Interreg IPA ADRION

ADRIONWIND

“Adriatic-Ionian Offshore Wind Network of Excellence”

D.2.2.1 - SWOT Analysis Report for the Offshore Wind Energy Sector

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Contents

Aim & Scope

The ADRIONWIND SWOT Analysis Report for the Offshore Wind Energy Sector provides a comprehensive evaluation of the sector's internal capabilities and external environment across the Adriatic-Ionian macroregion. Its primary purpose is to identify and rigorously analyse key strengths, weaknesses, opportunities, and threats specific to each participating country. The insights derived from this detailed analysis establish an evidence-based foundation critical for shaping the ADRIONWIND Joint Transnational Research & Innovation (R&I) Strategy. Ultimately, this report aims to inform strategic decision-making, highlight areas for collaborative intervention, and guide targeted actions designed to advance regional sustainable growth and competitive positioning in the offshore wind energy sector.

Contributors

The analysis had been conducted with the cooperation of all ADRIONWIND project partners. A main responsible per country was assigned, aided by a peer organisation in the cases of Croatia, Greece, and Italy. Final form has been subjected to editing by KiNNO Innovation Intermediaries Ltd.

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Introduction

Croatia's offshore wind energy sector is at a pivotal stage, set between immense potential and foundational challenges. This SWOT analysis is prepared within the Interreg IPA ADRION project ADRIONWIND, to evaluate Croatia's internal capabilities and external environment for offshore wind. The goal is to inform strategic planning (e.g., the forthcoming ADRIONWIND Joint Transnational R&I Strategy) by identifying key Strengths, Weaknesses, Opportunities, and Threats specific to Croatia [1]. This country-level analysis also highlights factors of transnational relevance within the Adriatic-Ionian region.

As of 2025, Croatia has no offshore wind farms installed in its part of the Adriatic Sea [2], but it has made significant strides in onshore renewables and recognizes offshore wind as a critical next step. In 2021, 53.5% of Croatia's electricity came from renewable sources [3] (primarily hydro and onshore wind), underscoring strong national commitment to clean energy. The government's updated National Energy and Climate Plan (NECP) targets an ambitious 73.6% renewable electricity share by 2030 [3]. To achieve this, offshore wind development is essential, and Croatia has indicative offshore wind capacity targets of 510 MW by 2030 and 3 GW by 2050 [3]. These targets were informed by the EU's Offshore Renewable Energy Strategy (European Commission, 2023) and reflect Croatia's intent to leverage its maritime resources.

Crucially, studies show Croatia's natural offshore wind potential is enormous - estimated at 17 GW (4 GW bottom-fixed + 13 GW floating) within 200 km of its coastline [4] and up to 25 GW in total in low-environmental-impact Adriatic zone [5]. Unlocking even a fraction of this potential could transform Croatia into a significant renewable energy player in the region [5]. However, realizing this vision requires addressing internal limitations (e.g. regulatory and infrastructure gaps) and navigating external challenges (such as environmental constraints and market competition).

This report presents a comprehensive SWOT analysis with prioritized factors supported by current data, stakeholder insights, and regional context.

Methodology

The SWOT analysis was developed through an in-depth literature review and synthesis of reliable, up- to-date sources. Key references include national studies (e.g. the Action Plan for Renewable Energy Sources at Sea in Croatia by RES Croatia/OIEH, 2023), market reports, policy documents, and academic research. Policy frameworks such as Croatia's NECP (2021-2030) and the EU Offshore Renewable Strategy were examined, alongside stakeholder insights reported in the media and project documents. Notably, statements from government officials, industry experts, and researchers (e.g. Ministry of Economy officials, RES Croatia representatives, and University of Zagreb experts) were used as proxies for stakeholder consultation [4], [7].

Data Collection: Quantitative data on key performance indicators (KPIs) were gathered from published sources. This includes current installed capacities, project pipelines, investment figures, and cost metrics. Where direct data for Croatia's offshore wind were unavailable (due to the lack of existing projects), analogous or projected data were used: e.g. technical potential estimates [5], government target figures [3], and cost benchmarks from regional studies (such as levelized cost of energy in the Mediterranean).

Analysis Approach: Internal factors (Strengths, Weaknesses) and external factors (Opportunities, Threats) were clearly delineated per guidelines. Each identified factor was examined for its strategic impact on Croatia's offshore wind development. The factors were prioritized by significance - ranking the top three in each category - based on criteria such as frequency of mention in sources, magnitude of impact (e.g. GW scale potential or major risks), and relevance to Croatia's 2030/2050 goals. For each factor, we provide a justification with supporting evidence. Any data gaps or uncertainties are explicitly noted (for example, lack of local cost data or employment estimates due to no operating farms).

Transnational Considerations: Given the regional scope of ADRIONWIND, we highlighted cross-border factors where appropriate, in line with guidelines. This includes collaborative opportunities (e.g. joint projects with neighbouring countries) and shared threats (e.g. competition for the same investment or environmental resources in the Adriatic-Ionian region). These regional factors are woven into the Opportunities/Threats sections and later summarized in the matrix.

All visualizations follow the project's standard format (consistent units, labels, and visual identity). The SWOT matrix provides a concise 2x2 overview of all key points, complementing the detailed narrative that follows.

SWOT Factors

In summary, Croatia's offshore wind sector starts from zero installed base but a high-potential foundation. The coming years (to 2030) will be critical in moving from planning to execution, requiring supportive policy, investment, and regional cooperation. The following SWOT analysis delves into the factors that will influence this trajectory.

Strengths

These are inherent internal attributes of Croatia's offshore wind sector or the enabling environment within the country that can facilitate offshore wind development.

1. **Exceptional Offshore Wind Potential - High Wind Resources & Ample Sites**: Croatia enjoys excellent natural wind resources and available maritime space for offshore wind. Studies have identified up to 25 GW of technically feasible offshore wind capacity in Croatia's Adriatic waters [5]. Wind measurements indicate favourable conditions, especially in the northern Adriatic Sea (Istria/Kvarner regions), with average wind speeds of ~6-7 m/s at 80 m height and consistent seasonal wind patterns (e.g., Maestral summer breeze, strong Bura wind in winter) [9]. Within 200 km of coastline, about 17 GW could be developed (including ~4 GW fixed-bottom in shallower areas and ~13 GW floating in deeper areas) [4]. This abundance of wind resource is a fundamental strength - it means Croatia has more than enough potential to far exceed its own energy needs and even export power. The availability of 29,000 km² of offshore area suitable for renewables (wind and floating PV) was mapped in the recent national Action Plan [7]. Critically, over 25 GW in "low environmental impact" zones was identified [5], indicating that this huge potential can be tapped with manageable ecological footprint. Such robust wind potential positions Croatia favourably among European nations - it could become a leading regional green electricity producer over the next decade [5]. This strength underpins many Opportunities (e.g., becoming an energy exporter) and attracts serious investor interest. *Supporting data*: Current estimates (25 GW) are comparable to the entire installed offshore wind capacity of Europe (~30 GW in 2023) [6], highlighting how large Croatia's resource is relative to the present European market.

2. **Strong Maritime Industry & Local Supply Chain Capabilities**: Croatia has an established industrial base and expertise relevant to offshore wind development. In particular, the country's shipbuilding and marine engineering industry - historically a significant sector - is a major strength. Croatian shipyards (e.g., Uljanik in Pula, 3. Maj in Rijeka, Brodosplit in Split) and many smaller marine firms have heavy fabrication capabilities, experienced workforce, and port infrastructure that can be repurposed to serve offshore wind projects [6]. This existing capacity means Croatia can locally handle aspects like manufacturing of foundations or platform components, assembly of turbines, and provision of installation vessels or crews. Indeed, the national renewable energy association noted that Croatian shipyards have production capacities to support construction and installation of wind turbines at sea [6]. Moreover, broader supply chain analysis has identified 60+ Croatian companies positioned to participate in offshore wind activities [10]. These include firms in steel structure fabrication, electrical equipment, transport and logistics, engineering design, environmental consulting, etc. The presence of these companies implies that a significant portion of the value chain (and job creation) can remain domestic once projects commence. Professors involved in Croatia's marine renewables study emphasized that these companies provide a skilled workforce for specialized tasks, leading to well-paid jobs, and that offshore wind can offer decades of sustained employment in operations & maintenance locally [10]. The specialized skills already present (from onshore wind, oil & gas, and maritime sectors) reduce the learning curve for offshore wind. In summary, Croatia's combination of port infrastructure, shipbuilding know-how, and a network of capable companies is a considerable strength that can accelerate project deployment and maximize economic benefits nationally. This internal strength could help Croatia avoid over-reliance on foreign contractors and integrate into the European offshore wind supply chain as a valuable contributor.

3. **Political Commitment and Renewable Energy Experience**: The Croatian government and public institutions demonstrate a strong commitment to renewable energy expansion, which bolsters the offshore wind sector. Policy support is evident in the ambitious targets set for offshore wind (0.5 GW by 2030, 3 GW by 2050) [3], as well as in the broader energy strategy

aiming for 42.5% of overall energy from renewables and 73.6% renewable electricity by 2030 [3]. This high-level political will creates a favourable environment for offshore wind, as evidenced by the proactive steps taken: commissioning the detailed Action Plan for Offshore Renewable Energy Sources (the first comprehensive maritime renewable study)[5], and seeking technical assistance from the EBRD and EU to develop the needed regulatory framework [3]. Croatia's track record in onshore wind is also an internal strength - it has successfully grown onshore wind capacity to ~1.2 GW over the past decade [11], integrating wind power into its grid and gaining experience with wind farm development and operations. Local utilities, investors, and engineers have familiarity with wind technology (turbines, grid connection, forecasting) from onshore projects, which can be leveraged for offshore despite the new challenges. The existing renewable energy institutions and stakeholders form a solid foundation: for example, the presence of an active Renewable Energy Association (RES Croatia/OIEH) advocating for policy improvements, and the involvement of academic experts in planning, indicate a supportive ecosystem [6]. Additionally, Croatia's public is generally supportive of renewable energy (the country has a history of valuing environmental preservation), which can translate to positive sentiment for well-sited offshore projects. In summary, strong policy backing, prior renewables experience, and stakeholder engagement are internal strengths that increase the likelihood of offshore wind initiatives moving forward effectively. Government officials have openly stated that offshore wind is a key part of reaching climate neutrality and reducing energy imports [33], aligning all levels of governance behind the effort.

4. *Natural Geographic Advantages for Project Logistics*: Croatia's long coastline and ports provide logistical strengths. The Adriatic Sea's northern part (along Croatia's Istrian and Kvarner coasts) is relatively shallow and sheltered, which is ideal for deploying conventional fixed-bottom turbines with manageable engineering complexity. Additionally, Croatia's central location in the Adriatic-Ionian region means it could serve as a hub for assembly or maintenance, servicing not only domestic farms but potentially those of neighbouring countries. The proximity of potential sites to the coast (some identified areas are near existing port cities like Pula or Rijeka) can lower transport and cabling costs compared to far-offshore projects. This geography, coupled with existing port facilities, is an inherent advantage. (This strength is

somewhat tempered by the fact that wind speeds in the Adriatic are moderate rather than superlative; however, the large area available compensates by allowing many turbines to be installed to capture aggregate energy.)

5. *Existing Offshore Infrastructure Available for Repurposing*: Though Croatia has no offshore wind yet, it does have legacy offshore infrastructure from the oil and gas sector in the northern Adriatic (gas platforms managed by INA and others). The Croatian Hydrocarbon Agency has been evaluating obsolete offshore gas fields for potential conversion to renewable energy hubs. This presents a unique strength: existing platforms could be reused for installing wind measurement equipment, electrical substations, or even mounting small turbines, potentially reducing infrastructure costs. Likewise, coastal grid infrastructure built for offshore gas (e.g., pipelines and onshore processing facilities) might be partly repurposed for offshore wind grid connections. While this repurposing is still exploratory, it represents an internal asset that many countries starting offshore wind do not have.

6. *Local Academic and Research Excellence:* Croatia's universities and research institutes contribute a strength in knowledge and innovation potential. The involvement of the University of Zagreb's experts in crafting the marine renewables Action Plan [6] shows the depth of local expertise. Croatian researchers are active in fields like wind resource assessment, marine ecology, and engineering design. This means that environmental impact assessments, wind modelling, and technology adaptation for Croatian conditions can be done in-country to a high standard. The presence of skilled graduates in mechanical, electrical, and naval engineering provides a talent pool for the emerging industry. This research capacity is an internal strength that will aid in optimizing projects (e.g., designing turbines to withstand the Bora winds or to minimize visual impact). It also positions Croatia to contribute to regional innovation initiatives (potentially hosting pilot projects or test sites for new offshore technologies in the Adriatic).

Marked Data Gaps: While strengths abound, it's noted that certain quantitative validations (e.g., exact wind speed maps, detailed supply chain readiness indices) are not fully public, as many are in unpublished studies or proprietary data. However, the consistent narrative from diverse sources (government, industry, academia) confirms the above strengths. Each strength is leveraged in Croatia's current strategy to kick-start offshore wind, providing a solid internal platform upon which external opportunities can build.

Weaknesses

These are internal weaknesses or limitations within Croatia's offshore wind sector that hinder growth or pose challenges. The top three weaknesses are in bold, as they require urgent attention to enable offshore wind development.

1. **Lack of a Comprehensive Offshore Wind Regulatory Framework**: Regulatory gap is the most cited weakness for Croatia. Until recently, Croatia had no dedicated legal or regulatory framework for offshore wind development [3]. This means clear procedures for site leasing, environmental permitting, grid connection, and revenue support (e.g., auctions or feed-in tariffs) have been largely absent or undefined. Developers face uncertainty about permitting timelines, authority responsibilities, and licensing processes, which severely slows down project initiation. The permitting of renewable projects on land in Croatia has been criticized for being slow and bureaucratic [3]; in the offshore domain, these issues are magnified by the involvement of multiple laws (maritime law, spatial planning, energy law) that were not originally designed with offshore wind in mind. As of 2024, policy reforms are only in progress - the government, with EBRD support, is drafting new legislation and a maritime spatial plan [6], but these have yet to be adopted and tested. The absence of an established "one-stop-shop" agency for offshore wind (to coordinate between ministries of energy, environment, defence, etc.) is a related weakness. This regulatory void has tangible impacts: for example, no auction or tender system exists yet to grant seabed rights for offshore wind, making it hard for investors to proceed. The complexity and uncertainty in current procedures can lead to delays of several years, deterring investment when compared to countries with streamlined frameworks. In short, Croatia's offshore wind ambitions are starting from a position of policy underdevelopment, requiring urgent action to set up rules of the game. Until a robust regulatory framework is in place (laws, permitting agencies, grid rules, incentive schemes), the sector's growth will be hampered. This weakness is well recognized by authorities - it's the very reason Croatia requested technical assistance to improve the policy framework [3] - but

as of the SWOT analysis, it remains only partially resolved and thus a critical internal weakness.

2. **Zero Experience and Operational Track Record in Offshore Wind**: Croatia currently has no installed offshore turbines and thus no domestic operational experience in this sector [2]. This lack of track record is a significant weakness because it entails a learning curve for all stakeholders. Local developers, suppliers, grid operators, and regulators have not yet managed an offshore wind project end-to-end. The absence of even a pilot project means uncertainties in real-world conditions (marine construction, maintenance challenges, etc.) are higher. For instance, Croatian grid operators (HOPS) have not dealt with integrating large offshore wind farms - which have different intermittency and connectivity challenges than onshore wind or hydro - raising concerns about grid preparedness and stability once offshore projects come online. Similarly, local engineering firms and contractors have not yet handled offshore turbine installation or cabling, so they lack practical know-how, potentially leading to reliance on foreign experts initially. There is also no in-country data on offshore wind capacity factors, O&M costs, or environmental impacts specific to Croatian waters, which makes planning and derisking projects harder. Essentially, everything will be a first-of-its-kind project until a baseline is established. This "blank slate" status can increase costs and delays due to trial-and-error. Additionally, banks and investors in Croatia may perceive offshore wind as higher risk without a domestic success example, possibly demanding higher financing costs or guarantees. While Croatia can draw on international experience (the global offshore wind industry's lessons), the local context - regulatory, oceanographic, social - will have unique aspects to navigate. This weakness underlines why initial projects might need extra support (technical partnerships, government guarantees). Overcoming this will likely involve implementing a smaller pilot or demonstration project to build local experience. Until then, the lack of operational track record remains an internal weakness that could slow momentum and requires mitigation through learning from partners and training local teams.

3. **High Initial Costs and Financing Challenges for First Projects**: Offshore wind projects are capital-intensive, and Croatia faces financial and

economic constraints in launching this new sector. The upfront investment required is very high relative to typical energy projects in the country - for example, a single 500 MW offshore farm is projected to cost ~€2 billion in CAPEX [7], which would be one of the largest infrastructure investments in Croatian history [7]. Securing such financing is a challenge for a country of Croatia's size and GDP, especially as a newcomer market (perceived risk is higher, so investors may be cautious). While international funders are interested, there may be limited capacity among domestic banks or investors to co- finance. High Levelized Cost of Energy (LCOE) is another aspect: offshore wind in the Adriatic is expected to have a higher cost per MWh than Croatia's current electricity mix (which includes low-cost hydro and onshore wind). Estimates indicate LCOEs around €90-100/MWh in Mediterranean projects [13], whereas onshore wind and solar in Croatia can be considerably cheaper (onshore wind PPA prices have been in the range of €50-70/MWh in Europe). This cost gap could strain support schemes or make electricity from offshore less competitive unless subsidized or unless costs fall. Furthermore, grid infrastructure upgrades represent an additional internal cost burden: transmitting offshore power to load centres requires new subsea cables, onshore substations, and grid reinforcements. Croatia's coastal transmission network will need expansion to handle gigawatt-scale inputs, and though a 10-year grid upgrade plan exists [6], it implies significant investments by the TSO. Another financial weakness is the limited size of the domestic electricity market- Croatia's peak demand is only on the order of 3 GW; integrating 3 GW of offshore wind by 2050 would be transformative but also potentially saturating unless excess can be exported. This raises questions about market absorption and revenue stability (prices could dip at high wind output times, affecting project economics). In summary, the economic hurdle of initiating offshore wind in Croatia - high CAPEX, potentially high generation costs initially, and necessary grid spending - is a notable weakness. It will require strong support mechanisms (e.g., EU grants, favourable PPAs, or contracts for difference) to make early projects viable. Any delay in securing such financing or policy support could stall projects.

4. *Limited Domestic Technical Supply Chain for Specialized Components*: While Croatia's general industrial base is a strength, it lacks certain specialized offshore wind components and services domestically. Notably, there is no turbine manufacturing in Croatia - the country will depend on foreign OEMs for

wind turbines (blades, nacelles, etc.), which means exposure to global supply chain risks and less local value-added. Similarly, high-capacity installation vessels (jack-up ships or heavy lift crane vessels) are not currently operated out of Croatia; these are usually mobilized from Northern Europe. The local maritime fleet would need upgrades or charters to handle transporting 100+ meter turbine blades or 1000-ton foundations. The absence of purpose-built port infrastructure for offshore wind is another gap - ports may require dredging, reinforcement, and large staging areas for turbines. Rijeka or Pula could be candidates, but upgrades and cranes would be needed. Without these, initial projects might have to use foreign ports as staging bases, adding cost and reducing local benefit. The supply of high-voltage subsea cables and related electrical gear is another niche not present in Croatia (these would be imported). Moreover, Croatia's workforce, while skilled in related fields, has not worked specifically on offshore wind installation, and there could be a shortage of certain experts (e.g., offshore project managers, marine HSE specialists) in the immediate term. Training and capacity building will be needed, meaning early projects might rely heavily on expatriate specialists, which is a short-term weakness. All these supply chain gaps could lead to higher costs or scheduling delays if not addressed (for example, waiting for an installation vessel slot). Over time, as the sector grows, these weaknesses can be mitigated by attracting manufacturers and developing local capabilities, but at present they remain points where Croatia is not self-sufficient internally.

