CENTER FOR THE STUDY OF DEMOCRACY

Winds of Change

Offshore Renewable Energy for a More Secure and Resilient Central and Eastern Europe

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Offshore wind energy in Central and Eastern Europe (CEE) is bound to become the cornerstone for accelerating the coal phaseout, strengthening energy and climate security, and enabling the transformation of the industry. The European energy sector is under pressure to swiftly align with the long-term net-zero targets but not at the expense of the system's resilience and competitiveness. Offshore wind energy stands out as a powerful alternative to fossil fuel-based energy supply in countries with access to the sea, which also has strong financial and institutional support from the European Union. Offshore wind deployment carries large technical, economic, social, and environmental benefits, making it an attractive investment option for the CEE region. This report provides an overview of the potential and progress in offshore wind energy development in Poland, Romania, Bulgaria, and Croatia.

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This publication is financed within a project, which is part of the European Climate Initiative (EUKI) of the German Federal Ministry for Economic Affairs and Climate Action (BMWK) and implemented by the Center for the Study of Democracy, the Energy Policy Group, the Instrat Foundation and the Faculty of Mechanical Engineering and Naval Architecture of the University of Zagreb. The opinions put forward in this publication are the sole responsibility of the authors and do not necessarily reflect the views of the Federal Ministry for Economic Affairs and Climate Action (BMWK).

Cover photo: Canva

ISBN: 978-954-477-483-7

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AEP	Average Energy Production
CAPEX	Capital Expenditures
CEE	Central and Eastern Europe
CfD(s)	Contract(s) for difference
CINEA	European Climate, Infrastructure and Environment Executive Agency
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EEA	Exclusive Economic Area
EEZ	Exclusive Economic Zone
EPG	Energy Policy Group
EU	European Union
EUR	Euro
GIS	Geographic Information System
GW	Gigawatt(s)
GWEC	Global Wind Energy Councel
HVDC	High Voltage Direct Current Cable
IECORED	Expert Committee for Offshore Renewable Energy Development
km	Kilometers
km^2	Square kilometers
kV	Kilovolt(s)
LCOE	Levelized Cost of Electricity
m/s	Meters per second
MSP	Maritime Spatial Planning
MW	Megawatt(s)
MWh	Megawatt-hour(s)
NECP	National Energy and Climate Plan
NGO	Non-Governmental Organization(s)
NRRP	National Recovery and Resilience Plan
PEP	Polityka Energetyczna Polski (Energy Policy of Poland)
PGE	Polska Grupa Energetyczna
PLN	Polish zloty
PV	Photovoltaic(s)
PWEA	Polish Wind Energy Association
RES	Renewable Energy Source(s)
TEN-E	Trans-European Networks for Energy
TSO	Transmission System Operator
TWh	Terawatt-hour(s)
TYNDP	Ten Years Network Development Plan
UNESCO	United Nations Educational, Scientific and Cultural Organization
W/m^2	Watt(s) per square meter
WACC	Weighted Average Cost of Capital

EXECUTIVE SUMMARY

Coastal countries in Central and Eastern Europe (CEE) have shown a growing interest in offshore wind energy deployment. It could play a particularly **important strategic role** for countries heavily dependent on coal, which seek to **decouple from their dependence on Russia**. Offshore wind would accelerate the decarbonisation of the power sector, improving energy security, and boosting the local economy. Europe must exploit the potential of all of its sea basins by 2026 to stay on track for achieving its energy and climate objectives by the end of the decade. Against this backdrop, the development of offshore wind on the eastern side of the Baltic Sea is still in its early stages, while wind farms in the Black Sea and the Mediterranean Sea are largely absent from the EU's offshore wind map.

According to the current, largely conservative projections of national authorities, Poland, Croatia, Romania and Bulgaria have the potential to host offshore wind projects with a **combined capacity of 15 GW** by the end of the decade. In addition, it is projected that they could support the buildout of around 40 GW of capacity by 2050, which still represents a small share of the **300 GW target**, included in the EU's Offshore Renewable Energy Strategy.

Among the four CEE countries studied, **Poland is the most advanced** in terms of laying the groundwork for offshore wind deployment, although there are currently **no operational wind turbines** in its waters. The country has included in its energy strategy a target of 5.9 GW of new wind energy capacity at sea by 2030, which can potentially increase to 18 GW by 2040. These targets are set to be met through competitive auctions that provide support in the form of one-sided Contracts for Difference. Offshore wind enjoys **widespread social acceptability** and is unlikely to have a negative impact on biodiversity, tourism, or the environment. However, there are several **factors that could delay and/or limit** the development of Poland's offshore wind deployment. These include electricity demand considerations, including the lack of flexibility of the Polish power system, the insufficient readiness of the supporting infrastructure, and competition from other renewable energy sources, as well as nuclear power. However, the deployment of cutting-edge technologies for the decarbonization of the industry and transportation through **green hydrogen** may open up opportunities for utilising additional locations that are currently considered less attractive for offshore wind development.

Croatia is characterised by **three wind resource-rich areas**, each presenting its unique set of challenges. Some areas are limited by the sea depth, making them suitable only for floating offshore wind projects. Other areas face maritime traffic and other competing economic uses. Currently, the optimal location for fixed offshore wind energy turbines is identified in open sea close to the town of Pula and the island of Mali Lošinj. Estimations conducted by the Global Wind Energy Council suggest that Croatia has a **projected total offshore wind capacity of 17 GW**. Approximately one-fourth of this capacity could be harnessed using bottom-fixed technology. Recent national studies have identified concrete areas, indicating an even higher potential offshore wind capacity of 25 GW in low-impact areas and 32 GW in medium-impact areas. Despite the significant potential, Croatia currently **lacks a specific offshore wind energy regulatory framework**. Offshore wind is absent from national strategic plans as well as from the Maritime Spatial Plan (MSP), although changes in the latter are underway. Additionally, the lack of suitable infrastructure, particularly **offshore grids and large-enough ports**, poses a challenge to the nascent sector. In an effort to assess the feasibility of offshore wind farms, a project has been awarded under the Connecting Europe Facility, which aims to evaluate the potential for a 300 MW offshore wind farm in the Northern Adriatic coastal zone, located between Croatia and Italy.

In the Black Sea, **Romania still lacks binding targets** for offshore wind development in its national strategic documents. However, the government has made progress in the development of the country's legal framework, and it is expected to enter into force by the end of 2024 introducing a competitive bidding procedure for awarding offshore wind concessions. Romania holds a **significant offshore wind potential, estimated at around 94 GW**, with 22 GW for fixed and 72 GW for floating turbines. This potential is attributed to the majority of the country's Exclusive Economic Zone (EEZ), which has water depths that exceed 50 meters, more suitable for wind projects utilizing floating platforms. The national Maritime Spatial Plan has included the identified offshore wind energy potential without outlining any prospective development areas. The **barriers** to renewable energy adoption in Romania **are primarily administrative in nature**, and there are no anticipated environmental conflicts if protected areas are not included in the offshore wind areas. Social resistance is also not likely, according to the preliminary assessment. The biggest obstacle before the construction of offshore wind energy parks in Romania is **the capacity of the power grid**, particularly in the Southeastern region where there is a significant concentration of new renewable energy investment projects. The transmission capacity available in the Dobrogea area, where there is around 3 000 MW worth of installed renewable energy plants, is just starting to expand on the back of new power line projects.

