NATIONAL REGULATIONS, PLANS & STRATEGIES

for the development of offshore wind energy in the Mediterranean basin

Energies renouvelables - Andalousie - Espagne- Credit : AdobeStock_Alice_D

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Renewable energy sources (RES) are at the forefront of global energy discussions, particularly as fossil fuels continue to dominate the economic landscape. RES offers an enticing promise: a sustainable, essentially limitless energy source that significantly mitigates greenhouse gas emissions. In a challenging geopolitical and economic context, with increasing climate change impact on the Mediterranean countries (considered a hot spot by IPCC), accelerating energy transition to achieve net zero and keep the 1.5 C goal alive is a must. In response, all Mediterranean countries have set ambitious RES targets, aiming to boost renewable energy's contribution to their electricity mix. However, realizing these goals demands substantial investment and a substantial expansion of energy-generating capacities. While solar and wind power are integral components, it is evident that diversifying with additional renewable sources is essential. Within the realm of renewable energy, marine renewable energy (MRE) emerges as a promising frontier. Two primary categories of MRE take the spotlight: offshore wind energy (OWE) and ocean energy, collectively referred to as Blue Energy (BE). Among MRE options, OWE shines brightly, since it boasts advanced technology, well-established regulatory frameworks, commercial viability, and significant operational capacity.

Offshore wind energy: A Promising and Efficient Renewable Energy Source

Offshore wind energy, a subset of renewable energy sources (RES), stands out as a beacon of promise in the global transition to cleaner energy solutions. It distinguishes itself from its onshore counterpart by harnessing the powerful winds found in the vast expanse of the sea or ocean. Offshore wind farms are strategically positioned away from land, tapping into offshore winds that exhibit higher speeds and remarkable consistency. Unlike onshore installations, these offshore farms encounter minimal physical interference from the land or human-made structures. Consequently, they are hailed for their efficiency and reliability, with the potential to significantly outperform onshore wind farms. One of the primary challenges of wind energy, regardless of its location, is the noise and vibrations generated by the rotor blades. Mitigating these disturbances is essential, not only for operational efficiency but also for the well-being of personnel working in the vicinity. Additionally, the sheer height of these turbines, often reaching 135 meters, can present visual concerns within communities (EWEA, 2013). However, when it comes to converting wind energy into electricity, offshore wind technology has already achieved commendable levels of performance.

With reported efficiency rates ranging between 40% and 50%, offshore wind power is closing in on the theoretical maximum efficiency predicted by Betz's law, which stands at 59% (IRENA, 2019). The process begins with the force of the offshore wind turning the turbine blades. These blades are connected to the turbine via a hub, with typical rotations occurring at a rate of 7 to 12 turns per minute. To further optimize energy conversion, a gearbox is employed to increase the rotational speed, often by more than 100 times, before transferring it to the generator (EWEA, 2013).

The development of fixed foundation offshore wind technology has witnessed remarkable progress since the inception of the first offshore wind farms. Extensive research and development initiatives have focused on cost reduction, capitalizing on larger wind turbines, optimizing wind utilization, and enhancing production processes. These endeavours have yielded a dramatic reduction in the levelized cost of electricity (LCOE), with some projects achieving up to a 70% reduction in less than five years. Recent European projects incorporating 10 MW turbines have resulted in even more substantial savings in investment and maintenance costs, alongside impressive capacity factors exceeding 50% in many locations.

In European auctions, electricity prices have reached rates below €50/MWh (IRENA, 2019). Looking ahead, the International Energy Agency (IEA) foresees continued advancements in technology leading to an additional 40% reduction in LCOE by 2030, with LCOE values projected to range between €30-40/MWh. By 2040, the IEA anticipates a remarkable 60% reduction in LCOE, cementing offshore wind energy's position as a cost-effective and sustainable energy source (IEA, 2019).

Current and Existing Offshore Wind Projects and Policies: Tapping into Offshore Potential

The journey of offshore wind energy began modestly with the installation of the world's first offshore wind farm in Vindeby, Denmark, back in 1991. At that time, it appeared more as a demonstration project than a harbinger of a global shift. However, three decades later, offshore wind energy has matured into a large-scale, reliable technology capable of supplying energy to millions worldwide. Recent installations boast high-capacity factors, and the costs associated with offshore wind have steadily declined over the past decade (GWEC, 2021).