5. *Potential Public Opposition and NIMBYism*: Domestically, there is a risk that segments of the public or local communities may resist offshore wind developments, especially if not properly consulted. Croatia's coastal areas rely on tourism and fishing, and there could be concerns about visual impact, tourism disruption, or fishing zone restrictions due to wind farms. While this is partly an external social factor, how the Croatian institutions manage and preempt these concerns is an internal challenge. A weakness so far is that public awareness about offshore wind is low, as there have been no projects to normalize the idea. Any early controversy (for instance, if a wind farm is proposed near a popular island) could slow down progress significantly. The government's decision long ago against wind farms on islands [5] highlights sensitivity to preserving natural and cultural seascapes. Thus, internal capacity for stakeholder engagement might be underprepared. This is listed as a

weakness to emphasize that community acceptance must be actively built by Croatian authorities and developers; currently, there's a gap in that no established process or precedent exists for offshore wind public outreach in Croatia.

6. *Administrative and Human Resource Constraints*: Croatia's institutions (ministries, agencies) may be under-resourced in terms of personnel dedicated to offshore wind permitting. The NECP analysis noted insufficient human resources for permitting processes as a barrier [3]. Processing complex environmental impact assessments, maritime spatial planning, and grid studies for offshore projects will require specialized knowledge and adequate staffing. If those are lacking, it can exacerbate the regulatory delays (Weakness #1). This internal shortcoming is being addressed by seeking external expertise (via EBRD's technical support), but it remains a bottleneck in the short term.

Data Gaps: In evaluating weaknesses, specific quantitative metrics (like "average permitting time in months" or "MW of grid upgrade needed") are not yet documented because the sector is new. We rely on qualitative assessments and analogous evidence (e.g., known slow permitting for onshore projects, or cost estimates from initial studies). These weaknesses are broadly recognized in policy discussions, and addressing them will be critical for Croatia to move from planning to construction in offshore wind.

Opportunities

Opportunities are external factors or trends that Croatia can capitalize on to advance its offshore wind sector. These can be regional, global, or market-driven. The top three opportunities are in bold, representing the most strategic external boosts for Croatia's offshore wind development.

1. **Strong EU Support and Funding for Offshore Wind Expansion**: Croatia can leverage significant support from the European Union and international institutions as a major opportunity. The EU's climate and energy goals (European Green Deal, REPowerEU) heavily emphasize offshore renewable energy, with funding mechanisms and policy frameworks to match. For example, the Connecting Europe Facility (CEF) has already co-funded a preparatory study for a 300 MW cross-border wind farm between Croatia and

Italy [12] - a clear indication of EU willingness to invest in Croatian offshore wind. Under the EU Offshore Renewable Strategy, binding targets for offshore energy have been set (Croatia's 3 GW by 2050 is part of an EU-wide 300 GW goal), which translates to technical and financial assistance for member states. Access to EU grants, loans, and technical expertise is a huge opportunity: Croatia can utilize programs like Horizon Europe for R&D, the Innovation Fund for first-of-a-kind projects, and the European Investment Bank (EIB) or EBRD for low-interest project financing. Indeed, the EBRD is actively supporting Croatia, having financed the initial Action Plan and indicating readiness to assist with both policy reform and direct project finance [6]. Additionally, EU initiatives such as the Offshore Renewable Energy Platform for the Mediterranean will provide knowledge exchange and possibly joint procurement opportunities. Another facet is the EU's focus on integrated networks - Croatia can tap into EU funding for grid interconnections (improving links with Italy, for instance, to handle offshore wind power trade). The external push from the EU to meet climate targets by 2030/2050 aligns perfectly with Croatia's needs, creating an environment where regulatory approval and financial backing for offshore wind can be obtained more easily than if Croatia were acting alone. Moreover, being an EU member gives Croatia access to best practices and frameworks already developed by countries like Germany, Denmark, or Poland for offshore wind tenders and maritime planning, which Croatia can adapt (a form of knowledge opportunity). In summary, the confluence of EU policy priority and funding availability is a major external opportunity that reduces financial risk, provides technical know-how, and adds political momentum to Croatia's offshore wind ambitions.

2. **Cross-Border Collaboration in the Adriatic-Ionian Region**: The Adriatic-Ionian regional context offers unique opportunities for transnational cooperation on offshore wind. Croatia's geographic position means any large offshore development will have implications for (and can benefit from partnerships with) its neighbours - Italy, Slovenia, Montenegro, and beyond. One concrete opportunity is the planned joint offshore wind project with Italy: Croatia and Italy are considering a 300 MW wind farm in the Northern Adriatic Sea, located between Pula (HR) and Ravenna (IT) [10]. This project, currently under study by Croatia's INA with EU funding, could become a flagship cross-border wind farm by 2029 [10], [12]. If it proceeds, Croatia stands to gain from

shared investment, shared infrastructure (potentially an interconnection linking both countries' grids [12]), and shared knowledge. Such cooperation can split costs and risks, making projects more feasible than if undertaken by one country alone. There are also broader regional initiatives: for example, the North Adriatic Hydrogen Valley (a partnership of Italy-Slovenia-Croatia) aims to utilize renewable energy for green hydrogen production [8], and offshore wind could become a key power source for that, opening additional funding and offtake opportunities. Transnational grid planning in the Adriatic is another area - a coordinated approach could lead to the development of an Adriatic offshore transmission backbone or interconnectors that allow Croatia to export surplus wind power to neighbours (Italy's market is much larger, offering an export opportunity for Croatia's potential 25 GW output). Additionally, knowledge exchange and joint research with nearby countries (e.g., sharing environmental monitoring data or maritime spatial planning methodologies) can accelerate learning. The ADRION region, through initiatives like ADRIONWIND, fosters a network of experts and stakeholders that Croatia can benefit from. Another external factor is the possibility of EU-wide offshore wind auctions or joint bidding zones in the future - participating in these with neighbours can attract bigger industry players to the Adriatic. In summary, cross-border collaboration and regional integration present opportunities to achieve economies of scale, attract investment (by presenting a larger unified market), and ensure efficient use of the Adriatic Sea space. For Croatia, working closely with Italy (which already has one offshore wind farm and many planned [14]) and others can jump-start its offshore sector through partnerships rather than going it alone.

3. **Emerging Market Potential and First-Mover Advantage in a New Sector**: Offshore wind represents a new market in Croatia with significant growth potential, and acting early gives Croatia the chance to establish itself as a regional leader. If Croatia successfully implements its first projects by the late 2020s, it will be among the first movers in the Eastern Adriatic - ahead of neighbours like Montenegro or Albania (who have good wind potential but even less infrastructure) and potentially competitive with Italy's southern Adriatic developments. This could allow Croatian companies and ports to become hubs for offshore wind in the Adriatic- Ionian region, capturing service contracts and export opportunities. As noted by industry observers, newcomers like Croatia can benefit from Europe's advanced supply chain and tech which are looking

for new markets [4]. Global offshore wind developers and turbine manufacturers are constantly seeking new project sites; Croatia can capitalize on this interest to bring in reputable partners (as seen with foreign companies like Western Power already studying Croatian sites [13]). The opportunity lies in attracting investment: a strong political signal (auctions, targets) plus huge wind potential could draw billions in foreign direct investment to Croatia's energy sector. Additionally, offshore wind can feed into new value streams - for example, producing green hydrogen or powering energy-intensive industries - creating industrial growth. With its high potential, Croatia could even explore exporting electricity to Balkan neighbours via existing interconnections, thus opening an external market for its offshore wind power (especially as these neighbours seek clean energy to meet their targets). There's also an opportunity to diversify Croatia's energy mix and increase energy security: offshore wind can significantly reduce reliance on imported fossil fuels (Croatia currently imports ~50% of its energy) [3], which is strategically important in the volatile global energy context. Each external driver - be it global corporate interest in new wind sites, rising regional electricity demand, or European decarbonization pressures - points to a scenario where Croatia's offshore wind sector, if nurtured quickly, could flourish and even outpace local demand, positioning the country as an exporter of green electricity and expertise. The first successful projects will create a demonstration effect that can bring further investments in a virtuous cycle. Thus, the market timing is a major opportunity: offshore wind is booming globally, and Croatia can ride this wave with strong potential and supportive trends at its back.

4. *Decarbonization and Energy Security Imperatives*: The global push for decarbonization and recent energy security concerns (e.g., volatile gas supplies in Europe) create an opportunity for Croatia to justify and accelerate offshore wind on strategic grounds. There is external pressure to reduce CO_2 emissions and meet climate commitments (Paris Agreement, EU Fit-for-55 targets), which means any clean energy source like offshore wind will be looked upon favourably by international stakeholders. This can translate into easier approval processes and possibly climate finance. Simultaneously, the desire to cut dependence on imported fossil fuels (especially after recent geopolitical events affecting natural gas) is high - Croatia can pitch offshore wind as a solution to replace aging fossil fuel generation and to supply green power to

electrify transport and heating. If Croatia moves swiftly, it can secure its own energy supply and even help neighbours (selling surplus), which might attract cooperative agreements or funding. In essence, the external environment of needing clean and secure energy is an opportunity that aligns perfectly with developing offshore wind capacity.

5. *Technology Innovation - Floating Wind and Hybrid Projects*: Technological advancements in offshore wind are an opportunity for Croatia to utilize its deeper offshore areas and integrate other marine renewables. Floating wind technology is rapidly maturing (with global floating projects expected to reach tens of GW by 2035). Croatia's potential includes ~13 GW of floating wind in deeper Adriatic waters [4]. As floating turbines become commercially viable, Croatia can open vast new zones for development that were previously off-limits due to depth. This could also attract specialized floating wind developers to the country, and possibly EU innovation projects (the Adriatic could host a floating pilot farm given its moderate wave climate). Additionally, Croatia can explore hybrid offshore projects, combining wind with floating solar PV (which the Action Plan also considered) [5], or using offshore wind power for green hydrogen production (tying into the Hydrogen Valley concept). These innovative approaches can draw R&D funding and put Croatia on the map as a test-bed for cutting-edge offshore solutions. For instance, an offshore wind farm could be coupled with an electrolyser on a decommissioned platform to produce hydrogen - a concept that may garner EU innovation grants. Embracing such technology opportunities could help overcome some weaknesses (like moderate wind speeds, by adding solar generation in low wind periods) and maximize use of sea space.

6. *Repurposing Oil & Gas Assets and Workforce*: Externally, the decline of oil and gas exploration in the Adriatic provides an opportunity to transition those assets and professionals into offshore wind. Internationally, there is momentum (and sometimes funding) for converting oil & gas platforms or using the expertise of oil industry workers for renewables. Croatia's INA and the Hydrocarbon Agency are already considering converting old gas fields to renewable sites [6]. If successful, this could draw positive attention and possibly funds aimed at just transition. The opportunity is to turn a potential liability

(abandonment of fossil infrastructure) into an asset for green energy, with support from EU Just Transition funds or similar.

In summary, Croatia's external landscape for offshore wind is highly favourable - European policy, regional cooperation, investor interest, and technology trends all present powerful opportunities. By proactively engaging with these external drivers (e.g., securing EU funds, partnering with neighbours and experienced developers, and positioning itself in new tech niches), Croatia can significantly accelerate its offshore wind deployment and amplify the benefits, turning its vision of a green Adriatic powerhouse into reality.

Threats

Threats are external challenges or risks from the broader environment that could hamper Croatia's offshore wind development. They often require mitigation strategies since they are outside direct control.

1. **Regulatory and Permitting Delays or Policy Uncertainty**: An overarching external threat is that slow regulatory processes or shifting policies (especially at the national, but on the EU level as well) could delay projects to the point of missing targets. While we listed the lack of framework as an internal weakness, the manifestation of that as project delays is an external risk: e.g., if maritime spatial planning is prolonged or if environmental permits get stuck in lengthy reviews, developers might abandon Croatian projects for more predictable markets. The NECP explicitly flags slow permitting as a barrier [3], and if reforms are not enacted swiftly (or if they get bogged down in political changes or bureaucratic inertia), Croatia could fail to allocate sites or sign contracts in time to meet 2030 goals. Policy uncertainty is another threat - if there are changes in government or priorities, support schemes for offshore wind could be reduced or delayed. Additionally, unpredictable regulatory requirements (for example, if new stringent environmental regulations at the EU level are introduced mid-project) can deter investment. A related threat is legal challenges: offshore projects in Europe often face lawsuits (from NGOs or local stakeholders), and an unclear legal framework could increase the vulnerability of Croatian projects to court injunctions. Essentially, until a stable regulatory regime is proven, there's a risk that external administrative or

political factors cause timeline slippages, jeopardizing investor confidence and causing Croatia to lag behind schedule. Mitigating this threat involves expediting the establishment of rules and maintaining political consensus on the importance of offshore wind regardless of political cycles.

2. **Environmental Constraints and Social Opposition**: The Adriatic Sea's environmental sensitivity and the risk of social pushback constitute a significant external threat. The Adriatic is a relatively enclosed sea with rich biodiversity (marine mammals, migratory bird routes, fisheries) and important protected areas (e.g., Natura 2000 sites). Environmental constraints could impose strict conditions on offshore wind projects: for instance, certain identified low-impact zones might still require extensive environmental impact assessments and mitigation measures (like turbine shutdowns during bird migration, noise limits for marine life, etc.), which could reduce energy yield or increase costs. If any proposed wind farm is perceived to threaten critical habitats or iconic seascapes (for example, near national parks or tourist coasts), it could face strong opposition from environmental groups and local communities. Social opposition may arise from concerns over visual impact on the pristine Adriatic horizon (important for tourism) or potential impacts on the fishing industry. In Croatia, coastal tourism is a huge economic driver, and any notion that wind farms could spoil views or deter visitors might rally public resistance. There's also a cultural attachment to seascape aesthetics and heritage (many coastal towns might resist industrialization of nearby waters). For example, Italy's experience shows that on its Adriatic coast, local objections have slowed some projects. If similar sentiment grows in Croatia - "Not In My Back Yard (NIMBY)" - it could pressure politicians to scale back or relocate projects, causing delays or cancellation. Another external factor is the transboundary environmental impact: since the Adriatic is shared, Italy or other neighbours could raise concerns if a Croatian project is near their waters, potentially invoking international environmental conventions. Furthermore, extreme weather events (strong Bora or Jugo storms) and seismic activity in the region pose environmental/technical threats to infrastructure that must be designed for, otherwise accidents or failures could cause environmental harm and backlash. Overall, the threat here is that without careful site selection and stakeholder engagement, environmental/social factors could significantly disrupt Croatia's offshore wind timeline. The mitigation involves early and transparent

engagement, rigorous environmental planning (as the Action Plan has attempted by focusing on low-impact areas [5]), and potentially compensation measures for affected communities (like revenue sharing or tourism promotion alongside wind farms).

3. **Competition from Other Countries and Energy Sources**: Offshore wind development in Croatia could face stiff competition - both for investment and for market space - from other countries' projects and alternative energy options. Regionally, Italy is aggressively pursuing offshore wind, particularly floating projects in the Adriatic and Ionian Seas. Italy currently has the first Mediterranean offshore wind farm (30 MW at Taranto) and has a pipeline of dozens of proposed projects totalling several GW [14]. International developers may prioritize Italy (a larger market with more experience) over Croatia if Croatian processes are slower or less lucrative. Additionally, countries like Greece and Spain are gearing up for floating wind in the Mediterranean, which could absorb industry resources (vessels, turbines, investment capital) that might otherwise come to Croatia. On a broader scale, global supply chain competition is a threat: the surge in offshore wind demand worldwide (North Sea, US, Asia) means there is competition for the same pool of wind turbines and construction vessels. If Croatia enters the market a bit later, it might struggle to secure the necessary equipment or contractors in a timely manner, potentially facing higher prices or scheduling bottlenecks. The threat of being a smaller, new market in a very hot global industry is real - larger markets may command priority. Another angle is competition from other energy sources: Croatia and investors might find other renewables (onshore wind, solar) or even imported energy more immediately cost-effective. For example, utility-scale solar PV has boomed in Croatia recently (700 MW by 2024) [15] with much lower costs and quicker build times. If solar and onshore wind continue to expand rapidly and meet mid-term targets, the urgency for offshore could diminish, leading to less political or financial support (offshore could be seen as too expensive in the short run). Similarly, if regional electricity prices remain low or gas infrastructure like LNG is expanded (Croatia has an LNG terminal boosting gas supply), the economics of offshore wind could be undercut. In essence, offshore wind must prove its value against strong competition; if not, projects might not materialize as planned. A specific threat example: if by 2025-2026 Croatia hasn't advanced its projects, and meanwhile Italy awards several

Adriatic projects and possibly builds interconnectors toward the Balkans, Croatia's window to attract investments could narrow. Another example is hydrogen: if the future energy paradigm shifts such that investments go directly into green hydrogen production or other tech, standalone offshore wind farms might see less interest. Therefore, competitive dynamics pose an external threat - Croatia needs to move decisively or risk losing out to other opportunities capturing the investment and momentum.

4. *Global Economic and Supply Chain Risks*: The offshore wind industry globally has been experiencing challenges like rising material costs (steel, copper), inflation, and supply chain disruptions (partly due to the COVID-19 aftermath and geopolitical tensions). These global factors threaten project viability in emerging markets. For Croatia, higher-than-expected inflation in turbine prices or interest rate hikes could make the difference between a project being bankable or not. If a major turbine manufacturer faces financial issues (some have had losses recently) or delays, a Croatian project could be pushed back. Additionally, currency fluctuations (as equipment is priced in Euros or dollars) and the need to import most equipment mean external economic stability is crucial. Any recession or downturn that tightens credit availability could delay financing for the multi-billion offshore investments. Thus, Croatia is exposed to the overall health of the offshore wind supply chain and global economy - factors beyond its control that could threaten timelines and costs.

5. *Maritime Use Conflicts*: The Adriatic Sea is used for various purposes: shipping lanes, military zones, fishing grounds, tourism, and potentially other energy (oil/gas extraction still ongoing in places). External conflicts with these uses can threaten offshore wind deployment. For instance, international shipping routes pass through the Adriatic; new wind farm zones must ensure they don't impede navigation. If a prime wind site conflicts with a heavy traffic route, international maritime authorities might object or require alterations. Similarly, fishing unions might lobby against large exclusion zones around turbines. The naval or coast guard operations of Croatia or NATO allies might restrict certain offshore areas (military exercise areas) where wind farms cannot be built, effectively reducing available sea space. Additionally, there are artillery

dumping sites in the northern Adriatic - remnants from the WW2 bombing campaigns - that might impact availability of suitable locations. While these are not insurmountable issues, they represent external constraints that could reduce flexibility and require careful maritime spatial planning to resolve. If not managed, these conflicts could become threats by delaying site approvals or causing diplomatic issues (in case of near-border installations).

6. *Climate and Natural Disaster Risks*: As an external threat, changing climate patterns could affect wind resources or increase extreme weather events. If wind patterns shift (although unlikely significantly by 2030, but possible by 2050), it could alter the energy output from planned sites. More immediately, the Adriatic could see more frequent extreme storms or rare events like waterspouts, which could damage infrastructure. Earthquake risk (the Adriatic is in a seismically active zone) could threaten offshore foundations or undersea cables. These natural threats require engineering solutions, but if underestimated, they could pose serious operational challenges or drive insurance costs up.