Bulgaria also has significant offshore wind power potential, that has gained attention from national policymakers, particularly in the aftermath of the Russian invasion in Ukraine. Bulgaria has initiated the process of creating its strategic and legal groundwork, although specific **deployment targets and legal procedures are still lacking**. In 2022, a comprehensive draft *Offshore Renewable Energy Law* was introduced in the National Assembly but is yet to be passed, proposing two approaches for site development, tenders for promising areas and integration of offshore wind deployment areas into the national Marine Spatial Plan. The latter was approved in the spring of 2023 but does not include specific areas for offshore wind energy deployment. At the same time, the European Commission has supported the building of **the first demonstration floating offshore wind energy project** in the Black Sea.

While the technical potential for offshore wind energy in the Bulgarian section of the Black Sea is estimated at 116 GW, one-fifth of which can be realised by using mature bottom-fixed technology, only between 3 and **4 GW of new capacity** additions are likely to be achieved until 2040. Bulgaria and Romania should **work on a joint effort** to unlock the development of the sector as this can serve as a common platform for attracting interested investors, develop the nearby port infrastructure, secure funding for preliminary investigations and cross-border projects, such as on the improvement of offshore and onshore grid infrastructure.

Box 1. Action Points for National Governments for Advancing Offshore Wind Energy in Emerging Markets in Central and Eastern Europe

Develop and implement strategic frameworks	1. Integrate offshore wind energy deployment targets into existing strategic documents to attract the attention of industry players and signal the government's commitment to the sector; 2. Develop a comprehensive roadmap with a concrete timeline, aligning national decarbonization efforts with the revised Renewables Directive; 3. Allocate a dedicated budget for research and innovation in the updated National Energy and Climate Plans, ensuring financial support for advancements in offshore wind technologies; 4. Strengthen regional cooperation fora to better coordinate planning efforts and foster offshore wind deployment across neighboring countries sharing the same sea basin; 5. Initiate cross-border projects with neighboring countries to leverage shared learning and financial mechanisms, promoting effective transborder cooperation in offshore wind endeavors; 6. Map future workforce needs and incorporate assessments into national programs for reskilling, upskilling, and preparing technical staff for the implementation of net-zero industry initiatives.
Facilitate the establishment of legislative milestones	7. Design and implement a dedicated law to promote renewable energy at sea, providing a legal framework to support offshore wind development; 8. Appoint an interdisciplinary, cross-institutional state authority to act as a one-stop shop for project developers, streamlining processes and facilitating efficient project approvals; 9. Simplify permitting processes to expedite deployments, reduce costs, and encourage the timely development of offshore wind projects; 10. Allocate responsibility for onshore and offshore grid planning and expansion to the Transmission System Operator (TSO), aligning with offshore wind site development plans; 11. Integrate EU plans for offshore grid corridors into current grid development planning to prevent competition between offshore wind farms and other renewable energy installations for grid capacity; 12. Establish clear rules for compensating investors involved in the development of grid infrastructure to provide financial certainty and encourage investment; 13. Simplify auction design in line with the Commission's Recommendation and Guidance on auction design, expected by March 2024.
Strategically plan the utilization of maritime space	14. Integrate offshore wind deployment areas into maritime spatial plans, ensuring efficient utilization of maritime space and aligning with broader maritime planning objectives; 15. Identify and communicate strategies for coexistence with other maritime activities, environmental considerations, and local populations; 16. Initiate early stakeholder involvement, addressing concerns of the local population to foster understanding and support for offshore wind projects.
Ready the infrastructure	17. Explore diverse financing sources to advance ports and grid-related infrastructure, ensuring access to adequate funding for project development; 18. Focus on the evolving roles of ports and explore synergies with decarbonization activities, maximising the potential of port infrastructure for offshore wind projects, their effective deployment, maintenance, and sustainability; 19. Embrace digitalisation of grids to enhance efficiency, reliability, and adaptability in managing offshore wind energy distribution; 20. Assess and unlock opportunities for the shipbuilding industry, fostering collaboration and innovation to support the offshore wind sector's growth.

INTRODUCTION

Power generation from renewable energy sources (RES) in European seas will play a pivotal role for enabling the EU's clean energy transition and the longer-term objective of climate neutrality by 2050. Following the outbreak of the energy price crisis in late 2021, exacerbated by Russia's invasion of Ukraine in 2022, **offshore wind has gained strategic importance** in helping the EU partially replace natural gas and coal. Offshore technologies have matured enough to provide easier access to less intermittent power supply. In addition, unlocking the offshore wind potential opens up a wide range of **opportunities for the economic development of coastal communities and for industrial decarbonisation**.

The EU experience shows that the successful penetration of offshore energy depends on a **sound public policy design and legislation**, well-coordinated marine spatial planning and permitting procedures, which ensure reliable environmental protection and geological-geophysical data. **Raising awareness** about the benefits of offshore energy by and among local communities enhances the social acceptance of capital-intensive and complex offshore energy investments. However, as offshore expansion threatens already **vulnerable ecosystems**, a major challenge is to develop the related infrastructure without undermining EU environmental law and considering EU's nature conservation and restoration targets.

Littoral countries in the CEE region have grown their interest in offshore energy, which will play an especially important role for reducing the dependence on coal and fossil fuel imports from Russia. Realising the potential of the Adriatic, Baltic, and the Black Seas requires **novel governance approaches** to conflict balancing, maritime spatial planning, and stakeholder engagement. Yet, the CEE region has the unique opportunity to benefit from the example of more advanced offshore energy markets in the North and Baltic Sea regions, and from mature technologies and industry. By studying and replicating well-established governance regimes, the CEE countries can **accelerate** their own **offshore energy development** while avoiding the pitfalls and maximizing the positive outcomes. They can learn from the expertise gained from the North and Baltic Sea markets to establish robust frameworks that **balance the needs** of energy production with environmental protection and biodiversity conservation. Learning from successful examples of **nature-offshore energy coexistence** can help them minimise potential conflicts with local communities and environmental activists. Furthermore, **offshore wind will stimulate innovation**, the smart specialisation of coastal regions and the development of a high-skilled labor force.

POWERING UP NEW EU OFFSHORE WIND MARKETS

Europe's energy mix will undergo **a profound transformation towards 2030** in response to the climate emergency, geopolitical instability, and the much higher energy price levels. These challenges have underscored the critical importance of securing reliable, affordable, and clean energy supply in the region, a task that will remain a priority for years to come. The EU has already emphasized the central role of renewable energy in its long-term vision for **achieving carbon neutrality by 2050**, as demonstrated by the unveiling of the *European Green Deal in 2019*. The full-scale Russian invasion in Ukraine has accelerated the transition process as it has become evident that the large-scale deployment of renewables is crucial to tackle the challenges arising from the confluence of an energy poverty and energy security crisis and ensure a sustainable energy future for Europe.

The *REPowerEU*[1] plan became the flagship instrument of this transformation process. **Europe has increased its 2030 renewable energy target** from 40 percent to 45 percent of final energy demand. For the successful implementation of the Plan, WindEurope has determined that 440 GW of operational wind capacity will have to be online by 2030.[2] This means the addition of 30 GW per year of new capacity on average until 2030, an impossible target if only onshore wind projects are considered.

The *EU Strategy on Offshore Renewable Energy*[3] demonstrates a strong commitment to developing the European marine energy sector and supporting climate neutrality. This strategy also recognizes the potential of the Black Sea in meeting EU energy and climate targets and emphasizes the importance of fostering collaboration and coordination among various stakeholders. Policymakers in countries like Poland, Estonia, Latvia, Bulgaria, Romania, Croatia, Greece, and Cyprus, which represent **EU emerging markets, are currently confronted with a difficult energy situation and must take swift action**.

