratory and the pre-commercial scale (pilot sites).

Recommended actions:

- **Invest in new testing sites for MRE in the Mediterranean:** the development of technologies capable of fully exploiting the potential of MRE sources of the Mediterranean should be supported through public and private investments.
- **Facilitate access to available test centres:** emerging MRE energy start-ups should have the opportunity to easily access demonstration sites. For example, under the Blue-GIFT project, nine ocean energy companies were awarded with vouchers allowing them access to test centres under real-water conditions in France and Spain[117]. MaRINET is the largest MRE Infrastructure Network that has provided since 2011 free-of-charge access to cross-border facilities to test devices at any scale, environmental data or to conduct tests in cross-cutting common areas such as power take-off systems, grid integration, materials or moorings[118].
- **Strengthen natural laboratories for measuring environmental impacts:** the establishment of natural laboratories to test MRE and related systems in operational environments helps also to collect long-term data on the real effects of MRE infrastructure on marine ecosystems and biodiversity[119].

Economic and financial

Challenge: Insufficiency of financial support at regional and national level

Over the last five years, the EU has trailed China in terms of private investment in MRE – the Chinese sector has received triple the amount of investments compared to the EU. In 2022, reported private investments in Europe totalled €15 million – more than two times less than in 2021. This drop in reported investments emphasises the need for policy action at European and national level. European and Mediterranean developers need more market visibility and dedicated funding for large demonstration projects to stay competitive in the face of increasing investment elsewhere[120].

Recommended actions:

- **Promote Green Incentive Mechanisms:** incentive mechanisms, tailored to each stage of technology development, should be implemented to support policy implementation. Direct subsidies are particularly effective in early stages and help to reduce capital costs and operating support. Taxes can be used as an alternative to or in combination with subsidies. Tax revenue from fossil fuels or carbon emissions can be redistributed to marine-based renewable energy sources. Additionally, developers of these technologies can benefit from tax exemptions from general energy taxes, or for initial investments[121].
- **Adapt Policy to New Market Trends:** there has been a policy shift and a new trend towards auctions, away from administratively determined price-controlled schemes (e.g., FITs or renewable obligations certificates). This changes the risk exposure between asset owners and the government. As of 2021, only 24% of all installed

114 Ibid., p.6
115 UfM (2021) Roadmap to set the path towards the implementation of the 2021 UfM Ministerial Declaration on Sustainable Blue Economy
116 Ibid., p.5
117 More information on BLUEGIFT project: https://bluegift.eu/
118 More information on MaRINET project: https://cordis.europa.eu/project/id/262552
119 Ibid., p.6
120 Ibid., p.3
121 UNEP, FAO, IMO, UNDP, IUCN, WorldFish Center, GRIDArendal (2012) Green Economy in a Blue World.

offshore capacity was auctioned, but this share is expected to rise to 97% by 2030[122]. The increasingly dominant use of auctions merits a renewed and comprehensive inventory taking of market volume, implemented mechanisms and adapting policy regulations.

- **Increase Funds from Financial Institutions:** access to funding should be facilitated through key European and international financial institutions (e.g. European Investment Bank, European Bank for Reconstruction and Development, World Bank, etc.), and these institutions could cooperate to develop a "Mediterranean Renewable Energy Infrastructure Fund" aimed at channelling financial resources or bonds from institutional investors to renewable energy companies in the region[123].

Challenge: Attaining competitiveness and commercial viability for MRE

While offshore renewable energy technologies have reached various degrees of maturity, the key challenge of these technologies – which is common across all technologies except for offshore wind with fixed foundations – is their commercialisation[124]. Technology costs are currently high and access to funding is difficult. Most existing technologies and especially those related to ocean energy still need to demonstrate their reliability and viability in the marine environment. Additionally, investors incorporate investment risk in the costs of capital (CoC), representing the expected return capital market participants require to fund a particular investment. Higher investment risks lead to higher return expectations and CoC. Consequently, offshore wind had, on average, 1.3 percentage points higher CoC than onshore wind and solar photovoltaics (PV) Europe[125]. Besides accelerating the rollout of offshore wind, decreasing the CoC could also lead to significant reductions in offshore wind production costs, creating less need for public support to make the projects economically viable.

Recommended actions:

- **Stabilize revenue streams:** implement measures to stabilize revenue for offshore renewable energy projects to reduce the CoC. This could involve government mechanisms such as credit guarantees for loans or governmental revenue stabilization for projects selling electricity to commercial customers.

- **Encourage blended finance and stage gate metrics:** utilize blended finance to combine private and public investments and introduce stage gate metrics for progressive project financing based on achieved milestones from inception to completion. This approach encourages investments that benefit society while supporting the development of innovative projects[126].
- **Support for SMEs and prototype advancement:** address challenges faced by SMEs in advancing MRE prototypes, particularly through the promotion of demonstration projects and the development of offshore test sites tailored to Mediterranean conditions.
- **Facilitate Private-Public partnerships and increase public investment:** share the risk of early movers through private-public partnerships and bolster public investment in research, development, and demonstration (RD&D) to improve technology readiness levels, reliability, and durability of offshore renewable technologies.
- **Streamline permitting and regulatory processes:** simplify and accelerate permitting procedures and ensure stable regulatory frameworks could lead to CoC reductions through financial learning or the accumulation of experience with evaluating and financing projects. For instance, the UK government announced plans to reduce the consent time for offshore wind from the current four to one year[127].
- **Develop new international standards:** establish new standards and methodologies for technological assessment and environmental impact, enhancing technological competitiveness valuations and increasing investor confidence.
- **Integrate Offshore renewables within the blue economy:** adopt a holistic approach by integrating offshore renewable energy projects with blue economy sectors, such as shipping, aquaculture, and oil and gas. This could lead to cost reductions through economies of scale and shared infrastructure.

122 Jansen et al. (2022). Policy choices and outcomes for offshore wind auctions globally.
123 UfM (2018). Blue Economy in the Mediterranean
124 Ibid., p.6
125 Ibid., p.1
126 Ibid., p.6
127 UK Parliament (2023) Research Briefing: Floating offshore wind.

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Fig.3 Aerial view of a sea wave at the shore
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