In summary, while the external environment offers many opportunities, it also presents critical threats that could impede or derail Croatia's offshore wind progress if not mitigated. Key among these are the risk of bureaucratic delays, environmental opposition, and stiff competition. Proactive planning, stakeholder engagement, and strategic alignment with regional and global trends will be necessary to manage these threats. Croatia's ability to anticipate and address these external risks will greatly influence the success of its offshore wind endeavours.

SWOT Matrix

The following matrix provides a high-level overview of the SWOT analysis, with the internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats) summarized in a 2x2 grid for quick reference.

Strengths	Weaknesses
1. Vast offshore wind potential (~17-25 GW) in Adriatic waters - excellent wind resources and ample suitable sites	**1. No established regulatory framework for offshore wind** - permitting and licensing processes are unclear, causing investor uncertainty
2. Strong maritime industry & supply chain - 60+ local companies and major shipyards ready to support offshore projects.	**2. Zero operational experience** - no installed capacity yet, leading to steep learning curve and reliance on foreign expertise initially.
3. High political commitment to renewables - ambitious targets (510 MW by 2030), government-backed studies, and >50% RE power share achieved.	**3. High initial costs** - ~€2 billion needed for first 500 MW project, high LCOE (~€90/MWh), and grid upgrades required (strain on financing).
4. Favourable geography - shallow coastal areas and existing offshore gas platforms offer easy sites and potential for repurposing.	4. Limited specialized infrastructure - no local turbine manufacturing, need to import technology and vessels (dependency on global supply chain)
5. Skilled workforce & R&D base -	5. Bureaucratic capacity

experienced onshore wind engineers, strong academic involvement in offshore research.	constraints - few dedicated personnel for offshore permitting, risking slow project approvals.
6. Established grid integration of renewables - knowledge from 1.2 GW onshore wind integration can aid future offshore integration.	6. Public acceptance untested - coastal tourism/ fishing sectors might resist wind farms (NIMBY concerns), with no engagement precedent.
Opportunities	**Threats**
1. EU support & funding - CEF, EBRD, and EU Green Deal initiatives provide financing, technical aid, and favourable policies for offshore wind.	**1. Permitting delays & policy risk** - slow approvals or shifting regulations could postpone projects beyond 2030 targets
2. Cross-border projects - collaboration with Italy and others (e.g., 300 MW joint wind farm planned with Italy by 2029) can share costs and improve grid integration.	**2. Environmental & social opposition** - concerns over marine ecology, fisheries, and tourism may lead to public resistance or legal challenges if not managed.
3. Growing market & first-mover advantage - chance for Croatia to lead in Adriatic offshore wind, attract foreign investors (already interest from developers), and export surplus green power to region.	**3. Competition** - Italy's and others' offshore plans (Italy ~9 GW floating pipeline) compete for investment; onshore/solar projects could outcompete offshore if offshore is slower or costlier
4. Decarbonization momentum - climate targets and energy security needs push demand for	4. Global supply chain bottlenecks - turbine supply, vessel availability and cost

offshore wind, easing high-level approvals and regional power purchase opportunities.	inflation could hinder project timelines and economics.
5. Tech innovation - floating wind advances open deeper Adriatic zones; opportunity to integrate wind with floating solar or green hydrogen production.	5. Maritime use conflicts - shipping lanes, military zones, or fishing areas might constrain available project sites if not coordinated.
6. Transition of oil/gas sector - chance to repurpose old offshore rigs and retrain oil industry workforce for renewables (with “just transition” support).	6. Extreme weather/climate risks - Adriatic storm events or seismic activity could pose engineering challenges and operational risks to turbines.

This SWOT matrix encapsulates the critical points discussed. Croatia’s path to offshore wind development will involve leveraging its strengths (e.g., abundant wind resources, industrial capacity) and opportunities (EU support, regional cooperation) to overcome the weaknesses (regulatory gaps, no prior experience) and guard against threats (delays, opposition, competition). The prioritization highlights where efforts might be most impactful: for instance, addressing the regulatory framework (W1) and environmental engagement (T2) early on, while harnessing EU funding (O1) and the local supply chain (S2).

Key Performance Indicators (KPIs)

Installed Offshore Wind Capacity (MW or GW)	0 MW (no operational offshore turbines to date).
Annual Energy Output (MWh) and Capacity Factor (%)	0 MWh/yr at present, future CF likely 35–45% based on N. Adriatic wind regime (6–7 m/s).
Number and Capacity of Planned or Under-Development Projects	~800 MW early pipeline, ~500 MW fixed-bottom off Istria and ~300 MW cross-border (Pula–Ravenna) under feasibility, no projects permitted yet.
Annual Investment Level (EUR)	No official offshore-specific annual figure yet, example CAPEX: ~€2.0 bn for a 500 MW project. Early-stage studies supported by EBRD and EU/CEF, annual needs likely hundreds of millions through 2030 (pending auctions/FIDs).
Levelized Cost of Energy (LCOE)	No Croatia-specific value, indicative Mediterranean €90–100/MWh for current tech. First projects may price higher until scale-up.
Employment Impact	0 direct offshore jobs currently. Readiness study identified ~60 Croatian firms positioned to participate. A 500 MW project could create hundreds of construction jobs and ~50–100 permanent O&M roles (project-specific).
Local Supply Chain Development	Moderate–high readiness: strong maritime/shipyards (Pula, Rijeka, Split), marine engineering, electrical and logistics firms, ~60 domestic companies mapped. No local turbine OEM, specialized vessels likely imported.

Innovation Metrics	Active university and R&D involvement (e.g., University of Zagreb, authors of national Action Plan). Offshore-specific patents low, related initiatives include North Adriatic Hydrogen Valley and research on floating and grid integration.
Regulatory Efficiency	Historically slow and complex. Dedicated offshore framework and maritime spatial plan under preparation, overlapping jurisdictions and no one-stop shop yet. Baseline permitting time unknown until first projects set precedent.

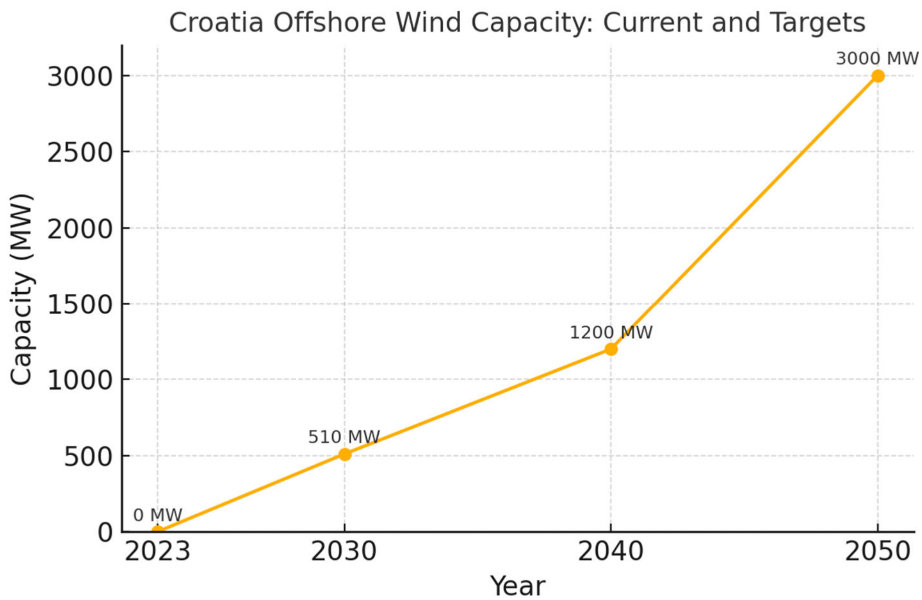

Figure 1. Croatia's offshore wind capacity targets for 2030-2050. The country aims for 0.51 GW by 2030, 1.2 GW by 2040, and 3 GW by 2050 [3] Currently, no offshore capacity is installed (0 MW as of 2025), underscoring the scale of growth required.

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Italy

Introduction

Offshore wind energy is indeed one of the most crucial measures for climate mitigation and adaptation. Offshore wind power in Italy has great potential, but it requires greater attention to costs, environmental impact, and regulations in order to be developed effectively and sustainably. The development of offshore wind energy can help achieve energy transition goals and create new economic opportunities.

The current state: 76 GW of renewable energy will need to be installed in Italy between 2024 and 2030 to meet the target set by RePower EU. Considering that around 8 GW of existing plants will need to be replaced due to obsolescence, in order to reach 143 GW by 2030, more than 12 GW per year will need to be built. This could bring significant benefits to the national economy and employment. In line with what was outlined at the beginning of this document when introducing the data analysis, it is important to highlight that the following SWOT analysis pays particular attention to the Floating Offshore Wind. This focus reflects the strategic role it plays in the Italian context in light of the country's energy transition, due both to the geomorphological characteristics and depth of its seabed and to local wind dynamics.

Italy's seabed morphology is such that fixed-bottom installations are viable only in limited coastal areas, while more than 90% of maritime zones reach depths greater than 50 meters within just a few nautical miles from shore. These conditions make floating offshore wind the only scalable option for most of the country. Coupled with offshore wind speeds that support capacity factors above 40%, floating wind emerges as one of the most competitive technologies for achieving the decarbonisation goals of the European Green Deal and the Fit for 55 package. According to estimates from the Global Wind Energy Council, Italy holds the third largest potential market worldwide for floating wind, with technical capacity estimated at 207 GW and potential generation above 540 TWh annually.

This strategic significance is also reflected in European and national energy planning. The EU's 2020 Offshore Renewable Energy Strategy established ambitious milestones of 60 GW offshore wind capacity by 2030 and 300 GW by 2050, reaffirmed by the European Climate Law, Fit for 55, and REPowerEU. Italy's updated PNIEC (2024) incorporates offshore wind—particularly floating technologies—for the first time as a pillar of its renewable strategy. Offshore wind is framed as a complement to onshore resources, minimising land use and enhancing energy diversification while aligning with EU commitments.

At the regional scale, not all Italian coastal regions offer the same preconditions for offshore deployment. Depth constraints, environmental sensitivities, and spatial conflicts limit opportunities in many areas. This explains why the focus of both project pipelines and strategic planning falls disproportionately on southern regions—above all Apulia—together with Calabria and Sicily. These territories combine strong wind resources, suitable maritime space, and high renewable penetration, making offshore development both technically viable and strategically necessary.

Apulia stands out as a national frontrunner. With over 3 GW of installed wind and 3.2 GW of solar, it already leads Italy in renewable generation. The updated Regional Energy and Environmental Plan (PEAR 2024) designates offshore wind as a strategic lever for the region's decarbonisation and economic transformation. Apulia currently hosts 22 of the 87 offshore projects under environmental assessment, including several of the country's most advanced floating wind proposals. The regional plan foresees an indicative 641 MW offshore wind capacity by 2030—nearly one third of Italy's national target—within a broader strategy that envisages more than 7 GW of new renewables in the same period.

The emphasis on Apulia is also justified by maritime spatial planning choices. Three planning units off the coasts of Manfredonia, Bari, and Brindisi have been designated as zones for offshore wind development, with potential to support up to 2 GW while avoiding ecologically sensitive areas such as Gargano and Salento. Beyond energy generation, offshore development in Apulia is expected to drive industrial renewal, centred on port upgrades in Taranto and Brindisi and the creation of a local supply chain in maritime engineering and offshore services. For these reasons, the Italian introduction highlights Apulia specifically, without extending equal focus to all coastal regions.

Methodology

The SWOT analysis for Italy was developed through a structured desk research approach. Key references included national policy documents such as the Integrated National Energy and Climate Plan, the PNIEC updates, and Terna's grid development plan. Reports and studies from ARERA, RSE, and other national agencies were also reviewed to provide data on current capacity, project pipelines, and regulatory conditions. Additional evidence was drawn from European Commission reports and industry publications to place Italy's offshore wind sector within a wider European context.

Internal and external factors were identified from these sources. Internal aspects included the existence of the first operational offshore wind plant at Taranto, the scale of the project pipeline under environmental assessment, and the availability of port and grid infrastructure. External aspects concerned the rapid growth of floating wind technology, the strong interest of private investors, and the role of European funding mechanisms in supporting large-scale deployment. Each factor was described with evidence and linked to its expected impact on Italy's offshore wind development.

The ADRIONWIND framework was applied to classify the findings into strengths, weaknesses, opportunities, and threats. Evidence was cited directly from official documents and industry reports, and the most critical factors were highlighted according to their influence on the medium- and long-term expansion of offshore wind. This ensured comparability with the other national analyses and provided a coherent basis for Italy's contribution to the transnational R&I strategy.

SWOT Factors

Strengths

1. **Higher Wind speeds:** In general, wind strength and speed are greater offshore than on land. Higher wind speeds lead to greater energy production in a shorter amount of time.
2. **More consistent energy without interruptions:** Offshore wind speeds tend to be more stable compared to those on land. Once again, a more stable wind supply results in a more reliable and non-intermittent energy source. The result is the higher capacity factor meaning that an installation of given nameplate capacity will produce more electricity at a site with more consistent and stronger wind which is usually found offshore and only at very few specific points onshore

3. **Lower environmental and noise impact:** Offshore wind farms are typically located beyond the visible horizon. As a result, they reduce both visual and noise impact compared to onshore installations. Moreover, in the case of Floating Offshore Wind, this strength is characterized by several significant peculiarities: in terms of reduced visual impact, at a distance of just 8 nautical miles (approximately 15 km), wind turbines are barely perceptible to the human eye. Moreover, the impact during construction is even lower: Construction activities are less invasive, minimizing disruption to the seabed and marine fauna. Regarding the lower environmental impact, in the specific case of Floating Offshore Wind, No Impact on Posidonia and Coralligenous Habitats deserves to be highlighted: Extensive Posidonia meadows and coralligenous formations are located near the coast and will not be affected by offshore wind installations.
4. **High End-of-Life Material Recoverability:** The cost of offshore wind farms using floating technology is significantly higher than that of fixed-foundation installations. The blades can be dismantled at the end of service to recover over 90% of the material.

Weaknesses

1. **Intermittency of the primary source:** wind power generation is subject to the issue of wind inconsistency. As for the floating offshore wind, wind energy generation is subject to the intermittency of the wind, which can vary over time and location, requiring storage systems to ensure stable supply.
2. **Impact on marine biodiversity** and possible collisions with marine animals, as a weakness also affecting Floating Offshore Wind.
3. **Navigation safety:** Offshore wind farms can pose a navigational obstacle, requiring proper marking and clearances to ensure the safety of maritime traffic. Referring to the Floating Offshore Wind, Ongoing maintenance and potentially high operating costs: The action of waves and extremely strong winds—especially during storms—can damage wind turbines, requiring immediate intervention to restore proper functionality. In such cases, restoring energy supply after a malfunction can take longer than in onshore wind farms, due to challenges related to transporting the necessary equipment for maintenance, leading to increased operational costs.

Opportunities

1. **Benefits to the national economy and employment**
2. **Benefits for Local Fisheries:** Offshore wind farms offer two key benefits to local fishing communities: they protect nearshore areas from bottom trawling and create a de facto marine protected area, promoting fish stock recovery.
3. **Benefits for fish stock recovery and potential offshore aquaculture** are worth highlighting, in the specific case of the Floating Offshore Wind.

Threats

1. **Bureaucracy and permitting delay:**. Complex bureaucracy and technical challenges can slow down the development of offshore wind projects, and in particular Floating Offshore Wind.
2. **Lack of maritime planning**
3. **Absence of reliable operational data**: this threat is relevant particularly for Floating Offshore Wind, as it introduces uncertainty in turbine assembly design and in the assessment of its long-term durability.

Top Three Critical Factors

(Key strengths, weaknesses, opportunities, or threats with highest strategic weight)

Top critical *strengths*: **More consistent energy without interruptions:** Offshore wind speeds tend to be more stable compared to those on land. Once again, a more stable wind supply results in a more reliable and non-intermittent energy source. The result is the **higher capacity factor**

Top critical *opportunity*: **Benefits to the national economy and employment.** Offshore wind development offers significant economic and employment benefits, including job creation, supply chain development, and increased tax revenue. It can also revitalize port communities and promote equitable economic development. The industry's growth fosters a skilled workforce.

Top critical *threat*: **Complex bureaucracy and technical challenges** can slow down the development of offshore wind projects, and in particular Floating Offshore Wind.

Interpretation of SWOT Findings

In the whole EU area, the challenging goals for the reduction of CO2 emissions until 2030 and even higher targets for 2050 will require a huge increase of the number of new RES capacities. In Italy +70 GW by 2030 compared to installed capacity in 2019 in the Fit-for-55 policy scenario). In the area of new sources, offshore wind power plants will play a greater role than before, due to their comparative advantages compared to onshore plants in terms of higher energy production and less impact on environment.

Currently, out of approximately 130 offshore wind projects proposed in Italy, only a small portion has initiated the Environmental Impact Assessment (EIA) process. According to the Offshore Renewable Energy Association (AERO), in 2024 only 23 out of 75 projects that accepted grid connection offers from Terna had begun the EIA process. This indicates a very low progress rate compared to the total target of 86 GW.

Authorization procedures are often slowed by institutional resistance, particularly from regional authorities and the Ministry of Culture. For example, between 2017 and 2021, Italian regions issued 41 negative opinions out of 42 national EIA cases, and the Ministry of Culture gave 35 negative opinions out of 45.

Beyond bureaucracy, Italy faces technical difficulties linked to the absence of maritime spatial planning. The lack of a clear strategy for allocating marine areas to offshore wind development has led the European Commission to initiate infringement proceedings against Italy for failing to implement the relevant EU directive.

These issues jeopardize Italy's ability to meet its decarbonization targets and reduce reliance on fossil fuel imports. According to environmental group Legambiente, at the current pace, Italy may not reach its goal of 90 GW of renewables by 2030 until 2046—16 years late.

To unlock the potential of offshore wind energy, it is essential to streamline permitting procedures, improve coordination among involved institutions, and develop effective maritime planning. Only through an integrated and proactive approach can the current barriers be overcome and a sustainable energy transition in Italy be ensured.