At this background, **spatial planning and permitting pose significant challenges** to achieving these targets. On average, it takes five years for a wind energy project to obtain all necessary permits in most EU countries, and the process can be even longer for offshore wind projects if not streamlined. In response to the REPowerEU plan, the EU Council[4] has proposed changes to the *EU Renewable Energy Directive*, which will require increased collaboration and coordinated planning among littoral countries in Central and Eastern Europe. These proposals aim to establish **joint offshore energy planning, integrated grid development, and cross-border sharing of offshore wind projects** among member states sharing a sea basin. However, the implementation of these commitments is contingent upon the approval of the updated *Renewable*

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1 European Commission, *REPowerEU Plan*, 18 May 2022.

2 Rystad Energy & WindEurope, *The State of the European Wind Energy Supply Chain*, April 2023.

3 European Commission, *An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future*, November 2020.

4 Council of the European Union, *Proposal for a Directive of the European Parliament and of the Council*, July 2021.

Energy Directive (RED)[5] by all member states. Given that the transposition process could take more than a year, the wind energy industry has continued to advocate for concrete measures to address permitting challenges.

To overcome some of the immediate obstacles, the EU adopted the associated *Council Regulation on December 22, 2022 (Emergency Regulation)*[6], aimed at expediting the permitting process for renewable energy projects across the EU. This regulation serves as a temporary and short-term response to the ongoing energy crisis.

Recognizing the imperative need for immediate actions to bolster the European wind power industry, the European Commission unveiled the European Wind Power Action Plan in October 2023. This comprehensive policy package is strategically designed to align the clean energy transition with industrial competitiveness, ensuring that wind power remains a success story for Europe. A pivotal component of the action plan involves **accelerating the deployment of wind energy through increased predictability and faster permitting processes**. The plan advocates for the digitalization of national permitting processes, introducing a dedicated online tool to support Member States in digital permitting by the end of 2023. To enhance transparency and coordination, the plan proposes the **establishment of an EU digital platform** where Member States can publish their **auction planning**. Additionally, Member States are encouraged to provide concrete wind deployment pledges for the period 2024-2026. This commitment is further reinforced by outlining 10-year plans for wind deployment, incorporating a 2040 outlook as part of the revised 2030 National Energy & Climate Plans. Recognizing the importance of **regional collaboration**, the action plan emphasizes reinforcing regional cooperation fora.

This step aims to better coordinate planning and foster the deployment of offshore wind projects, contributing to a harmonized and efficient European energy landscape.The plan underscores the acceleration of key **cross-border grid projects, addressing bottlenecks hindering grid reinforcement and expansion**. To ensure the necessary grid development, the plan advocates for facilitating anticipatory investments in critical infrastructure, enabling a seamless integration of renewable energy sources. In line with the commitment to streamlining processes, the Commission will initiate a dialogue with Member States and stakeholders on **enhancing and simplifying renewable energy auction design**. This includes exploring pre-qualification criteria, project execution clauses, and bid ceilings to optimize the effectiveness of these auctions. The next steps build on the **Commission's assessment of achievements since the publication of the 2020 Offshore Renewable Energy Strategy** (ORES). It identifies new priorities aligned with current challenges and heightened ambitions. Key focus areas include strengthening regional cooperation, expediting cross-border grid infrastructure, enhancing maritime spatial planning (MSP), promoting skills development, and fostering research and innovation (R&I).

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5 European Commission, *European Green Deal: EU agrees stronger legislation to accelerate the roll-out of renewable energy,* Press Release 30 March 2023.

6 Council of the European Union, *Council Regulation (EU) 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy*, 29 December 2022.

So far, initial attempts to streamline the development of ambitious **national maritime spatial plans** (MSPs) have involved detailed mapping of the most prospective zones for offshore wind energy. MSPs serve as tools for Member States to organise and optimise their sea space, aligning its contours with the national energy objectives. These plans allocate specific areas to offshore wind earmarked for preliminary studies and prepared for development. As of 2022, EU coastal countries have approved spatial plans, which include areas that can support the construction of 220 GW worth of offshore wind power capacity.[7] The member states have improved the zoning process for the EEZ in their MSPs, which benefits offshore wind development while taking into account the other maritime activities, as well as nature protection concerns. However, some CEE countries including Romania, Bulgaria, and Croatia, have not added dedicated areas for blue energy in their MSPs, raising concerns about potential conflicts between economic operators, the environment, and offshore wind developers, which sends a negative signal to interested investors, and risks the delay of MSP approvals. It is crucial that these countries include dedicated areas for offshore wind in their MSPs to ensure sustainable marine development.

Nevertheless, MSPs represent just the initial step in the process. It is essential to also establish **appropriate national frameworks**, including via the revised NECPs that contain clear national offshore wind energy targets, and a supportive legislative framework.

Moreover, strengthening **cross-border cooperation** is another key milestone for powering up new EU offshore wind markets. *The Esbjerg*[8] and *Marienborg*[9] *Declarations* for offshore wind demonstrate a good approach for communicating the ambition of North Sea and Baltic Sea countries to accelerate the development of their offshore wind capacity by identifying common actions and enhancing political collaboration. Additionally, several EU countries are in the process of developing roadmaps, regulations, and targets to expedite their national renewable energy uptake. In 2022, significant policy initiatives were focused on raising targets and streamlining permitting procedures but much more needs to be done for the offshore wind potential to be unlocked.

To promote cross-border offshore network cooperation, initial steps are expected to be implemented in 2023 through *Regulation (EU) 2022/869 on guidelines for trans-European energy infrastructure*.[10] The European Network of Electricity Transmission System Operators (ENTSO-e) will develop plans to establish an integrated offshore network aligned with the objectives of the European Green Deal. Five **priority offshore grid corridors** will be established, including the South and East offshore grid corridor connecting Bulgaria, Croatia, Romania, and four other countries in Southeastern Europe. This initiative aims to enhance regional cooperation and facilitate the transmission of offshore wind energy.

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7 WindEurope, *Offshore Wind in EU Maritime Spatial Plans*, September 2022.

8 Ministry of Climate, Energy, and Utilities of Denmark, *The Esbjerg Declaration on The North Sea as a Green Power Plant of Europe*, 2022.

9 Danish Government, *The Marienborg Declaration from The Baltic Sea Energy Security Summit*, August 2022.

10 Council of the European Union, *Regulation (EU) 2022/869 on Guidelines for Trans-European Energy Infrastructure,* May 2022.

Overall, the development and implementation of MSPs, along with supportive national frameworks and cross-border cooperation initiatives, are instrumental in unlocking the potential of new offshore wind markets in the CEE region. As presented in Table 1, the four countries in the focus of this report— Poland, Croatia, Romania and Bulgaria —could host in their marine areas **offshore wind power projects with total capacity of 15 GW by the end of the decade.** Furthermore, it is projected that these countries could support a capacity of more than **40 GW by 2050**.

Table 1. Comparative Technical Potential for Offshore Wind Energy in the CEE region

Country	Total technical potential	Fixed	Floating	Capacity Factors	LCOE fixed	LCOE floating	Capacity by 2030	Capacity by 2050
Poland	31.2 – 45 GW	23 GW	10 GW	42.7 – 48.9 percent	70 – 80 EUR/MWh[11]		5.9 GW	18 GW[12]
Croatia	17 GW	4 GW	13 GW	24 percent	73 EUR/MWh	95[13] EUR/MWh	0.51 GW	3 GW[14]
Romania	77 – 94 GW	22 GW	55 – 72 GW	24 – 47 percent[15]	52 – 119 EUR/MWh	82 – 163 EUR/MWh	5 GW	15 GW
Bulgaria	77.5 – 116 GW[16]	26 GW[17]	90 GW	40 – 48 percent	62 – 91 EUR/MWh	110 – 133 EUR/MWh	1.2 – 1.8 GW	3.4 – 5 GW[18]

Source: CSD based on national policy frameworks and existing studies of the technical-economic potential for offshore wind development.