While numerous offshore wind projects have gained approval, progress in recent years has been somewhat limited. Yet, there is no shortage of potential, particularly in the Mediterranean region. Studies have identified the Gulf of Lion and the Aegean Sea as the most promising locations for offshore wind energy projects, boasting substantial wind potential (1,050 and 890 W/m2, respectively, at 80 m above sea level). Additionally, the Adriatic Sea and the Gulf of Gabe's show promise when considering factors like appropriate bottom depths. When accounting for other constraints such as proximity to the coast, existing grid connections, and seafloor conditions, the Aegean Sea emerges as a prime location for offshore wind turbine deployment.

Based on optimal wind farm layouts and the characteristics of selected turbine types, it is estimated that the theoretical maximum annual offshore wind production across the entire Mediterranean area could reach approximately 742 TWh/year. These promising prospects align with the European Strategic Energy Technology Plan (SET Plan), which focuses on increasing the share of offshore wind and wave energy. The SET Plan aims to boost offshore wind energy's contribution, with anticipated capacity ranging from 240 to 445 GW by 2030. The overarching goal is to enhance competitiveness and reduce the cost of offshore energy (EC Directorate-General for Energy et al., 2018).

France, for instance, has taken notable strides in this direction by initiating a tender for 500 MW of floating wind power, encompassing two new 250 MW projects in the Mediterranean Sea. These projects, located off the coasts of Narbonne and the Gulf of Fos, are situated at a minimum distance of 22 kilometres from the coast, pending the results of environmental assessments (Ministère de la Transition écologique, 2021).

Innovation stands as a key imperative, particularly in the realms of installation, operation, and maintenance cost-effectiveness. Forecasts indicate substantial investments, with an estimated €10 million earmarked for digital transformation between 2018 and 2022 to enhance energy production. Additionally, plans include allocating €350 million to construct larger wind turbines capable of generating more electricity and capturing wind at lower speeds between 2018 and 2025 (European Commission, 2019).

The emergence of a supply chain that capitalizes on cutting-edge ocean technology in Europe remains a core objective, aimed at fostering economic growth and employment opportunities. The realization of this vision calls for the development of new infrastructure, logistics, and installations, ideally positioned in close proximity to energy sources.

Amidst these dynamic developments, the implementation of policies to combat climate change and facilitate energy transition, combined with the industrial prowess of the wind and naval sectors, has generated substantial investor interest. Numerous projects submitted to Mediterranean governments further underscore the region's potential. The significant reduction in offshore wind energy costs positions the current moment as an opportune one to harness the Mediterranean region's offshore wind power potential. The evolution of floating wind power technology has expanded the horizons, opening doors to locations farther from the Mediterranean coasts, characterized by high-capacity factors and reduced environmental and visual impact compared to projects proposed more than a decade ago.

Challenges and Concerns of Offshore Wind Development

Balancing renewable energy generation with coastal ecosystem preservation is an ongoing challenge in offshore wind development, articularly when routing cables through coastal areas (Bryden et al., 2018). The offshore wind value chain involves efficient component fabrication and importation, with considerations specific to the Mediterranean. Key components and services can be sourced from Mediterranean companies, including engineering studies, support structures, vessels, and more.

While offshore wind technology has evolved with cost reductions and capacity expansions, regional opposition necessitates regulatory initiatives to engage stakeholders and build public support (IEA, 2019).

Sectoral Characteristics:

1-Floating Offshore Wind Technology: Well-suited to the Mediterranean's deep waters and abundant wind resources.
2-Emerging Blue Industry: Drives technological progress, economic development, and emissions reduction.
3-Regional Collaboration: Vital for cost-effective deployment.

Challenges:

1- Coexistence with Other Marine Uses: Balancing MRE development with existing activities, like fishing and tourism.

2-Understanding Long-term Environmental Effects: Addressing concerns related to noise, accidents, habitat disturbances, and pollution.

Opportunities:

1-Carbon-Neutral Ports: Integrating MRE technologies to reduce ports' carbon footprint.
2-Sustainable Energy Self-Sufficiency: Coastal regions and islands can enhance energy self-sufficiency with MRE.
3-Versatile Applications: MRE systems can serve various purposes beyond energy generation, including marine surveillance and research.