SWOT Matrix

Table 1. Offshore Wind

Strengths	Weaknesses
1. Higher Wind speed	**1. Intermittency of the primary source**
2. More consistent energy without interruptions	**2. Impact on marine biodiversity** and possible collisions with marine animals
3. Lower environmental and noise impact	**3. Navigation safety** concerns to maritime traffic
4. High End-of-Life Material Recoverability	
Opportunities	**Threats**
1. Benefits to the national economy and employment	**1. Complex Bureaucracy and permitting delays**
2. Benefits for Local Fisheries	**2. Lack of maritime planning**
3. Benefits for fish stock recovery and potential offshore aquaculture	**3. Absence of reliable operational data**

Key Performance Indicators (KPIs)

Key Performance Indicators related to the development of offshore wind energy are as follows:

Installed Offshore Wind Capacity (MW or GW)	30 MW (Beleolico, Taranto)

Annual Energy Output (MWh) and Capacity Factor (%)	Almost 58,000 MWh/yr from Beleolico. implied CF = 22% for that plant (illustrative, not national average)
Number and Capacity of Planned or Under-Development Projects	About 87 proposals under environmental assessment; cumulative pipeline multi-GW; no final authorisations as of 2025
Annual Investment Level (EUR)	System enablers: €16.5bn Terna grid plan (5-year horizon). Wind sector facility to mobilise up to €8bn via EIB–Intesa counter-guarantee; offshore-specific CAPEX pending FIDs
Levelized Cost of Energy (LCOE)	€85–150/MWh (indicative range; technology/site dependent; floating generally higher)
Employment Impact	Early-stage jobs in ports/logistics (Taranto, Augusta). No robust national offshore-specific headcount yet; impacts expected to scale with project approvals
Local Supply Chain Development	Emerging: ports (Taranto, Augusta) adapting; partnerships (e.g., Ming Yang–Renexia) exploring local manufacturing; domestic shipbuilding/steel/service firms poised to enter
Innovation Metrics	Active R&D on floating foundations, dynamic cables, and grid integration; universities and RSE engaged; Italian partners in EU projects (e.g., FLOW, MISTRAL)
Regulatory Efficiency	Permitting remains lengthy (~4–6 years) for EIA/approvals; no large projects authorised yet; streamlining underway via Maritime Spatial Plan and TEN-E offshore corridors

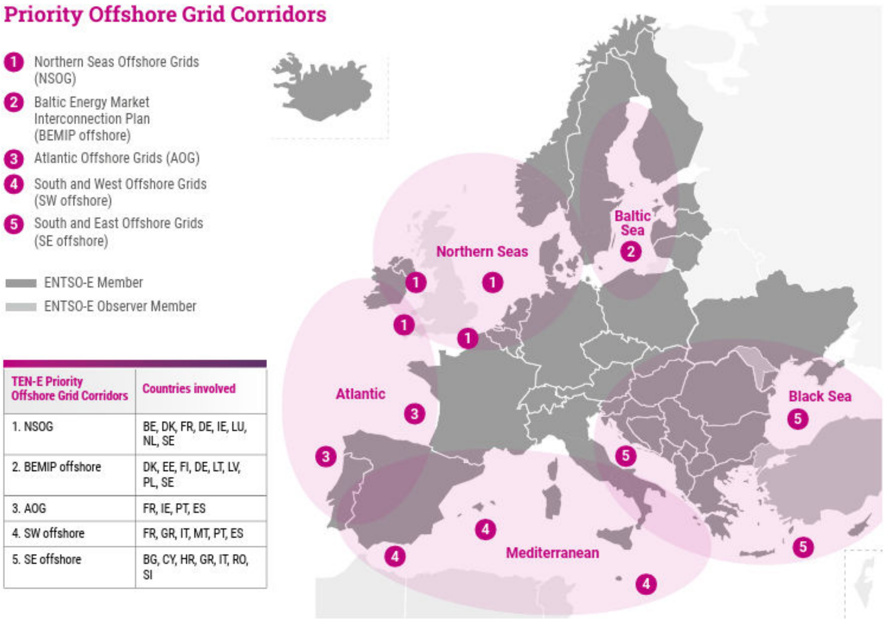
In detail:

- **Installed offshore capacity**: Target of approximately 2.1 GW of offshore wind capacity installed by 2030, as part of a total wind capacity (onshore + offshore) expected to reach around 28.1 GW by the same year.
- **Annual Energy Output (MWh) and Capacity Factor (%)** - Italy's annual energy output from offshore wind is estimated to be over 58,000 megawatt-hours (MWh) per year, according to the International Trade Administration. The Beleolico Park, a 30 MW offshore wind farm, contributes to this output. Additionally, Italy has a large potential for floating offshore wind, with estimates reaching 540.8 TWh/year.
- **Number and Capacity of Planned or Under-Development Projects**.

(See Figure 1.and Figure 2.)

- **Annual Investment Level (EUR): Public and private investment in offshore wind.** Italy's Terna approved a plan for €16.5 billion in investments over five years, including infrastructure projects. Additionally, the European Investment Bank (EIB) is working with Intesa Sanpaolo to stimulate up to €8 billion in investment in the wind industry through a €500 million EIB counter-guarantee, according to the European Investment Bank.
- **Levelized Cost of Energy (LCOE): Economic competitiveness indicator (EUR/MWh).** Studies have shown that offshore wind LCOE can vary significantly. For example, a study by ScienceDirect comparing different technologies indicated an LCOE of 150 EUR/MWh for a 500 MW offshore wind farm. (A. Martinez, G. Iglesias, 2024)Another study by the European Commission reported LCOE of around €85/MWh for offshore wind in the EU27.
- **Local Supply Chain Development: Percentage or number of local companies involved in offshore wind projects**. While there's no specific percentage or number for local companies involved in offshore wind projects in Italy, the industry is still developing its local supply chain. Italy aims to increase local capabilities to capture the economic benefits of offshore wind development, with existing local companies potentially reconverting or opening new business units to meet industry demands. Furthermore, Italy is exploring partnerships with international companies, such as Ming Yang and Renexia, to establish a local wind turbine manufacturing hub.
- **Participation in EU priority offshore grid corridors**. The revised TEN-E regulation (EU) 2022/869 went into force, mandating ENTSO-E with the new task of developing offshore network development plans (ONDPs) for each sea basin by 24 January 2024. Italy is part of the South West Priority Corridor (Corridor 4) and on the South Est Priority Offshore Corridor (Corridor 5, See Figure 1. below)

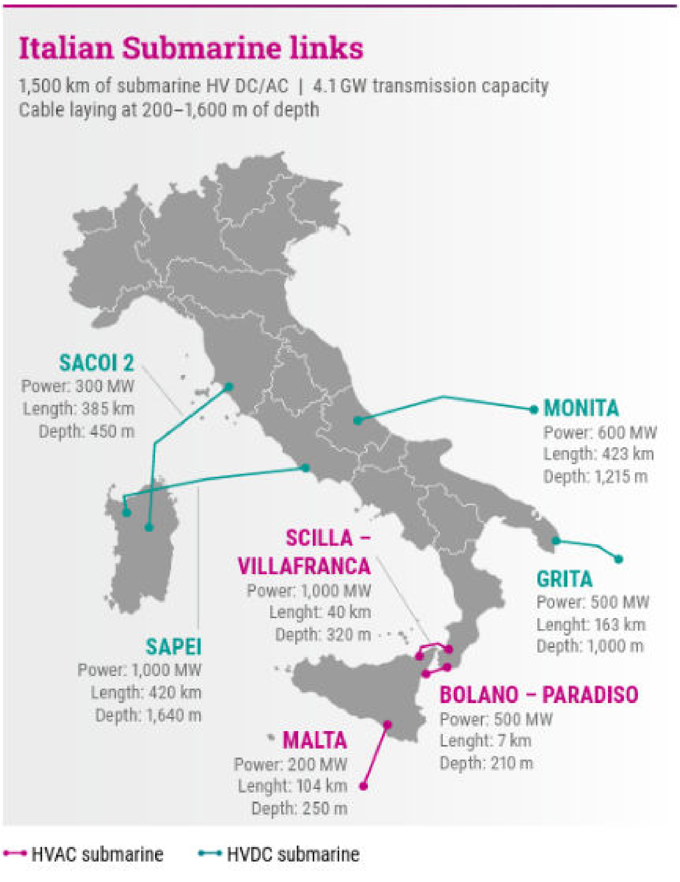
Figure 1. TEN-E Priority Offshore Grid Corridors as laid down in Regulation (EU) 2022/869.



Source: Sea Basin ONDP Report 2024

The Italian peninsula is an energy hub in the Mediterranean Basin, electrically connected with 7 countries (France, Switzerland, Austria, Slovenia, Montenegro, Greece, and Malta) through 26 tie lines both AC and DC technology mostly Extra High Voltage.

Figure 2. Italian existing submarine cables (Source: Sea Basin ONDP Report 2024)



- **Potential additional capacity from innovative offshore technologies**: Forecasted development of over 5 GW from innovative offshore technologies, mainly floating offshore wind.
- **Development of supporting infrastructure**: Number and capacity of ports equipped for the assembly and installation of floating turbines; number of state maritime areas identified and designated for offshore plant development.
- **Research and technological innovation**: Annual investments and R&D projects dedicated to the optimization of floating platforms, low-impact anchoring systems, and sustainable technologies.
- **Simplification and digitization of authorization procedures:** Percentage of authorization practices managed through the integrated digital system and reduction of average authorization release times for offshore plants.
- **Contribution to the national renewable energy coverage target**: Percentage of electricity from renewable sources produced by offshore

plants relative to total national electricity, with a target of 63.4% coverage from renewables overall by 2030.

- **Direct and indirect employment impact**: Estimated number of workers in the offshore wind sector (installation, maintenance, research) with growth expected in line with installed capacity increases.
- **Environmental and landscape impact**: Qualitative and quantitative assessment of the impact of new installations, with particular attention to minimizing negative effects, especially in floating solutions.

Figure 2. Connections' request (31.05.2025) - all renewable sources

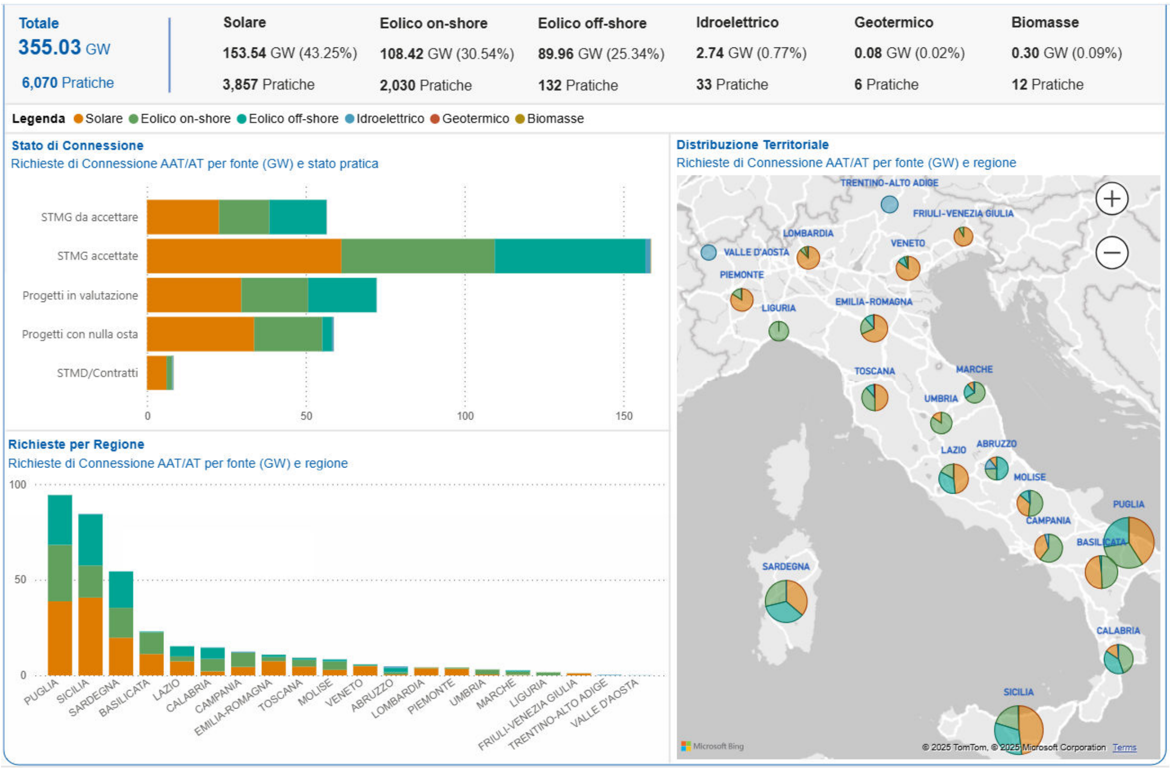
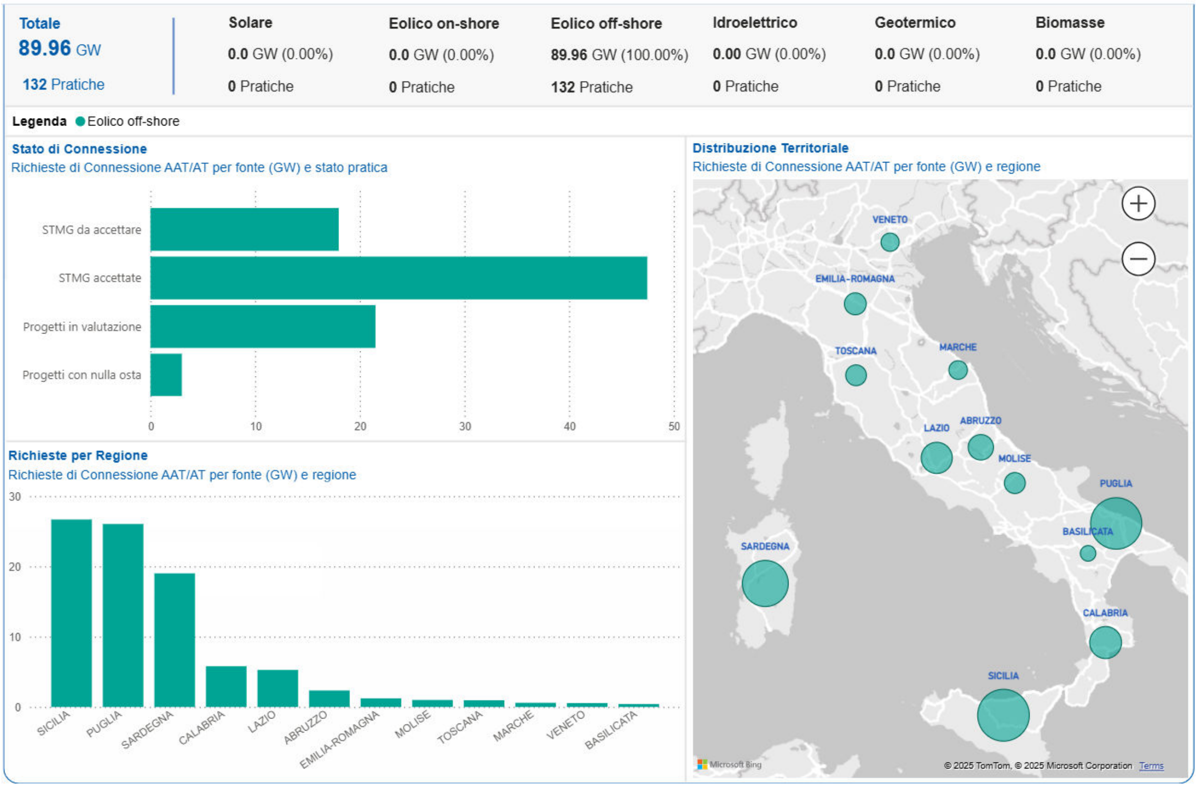


Figure 3. Connections' request (31.05.2025) Focus on Offshore wind



Source: Terna SpA

References

[1] The Directive 2001/77/EC was repealed and replaced by Directive 2009/28/EC, which introduced more ambitious binding targets for 2020. Subsequently, Directive 2018/2001/EU set a new binding target of 32% renewable energy by 2030, recently updated to 42.5%, with the additional commitment of Member States to collectively reach 45% by the same date

[2] https://commission.europa.eu/document/download/5ef1819e-1c42-446f-91d0-abb9cf7719e8_en?filename=IT_FINAL%20UPDATED%20NECP%202021-2030%20%28English%29_0.pdf

[3] 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; COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS European Wind Power Action Plan, COM/2023/669 final. See also the European Wind Charter signed by the energy ministers of 26 EU member States on December 19, 2023.

[4] Pantusa, D., & Tomasicchio, G. R. (2019). Large-scale offshore wind production in the Mediterranean Sea.

[5] The other areas include the Gulf of Lions and the Agean Sea, where the wind speed ranges between 8 m/s and 10 m/s (Onea et al, 2016; Pantusa and Tomasicchio, 2019).

[6] GWEC. (2023). Global Offshore Wind Report 2023.

[7] https://atlanteeolico.rse-web.it/

[8] The European House - Ambrosetti su dati Terna, Decree "Aree Idonee" Draft, Marine Offshore Renewable Energy Lab (MOREnergy Lab) e Politecnico di Torino, 2024

[9] Serri, L., Airoldi, D., Lanni, F., Naldi, R., Castorrini, A., Rispoli, F., Soukissian, T., Castro Santos, L., Le Boulluec, M., & Maisondieu, C. (2024). Technical and economic challenges for floating offshore wind deployment in Italy and in the Mediterranean Sea. WIREs Energy and Environment, 13(4), e533.

[10] https://va.mite.gov.it/it-IT

Greece

Introduction

This SWOT analysis was conducted following a common framework, combining a literature review of market reports, policy documents, and sector studies with insights from stakeholder of the field. Key data sources include Greece's National Energy and Climate Plan (NECP), the new 2022 Offshore Wind Law, industry analyses by the Hellenic Wind Energy Association (HWEA/ELETAEN), EU reports, and articles of the online special press, focusing on the Energy Sector.

Methodology

The analysis was developed through a multi-step methodology as follows:

Literature & Data Review: : We reviewed key documents including Greece's National Energy and Climate Plan (NECP 2019 and draft 2023 update), the Offshore Wind Law 4964/2022 and related regulatory texts, and reports by industry bodies (HWEA/ELETAEN, WindEurope) and research institutes. Statistical data on wind capacity and generation were taken from HWEA's 2023 statistics and IEA reports. We also incorporated findings from the "Status and Challenges for the Offshore Wind supply chain in Greece" study (2024) and the IOBE economic impact study commissioned by HEREMA [1] These provided quantitative targets, economic forecasts, and identified infrastructural needs.

Stakeholder Input: The analysis integrated stakeholder perspectives. We drew on the Summary of Stakeholder Consultations conducted by HWEA, which included surveys and focus groups with Greek industry players in 2023. The results (as summarized in a SWOT chart in HWEA's report) were used extensively to identify internal strengths/weaknesses and external opportunities/threats as seen by companies and experts on the ground. For example, stakeholder rankings of threats (like bureaucracy, local acceptance) and weaknesses (like port readiness) are directly cited in the relevant sections. We also noted statements from government officials and investors at public forums (COP29 Greek side-event, etc.) to incorporate real-world sentiment - e.g. comments from the Energy Minister and investors like Masdar's COO gave insight into strengths (government support) and what investors view as necessary conditions) [1]

Comparative Analysis: The SWOT factors were weighed against regional and global trends. We compared Greece's situation with other countries' experiences (e.g. how Spain or UK handle floating wind, how Italy's timeline compares) to gauge what is realistically an opportunity or threat. This helped in prioritizing the top 3 in each category. For instance, understanding the European supply chain crunch informed ranking supply bottlenecks as a top threat.

Prioritization: We prioritized factors based on frequency of mention and impact. Strengths like wind resource and political will emerged as top internal enablers in multiple sources (NECP, HWEA survey, investor statements). Weaknesses like infrastructure gaps were repeatedly stressed in studies and interviews (thus ranked high). Opportunities and threats were similarly prioritized by looking at external drivers: EU support clearly stands out as an opportunity in policy documents and funding allocations, whereas permitting delays were a common thread in analyses of Greece. The top three in each category were those likely to have the most significant impact on the sector's success or failure if realized. These are clearly indicated in the text and in the SWOT matrix.

Source selection: All information has been corroborated with reliable, up-to-date sources. For instance, market news sites (OffshoreWind.biz, Euronews Green) provided the latest updates on Greece's offshore wind plan launch and targets [2] [3] Legal and consulting sources (Norton Rose Fulbright, Reed Smith LLP) gave interpretation of the new law and process [4] Academic and NGO reports (e.g. Plan Bleu, WindEurope) informed cost and environmental aspects (3]

This methodology ensured a comprehensive view: internal factors (strengths & weaknesses) were identified from Greece's resources, capabilities and gaps, while external factors (opportunities & threats) were derived from the European renewable energy context, technological trends, and regional dynamics. Below, the SWOT analysis is presented with the Top 3 critical factors in each category clearly indicated. All findings are supported by up-to-date evidence and key performance indicators (KPIs) such as capacity targets, investment needs, and cost metrics.