The term "technical potential" refers here to the maximum achievable capacity (in MW) based on the available and suitable land area (in km^2). This estimation considers multiple factors, including system performance, topography, environmental factors, and land-use constraints. The technical potential provides an upper-boundary estimate of the renewable energy development potential in a specific area. The values include estimates for both fixed and floating offshore wind energy.[19]

In the Baltic Sea, Poland is estimated to have a technical offshore wind potential of 45 GW at a height of 100 meters, primarily for bottom-fixed infrastructure (23 GW). With such wind potential, the capacity factors are expected to range between 42.7 and 48.9 percent. Factors such as low biodiversity, minimal anticipated impact on tourism and coastal communities, and

11 1 EUR = 4.5 PLN, LCOE for fixed foundations

12 By 2040

13 Assessment for 2030 LCOE levels for fixed and floating Offshore wind technology from European Commission, *Study on the offshore grid potential in the Mediterranean* region, November 2020.

14 Capacity by 2030 and 2050 from European Commission, *Member States agree new ambition for expanding offshore* renewable energy, January 2023.

15 Depending on a location in the EEZ and the season

16 With wind turbine heights of 100 m or 150 m

17 With 150 m wind turbines

18 Based on scenarios developed by the Energy Transition Commission and Climate-Neutrality scenarios modelled by CSD. Center for the Study of Democracy, *Back to the Drawing Board The Contours of Bulgaria's Climate Neutrality Roadmap*, March 2023.

19 National Renewable Energy Laboratory, *RE Explorer*.

favourable technical conditions in viable areas contribute to the projected capacity of 5.9 GW by 2023 and 18 GW by 2040, based on progress in Phases I and II. Along the Croatian shores of the Adriatic Sea, there are three potential areas for offshore wind farms, projecting a total potential of 17 GW. Most of this capacity (76 percent) is attributed to floating wind farms, with a corresponding capacity factor of 24 percent. Given these conditions, Croatia has the capability to achieve a capacity of 0.51 GW by 2030 and 3 GW by 2050.

Based on the only techno-economic assessment conducted so far, which utilized national-specific data for **Bulgaria**, it has been determined that the country possesses an untapped technical offshore wind potential of 116 GW at a wind turbine height of 150 m.[20] With mature bottom-fixed technology and considering favourable areas modelled by CSD, it is estimated that approximately 26 GW could be realistically achieved, resulting in capacity factors ranging from 40 percent to 48 percent. Zooming in on sea-use constraints, economic considerations, environmental protection criteria, and alternative technology options outlined in the national decarbonization pathways, the Energy Transition Commission, a sub-commission to the Consultative Council for the European Green Deal at the Council of Ministers, has conservatively projected offshore wind development prospects of 0.5 GW by 2030 and 3.3 GW by 2050. However, further modelling conducted by CSD underscores the necessity to develop at least 5 GW by 2050 in a scenario that leads to climate-neutrality.[21,22]

Romanian shores can host 94 GW of offshore wind at 100 m, mostly with floating turbines (72 GW). However, only the central part of the country's deep-water sector has more sizeable mean wind speeds (close to 7 m/s), while in the south-eastern part of the Romanian EEZ the wind speed decreases. Wind speeds depend also on seasonal distribution: in deep-water areas, wind speeds can reach up to 8-9 m/s in winter, while the north-eastern part of the deep waters hardly reaches 7 m/s in summertime.[23]

In 2020, the World Bank conducted an assessment of the overall technical potential of the Black Sea region, estimating it to be around 435 GW.[24] It is worth noting that a significant portion of this potential lies outside the EU member states. Within the wider Black Sea area, the World Bank's assessment identifies Ukraine as having the highest potential (251 GW), with 183 GW in fixed installations and 68 GW in floating installations. However, due to the ongoing Russian invasion of Ukraine, the prospects for offshore wind in the country have been severely hindered. Despite this, Ukraine's Black Sea territorial waters still hold substantial potential for decarbonizing the country's energy system, promoting renewable hydrogen production, and fostering economic development in local communities. In the aftermath of the war, focusing on post-war reconstruction efforts such as offshore wind power,

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20 Trifonova, M. and Vladimirov, M., *Wind Power Generation in Bulgaria. Assessment of the Black Sea Offshore Potential*, Center for the Study of Democracy (CSD), September 2021.

21 Vladimirov, M., Tcolova, K., Trifonova, M., *Back to the Drawing Board: The Contours of Bulgaria's Climate Neutrality Roadmap*, Center for the Study of Democracy (CSD), March 2023.

22 Vladimirov, M. et al, *Decarbonising the Bulgarian Power Sector Resolving the Coal Phase-Out – Security of Supply Conundrum*, Center for the Study of Democracy (CSD), September 2023.

23 Energy Policy Group, *Romania's Offshore Wind Energy Resources*, November 2020.

24 World Bank, *Offshore Wind Energy Potential in the Black Sea*, March 2020.

port refurbishment, and modernization would be crucial areas for EU post-war aid to support. By directing aid towards these areas, **Ukraine has the potential to become a key partner of the EU in achieving its decarbonization objectives.**

Turkey is also important for offshore wind deployment in the region, even though most of its offshore wind potential is in the western part of the country, on the Mediterranean coast. The World Bank (2020) estimates the country's offshore wind potential in the Black Sea to be 75 GW in total, and most of Turkey's adequate offshore wind resources are found in deep waters suited for floating turbines, which means that the development of floating wind would be a good opportunity for Turkey to exploit its full offshore wind potential. There is strong political support for the deployment of offshore wind as, in May 2023, the marine renewables were added to the country's support scheme. Turkey is currently collaborating with international financial institutions to develop an offshore wind energy roadmap, which is scheduled to be published later this year.

PROFILES OF EMERGING OFFSHORE WIND MARKETS IN CENTRAL AND EASTERN EUROPE

The following chapters outline the offshore wind energy **profiles of Poland, Croatia, Romania, and Bulgaria**, based on several key elements. Each profile first provides an overview of the **current status of offshore wind development** in the respective country. Then, the report evaluates the **techno-economic potential** of offshore wind, considering factors such as resource availability, technological advancements, and cost-effectiveness. Thirdly, it explores the **national marine energy strategies** implemented by each country and assesses their alignment with the country's overall decarbonisation goals. Another crucial aspect is the evaluation of the **national support framework** for offshore wind projects, including permits, licenses, and incentives. The analysis also scrutinises the effectiveness of Maritime Spatial Planning, including in minimising conflicts with other maritime activities. Moreover, the report considers the **environmental constraints and social acceptability** aspects associated with offshore wind projects, considering ecological considerations and stakeholder engagement. Lastly, it assesses the **infrastructure readiness** of the countries to accommodate offshore wind, looking at grid connectivity bottlenecks, the need for upgrades of port facilities, and the strengthening of relevant supply chains.

Poland

As of 2023, offshore wind farms are not yet a prominent feature of the Polish energy landscape. However, Poland recognizes their **significant potential** and has **ambitious plans** for offshore wind development. The country aims to connect its first offshore wind farms to the grid starting from 2026. These projects will play a crucial role in the ongoing decarbonisation of the Polish power system, which still heavily relies on coal for 70 percent of its electricity production.[25] In Poland's clean generation capacity, variable **renewable energy sources will take the lead**, supported by bioenergy, and planned nuclear power plants. Offshore wind in the Baltic Sea holds great promise due to its expected high efficiency and stability of electricity production, offering key advantages over onshore wind and solar PV, which are more susceptible to the fluctuations of the Polish weather conditions.