Harnessing marine renewable energy in the Mediterranean demands' innovation, collaboration, and environmental stewardship. Addressing challenges and leveraging opportunities can lead to a sustainable energy future while protecting marine ecosystems.

National Policies/Regulations

	Country	National Policies/Regulations	Ref.
Northern	Albania	Exploring actively /offshore wind projects of 100MW.	Link
	Croatia	Plan of 25 GW in offshore wind farms has been identified	Link
	Greece	Law 4964/2022, dated 30 July 2022. By 2030 Greece wants to build at least 2 GW of offshore wind	Link
	Slovenia	Slovenia does not have the option of setting up offshore wind farms. Renewable Hydrogen projects by (NAHV) signed in September 2023.	Link
	Spain	Law 7/2021 of 20 May on Climate Change and Energy Transition. Spain aims for 3 GW of offshore wind capacity by 2030	Link Link
	Malta	No existing projects nor exploring actively. Malta, 10 July 2023: The Parliament of Malta is planning its first Offshore wind tender. Six areas outside Malta's territorial waters identified for offshore wind farms	Link Link
	Monaco	No existing Offshore wind farm/ January 25th, 2021 (the president of M.E.R. said that there are no current projects).	Link
	Montenegro	No existing offshore wind farms/only onshore /future projects: Floating Solar Power plants (50MW)	Link
	France	Law no. 2019-1147. 27 offshore wind turbines in Saint-Nazaire which eventually will become 80. Target of 50 offshore wind farms by 2050 (adding 480 MW to the grid)	Link Link
	Italy	Law: unprovided. Beleolico developer / Apulia – Italy/ Ten blades/30MW. Aiming to Offshore wind estimated at 5.5 GW by 2030	Link
Eastern	Cyprus	Exploring mode (studies of wind speed performance)	Link
	Lebanon	No offshore wind projects in Lebanon. Studies by Atlas said wind is overestimated to be a potential in Lebanon	Link
	Syria	No strategies or regulations in 2023.	/
	Palestine	No strategies or regulations in 2023.	/
	Israel	Ambition targets for renewable energy to decrease gas emission	Link
Southern	Egypt	No current Offshore wind turbine /Studies are being prepared.	/
	Morocco	Law No. 13.09 (19 September 2011). 30th September 2022 (2 million euros granted to finance feasibility study for small scale offshore wind energy project for the private sector	Link
	Algeria	Algeria has primarily focused on other forms of renewable energy, such as solar and wind energy onshore.	Link
	Libya	No strategies or regulations in 2023.	/
	Tunisia	No current Offshore wind turbines/ feasibility studies are being prepared.	Link

LEGEND : Very advanced | Advanced | Starting point for developing strategies | No strategies/ regulations/plans | Other

Table 1 Regional Policies/National Regulations in the Mediterranean Regarding Offshore Projects

Conclusion

Internationally, the momentum for MRE development is palpable, bolstered by the European Union's commitment to achieving a minimum 27% energy generation share from RES by 2030 (European Commission, 2019). This momentum extends to the Southern Mediterranean countries, where ongoing studies are actively evaluating the vast potential of OWE. Installation projects are poised to materialize soon, signalling the Mediterranean region's dedication to a sustainable energy future.

Regulations governing offshore wind energy in the Mediterranean region are currently specific to each country, with Spain, Italy, and Greece making significant strides in establishing their regulatory frameworks. Meanwhile, the European Union's Clean Energy Package offers essential guidance and targets for member states embarking on offshore wind projects. Despite increasing interest in offshore wind energy, its development in the Mediterranean remains at an early stage, emphasizing the need for a unified, long-term policy framework to foster sustainable coexistence and environmental protection.

Stability in legislative frameworks is a pivotal factor in the issuance of permits and overall project development.

The feasibility of offshore wind farms in Mediterranean nations hinges on various considerations, including existing infrastructure, environmental concerns, and potential conflicts among different economic sectors. Given the intricate regulatory, environmental, and financial factors at stake, establishing operational offshore wind projects in Southern Mediterranean countries may necessitate a substantial amount of time.

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