SWOT Factors

Prior to summarising the Strengths, Weaknesses, as internal factors for the Offshore Wind Sector, as well as Opportunities, and Threats, as External Factors, a more detailed approach is presented that explains the prioritisation and provides additional insights on the technical, economic, and regulatory landscape of the sector in Greece.

Strengths

Greece's offshore wind sector has several inherent advantages that can make a good case for its utility. **Top 3 strengths** ranked by perceived importance:

1. **Abundant Wind Resource Potential:** Greece enjoys **strong and constant winds** in the Aegean and Ionian Seas, giving it some of the best offshore wind potential in the Mediterranean. Wind speeds in many Greek marine areas are high and consistent, which can yield excellent capacity factors. According to the Hellenic Wind Energy Association, Greece's offshore wind resource is "among the most attractive for energy production in Europe," underscoring the vast untapped potential. This strong wind potential provides a solid energy resource base for offshore projects. [5]
2. **Consistent Political Will and Policy Support:** The Greek government has demonstrated a strong commitment to offshore wind through ambitious targets and a new regulatory framework. In 2022, Parliament passed the first Offshore Wind Law (Law 4964/2022) to jump-start the sector [5]. The National Energy and Climate Plan sets a goal of at least 2 GW of offshore wind by 2030, recently confirmed in the draft updated NECP [5] [7] In late 2023, authorities announced a National Offshore Wind Farm Development Programme designating 10 priority zones with ~4.9 GW capacity by 2030-2032 (mostly floating) [8] Top officials have declared offshore wind a "national priority" for Greece's clean energy transition

and energy security, with plans to use it for future green electricity exports [2]. This high-level political support - including clear goals, new legislation, and dedicated agencies (the state-owned HEREMA as offshore wind authority) - creates a favourable policy environment for investors and developers. Greece is also streamlining permitting to reduce bureaucratic delays for renewables [10] which should improve regulatory efficiency in the long run.

3. **Extensive Maritime Industry & Infrastructure:** Greece's long maritime heritage provides a strong industrial and logistical foundation for offshore wind. The country has over 2,000 islands and dozens of commercial ports and shipyards, offering widespread sea access and potential staging sites for offshore projects. Greek companies have deep expertise in shipping and shipbuilding - Greece controls the world's largest merchant fleet, a shipping industry worth ~$22 billion that employs ~392,000 people. This means a skilled maritime workforce (engineers, seafarers, etc.) and existing know-how in vessel operations, heavy engineering and marine construction. Local heavy industries further bolster the supply chain: Greece has strong domestic steel, cable, and cement industries that are internationally competitive. For example, Greek firms like Hellenic Cables export submarine cables worldwide, and large steel/metalworks could pivot to manufacture turbines or foundations. These assets - ports, ships, industrial firms, and human capital - can be leveraged to support offshore wind installation and maintenance, reducing the need to import all expertise. Moreover, Greece's experience in developing onshore wind farms (5.2 GW installed) provides project management know-how and grid integration experience that can translate to offshore [11] [12] In short, Greece's geography and blue-economy strengths give it a strong starting platform to build an offshore wind industry.

4. **Experience with Renewables Integration & Onshore Wind Energy :** Greece is already a leader in renewable electricity domestically, which is an encouraging sign for offshore wind uptake. Wind energy (currently all onshore) supplied a record 23-25% of Greece's power in 2023, generating ~11 TWh [13] The grid operator has gained experience managing variable wind output, and developers have built dozens of wind projects on Greek

terrain. This track record in onshore wind deployment means local stakeholders (utilities, regulators, EPC contractors) have relevant experience and confidence to now extend into the offshore domain. Additionally, many Greek renewable developers (e.g. TERNA, PPC Renewables) are financially strong and now partnering with international experts to pursue offshore wind - for instance, domestic firms are teaming up with global players like Masdar and Iberdrola, bringing a blend of local knowledge and international expertise [14] The existing renewables sector momentum and partnerships form an intangible strength that will help kick-start offshore projects.

5. **Strategic Location for Energy Trade:** Greece's position at the crossroads of Europe, the Middle East and North Africa offers strategic advantages for offshore wind development and export. The country sits on the south-eastern edge of Europe, near the Suez Canal route and Eastern Mediterranean energy assets. This location means Greece could become an energy hub connecting continents - for example, transmitting surplus green electricity from future Greek offshore wind farms to neighbours, or using its grid links to channel wind power from North Africa or the Middle East into Europe. Plans are underway to expand interconnections: Greece aims to double its power link capacity with Italy, and establish new links to Egypt and other neighbours by 2030 ([7] Such grid expansions coupled with offshore wind would let Greece export clean power to the region, enhancing energy security for Southern Europe. Being surrounded by sea on three sides also means Greece has abundant offshore sites relative to many EU countries, and less congested waters than the busy North Sea. This geographic edge, combined with regional cooperation, positions Greece to capitalize on transnational renewable energy trade - a strength that extends beyond just domestic needs.

Weaknesses

Despite its advantages, Greece faces significant internal challenges and gaps in its offshore wind sector. The **Top 3 weaknesses** that could hinder development are:

1. **Inadequate Port Infrastructure & Know-how for Offshore Wind:** Greece currently lacks the specialized port infrastructure and facilities needed to deploy large offshore wind projects. No Greek port is fully ready to handle the assembly of massive turbines, foundations, and floating platforms at the scale required. Industry stakeholders highlight "insufficient infrastructure in port space and equipment" as a key weakness. Many ports would need major upgrades (e.g. deeper quays, larger cranes, storage yards) to support staging and installation of 12-15 MW turbines and floating substructures. Additionally, there is a lack of assembly and installation know-how in ports - Greece has never built an offshore wind farm, so local teams have limited practical experience with the complex marine construction and heavy-lift logistics involved. This know-how gap extends to the supply chain; the domestic offshore wind supply chain is nascent, with no local turbine manufacturers and only a few companies (e.g. cable makers) having offshore-specific products. Without significant investment in port upgrades (several candidate ports like Alexandroupolis, Thessaloniki, etc. are being evaluated, also marking an increased interest in Aegean Sea ports rather that Ionian ports) and training of local contractors, these infrastructure deficiencies could cause delays, cost overruns, or reliance on foreign ports/vessels. Notably, uncertainty surrounds some key port facilities due to privatization plans - several major Greek ports are undergoing ownership changes, leaving questions about who will invest in offshore wind infrastructure. This infrastructure bottleneck is a critical weakness that Greece must address to meet its 2030 goals.

   As an indicator, an IOBE study estimates over €7.7 billion investment needed by 2030 for offshore wind, much of which would go into grid and port infrastructure [15] [16]

2. **Complex and Unproven Regulatory Framework:** Greece's regulatory and administrative framework for offshore wind, while now in place, is still untested and has areas of uncertainty. The 2022 Offshore Wind Law and subsequent planning define roles and processes, but the detailed permitting steps are lengthy and intricate [4] For example, the government (via HEREMA) must identify Offshore Wind Development Areas, conduct strategic environmental assessments, issue Presidential decrees for specific installation sites, and only then tender projects [4] As of early 2025, these steps are in early stages - the National Development Programme is in draft form, and site surveys are just beginning [14](). A survey of industry experts noted the "regulatory constraints" and lack of clarity in certain rules as weaknesses. Importantly, the law does not set firm timelines for each phase; analysts warn that this uncertainty could slow down projects [4] Indeed, the first tenders are not expected until 2027 for a handful of zones [15], implying a tight schedule to achieve any installations by 2030. Greece's bureaucracy is historically slow, and although efforts are underway to simplify procedures, investors remain cautious. They cite the need for more detailed secondary legislation (on grid access, licensing, revenue support, etc.) and faster approvals. Until Greece demonstrates an efficient permitting process in practice, the uncertainty and complexity of the new framework remain a weakness. This could lead to delays or deter some developers, as projects may face unpredictable approval timelines, multiple authorities, and potential legal challenges. In short, regulatory risk and administrative inefficiency — if not managed — could undermine Greece's offshore wind ambitions from within.
3. **High Capital Costs & Funding Gaps:** Offshore wind is capital-intensive, and Greece faces economic and financial weaknesses in launching this new sector. The upfront costs for developing projects in Greek waters are expected to be high, especially as many sites will require floating turbines (a technology currently more expensive than fixed-bottom turbines). The levelized cost of energy (LCOE) for initial Mediterranean floating projects is still relatively high (well above €100/MWh at present). While costs are forecasted to drop - e.g. floating wind LCOE could fall to ~€53-76/MWh by 2030 with innovation - early projects will need significant capital. Greece is emerging from a decade of economic

hardship, and its domestic financing capacity is limited. Thus, reliance on foreign investment and EU funds is critical, which can be a weakness if capital markets tighten. The IOBE study projects total investment needs of €6-8 billion by 2030 and up to €60 billion by 2050 for Greece's offshore wind build-out [15]. Mobilizing this scale of funding requires investor confidence in Greece's market. However, investors see Greece as higher risk until the framework is proven (raising the cost of capital). Moreover, grid infrastructure needs (e.g. undersea cables to bring power to shore, reinforcing the onshore grid for 2 GW by 2030) will demand large public expenditure, and any shortfall or delays in grid upgrades could slow projects. Local content requirements or limited local supply capabilities may also inflate costs if everything must be imported at the start. In summary, financial and cost barriers - from the sheer scale of required investment to the current high cost of floating technology - represent a weakness. Greece will need to secure strong public-private financial support (e.g. through subsidies, EU Recovery Fund grants, or low-cost loans) to overcome these challenges [12] (KPI: Greece's offshore wind LCOE is expected to start high but decline ~50% by 2030 ; ~€7.7B investment needed by 2030 [20] first pilot projects likely require subsidy support approved by EU [15].

4. **Absence of Operational Track Record:** Greece has no previous offshore wind farms, which means a learning curve lies ahead. This lack of track record is an internal weakness because domestic institutions and companies have not yet faced the real-world challenges of offshore deployment (unlike North Sea countries with decades of experience). For instance, Greek environmental permitting authorities have dealt with onshore wind but not the complex marine ecology issues of offshore; local supply firms might be unfamiliar with certification standards for offshore components; and project managers must navigate new technical hurdles (deep-water moorings, etc.). The stakeholder consultation by HWEA found that many Greek companies are interested in the offshore wind supply chain, but they acknowledge gaps in know-how and need for training. Until Greece completes a pilot project, this uncertainty in execution capability looms as a weakness. It may necessitate heavy reliance on foreign engineering expertise in the early

projects, which can increase costs and reduce local economic benefits initially. The planned 600 MW pilot wind farm in Thrace (North Aegean) by a JV of PPC, TERNA (with Masdar) is essentially a test case to build local experience by 2030 [15]. Successfully delivering that will be crucial to overcoming this internal weakness.

5. **Deep Waters and Grid Constraints:** Greece's sea areas, while windy, pose some challenging conditions that count as weaknesses in project development. The Ionian Sea is deep and often seismically active, meaning many sites will require floating wind technology (for water depths >50m) [15]. Floating projects are more technically complex and currently costlier than fixed-bottom turbines, raising the difficulty of Greece's rollout. Additionally, Greek waters are used for tourism, fishing, and shipping, which could constrain siting. Both the Ionian and the Aegean have many islands and are busy corridors; finding large contiguous zones for wind farms that don't conflict with other marine users (or military exercise zones) is a challenge. This is partly an external issue (stakeholder opposition), but also an internal constraint of geography and spatial planning. The grid connectivity of remote offshore sites is another challenge - many Greek islands are not yet grid-connected to the mainland (though plans aim to connect most by 2030 [22] complicating how offshore wind power will be delivered to demand centres. Until grid links (e.g. island-to-mainland cables) are completed, offshore projects near those islands may face evacuation limitations. These inherent challenges mean Greece's project designs must be innovative (floating platforms, long export cables, etc.), effectively raising the bar compared to regions with shallow continental shelves. This counts as a structural weakness that must be managed through careful marine spatial planning and infrastructure investment.

Opportunities

The external environment offers numerous opportunities that Greece can exploit to accelerate its offshore wind sector. The **Top 3 opportunities** identified are:

1. **Strong EU Support and Funding Initiatives:**): Greece's offshore wind push aligns with broader European Union clean energy targets and funding programs, which provides a major growth opportunity. The EU's Offshore Renewable Energy Strategy calls for expanding offshore wind from ~12 GW today to 60 GW by 2030 and 300 GW by 2050 across member states [23] As a member, Greece stands to benefit from this policy momentum - the EU is encouraging development in all sea basins, including the Mediterranean, making Greece a focal point for future projects. Crucially, substantial EU funding is available. Greece's post-pandemic Recovery and Resilience Facility (RRF) plan includes a reform to create the national offshore wind development program [24] and EU grants are being used for preliminary steps (e.g. €24 million in EU funds was secured to upgrade Alexandroupolis port, a likely offshore wind hub [25] Additional EU financing instruments (Connecting Europe Facility, Horizon Europe for R&D, etc.) can support grid interconnections, research on floating technology, and port improvements. For example, the Recovery Plan's REPowerEU chapter provides extra grants for renewables - which Greece is tapping - and specifically mentions accelerating offshore wind park development [26] International investment interest is also high because of Greece's EU-backed stability: at COP29 in 2024, global players (Masdar, Iberdrola) praised Greece's program and expressed strong interest in investing [1] Moreover, EU market integration means Greece could export green electricity to higher-priced markets, improving project economics. In summary, the opportunity for Greece to leverage EU support - policy, funding, technical assistance - is significant. By aligning with the European Green Deal objectives and utilizing EU funds, Greece can de-risk projects and lower the cost of capital. This external tailwind can help turn Greece's ambitious plans into reality faster and more cheaply than if it were acting alone. (EU funds allocated: Greece's RRF allocates part of €18.2B grants

to green energy including offshore [27] with EU Innovation Fund and EIB financing also being potential sources.

2. **Advancements in Offshore Wind Technology & Cost Decline:** Rapid global technological progress in offshore wind, especially floating wind, presents a key opportunity for Greece. As a late entrant, Greece can take advantage of maturing technologies and cost declines achieved elsewhere. The next generation of turbines (12-15 MW and larger), improved floating platform designs, and more efficient installation techniques will significantly reduce the cost of offshore wind by the time Greece builds at scale. Industry projections show floating wind LCOE could drop below €60/MWh by 2030 (over 50% reduction from 2020) and continue falling towards competitiveness with fixed-bottom wind by 2050 [29] These trends mean Greece's inherently deep-water sites will become economically viable. Ongoing R&D and pilot projects around the world (e.g. in the North Sea and Asia) are proving the viability of floating turbines in harsh conditions, which Greece can directly apply to the moderate Mediterranean climate. The timing is advantageous: floating technology is moving from pilot to commercial scale this decade (e.g. projects in France, UK, and Norway are commissioning), so by the late 2020s when Greek projects are ready, a competitive supply market for floating substructures and specialized installation vessels will exist. This can mitigate Greece's lack of domestic experience - foreign technology providers will be more established and looking for new markets. Additionally, digital and remote operation technologies (satellite wind resource assessment, AI for maintenance, etc.) are improving, which Greece can incorporate from the start to optimize operations [30] Embracing these innovations could also create a new high-tech sector in Greece (e.g. manufacturing parts of floating platforms or advanced mooring systems) if nurtured through partnerships. In short, the global tech trajectory - bigger turbines, better floaters, smarter grids - is an external force working in Greece's favour, making its offshore wind potential more attainable and attractive to develop over the next 5-10 years. This will help drive down the levelized cost of energy and make projects bankable. (Notably, Greece's plans already assume most projects will be floating by necessity [2], so the opportunity lies in capitalizing on the floating wind industry's rapid scale-up.)

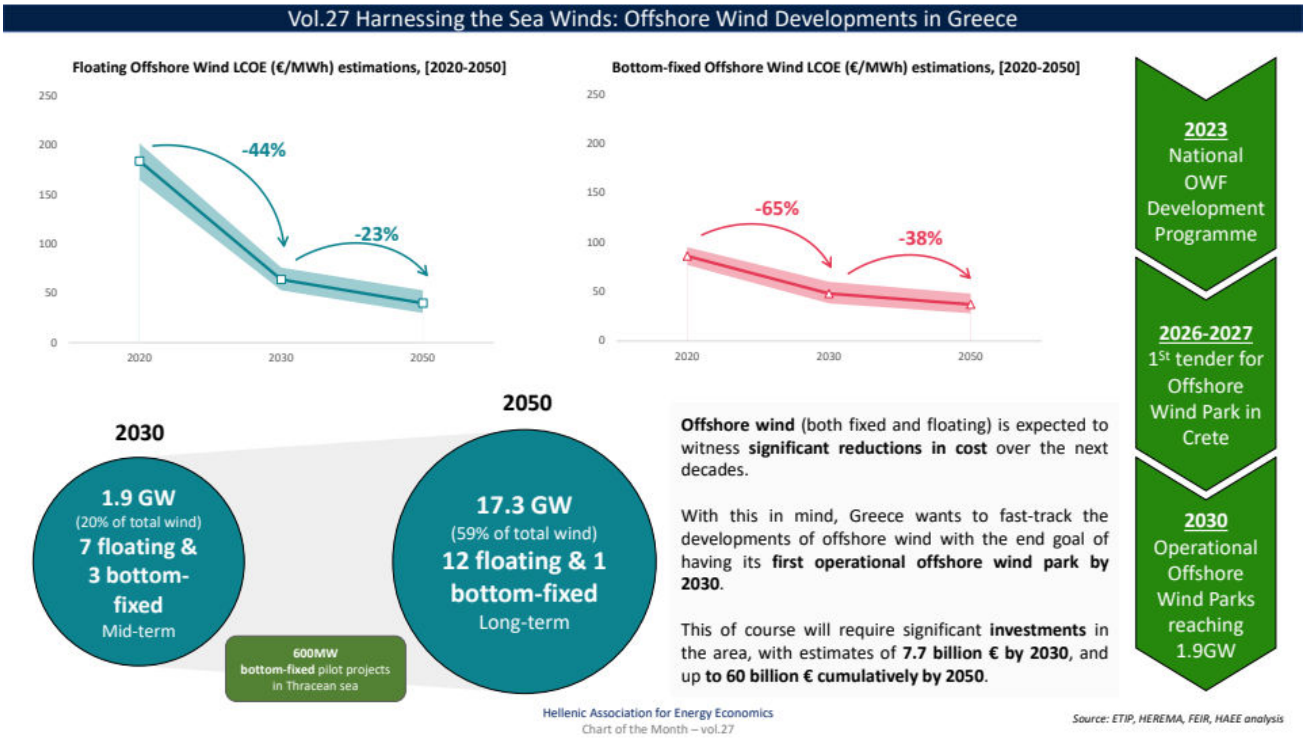
3. **Regional Cooperation and Energy Export Opportunities:** Greece can seize the opportunity of its regional position and partnerships to boost offshore wind development. The Adriatic-Ionian and East Mediterranean regions are increasingly focusing on cross-border energy collaboration, and Greece is at the centre of several initiatives. There is also opportunity in linking Greece's offshore wind to broader regional grids: for instance, plans are underway to strengthen interconnectors with Italy and the Balkans and to build a Euro-Asia Interconnector toward Cyprus/Israel [7] As Greece develops surplus renewable generation, it could export green electricity to neighbours facing deficits, turning offshore wind into a revenue stream and improving Southeast Europe's energy security. Greece and Italy, in particular, could coordinate on offshore wind in the Ionian Sea - e.g. aligning site development in the southern Adriatic and potentially creating an offshore grid hub to serve both countries. Additionally, Greece's strategic relations with Middle Eastern/North African countries (like Egypt) open opportunities to integrate offshore wind with future green hydrogen production and export. Excess wind power could be used to produce hydrogen or e-fuels for shipping, leveraging Greece's port infrastructure to export these to Europe. Another external opportunity is the interest of experienced countries in partnering with Greece: for example, Norway's offshore wind industry has been actively collaborating with Greece (signing MoUs to provide expertise on floating wind) [34] Such international partnerships bring technical know-how and potentially financing to Greek projects. Finally, tourism and local economies could benefit if Greece positions some offshore wind farms as testbeds for eco-friendly innovation (e.g. creating artificial reefs or using offshore platforms for research or dual-use like aquaculture). In essence, Greece's ability to embed its offshore wind rollout in a regional cooperative framework and tap into cross-border projects or markets is a major opportunity. It can amplify the scale and economic viability of Greek projects beyond what the domestic market alone would justify. The government's focus on becoming a "regional energy hub" for renewables underscores this opportunity [2].