The journey towards **establishing the offshore wind industry** in Poland has been relatively long, as the preliminary deployment plans were already included in the domestic strategies as early as 2009. Despite significant milestones achieved in recent years, the development process has encountered challenges, as highlighted by the Supreme Audit Office in 2022.[26] The obstacles such as **delayed installation terminals** and **complex permitting procedures** may cause implementation delays and increased costs. Polish institutions and state-owned enterprises need to further develop their **administrative and operational capabilities** to successfully achieve the ambitious national offshore wind targets.

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[25] Instrat, Available at: *https://energy.instrat.pl/*, Accessed: 27.04.2023.

[26] Supreme Audit Office, *Informacja o wynikach kontroli. Rozwój morskiej energetyki wiatrowej* (In Polish), March 2022.

The planning and development of offshore wind farms in Poland is **structured in two phases**. Phase I encompasses projects initiated over a decade ago, with approvals for artificial islands granted in 2012-2013. In 2021, these projects were allowed to **negative balance coverage for electricity**, a type of a Contract for Difference (CfD) support tool that guarantees a minimum price to cover investment costs, initially set at 320 PLN/MWh (approximately 73 EUR/MWh).[27] Phase I projects typically involve **collaboration** between the Polish power sector enterprises (mostly state-owned, such as PGE and Orlen) and international partners with offshore wind experience.

Table 2. Polish Offshore Wind Farms – Phase I

Name	Investor	Capacity	Commissioning date
MFW Bałtyk II, MFW Bałtyk III	Polenergia[28], Equinor	1.4 GW	2026
Baltica 2, Baltica 3	PGE[29], Orsted	2.5 GW	2026 – 2027
BC-WIND[30]	Ocean Winds	0.4 GW	2027
Baltic II	RWE[31]	0.4 GW	2026
Baltic Power[32]	Orlen, Northland Power	1.4 GW	2026

Source: Instrat based on Polenergia, PGE Baltica, Baltic Power, Ocean Winds, RWE.

Moving on to Phase II, the next batch of projects in the Polish Baltic Sea falls under the framework of the legislation introduced in 2020. In addition to the ongoing projects like Baltica 1 by PGE, which is expected to have a capacity of 0.9 GW after 2030, new areas for offshore wind development have been distributed through **competitive procedures**. Starting in 2025, all Phase II wind farms under development will have the opportunity to participate in dedicated auctions for contracts for difference. Competitive auctions remain the only option to award support to offshore wind farms construction in Phase II.

Potential

Poland benefits from a 770 km long and relatively straight coastline along the Baltic Sea, providing a vast territorial sea area of 8 700 km^2. Additionally, its EEZ extends over 30 000 km^2. Several factors contribute to the potential of the Polish Baltic Sea as **a destination for offshore wind development**:

27 Polish Government, *Offsore Wind Energy* (In Polish), Accessed: 23.06.2023.
28 Polenergia, Available at: *https://www.baltyk2.pl/en*, Accessed: 28.04.2023.
29 PGE Baltica, Available at: *https://baltica.energy/?sc_lang=en*, Accessed: 28.04.2023.
30 Ocean Winds, Available at: *https://www.bc-wind.pl/en/*, Accessed: 28.04.2023.
31 RWE, Available at: *https://fewbalticii.rwe.com/en*, Accessed: 28.04.2023.
32 Baltic Power, Available at: *https://www.balticpower.pl/en/*, Accessed: 28.04.2023.

Relatively strong winds

The Polish Baltic experiences **average wind speeds of 8-10 m/s** at a height of a hundred meters. The average wind power density ranges from 850-880 W/m^2.[33] While these values are lower than in the North Sea, they surpass the wind potential of the southern European Atlantic coastal waters, the Mediterranean, and the Black Sea. The wind in the Polish Baltic is stronger and more consistent than on land, although it still exhibits seasonal and daily variations.

Low water depth

The Baltic Sea is characterized by its relative shallowness, with an **average depth of 55 meters**. This makes offshore wind turbines with fixed foundations feasible for installation.

Coastline shape

The straight shape of the Polish coastline, i.e., without islands, bays, or any rough edges, allows for the placement of offshore wind farms in areas that are not visible from the coast. This **mitigates the potential impact on tourism** and the well-being of coastal communities.

Relatively low biodiversity

The brackish waters of the Baltic Sea host a combination of saltwater and freshwater species, although the overall diversity and wildlife abundance are lower compared to the North Sea.[34] Human activities have also heavily influenced the inland Baltic Sea, resulting in pollution, eutrophication, algal blooms, and low-oxygen dead zones. While remaining marine ecosystems are protected, the **environmental impact** of new offshore wind turbines is generally **expected to be less significant** compared to installations placed in more ecologically diverse areas.

Other geographic factors

The water in the Baltic has low salinity, thus **reducing the risk of saltwater corrosion**. The southern part of the Baltic Sea does not freeze in winter, although ice may accumulate on the installations during that period. However, severe winter storms can pose challenges, especially during the construction phase.

Other Socio-economic and technical factors

The practical potential of offshore wind power in Poland is influenced by various **socio-economic and technical factors**. The coastal areas are generally not heavily industrialized or densely populated, which means that the generated power would need to be distributed further inland or even to southern regions in the country. While offshore wind turbines themselves have limited impact on tourism and the environment, the associated onshore infrastructure can be more difficult to construct and approve.

The availability of sea areas is not expected to be a limiting factor for Polish offshore wind development in the coming decades, even with more ambitious decarbonization goals. As of 2023, the official plan for offshore wind auctions outlines the procurement of 12 GW of capacity in Phase II,[35] in addition to the 5.9 GW from Phase I.[36] The target of 18 GW[37] by 2040 is expected to be included in the *Energy Policy for Poland until 2040* updated strategy.

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33 Global Wind Atlas, Available at: https://globalwindatlas.info/en/, Accessed: 21.06.2023.

34 Voice of the Ocean, Available at: https://voiceoftheocean.org/baltic-sea-biodiversity/, Accessed: 21.06.2023.

35 Polish Wind Energy Association, *The government believed in the potential of offshore wind – offshore auctions from 5 to 12 GW* (In Polish), Accessed: 23.06.2023

36 Polish Government, *Offshore Wind Energy*, (In Polish), Accessed: 23.06.2023

37 Rzeczpospolita, *Wind energy in Poland – a new deal* (In Polish), Accessed: 23.06.2023

However, the overall potential goes beyond these figures. Independent analyses conducted by non-governmental organizations (NGOs) and industry associations have considered various factors such as water depth, wind speed, conflicts with Natura 2000 sites, and other marine uses. The Instrat Foundation estimated a potential deployment of up to 31.2 GW[38], while reports by McKinsey&Company[39] and the Polish Wind Energy Association (PWEA)[40] assessed the potential at 45 GW and 33 GW, respectively. Achieving these numbers would require appropriate **changes in spatial planning and regulations**. The PWEA report provides a more detailed preliminary analysis of technical conditions and costs, suggesting that some later additions may need to utilize floating technology, resulting in a higher relative Levelized Cost of Electricity (LCOE). Challenges such as spatial conflicts with fisheries, maritime military training areas, and a negative influence on landscape has also been identified.

In general, Poland has sufficient marine areas with **high potential to accommodate ambitious additions** of new offshore power until at least the early 2040s. Limitations and delays are likely to arise from other factors, including the electricity demand, flexibility of the Polish power system, investment costs, or competition from other renewables, and nuclear power. However, emerging trends such as the decarbonization of industry and transport through green hydrogen may lead to the utilisation of additional locations currently deemed less attractive.

In 2021, the PWEA argued that a fair strike price for electricity produced from offshore wind power plants would be 370 PLN/MWh (approximately 84 EUR/MWh).[41] The government, however, set the price at 320 PLN/MWh (approximately 73 EUR/MWh), annually indexed to inflation.

Strategic fit

The development of large-scale offshore wind farms **in the North Sea has served as an inspiration** to pursue a similar path on the Baltic Sea. As early as 2011, the first joint venture was established with the aim of developing the Bałtyk II/III[42] offshore wind power plant, with a capacity of 1.4 GW. The project, initially planned to be completed by 2022, demonstrated the early aspirations for offshore wind power in the region. It was assessed in 2013 that offshore wind power has the potential to contribute significantly to the growth of the Polish economy, generate large tax income, and create approximately 30 000 new jobs.[43] Three scenarios have been defined expecting the addition of

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[38] Instrat, *What's next after coal? RES potential in Poland*, June 2021.

[39] McKinsey&Company, *Carbon-neutral Poland 2050. Turning a challenge into opportunity*, June 2020

[40] Polish Wind Energy Association, *Potencjał morskiej energetyki wiatrowej w Polsce. Kompleksowa analiza możliwości rozwoju morskiej energetyki wiatrowej w polskich obszarach morskich* (In Polish), November 2022.

[41] Polish Wind Energy Association, *Letter to Mr. Michał Kurtyka Minister of Climate and Environment*, February 2021

[42] Polenergia, Available at: *https://www.baltyk3.pl/permitting-process*, Accessed: 21.06.2023

[43] Additional information at Wprost, *Raport EY: Morskie farmy wiatrowe mogą dać miliardy polskiej gospodarce,* May 2023.

1 GW, 3.5 GW, and 6 GW of capacity by 2025. These projections demonstrated the high policy ambition to rapidly expand offshore wind energy in Poland.

The development of the Polish offshore wind energy sector has been divided into two phases – Phase I and Phase II – as indicated in the country's 2040 strategic vision. The former encompasses projects set to be completed by 2030, whereas the latter has a time framework in the 2030s. During Phase I of the Polish offshore wind energy development, a total of 5.9 GW[44] of projects were initiated, reflecting the commitment to advancing the country's nascent industry.

The first strategic document, which mentioned the offshore wind power potential, was the ***Energy Policy of Poland*** **until 2030** ***(PEP2030)***.[45] The document identified the legislative steps necessary for offshore wind development but the development of an appropriate regulatory framework was delayed significantly. The **competitive advantage of offshore wind** development in the 2010s was hindered by multiple factors including the low prices of Emission Trading Scheme (ETS) quotas in Europe, low fossil fuel prices, and the European economic slowdown. Meanwhile, advancements in onshore wind turbine technology improved its viability in Poland, leading to significant growth in this subsegment. In addition, the government believed that the fast deployment of wind energy facilities would have severe **economic and technical implications** for the inflexible coal power plant fleet dominating the electricity mix of the country. As a result, the implementation of many of the offshore wind projects have faced consistent project implementation delays. In 2019, the National Energy and Climate Plan[46] projected only 3.8 GW of installed capacity by 2030, with projected expansion of up to 8 GW by 2040.

The ***Energy Policy of Poland until 2040*** **(PEP2040)**[47] paints a much more realistic and relevant picture about the development of the Polish power sector and the role offshore wind energy will play in its decarbonisation. Although it was introduced only in 2021, it is currently undergoing a major update so as to integrate the most recent developments in the aftermath of the energy security crisis of 2021/2022 and the subsequent EU policy response including REPowerEU and Fit-for-55 strategies. PEP2040 consists of **three pillars**: just transition, climate neutral energy system, and high air quality. The development of renewable energy sources, including offshore wind energy, is listed as one of the eight specific objectives. The strategy envisions that the **installed offshore wind energy capacity will reach 5.9 GW in 2030** and **up to 11 GW in 2040**. While the initial plan aimed for the first installations to be operational by 2025, this timeline is no longer feasible. The strategy recognises the value of offshore wind energy due to its higher capacity factors and resource availability compared to onshore wind energy. The plan also anticipates **the creation of up to 60 000 new jobs** in Poland in the offshore wind segment. Furthermore, it emphasises the need to expand the high

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44 Ministry of Climate and Environment, *Polityka Energetyczna Polski do roku 2040* (In Polish), February 2021.

45 Ministry of Economy, *Polityka energetyczna Polski do 2030 roku* (In Polish), November 2009.

46 Ministry of State Assets, *Krajowy plan na rzecz energii i klimatu na lata 2021 2030* (In Polish), December 2019.

47 Ministry of Climate and Environment (footnote № 43).

voltage power grid as to transport electricity from the Baltic Sea to demand centres across the country and beyond.

According to the scenario outlined in PEP2040, offshore wind is projected to **become the largest source of renewable energy by 2030**, generating 24 TWh annually (equivalent to 13 percent of total electricity generation).[48] The emphasis on offshore wind can be seen as a strategic move to deploy large volumes of clean energy without compromising the system's integrity and also by preserving the framework for onshore renewables. It serves as a partial solution to diversify the renewable energy mix and compensate for the limitations imposed on onshore wind development.

Those political considerations do not change the fact that the development of offshore wind power in Poland enjoys **broad support by experts, political parties, industrial stakeholders, NGOs and local governments**. Poland has to accelerate the process of transition to climate neutrality as its role for the overall decarbonisation of the European economy is critical. The deployment of the enormous offshore wind energy potential in Poland would be a key ingredient of the success of this strategy. The energy crisis of 2023 has exposed **Poland's strategic vulnerability** as it heavily relies on imports for oil, gas, and a significant portion of coal used for residential heating (about 50 percent). Consequently, the projected renewable capacity is now expected to reach 50 GW by 2030, accounting for approximately 47 percent of annual production (compared to 32 percent in the previous scenario). By 2040, the revised strategy anticipates that 73 percent of electricity production will come from low-carbon sources, including renewables and a new nuclear fleet. These welcomed developments also present new challenges, such as the need for further expansion of the transmission grid and effectively managing the increasing curtailment of renewable energy sources in the 2030s.

Regulatory framework

The offshore wind energy projects in Poland have faced significant delays of their development process, primarily due to **the absence of a comprehensive regulatory framework**. As a result, the Phase I projects, initially planned for completion by 2030, experienced substantial setbacks. A 2022 report by the Supreme Audit Office[49] acknowledged the recent progress made to advance these projects but also identified several issues that have hindered their development. These include delays in regulatory changes, **complex and time-consuming permitting processes**, flawed strategic planning, and the delayed establishment of port infrastructure. As a result, the initial goal of connecting the first turbines to the grid by 2024/2025 is unlikely to be achieved.

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[48] PEP 2040 forecasted 5-7 GW of photovoltaic capacity by 2030 and 10-16 GW by 2040. In fact, Poland has already reached nearly 13 GW of installed solar capacity as of early 2023, largely due to state subsidies and support schemes for prosumers, such as net metering. The strategy maintains the restrictive approach towards onshore wind development that was introduced through legislative changes in 2016. These changes effectively halted new investment projects for onshore wind, limiting its expansion.

[49] Supreme Audit Office, *Wiatr w żagle morskiej energetyki wiatrowej potrzebny od zaraz* (In Polish), July 2022.

To address the regulatory gaps, **a dedicated *Act on Promoting the Generation of Electrical Energy in Offshore Wind Farms* (Offshore Act)** was introduced in 2021 with broad political support. The new Law provided a comprehensive framework for various processes related to the construction of offshore wind farms, including on their micrositing, permitting, development, exploitation, and liquidation. One of the key provisions of the *Offshore Act* is the support scheme in the form of **one-sided CfDs**, known as the right of negative balance coverage.