4. **EU Climate Goals & Energy Security Needs:** The pressing EU-wide need for clean energy and energy security (especially post-2022 energy crisis)

creates a favourable external environment. There is a continent-wide push to reduce reliance on imported fossil fuels, and offshore wind is a key solution. This means Greece's projects, once operational, could find high demand and political support as part of Europe's energy mix. The EU's Green Deal and Fit-for-55 policies increasingly incentivize rapid renewable deployment - Greece can ride this wave, accessing mechanisms like Contracts for Difference or EU guarantee funds to ensure revenue stability for offshore wind farms. Moreover, Greece's timing coincides with the global ESG investment trend: international investors are actively seeking green infrastructure investments. Large renewable developers and funds view new markets like Greece as opportunities for portfolio growth. The fact that Greece's offshore wind sector is effectively starting from zero means there is a blank slate to implement international best practices (in design, stakeholder engagement, etc.), potentially avoiding mistakes others made and fast-tracking modern approaches (e.g. multi-use marine space or co-location with fish farms as being piloted elsewhere). All these external factors - policy drivers, market appetite, and timing - converge to create an opportune moment for Greece to launch its offshore wind industry with strong backing.

5. **Long-Term Economic Development, Jobs, and Investor Interest:** Developing offshore wind offers Greece a 30-year industrial growth opportunity. Stakeholders view this as a novel sector that can fuel economic activity for decades. If Greece successfully establishes a local supply chain, it can capture high local added value from manufacturing and O&M services. The IOBE economic study projects offshore wind could boost Greece's GDP by up to €1.9 billion per year and support ~44,000 jobs annually on average from 2024-2050 [1] This includes not just construction jobs, but also new industries in turbine maintenance, port services, and possibly component exports. For regions like shipyards, offshore wind offers diversification - e.g. Greek shipyards could start building foundations or support vessels. There is also an opportunity for Greece's oil and gas sector to pivot - companies like HELPE (Hellenic Petroleum) and Motor Oil are already investing in offshore wind consortia, leveraging their offshore engineering experience to stay relevant in a carbon-neutral future. Such transitions are win-win:

retaining jobs and repurposing skills from fossil fuel industries to renewables. Additionally, Greece can position itself as an offshore wind training and R&D hub for the Eastern Med, attracting research projects (for example, studying Aegean wind patterns, seismic design of turbines, etc.). These longer-term economic opportunities are external in that they depend on global industry growth and Greece's integration into it. With proper strategy, Greece can capture a share of the expanding global offshore wind market (expected >$1 trillion investment by 2040), becoming a regional centre of excellence. This would contribute to sustainable growth and help meet other national goals like reversing brain drain by creating high-skilled green jobs at home.



Collaboration Opportunities: Greece can work with neighbouring countries (Italy, Albania, Cyprus, etc.) on joint research, standard-setting, and even project development. The ADRIONWIND project itself fosters a network for exchanging best practices and perhaps developing common strategies (e.g. a joint Adriatic tender or shared infrastructure) [32]. There is also scope for supply chain complementation - for instance, Italian yards could build some components while Greek ports handle assembly, creating a regional value chain. The EU encourages such cooperation (e.g. the EU Strategy for the Adriatic-Ionian Region - EUSAIR - highlights blue energy cooperation). This could reduce costs and accelerate learning, benefiting all involved. Another example is the planned EuroAsia interconnector linking Israel, Cyprus, and Greece: if realized, it could facilitate developing offshore wind in Cyprus with Greece acting as the gateway to the European grid [7]. Regional working groups could tackle common issues like Mediterranean wind standards (considering seismic conditions) and environmental protection guidelines suited for enclosed seas. All these collaborative efforts will strengthen Greece's position and are an opportunity to distribute the benefits of offshore wind across borders.

Threats

The offshore wind sector in Greece faces several external threats that could impede its progress. The **Top 3 threats** identified are:

1. **Policy and Regulation Uncertainty - Potential Delays:** A major threat is the risk of implementation delays and policy uncertainty undermining Greece's offshore wind timeline. While the government has set targets, the multi-step rollout (marine spatial planning, tenders, construction) is tight, and any holdup could cause Greece to miss 2030 goals. Key concerns include bureaucratic slowdowns, prolonged environmental approval processes, or political changes that alter support. Stakeholder voice concerns over the "risk of delays" and bureaucracy as top threats, noting that if objectives are not met on schedule, Greece could "lose the opportunity" presented by the current favourable environment. For example, if the Strategic Environmental Assessment of the offshore zones takes longer than expected or faces legal challenges (perhaps from local communities or environmental groups), planned tenders in 2027 might slip to later years. The lack of a clear, time-bound roadmap in the law adds to this uncertainty [4] Additionally, Greek national elections or policy shifts pose a threat - a change in political priority or a less supportive government in the future could slow allocation of resources or introduction of necessary subsidy schemes. The industry also worries about regulatory roll-back or inconsistent application of rules. If investors perceive Greek permitting to be too unpredictable or lengthy relative to other countries, they may redeploy capital elsewhere (a form of opportunity cost threat). Essentially, time is a threat: the global offshore wind race is on, and any Greek delays mean losing economic benefits and possibly missing EU funding windows (like the RRF which must be utilized by 2026). Ensuring stability and speed in the regulatory process is critical to mitigating this threat. Another aspect is policy continuity - offshore projects have 20+ year lifecycles, so stability of market rules (electricity market, tariff support, etc.) is vital. Uncertainty over long-term revenue (e.g. will Greece introduce contracts-for-difference? How will merchant risk be handled?) could threaten financing. In summary, policy and permitting risks - if not carefully managed - could significantly

threaten Greece's offshore wind rollout by causing costly delays or scaring off developers. [35]

2. **Economic/Supply Chain Constraints and Competition - Cost:**): The broader macroeconomic and supply chain context presents threats to timely and cost-effective project delivery. Global supply chain bottlenecks for offshore wind components and services are a real concern - currently, there is limited manufacturing capacity for big turbines and a shortage of specialized installation vessels in Europe. As many countries ramp up offshore wind simultaneously, Greece will face stiff competition to procure turbines, cables, floating platforms, and to book experienced marine contractors. This could lead to higher prices or delays in equipment delivery. Stakeholders specifically pointed to the "limited capacity Europe-wide" for construction as a threat. For instance, if dozens of projects in the North Sea and Asia are underway in late 2020s, vessel availability to install turbines in Greece might be very tight, potentially postponing construction windows (especially given seasonal weather constraints that may affect installation timelines). Furthermore, rising costs and inflation in the global economy threaten project finances - the wind industry has seen cost inflation in materials (steel, copper) and higher interest rates, which could make Greek projects less economically viable if not offset. Stakeholders noted "increasing costs" as a significant threat, alongside the massive "investments required in infrastructure" stretching budgets. If capital costs stay high, Greece might struggle to achieve low auction prices or could need to offer higher tariffs to investors, testing political appetite. Additionally, the Eurozone energy market volatility (e.g. gas price swings affecting electricity prices) can complicate revenue modelling for new wind farms. On the competition front, other Mediterranean countries (Italy, Spain, France) are also pursuing floating wind - whichever country creates the most attractive conditions first could absorb the limited supply chain resources. If Italy, for example, auctions several GW and secures turbine orders earlier, Greece's projects might be queued later or face supply shortages. There's also competition for EU funding - only so much grant money or cheap loans exist, and delays could mean losing out to others. In essence, external market pressures - supply chain limits, cost escalation, and regional competition for resources - pose a threat to Greece's offshore

wind timeline and cost targets. Mitigating this will require strategic planning, such as early procurement, incentivizing local manufacturing (to reduce import dependence), and collaborating with neighbours to possibly aggregate demand for better bargaining power.

3. **Social and Environmental Opposition:** As with any major infrastructure, public acceptance and environmental concerns could threaten project implementation in Greece. The country's beautiful seascapes and rich marine biodiversity mean that offshore wind farms, if not carefully sited and managed, may face pushback. Environmental NGOs have voiced concerns that offshore turbines could harm wildlife - for example, construction noise and vibration might disturb marine mammals or fish, and turbine blades pose risks to birds and bats migrating over the Greek waters. Greece has many Marine Protected Areas (Natura 2000 sites, etc.) in its waters, and projects will need rigorous environmental impact assessments. If any project is perceived to threaten an ecologically sensitive area (e.g. important seabird nesting islets or Poseidon seagrass meadows), legal challenges or protests could ensue, delaying or halting development. Likewise, local community opposition is a tangible threat. Island communities reliant on tourism may object to turbines visible offshore, fearing visual impact or that it could deter tourists. There is also sensitivity about island landscapes - some Greeks have opposed even onshore wind on islands for aesthetic reasons, so offshore (though farther out) could be contentious if near popular islands. Stakeholder surveys indicate a "limited or lack of social acceptance" as a concern, along with "local reactions" being noted as a key threat that could disrupt project timelines. For instance, fishermen might worry that offshore wind arrays could restrict fishing areas or alter fish habitats. In the worst case, strong local opposition could pressure authorities to slow or relocate projects. Moreover, Greece's naval and defence interests might pose a threat if certain offshore zones conflict with military radar or operational areas (though the national program should account for this in site selection). Lastly, the risk assessment by Greek experts highlights that grid limitations could also pose an "infrastructure and environmental" risk - if the grid can't handle output, curtailment could occur, and if not managed, that could become a community issue (e.g. if cable landfalls raise NIMBY issues on shore) (Hellenic Association for Energy Economics,

2023). In summary, winning and maintaining stakeholder support is a critical external threat: Greece must ensure robust environmental protections and community engagement to prevent opposition from stalling the offshore wind rollout. Transparent planning (avoiding iconic coastal views and sensitive ecosystems) and benefit-sharing with local communities (such as jobs or revenue sharing) will be key to mitigating this threat.

- **Geopolitical and Regional Stability Risks:** Broader geopolitical factors in the region also pose potential threats. The Eastern Mediterranean has some territorial disputes and heightened military sensitivities (e.g. between Greece and Turkey). While Greece will develop projects in its undisputed waters, any regional tensions could indirectly affect investor confidence or complicate things like shared search & rescue areas, etc. Additionally, if instability or conflicts arise in nearby regions, that could disrupt supply routes or divert political attention/funding. Another angle is that the success of neighbouring countries' offshore wind programs could set a competitive benchmark - if Greece lags, it risks being seen as less attractive. For example, if by 2030 Greece still hasn't built significant capacity while other EU countries have far exceeded their targets, Greece might face pressure or even penalties under EU climate commitments. There's also the threat of market fluctuations. For instance, if global oil & gas prices remain relatively low, there could be less urgency for renewables (though climate goals mitigate this risk). Finally, climate change itself poses a paradoxical threat: while offshore wind helps fight it, the effects of climate change (e.g. increasingly severe weather events) could impact construction schedules or infrastructure (e.g. more intense storms could necessitate even sturdier - costlier - designs). All these external uncertainties mean Greece's plans must be resilient to a range of scenarios.
- **Grid and Integration Challenges:** Externally, if Greece cannot upgrade its grid infrastructure in time, this becomes a threat to effectively using offshore wind power. The country's power system will need absorption capacity and flexibility (e.g. storage or demand response) to handle large offshore wind influx. If those upgrades lag, it could lead to curtailment of wind production or instability, undermining project economics. This is

partly an internal issue of investment, but also external in that it depends on how quickly technology like energy storage becomes affordable and how interconnector projects with neighbours progress (to export excess power). Delays in planned interconnectors (for example, if doubling the Italy link or the new Egypt link face geopolitical or technical hurdles) would constrain Greece to its internal market, which might not need all the offshore output at certain times, posing a threat of wasted potential. Integration challenges also include managing variability – if Greece doesn't have sufficient balancing mechanisms (which often rely on regional power trade), it might be forced to keep fossil backup, affecting the perceived value of wind. Thus, ensuring the broader energy system is ready is crucial to avoid this threat.

- **Regional Threats:** One shared threat is competition for investment - Mediterranean countries are all courting the same developers and investors. If Greece's process is slow, investors might focus on Italy or Spain first. Additionally, an underdeveloped regional grid poses a threat: without sufficient interconnections between Balkan countries, surplus power might have nowhere to go during windy periods, undermining economics. Environmental impacts can also be regional: migratory bird routes and marine mammal habitats span countries, so a poorly placed Greek wind farm could have biodiversity impacts beyond its waters, or vice versa. This calls for regional marine spatial planning to ensure coherence. There's also the risk of a "race to the bottom" in incentives - if countries undercut each other to attract investors (e.g. offering higher subsidies or looser regulations), it could lead to suboptimal outcomes. A cooperative regional approach can mitigate that. Moreover, geopolitical tensions in the Eastern Med are a regional threat - they could affect cross-border projects or cause hesitation among international partners. Keeping diplomatic channels open and energy cooperation (such as the East Med Gas Forum expanding to renewables) will be important.

SWOT Matrix

The **top 3 factors in each category** are emphasized in **bold**:

Strengths	Weaknesses
1. Abundant Wind Resource Potential - High wind speeds and constant offshore winds (some of the best in the Med) give Greece a strong energy resource base	**1. Inadequate Port Infrastructure & Know-how** - Ports lack space, heavy-lift cranes, and assembly experience for large turbines; major upgrades needed
2. Consistent Political Will and Policy Support - Government commitment with new 2022 law, clear target of 2 GW by 2030, and a national development plan in motion	**2. Complex and Unproven Regulatory Framework** - New permitting process untested; potential bureaucratic hurdles and unclear timelines can delay projects
3. Extensive Maritime Industry & Infrastructure - Extensive port network, world-leading shipping industry, and heavy industry (steel, cables) expertise can be leveraged for offshore wind	**3. High Capital Costs & Funding Gaps** - Floating tech is costly initially; Greece needs ~€7.7 B by 2030 and depends on external capital, posing financial strain.
4. Experience with Renewables Integration & Onshore Wind Energy - ~5 GW onshore wind installed gives know-how in project development and grid integration	4. No Operational Track Record - No operational projects yet; local companies and agencies face a learning curve, increasing execution risk.
5. Strategic Location for Energy Trade - Geographic position enables export of wind power to SE Europe; emerging hub for regional green energy exchange	5. Deep Waters and Grid Constraints - Most sites require floating turbines (technical challenge); grid links for offshore sites must be built, or wind power could be curtailed.
Opportunities	**Threats**
1. Strong EU Support and Funding Initiatives - EU targets (60 GW offshore	**1. Policy and Regulation Uncertainty - Potential Delays** -

by 2030) drive policy support; substantial EU funds (RRF, CEF) available for planning, grid and ports	Slow bureaucratic processes or shifting political winds could delay projects; no guaranteed timelines in law raises investor concern
2. Tech Advancements & Cost Decline - Rapid innovation in **floating wind** and larger turbines is cutting LCOE (~50% drop by 2030), making Greece's deep-sea resources economically viable.	**2. Economic/Supply Chain Constraints and Competition - Cost Inflation** - Competition for turbines, vessels, and materials in Europe may lead to shortages or higher prices, endangering project schedules
3. Regional Cooperation and Energy Export Opportunities - Cross-border initiatives (ADRION, interconnectors to Italy/Balkans) let Greece export surplus wind power and attract foreign expertise/investors	**3. Social & Environmental Opposition** - Local communities or NGOs might resist wind farms over visual or ecological impacts (wildlife disturbance), leading to legal challenges or relocation
4. EU climate goals & Energy Security Needs favour clean energy - A continent-wide push to reduce reliance on imported fossil fuels, and pivot to sourcing energy from sources within the EU; wind potential in Greece is such a source.	4. Geopolitical and Regional Stability Risks - Possible of instability or conflicts in nearby regions could disrupt supply routes or divert political attention/funding
5. Economic Growth, Jobs, an Investor Interest - Offshore wind could inject €1.9 B annually into GDP and create ~44k jobs/year, garnering broad support and justifying public investment	5. Grid Risks - Regional tensions or delays in expanding grid interconnections could limit offshore wind utilization and investment flow

Key Performance Indicators (KPIs)

Installed Offshore Wind Capacity (MW or GW)	0 MW (2024) /2,000 MW by 2030
Annual Energy Output (MWh) and Capacity Factor (%)	0 GWh currently/ (Expected ~7–8 TWh/year by 2030 if 2 GW installed (assuming ~40-45% capacity factor).
Number and Capacity of Planned or Under-Development Projects	Under exploration in Ionian 1 pilot farm in the Aegean (Thrace/Alexandroupolis, ~600 MW) in development for 2030 10 development areas to be tendered from 2027 onward
Annual Investment Level (EUR)	€7.7 billion needed by 2030 for offshore wind Up to €60 billion by 2050 for full build-out estimated based on studies
Levelized Cost of Energy (LCOE)	Currently estimated high for floating projects (estimated €100–120/MWh+).
Employment Impact	44,000 jobs annually on average from 2024–2050 estimated over Foundation for Economic & Industrial Research (IOBE) economic study
Local Supply Chain Development	44,000 jobs annually on average from 2024–2050 estimated over IOBE economic studyN/A
Innovation Metrics	Up to 55% Report (Status & Challenges for the supply chain for Offshore Wind in Greece)N/A
Regulatory Efficiency	Permitting and approval processes for offshore wind projects currently average 5–7 years in Greece, with reforms under Law 4964/2022 aiming to shorten timelines

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Albania

Introduction

The offshore wind energy sector in Albania remains in its infancy. However, with a coastline of over 400 km along the Adriatic and Ionian seas, the country possesses a strategic advantage for developing offshore wind infrastructure. Albania's energy sector is predominantly hydro-based, making it vulnerable to seasonal and climate-related variability. Offshore wind energy provides a promising avenue for diversification and strengthening energy security, while aligning with Albania's ambitions to integrate into the European Union and comply with its energy directives.

Albania's country's coastline is north-south direction, where a part is the coastal lowlands and the other coast very close to the south seaside mountain. Inside the territory, the direction and intensity of wind from area to area varies in time. The main existing constraints (altitude, site accessibility, infrastructures, natural protected areas, power grid) were applied to the actual wind speed and wind potential maps, in order to provide an estimation of the exploitable wind potential. According to the estimates, Albania shows an excellent wind potential, with wind speed values exceeding 6.5 to 8.5 m/s in many areas. A number of interesting areas, especially along the coast and on the ridges of the mountains, with particularly strong winds in the southern part of the Country, have been identified. The main directions of wind in our country are northwest-southeast and southwest-northeast, with dominant direction towards land.

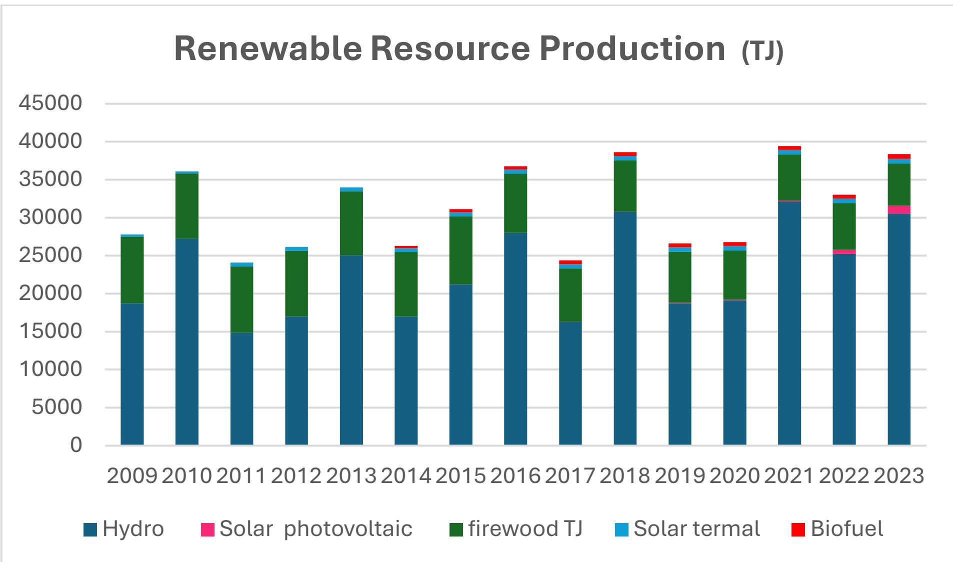
The present assessment explores the current landscape, challenges, opportunities, and strategic.

Albania's current energy mix illustrates both its strengths and vulnerabilities. Hydropower accounts for around 95% of installed generation capacity, with solar contributing about 1% and crude oil 4%. While this places Albania among Europe's renewable leaders by share, reliance on hydropower creates exposure to climate-related risks and seasonal variability. Wind, solar, and biomass therefore represent essential resources for diversification, with offshore wind emerging as a scalable option that could balance hydro dependency and strengthen long-term security of supply.

The legal and regulatory environment has also evolved to support renewable deployment. The Renewable Energy Sources Law, adopted in March 2023 and aligned with Directive (EU) 2018/2001, introduced competitive support mechanisms, renewable energy communities, and the possibility of power purchase agreements. This reform abolished earlier feed-in tariffs and placed future support schemes under competitive procedures. Together with Albania's National Energy and Climate Plan (NECP 2023), which sets a 54% renewable share by 2030, these measures indicate a commitment to market alignment with the European Union and the Energy Community Treaty. Offshore wind is not yet explicitly included in these frameworks, but its potential is increasingly recognized within broader energy transition strategies.

Infrastructure considerations further shape the outlook for offshore wind. The Albanian transmission grid remains constrained, requiring modernization to integrate large-scale renewable inputs. Planned interconnectors with Greece, Kosovo, and Montenegro, however, could provide export routes and improve system flexibility. Port infrastructure, particularly Durrës and Vlora, will need upgrades to handle turbine assembly, transport, and servicing. Access to international instruments such as the Western Balkans Investment Framework and the EU Green Deal can support these investments, while cooperation with regional partners may accelerate development of both grid and supply chain capacities.

Graph 1 The progress of the production from RES (TJ)



Graph 2 RES Contribution in years

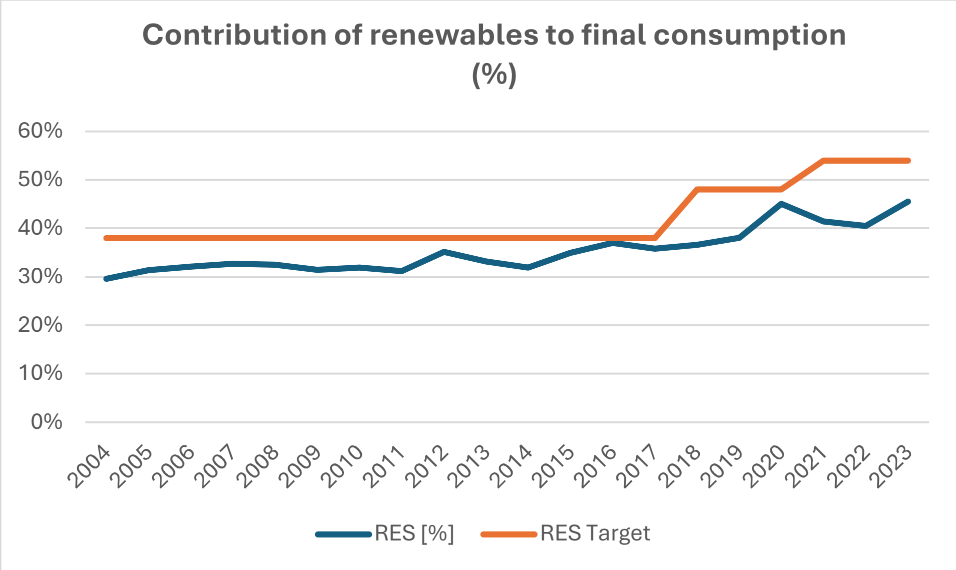


Table 1 Actual and potential capacities on RES in Albania

Technology	Capacity in 2023	Economic potential (MW) in 2030	Technical Potential (MW) in 2030
HPP	1 ,350	2150	4813
PV	756	1074	2378
Wind	0	616	7483
Bioenergy	1	86	1832

Methodology

The SWOT analysis for Albania was carried out through systematic desk research. National policy documents, such as the National Energy Strategy 2023-2030 and the Integrated National Energy and Climate Plan, were examined together with reports issued by AKBN. These sources were complemented with comparative evidence from IRENA, IEA, and the European Commission to situate Albania's potential within regional and European developments.

Internal and external factors were identified from these materials. Internal aspects, including the dominance of hydropower, the absence of existing offshore wind capacity, and limitations in transmission infrastructure, were drawn directly from national sources. External aspects, such as favourable wind resources along the Adriatic coast, complementarities with hydropower generation, and prospects for cross-border integration with Italy, were assessed primarily through international technical and market studies.

The ADRIONWIND framework was applied to structure the findings into strengths, weaknesses, opportunities, and threats. Each factor was supported with documented evidence and assessed for its likely effect on the medium- and long-term development of offshore wind in Albania. The most critical factors were highlighted to ensure comparability with the other country analyses and to provide a coherent input to the transnational R&I strategy.

SWOT Factors

Albania, located along the Adriatic and Ionian coasts, has long relied on hydropower for its energy supply. However, increasing climate variability and the need to decarbonize its energy sector have opened new opportunities for diversification, particularly through wind energy. While onshore wind is in its nascent stages in the country, offshore wind energy remains largely unexplored. Given regional developments and Albania's alignment with EU renewable energy goals, assessing offshore wind potential is both timely and strategic.

This report presents a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) to evaluate the viability of offshore wind energy in Albania. The analysis incorporates current infrastructure, policy frameworks, economic considerations, and regional dynamics.

Strengths

1. **High Wind Potential**
   Albania's Adriatic and Ionian coastlines possess favourable wind speeds and patterns, especially during the winter months, making them suitable for offshore wind development. This natural endowment provides a reliable foundation for long-term power generation.
2. **Geographic and Natural Advantages**
   Wind Resource Potential: The coastal regions of Albania experience average wind speeds between 6.5 and 8.5 m/s at 100 meters hub height, particularly favourable for offshore wind development.
   Hydro-Wind Complementarity: Hydropower accounts for over 95% of Albania’s domestic electricity production. Offshore wind can help stabilize generation during dry seasons, improving energy reliability.
3. **Untapped Market**

Offshore wind energy remains largely unexplored in Albania. This creates significant opportunities for first movers to establish leadership, benefit from initial incentives, and shape the development framework.

4. **Strategic Geographic Location**
   Albania's coastal position near Italy, Greece, and other European markets enables potential electricity exports through regional interconnectors, enhancing the commercial viability of offshore wind projects.
5. **Governmental Support for Renewables**
   The Albanian government has demonstrated increasing commitment to renewable energy through policy frameworks and alignment with EU directives, potentially providing regulatory support and incentives for offshore wind development.

Weaknesses

1. **Infrastructure Deficit** There is a lack of essential infrastructure such as offshore-capable ports, maintenance vessels, and grid interconnection points along the Albanian coast. These would require substantial investments and development.
2. **Limited Technical and Institutional Capacity** Albania lacks experience in offshore wind development, both in terms of local workforce skills and institutional knowledge. This could lead to dependence on foreign companies and consultants in the short to medium term.
3. **High Capital Requirements** Offshore wind projects are capital-intensive, with long payback periods. Attracting investment could be difficult without robust financial guarantees, subsidies, or partnerships with international development banks.
4. **Absence of Regulatory Framework** Albania does not yet have a dedicated legal or regulatory framework specifically for offshore wind, which can delay project development and deter investor confidence due to legal uncertainties.

Opportunities

1. **Access to EU and International Funding** Albania is eligible for funding and technical assistance through EU pre-accession instruments, climate action

funds, and the Western Balkans Green Agenda. These can help mitigate financial and technical barriers.

2. **Economic and Employment Growth** The development of an offshore wind industry could stimulate job creation in construction, operation, maintenance, and services. It could also boost the broader coastal economy through infrastructure development.
3. **Technological Innovation** Newer technologies such as floating wind turbines can enable deployment in deeper waters, overcoming limitations posed by the continental shelf's narrowness along parts of the Albanian coast.
4. **Regional Energy Integration** Offshore wind could help Albania become a significant player in the regional electricity market by contributing to cross-border energy security and stability via Balkan and Mediterranean power corridors.

Threats

1. **Environmental and Social Concerns** Offshore wind development can impact marine ecosystems, fisheries, and local tourism. Environmental impact assessments (EIAs) and stakeholder engagement will be critical and may result in project delays or additional mitigation costs.
2. **Political and Economic Instability** Potential investors may be cautious due to broader political risks, regulatory unpredictability, or macroeconomic instability in the Western Balkans, which could hinder long-term project commitments.
3. **Competition from Other Renewables** Solar and onshore wind currently offer lower levelized costs of energy (LCOE) in Albania. These technologies are also quicker to deploy, which might reduce the perceived urgency to pursue offshore wind.
4. **Climate Uncertainty** Changes in climate conditions over time may affect wind patterns, leading to variability in energy output and potentially reducing the reliability of long-term forecasts.

SWOT Matrix

Strengths	Weaknesses
1.High Wind Potential	**1.Infrastructure Deficit**

2.Geographic and Natural Advantages	**2.Limited Technical and Institutional Capacity**
3.Untapped Market	**3.High Capital Requirements**
4.Strategic Geographic Location	4.Absence of Regulatory Framework
5.Governmental Support for Renewables	
Opportunities	**Threats**
1.Access to EU and International Funding	**1.Environmental and Social Concerns**
2.Economic and Employment Growth	**2.Political and Economic Instability**
3.Technological Innovation	**3.Competition from Other Renewables**
4.Regional Energy Integration	4.Climate Uncertainty

Key Performance Indicators (KPIs)

Installed Offshore Wind Capacity (MW or GW)	0 MW
Annual Energy Output (MWh) and Capacity Factor (%)	0 MWh
Number and Capacity of Planned or Under-Development Projects	No projects under development
Annual Investment Level (EUR)	0
Levelized Cost of Energy (LCOE)	N/A
Employment Impact	N/A
Local Supply Chain Development	N/A
Innovation Metrics	N/A
Regulatory Efficiency	N/A

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Montenegro

Introduction

This report presents a comprehensive SWOT analysis of the offshore wind energy sector in Montenegro, prepared within the framework of the ADRIONWIND project (Deliverable D2.2.1). The objective is to assess the strategic environment for the development of offshore wind and to provide input for the formulation of a transnational research and innovation (R&I) strategy. The analysis was conducted based on national energy and climate policy documents, regulatory frameworks, stakeholder engagement, and regional development plans.

Strategic implications for Montenegro and ADRIONWIND

The SWOT analysis highlights a strong alignment between national potential and regional collaboration goals. Montenegro is strategically positioned to become an emerging actor in offshore wind development in the Adriatic-Ionian region, provided that infrastructural, institutional, and regulatory gaps are addressed.

For the ADRIONWIND project, this analysis provides:

- A baseline for Montenegro's national contribution to the transnational R&I strategy (D2.1.1).
- A foundation for future capacity-building and SME engagement in WP3.
- A reference for targeting policy harmonization, spatial planning, and cross-border innovation transfer.

The findings reinforce the need for a coordinated approach among public authorities, academia, industry, and civil society, reflecting the quadruple helix model and aligning with EU Green Deal, REPowerEU, and Energy Community Treaty commitments.

Purpose of the analysis

This deliverable, titled D2.2.1 - SWOT Analysis Report for the Offshore Wind Energy Sector in Montenegro, is prepared within the framework of the ADRIONWIND project under the Interreg IPA ADRION Programme. The purpose of this deliverable is to analyze the internal and external factors affecting the development of offshore wind energy in Montenegro through the SWOT (Strengths, Weaknesses, Opportunities, and Threats) framework. The report aims to provide a strategic evidence base to support decision-making at both national and regional levels, focusing on the integration of Montenegro into a transnational ecosystem of research and innovation (R&I) in offshore wind energy.

This analysis directly contributes to the formulation of the Transnational R&I Strategy (Deliverable D2.1.1) by identifying country-specific enablers and constraints, aligning national contexts with regional objectives, and helping shape future actions under subsequent work packages (notably WP3 related to capacity-building and stakeholder engagement).

Methodology

1. Approach to SWOT Analysis

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) framework was applied to evaluate the internal and external factors influencing the development of the offshore wind energy sector in Montenegro. This analysis provides a structured and evidence-based assessment of the current landscape, helping to identify key leverage points and barriers that affect the country's readiness for offshore wind deployment. The methodology followed a qualitative and interpretive approach, supported by document analysis, stakeholder insight, and comparative policy review.

Each SWOT category was examined through a national lens, while also considering the regional dynamics of the ADRION area, to ensure consistency with the objectives of the ADRIONWIND project and its transnational research and innovation strategy (D2.1.1).

2. Sources consulted

To ensure analytical depth and accuracy, the SWOT analysis drew upon a broad range of national and international sources, including:

1. **National strategic documents**:
    - *Energy development strategy of Montenegro until 2030 (Ministry of Economy, 2014)*
    - *Draft of National plan for adaptation to climate changes - NPP (UNDP & Government of Montenegro, 2023)*
    - *Report on energy sector condition REGAGEN (2023*
    - *Report on realisation of energy balance for 2024*

2. **Legislation and regulatory frameworks**:
    - *Law on energy (Official list of Montenegro, 2022)*
    - *Law on Maritime Property* (*Official list of Montenegro*, 2011)
    - Relevant EU directives via the Energy Community

3. **Energy data and international databases**:
    - *Energy balance of Montenegro* (Eurostat, IEA datasets - 2023)
    - IRENA and Energy Community Secretariat reports

4. **Stakeholder consultations**:
   Informal consultations were conducted with representatives from:
    - Ministry of Capital Investments
    - University of Donja Gorica (UDG)
    - EPCG and local environmental NGOs
    - Private sector actors in renewable energy

These sources were synthesized to provide a multi-dimensional view of Montenegro's offshore wind landscape, accounting for technical, institutional, environmental, economic, and social factors.

3. Factor prioritization method

To identify the **most critical factors in each quadrant**, a simple **impact-relevance matrix** was used. Each item was assessed based on:

- **Strategic Relevance**: Alignment with Montenegro's national energy and climate goals, as well as its role in the ADRIONWIND collaboration network.
- **Potential Impact**: Degree to which the factor influences the success or failure of offshore wind deployment in the short-to-medium term.
- **Stakeholder Perception**: Initial insights from stakeholder interviews and past workshop findings (where available).
- **Evidence from Policy and Data**: Strength and credibility of source backing each factor.

The top three factors in each SWOT category were then clearly marked and prioritized in the SWOT table), providing a focused basis for further analysis in the next chapter.

SWOT Factors

Strengths

Montenegro benefits from a **favourable geographical position** along the Adriatic coast, offering substantial offshore wind potential. The country's **alignment with EU energy and climate goals**, supported by an **established legal framework for renewable energy development**, creates a stable foundation for future offshore wind projects. Moreover, its **membership in the Energy Community** ensures gradual harmonization with EU directives.

1. **Significant offshore wind potential along the Adriatic coast**

Montenegro has favourable wind conditions along its coastline, particularly in the southern and central Adriatic, which offer consistent wind speeds suitable for offshore wind development. This resource potential makes the sector a viable option for future renewable energy growth.

(Energy development strategy of Montenegro until 2030 - Ministry of Economy, 2014)

A study by Bogdanović and Ivošević (2024) identified seven offshore blocks in Montenegro's territorial waters with significant potential for wind farm construction. These blocks are located south of the municipality of Ulcinj, near the maritime border with Albania. The area spans approximately 766.6 km², with varying sea depths suitable for different types of wind turbine foundations. The total estimated technical potential for offshore wind energy in the identified area is approximately 2,300 MW. This includes:

- 126.8 MW suitable for fixed-bottom structures in depths less than 50 meters.
- 138.6 MW suitable for jacket-fixed structures in depths between 50 and 60 meters.
- 2,034.5 MW suitable for floating structures in depths greater than 60 meters.

(Bogdanović, Miloš; Ivošević, Špiro (2024), *Winds of Change: A Study on the Resource Viability of Offshore Wind Energy in Montenegro*, MDPI)

The average annual wind speeds in these zones exceed 7 m/s at 150 meters above sea level, which is considered technically viable for offshore wind energy production. The sea depths in the identified area range from less than 50 meters to over 60 meters, allowing for the use of both fixed and floating wind turbine structures.

(Bogdanović, Miloš; Ivošević, Špiro (2024), *Winds of Change: A Study on the Resource Viability of Offshore Wind Energy in Montenegro*, MDPI)

2. Political alignment with EU Green Deal and REPowerEU targets

Montenegro is in the process of harmonizing its energy and climate policies with EU directives, which promotes the deployment of renewable energy, including offshore wind. This alignment provides a strong strategic push and

access to technical and financial support from the EU.
(Nacional plan za adaptation to climate changes, 2023)

3. **Existence of legal framework for renewable energy development (e.g., Law on energy)**

The updated Energy Law defines and regulates activities related to renewable energy production, transmission, and integration, which includes offshore wind energy. This legal clarity is a key enabler for attracting investors.
(Law on energy, 2022)

4. **Membership in the Energy Community facilitating regulatory convergence**

As a member of the Energy Community, Montenegro is actively adopting EU energy market rules, which include standards for infrastructure development, market access, and competition—important factors for offshore wind development.
(Energy development strategy of Montenegro until 2030 - Ministry of Economy, 2014)

5. **Commitment to energy diversification and decarbonization by 2030**

The national energy strategy emphasizes the shift from fossil fuels (particularly reliance on coal through TE Pljevlja) to cleaner energy sources, including solar, wind, and hydropower. Offshore wind fits this transition pathway.
(REGAGEN, 2024)

Weaknesses

However, there are significant limitations, including the **lack of grid infrastructure suitable for offshore wind integration**, **limited domestic technical capacity**, and **uncertainty in regulatory and permitting procedures**. These factors represent structural barriers to early-stage investment and development. In addition, **seasonal wind variability** and low stakeholder awareness could impact long-term planning and social acceptance.