Under the Phase I of the Offshore Act, the most advanced projects in the pipeline could directly apply for support, with a total capacity of up to 5.9 GW. Subsequent projects are eligible to participate in **non-obligatory auctions** under Phase II. The energy regulator was granted new competences related to the support scheme and permitting process. The strike price was initially proposed at 302 PLN/MWh (approximately 69 EUR/MWh) but was ultimately set at 320 PLN/MWh (approximately 73 EUR/MWh)[50] in a supplementary regulation by the Minister of Climate and Environment. The industry criticised the initial proposed price as insufficient to cover investment and operating costs, and the Polish Wind Power Association suggested a price of 370 PLN/MWh (approximately 84 EUR/MWh) to reflect the rising development costs as a result of the disruptions in the global supply chains.

The Polish government issued additional regulations to further **clarify the structure of concession payments** by operators and supply chain reporting. The rules for participants in Phase I included the preparation of reports on their supply chain plans, which were published to support domestic value chains, improve fair competition, and encourage productive partnerships and collaborations.

The *Act on Maritime Areas and Maritime Administration*, which governs **maritime spatial planning**, was amended to include criteria for granting concessions necessary to initiate the offshore wind development processes. The assessment of projects is based on the alignment with maritime spatial planning, timeline for development and operations, financing for concession payments and investments, organizational and logistical capacity, and alignment with relevant Polish and European policies.

The assessment aims to ensure that the allocation of scarce maritime locations favors the best projects that align with the needs of the Polish power system and have a high likelihood of timely implementation. However, the criteria were criticized for **potentially providing unfair advantages to Polish state-owned enterprises**. For instance, additional points are awarded for companies with experience with onshore wind power plants in Poland, but not for offshore wind power plants developed in the UK, the leading European offshore wind market. The tender procedure gives points to enterprises relying heavily on fossil fuels and the preference for predominantly state-owned Polish financial institutions as guarantee providers. The European Commission has also been evaluating the procedures for the granting of concessions as they are a prerequisite for participating in later CfD auctions, which have to be approved for not **violating state aid rules**. The unclear situation could delay

[50] Polish Government, *Offsore Wind Energy* (In Polish), Accessed: 23.06.2023.

the initiation of Phase II investment processes. Phase I projects expected to be connected to the grid by 2030 are not affected by these uncertainties.

Box 2. Criteria for Granting Concessions in a Competitive Process for Offshore Wind Power Plants in Poland*

Alignment with maritime spatial planning, including: the positive opinion of relevant authorities, description of the investment, enabling other simultaneous uses of the area after development of the farm	up to 8 points
The timeline for development and operations, including alignment with energy strategy and public good	up to 5 points
The financing for concession payments, most points for deposits or bank guarantees by Polish financial institutions	up to 8 points
The financing for investment, most points for financing with own capital, access to credit, access to public funding	up to 25 points
The organisational, logistical and HR capacity, experience with offshore or onshore wind farms and other infrastructure – but only in the EU, Norway, Iceland, Switzerland or Liechtenstein	up to 22 points
The alignment with relevant Polish and European policies, including points for enterprises which are on the lower stage of the decarbonization process, to encourage the transition	up to 15 points

*The Minister of Infrastructure can choose the most relevant criterion in the specific competition and double its weight.

The government is now planning to amend the regulations to streamline the offshore development process. In late 2022, the Offshore Act addressed various issues identified in the permitting process. Additionally, the **price in the support scheme has been indexed to inflation**, and investors can now set the CfD price in Euros, reducing currency risks.

Maritime spatial planning, social and environmental sustainability

The current maritime spatial plan[51], introduced in 2021, takes into consideration various **environmental, economic, and military factors**. It allocates approximately 1 800 km^2 or just below 10 percent[52] of the EEZ for offshore wind energy deployment. These areas might result in roughly **18 GW power generation capacity**.

The plan provides information about **environmental conditions** and allowed uses for different parts of the sea, which is crucial when conducting micrositing for projects. Maritime transportation is of utmost importance to the Polish economy, with major international ports in Gdańsk and Gdynia serving as major trading hubs. **Military considerations** also play a significant

[51] Journal of Laws of the Republic of Poland, *Regulation of the Council of Ministers on the adoption of the spatial development plan for internal sea waters, the territorial sea and the exclusive economic zone on a scale of 1:200 000*, May 2021

[52] European MSP Platform, *https://maritime-spatial-planning.ec.europa.eu/countries/poland*, Accessed: 23.06.2023

role, limiting wind farm development in certain areas. In the future, safeguarding offshore wind power plants and infrastructure will become a matter of national security. Fishing, due to past overfishing and pollution, has diminished in economic significance, and efforts are underway to restore fish populations. While tourism is a vital use of coastal areas, sailing is less popular in the Polish Baltic Sea region due to unfavourable conditions. Artificial island construction for offshore wind farms is a permitted use. The concession competitions align with the maritime spatial plan.

Overall, the development of offshore wind power enjoys **considerable social and political support**. Some 73 percent of Polish citizens, who participated in the YouGov survey, expressed willingness to live near an offshore wind farm against only 12 percent who would oppose it.[53] Unlike onshore wind power, which have faced country-wide restrictions since 2016 due to local controversies, no such issues have arisen regarding offshore wind development thus far. All current offshore wind locations are situated out of sight from the shore, preserving the landscape and tourism experience.

However, **potential controversies** may arise regarding onshore infrastructure, including ports, power system substations, and the planned high-voltage direct current transmission line connecting the offshore wind and the new nuclear power plants in the Choczewo municipality to consumption centers in southern Poland.

The permitting process for offshore wind power plants involves conducting **environmental impact assessments**. The results of these assessments have not faced major challenges from Polish environmental organizations, as they generally support renewable energy investments. However, opposition may still emerge for specific projects, as seen with the PV farm near the Białowieża primaeval forest or the planned pumped hydroelectric energy storage facility near Bystrzyca Kłodzka in Lower Silesia. In 2021, Grand Agro, an NGO seen by some as controversial, challenged the environmental assessment for the Baltic Power offshore wind project, leading to additional permitting delays although its campaign against the industry was ultimately unsuccessful. It is possible that **future social and environmental concerns may arise**, underscoring the importance of clear regulations and administrative capacity within state institutions to ensure efficient management and avoid unnecessary delays.

Infrastructural readiness for accommodating offshore wind

As of 2023, **Poland does not have any operational offshore wind power plants**, indicating that the country's infrastructure readiness and capacity to efficiently facilitate the development process is yet to develop. There is also the need to develop further the country's electrical grid to accommodate the new 2040 offshore wind targets. However, Poland has shown its capacity to support projects such as onshore wind farms, modern electric grid infrastructure, and underwater gas pipelines.

[53] European Climate Foundation, *Cross-EU polling on renewable energy*, Conducted by YouGov, October 2021.

The technical and infrastructural capabilities of Polish actors are crucial not only for project timelines and costs but also for the degree of local content engagement. While major power-system enterprises are investors in Polish offshore projects (Phase I involved cooperation between Polish state-owned entities and international partners, and Phase II has been led by the Polish state-owned companies PGE and Orlen), the development of the offshore wind value chain has been promoted as a significant business opportunity for smaller Polish suppliers, potentially creating tens of thousands of new jobs.