1. **Lack of grid infrastructure adapted for offshore integration**

   There are currently no high-capacity offshore transmission lines or substations along the Montenegrin coast, limiting the feasibility of connecting new offshore wind farms to the national grid. *(Report on realization of energy balance, 2024)*

2. **Limited domestic technical and R&D capacities in offshore wind**

   The country lacks specialized knowledge and infrastructure for offshore wind development, including engineering, marine logistics, and maintenance operations. This raises dependency on foreign expertise. *(Energy development strategy of Montenegro until 2030 - Ministry of Economy, 2014)*

3. **High investment risks due to regulatory and permitting uncertainties**

   Although legal frameworks exist, the practical procedures for obtaining permits—especially those involving maritime zones and environmental impact assessments—remain unclear and fragmented. *(Law on Maritime Property, 2011; Law on energy, 2022)*

4. **Seasonal variation in wind patterns along the coast**

While the coast offers overall good wind potential, seasonal variation (e.g., calm summer months) may affect generation predictability and grid balancing.
(IEA Wind Data Set, 2023)

5. **Low public awareness and limited stakeholder coordination mechanisms**

Public understanding of offshore wind's benefits and risks is still limited, and structured engagement processes for communities, local governments, and private sector stakeholders are not yet well developed. *(NAP project - UNDP Montenegro, 2023)*

Opportunities

Montenegro has access to a **range of EU and international funding instruments** such as IPA and the Green Climate Fund. The **existing interconnector with Italy** provides an opportunity to export green electricity to EU markets. There is also a growing momentum to **mainstream offshore wind into national climate adaptation strategies**, creating a compelling case for cross-sectoral integration. These opportunities align well with **ADRIONWIND's goal of fostering innovation ecosystems** in the Adriatic-Ionian region.

1. **Access to EU and international climate finance instruments (e.g., IPA, WBIF, Green Climate Fund)**

Montenegro qualifies for multiple EU and international funding sources that can support feasibility studies, pilot projects, and large-scale offshore wind investments.
(Green Climate Fund - NAP Project Overview, 2023)

2. **Potential for regional export of renewable electricity via interconnectors (e.g., cable to Italy)**

The submarine interconnector between Montenegro and Italy offers a strategic opportunity to export clean electricity to the EU market, creating revenue streams and energy diplomacy leverage. *(Energy development strategy of Montenegro until 2030 - Ministry of Economy, 2014)*

3. **Possibility to integrate offshore wind into national adaptation/resilience strategies**

Offshore wind development can be positioned as part of Montenegro's climate adaptation strategy, contributing to energy independence, emissions reduction, and resilience to fossil fuel price shocks. *(National plan for adaptation to climate changes, 2023)*

4. **Emerging interest from private sector and foreign investors**

Preliminary interest from international developers has been noted, and with proper incentives and regulatory stability, Montenegro can become a regional hub for offshore wind investment. *(Ministry of Energy, unpublished internal communications, 2024)*

5. **Scope for technology transfer and regional cooperation under ADRION framework**

ADRIONWIND and similar projects promote exchange of knowledge, capacity building, and infrastructure planning across Adriatic-Ionian countries, creating favourable conditions for joint ventures. *(ADRIONWIND Application Form, 2023)*

Threats

Key threats include the **high ecological sensitivity** of the marine and coastal environment, as well as **competition for space in the coastal zone** from tourism and maritime transport. Delays in **maritime spatial planning** and inconsistent regulatory enforcement further exacerbate investment risks. Additionally, **climate-related risks** such as sea-level rise and extreme weather, along with potential social opposition, could hinder deployment.

1. **Environmental sensitivity of the coastal and marine ecosystem**

   Offshore wind projects may pose risks to marine biodiversity, migratory birds, and sensitive habitats, particularly in protected or ecologically significant zones along the Montenegrin coast. *(Law on Maritime Property, 2011; Agency for environment protection, 2023)*

2. **Competing interests in the coastal zone (tourism, fisheries, maritime transport)**

   Spatial limitations and user conflicts in the coastal area may hinder the allocation of suitable zones for offshore wind farms, particularly in high-value tourist zones like Budva, Ulcinj, and Bar. *(Draft NPP, 2023; Law on Maritime Property, 2011)*

3. **Delays in regulatory harmonization and implementation of maritime spatial planning**

   The absence of a finalized **maritime spatial plan** delays strategic site allocation for offshore infrastructure, increasing project risk and timeline uncertainty.
   (Energy development strategy of Montenegro until 2030 - Ministry of Economy, 2014)

4. **Climate-related impacts such as rising sea levels and extreme weather events**

Long-term planning must account for increased exposure to marine hazards, which may affect both construction and operational stages of offshore wind farms.
(Nacional plan for adaptation to climate changes, 2023)

5. **Potential social opposition due to landscape and noise concerns**

Public concerns about the visual and acoustic impacts of offshore wind turbines—especially near populated coastal areas—may create resistance to project implementation.
(Nap project, UNDP CG, 2023)

SWOT Matrix

Strengths	Weaknesses
1. Significant offshore wind potential along the Adriatic coast	**1. Lack of grid infrastructure adapted for offshore integration**
2. Political alignment with EU Green Deal and REPowerEU targets	**2. Limited domestic technical and R&D capacities in offshore wind**
3. Existence of legal framework for renewable energy development (e.g., Law on ENergetics of Montenegro)	**3. High investment risks due to regulatory and permitting uncertainties**
4. Membership in the Energy Community facilitating regulatory convergence	4. Seasonal variation in wind patterns along the coast
5. Commitment to energy diversification and decarbonization by 2030	5. Low public awareness and limited stakeholder coordination mechanisms
Opportunities	**Threats**
1. Access to EU and international climate finance instruments (e.g.,	**1. Environmental sensitivity of the coastal and marine ecosystem**

IPA, WBIF, Green Climate Fund)	
2. Potential for regional export of renewable electricity via interconnectors (e.g., cable to Italy)	**2. Competing interests in the coastal zone (tourism, fisheries, maritime transport)**
3. Possibility to integrate offshore wind into national adaptation/resilience strategies	**3. Delays in regulatory harmonization and implementation of maritime spatial planning**
4. Emerging interest from private sector and foreign investors	4. Climate-related impacts such as rising sea levels and extreme weather events
5. Scope for technology transfer and regional cooperation under ADRION framework	5. Potential social opposition due to landscape and noise concerns

Key Performance Indicators (KPIs)

Installed Offshore Wind Capacity (MW or GW)	0 MW /Estimated 2,300 MW over a study
Annual Energy Output (MWh) and Capacity Factor (%)	33% renewable energy share by 2030
Number and Capacity of Planned or Under-Development Projects	No current project
Annual Investment Level (EUR)	€0
Levelized Cost of Energy (LCOE)	N/A
Employment Impact	N/A
Local Supply Chain Development	N/A
Innovation Metrics	N/A
Regulatory Efficiency	N/A

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Bosnia and Herzegovina

Introduction

As of April 2025, Bosnia and Herzegovina does not have specific national market reports or sectoral studies dedicated exclusively to offshore wind power plants. However, the country has made notable progress in reforming its energy sector to align with European Union standards and the Energy Community Treaty [3]. These efforts aim to foster the development of renewable energy, including wind power, by strengthening the regulatory framework, simplifying permitting procedures, and introducing investment guidelines [5].

In August 2023, the Federation of Bosnia and Herzegovina (FBiH) adopted a comprehensive legislative package, including the Law on Electricity, the Law on Renewable Energy and Efficient Cogeneration, and the Law on Energy and Regulation of Energy Activities [5]. These laws streamline administrative procedures, encourage the use of renewable energy sources, and ease permitting for small-scale wind and solar installations. Republika Srpska (RS) has also advanced its regulatory environment by implementing a rulebook for certifying renewable energy production facilities [6].

The International Renewable Energy Agency (IRENA), in collaboration with national institutions (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (MoFTER), Federal Ministry of Energy , Mining and Industry (FMERI), Ministry of Industry, Energy and Mining of Republika Srpska (MEM RS), Federal Ministry of Environment and Tourism, Independent System Operator in BiH (NOSBiH), Regulatory Commission for Energy in FBiH (FERK), Elektroprivreda BiH and Elektroprivreda HZHB Mostar), conducted a Renewables Readiness Assessment for Bosnia and Herzegovina, which highlights the country's potential for renewable energy growth and outlines key recommendations for accelerating deployment. Moreover, investment guidelines supported by international organizations (e.g., USAID and GIZ) provide clear pathways for private and foreign investors interested in renewable projects. These gudilines are custom-developed for Bosnia and Herzegovina, with detailed country-level adaptation to its decentralized governance, administrative procedures, and technical requirements.

Although Bosnia and Herzegovina has a short 20 km coastline and lacks a suitable site for the direct development of offshore wind power plants, its strategic position near coastal neighbors—Croatia and Montenegro—presents opportunities for cross-border cooperation in regional offshore wind initiatives [7]. Additionally, the country is participating in the ADRIONWIND project, aimed at promoting innovation and knowledge-sharing for offshore wind development in the Adriatic-Ionian region.

In this context, the following SWOT analysis explores the internal strengths and weaknesses of Bosnia and Herzegovina's energy landscape, as well as external opportunities and threats relevant to offshore wind energy development and collaboration.

Methodology

The SWOT analysis for Bosnia and Herzegovina was prepared in line with the ADRIONWIND Deliverable D.2.2.1 framework, ensuring consistency with the other country reports. The analysis relied on a structured desk review of official policy documents, most notably the National Energy and Climate Plan (NECP 2023), along with relevant national energy strategies and legislation. Literature from international organizations and regional studies was also incorporated to situate Bosnia and Herzegovina's role within the Adriatic-Ionian context. In addition, sources recommended under the ADRIONWIND project provided a common baseline for cross-country comparability and methodological alignment.

As Bosnia and Herzegovina does not yet have direct offshore wind activity, the analysis focused on identifying enabling conditions, national energy priorities, and regional frameworks. Internal factors were drawn from the country's energy system and institutional setting, while external factors reflected regional and European opportunities and risks. Each element was documented with reference to available evidence and aligned with the standardized ADRIONWIND framework.

SWOT Factors

Strengths

1. **Strong national commitment to renewable energy development**

- Both entities (FBiH and RS) have adopted progressive renewable energy laws (e.g., Law on Renewable Energy and Efficient Cogeneration, 2023) that simplify administrative procedures and promote investments in green energy (Balkan Green Energy News, 2023).

2. **Improved permitting framework for wind energy projects**
   - Streamlining of procedures across both entities is underway to reduce administrative delays (Bankwatch, 2024).

3. **Increasing government and donor support for energy transition**
   - Government strategies backed by organizations like USAID, GIZ, and IRENA provide clear guidelines and incentives for investors (IRENA, 2024).

Weaknesses

1. **No suitable coastline for offshore wind development**
   - Bosnia and Herzegovina has a very limited coastline (approx. 20 km) along the Adriatic Sea, which lacks technical and geographic conditions suitable for offshore wind deployment.

2. **Lack of existing offshore wind infrastructure and experience**
   - No offshore wind farms are operational or under construction; expertise, supply chains, and port infrastructure are currently underdeveloped.

3. **Complex and fragmented permitting system**
   - Building a wind farm in the Federation of BiH requires approximately 29 different permits, none of which are available online (Bankwatch, 2024).

Opportunities

1. **Potential for regional cooperation with Croatia and Montenegro**
    - Close proximity to countries with extensive coastlines and growing offshore capabilities could enable shared infrastructure, investment, and research platforms [7].
2. **Access to EU funding and support mechanisms**
    - EU's Green Deal, Connecting Europe Facility, and the Western Balkans Investment Framework (WBIF) can offer substantial financial and technical support.
3. **Rising regional and EU demand for renewable energy imports**
    - BiH could become a key electricity exporter through grid interconnectors, taking advantage of its renewable potential and strategic location [7].
4. **Moving towards a just transition to renewables**
    - BiH, which was historically dependent on coal-based electricity production, will move towards a renewable energy source production, which will reduce greenhouse gas emissions [4].

Threats

1. **Competition from neighbouring countries with better coastal assets**
    - Croatia and Montenegro offer more favourable conditions for offshore wind, potentially attracting most foreign investment in the region.
2. **Regulatory and policy uncertainties**
    - Although improvements are ongoing, lack of specific offshore wind policies or zoning plans may delay investor interest.
3. **Environmental and public opposition risks**

- Renewable projects may face delays or cancellations due to local resistance or environmental protection regulations, especially in cross-border collaborations.

SWOT Matrix

Strengths	Weaknesses
1. National commitment to renewables	1. No suitable coastline for offshore WPP
2. Improved permitting framework	2. Lack of offshore infrastructure and experience
3. Support from international organizations	3. Complex and fragmented permitting system
Opportunities	**Threats**
1. Cross-border cooperation with Croatia & Montenegro	1. Competition from countries with better offshore potential
2. EU and donor funding availability	2. Regulatory and policy uncertainties
3. Rising demand for clean energy exports	3. Environmental/public resistance risks

Key Performance Indicators (KPIs)

(Note: As of April 2025, offshore wind KPIs are aspirational for BiH due to the lack of existing projects.)

Installed Offshore Wind Capacity (MW or GW)	0 MW
Annual Energy Output (MWh) and Capacity Factor (%)	Not applicable
Number and Capacity of Planned or Under-Development Projects	No project planned
Annual Investment Level (EUR)	0
Levelized Cost of Energy (LCOE)	Not applicable
Employment Impact	None yet in offshore sector
Local Supply Chain Development	0% for offshore projects
Innovation Metrics	Limited to academic interest; no patents or projects specifically for offshore wind yet
Regulatory Efficiency	Not applicable for OFW

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Overview of SWOT items

Methodology for Ranking and Normalisation of SWOT Factors

The prioritisation of SWOT items in ADRIONWIND applies a frequency-weighted rank aggregation approach, designed to balance national importance with transnational consensus. Each item was first ranked within the national SWOT lists, then its average rank across countries was calculated. This average was further divided by the number of countries mentioning the item, thereby giving greater weight to factors recognised across multiple contexts. The resulting indicator reflects both the salience of an item within each country and its consensus across the region, ensuring that shared and consistently prioritised issues emerge as top strategic priorities.

Formula:

Priority Indicator(i) = (Average Rank across countries mentioning i) ÷ (Number of countries mentioning i)

This approach aligns with established practices in rank aggregation (e.g. Borda-type methods in voting theory) and composite indicator construction (OECD & JRC, 2008), where normalisation and weighting are applied to make heterogeneous rankings comparable. Its application in SWOT analysis builds on widely used prioritisation techniques in strategic management, where both frequency of mention and perceived importance are considered in order to identify the most critical factors for policy and strategy.

See: OECD/JRC (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. Paris: OECD Publishing; Young, H.P. (1988). Condorcet's Theory of Voting. American Political Science Review, 82(4), 1231-1244; Helms, M.M. & Nixon, J. (2010). Exploring SWOT analysis - where are we now? Journal of Strategy and Management, 3(3), 215-251.

Worked Examples

Factor A: "Vast offshore wind potential"

Example 1 - Widely Recognised, Highly Ranked Item

Item: "Vast offshore wind potential"

- Mentioned in 5 countries (n = 5)
- Ranks assigned: 1, 1, 1, 1, 1
- Average Rank = (1+1+1+1+1) / 5 = 1.0
- Indicator = Average Rank ÷ n = 1.0 ÷ 5 = **0.20**

Interpretation: This very low score shows that the factor is consistently recognised across countries and ranked as the top priority, making it the strongest transnational priority.

Example 2 - Locally Important, Less Shared Item

Item: "Experience with renewables integration"

- Mentioned in 2 countries (n = 2)
- Ranks assigned: 4, 5
- Average Rank = (4+5) / 2 = 4.5
- Indicator = Average Rank ÷ n = 4.5 ÷ 2 = **2.25**

Interpretation: This higher score reflects that while the factor is relevant nationally, it is less widely recognised across the region, and thus has lower transnational strategic weight compared to items like offshore wind potential.

This method highlights factors that are both widely recognised and consistently prioritised, while still capturing items that may be locally significant.

STRENGTHS	HR	IT	EL	AL	ME	BIH	PI
Vast offshore wind potential	1	1	1	1	1		0.2
High political commitment to renewables	3		2	5	2	1	0.52
Existence of legal framework for renewable energy development					3	2	1.25
Geographic and Natural Advantages		3		2			1.25
Strong maritime industry & supply chain	2		3				1.25
Strategic Geographic Location	4		5	4			1.44
Experience with Renewables Integration & Onshore Wind Energy	5		4				2.25

WEAKNESSES	HR	IT	EL	AL	ME	BIH	PI
Limited Technical and Institutional Capacity	2		1	2	2	2	0.36
Lack of grid infrastructure adapted for offshore integration	4			1	1	2	0.5
Absence of Regulatory Framework	1		2	4			0.77
High initial costs	3		3	3			1
Wind inconsistency		1			4		1.25
Bureaucratic capacity constraints	5					3	2

OPPORTUNITIES	HR	IT	EL	AL	ME	BIH	PI
EU support & funding	1		1	1	1		0.25
Cross-border projects	2			4	3	1	0.625
Benefits to the national economy and employment		1		2			0.75
Tech innovation	5		2	3			1.11
Regional Cooperation and Energy Export Opportunities			3		2		1.25
Emerging interest from private sector and foreign investors	3		5		4		1.33
EU climate goals & Energy Security Needs favour clean energy			4			3	1.75

THREATS	HR	IT	EL	AL	ME	BIH	PI
Policy and Regulation Uncertainty - Potential Delays	1	1	1	2		2	0.28
Environmental & social opposition	2		3	1	5	3	0.56
Competition from countries with better offshore potential	3					1	1
Lack of maritime planning	4	2			3		1
Climate Uncertainty	5			4	4		1.44

Synthesis of SWOT Findings and Thematic Priorities for Follow-up Actions

The comparative review of national SWOT analyses reveals a clear convergence of challenges and opportunities across the Adriatic-Ionian offshore wind sector. While national contexts differ in regulatory maturity, infrastructure readiness, and investment dynamics, the same structural factors influence the region's capacity to accelerate offshore wind deployment.

Regulatory and governance issues emerged as the most critical cross-cutting weakness. All partner countries report complex or fragmented permitting procedures and the need for better coordination between maritime spatial planning and energy regulation. The absence of streamlined, transparent frameworks delays project realization and discourages early investment.

Infrastructure and supply-chain gaps represent a second major bottleneck. Most national analyses highlight limited port capacity, insufficient logistics infrastructure, and underdeveloped manufacturing capabilities for large-scale or floating components. These limitations also constrain SME participation and regional industrial cooperation.

A third shared priority concerns **financing and investment models**. Offshore wind remains capital-intensive, and most countries face restricted access to affordable long-term finance. The need for blended financing mechanisms, public-private partnerships, and improved investor confidence is repeatedly stressed.

The fourth recurrent theme is **innovation and technology development**, with particular emphasis on floating offshore wind. Italy, Greece, and Croatia already recognize floating technologies as the main technological pathway for deep-water sites. Strengthening regional R&I capacity, test sites, and knowledge transfer mechanisms is considered essential for competitiveness and for linking national research efforts into a coherent transnational framework.

Finally, **skills development and social acceptance** appear in every SWOT as both an opportunity and a requirement for success. Workforce upskilling, just transition measures, and stakeholder engagement are central to ensuring that offshore wind expansion delivers inclusive economic and social benefits.

These five thematic areas collectively represent the region's critical axes for coordinated action. These form the conceptual basis and will be considered for the establishment of the **ADRIONWIND Thematic Working Groups (Activity 1.5)**, which will address:

- Regulatory and Governance Frameworks
- Infrastructure, Ports, and Supply Chains
- Financing and Investment Models
- Innovation and Technology Development (with a focus on Floating Wind)
- Skills, Employment, and Social Acceptance

The thematic structure ensures that the lessons of the SWOT analysis are translated into concrete collaboration mechanisms within the ADRIONWIND network. Each group will integrate expertise from different partner types and countries during A 2.4.-Stakeholder consultations and focus groups on R&I strategy development, enabling targeted discussion, joint problem-solving, and the formulation of transnational recommendations that will directly inform the design of the Joint R&I Strategy (Deliverable D2.5.1).