One of the essential infrastructural requirements for building offshore wind plants is the availability of **appropriate specialized seaports**. If Polish offshore terminals are not ready in time, construction will either be delayed or based on foreign ports, leading to higher costs and negatively impacting the overall local content level of the investment. The Supreme Audit Office's report[54] highlighted that as of 2021, Gdynia was initially considered as a location for an offshore terminal, but in 2022, it was changed to Gdańsk. The report also pointed out **funding challenges**, as the Polish NRRP has been frozen due to the ongoing political conflict between the EU and the Polish government on rule of law issues. Although the Gdańsk offshore terminal is expected to be ready by 2025, the procurement procedure initiated in March 2022 has yet to be concluded due to the lack of interested participants. Additionally, more specialized terminals will be required later on, with plans to locate service terminals in Łeba and Ustka, which are small ports and major tourist towns.

To **prepare the future workforce** for the Polish offshore wind industry, developers of Polish offshore wind farms are initiating partnerships.[55] For example, PGE Baltica and the Gdynia Maritime University have organized post-graduate courses in the field. In 2022, the Pomeranian Centre for Offshore Energy Competence was established in cooperation with Polenergia and Equinor Polska.[56] In 2023, the EduOffshoreWind job fair[57] took place as the first event of its kind in Poland. These initiatives not only invest in the development of human capital needed in later stages of offshore projects but also advance the potential of the regional economy.

Croatia

Potential

In the Croatian section of the Adriatic Sea, **three potential locations** have been identified for offshore wind development. These include the open sea in front of the town of Pula and the island of Mali Lošinj, the open sea in front of the town of Šibenik, and the island of Mljet.[58] The Pula area stands out as favourite due to its shallow sea depth of less than 60 meters. Additionally, its proximity to the coast offers the advantage of readily available infrastructure. However, the proximity to the entrance of the Kvarner Bay, which is significant

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54 Supreme Audit Office (Footnote № 48).

55 City of Gdynia, *Studia dla menedżerów branży offshore w Gdyni* (In Polish), March 2023.

56 Baltic Wind, *Pomeranian Centre for Offshore Energy Competence is developing cooperation with Polenergia and Equinor Polska*, October 2022.

57 Find more at EduOffshoreWind: *https://eduoffshorewind.pl/en/.*

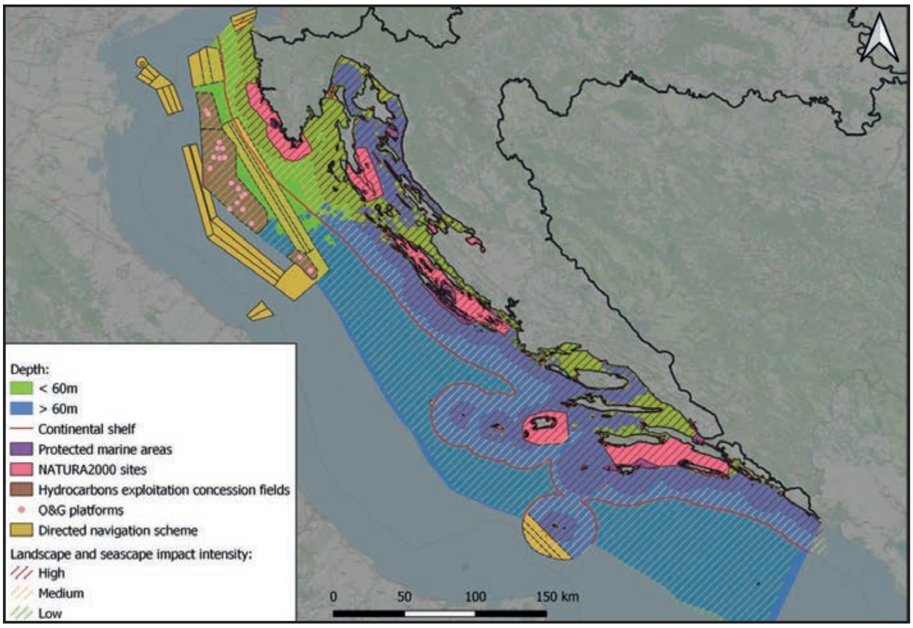
58 Božidar Liščić et al., *Offshore Wind Power Plant in the Adriatic Sea: An Opportunity for the Croatian Economy*, 2014.

for maritime traffic, could create logistical obstacles. The location near the island of Mljet is not suitable for an offshore wind power plant due to its greater sea depth. The floating structure required for wind turbines in such deep waters significantly increases the necessary investment, making it less feasible. A better location in terms of less crowded sea routes is the open sea in front of Šibenik. Yet, it does have a significant sea depth of up to 90 meters, which presents a significant engineering challenge.

Based on estimates, Croatia is projected to have a **total offshore wind capacity of 17 GW**. Within this capacity, fixed wind farms are expected to contribute 24 percent (4 GW), while floating wind farms will account for the remaining 76 percent (13 GW).[59]

A high-level spatial analysis categorised these areas into **low and medium impact zones**, considering various constraints and limitations for bottom-fixed wind farms. These included a maximum feasible sea depth of 60 meters, avoidance of existing hydrocarbon exploitation concession areas, steering clear of navigation zones, exclusion of protected marine areas and Natura 2000 sites, minimising the impact on bird migratory corridors, ensuring low impact on landscape and seascape or being located within the 12 nautical miles from the shoreline. An **additional important constraint** was the exclusion of the channel sea area in Croatia. This decision was based on the intensive use of the channel sea waters for maritime transport, fishing, and marine tourism, as well as the higher biodiversity and presence of priority species and habitats in that area.

Figure 1. Identified Areas for Offshore Renewable Energy Development in Croatia



Source: Action Plan for the Uptake of Offshore Renewable Energy Sources in Croatia.[60]

[59] Global Wind Energy Council, *Offshore Wind Technical Potential in Croatia*, June 2021.

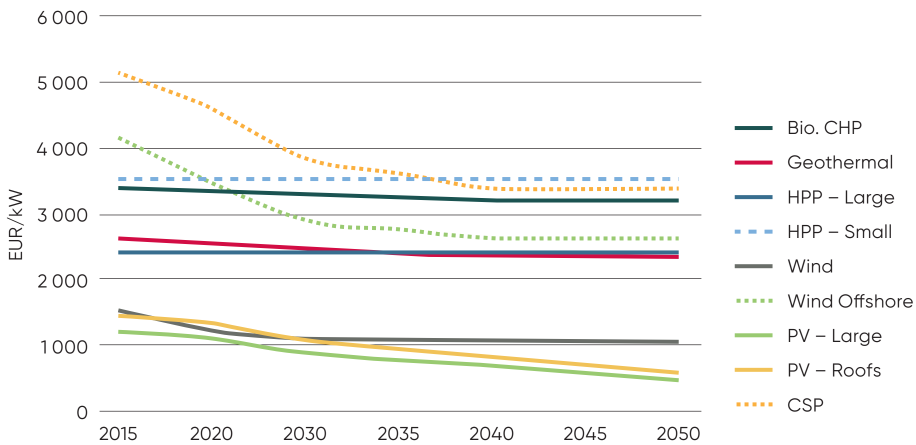
[60] Neven Duić et al., *Action Plan for the Uptake of Offshore Renewable Energy*, May 2023.

In the **low-impact zone**, which spans from the southern part of Mali Lošinj island to the northern tip of the Istria peninsula in the northern part of the Croatian Adriatic Sea, a prospective area, which was identified, has the potential to accommodate up to 25 GW of offshore wind capacity (Figure 1). It is considered the best option due to its minimal environmental and visual impact. **Medium-impact zones** could potentially increase the offshore wind capacity by an additional 32 GW. The central and southern parts of the Croatian Adriatic Sea offer over 26,000 km^2 of available area for offshore renewables. Due to the greater water depths in these areas, they are more suitable for floating offshore wind and floating photovoltaic power plants.

Strategic fit

The strategic framework for decarbonisation and long-term energy planning of Croatia does not explicitly include targets and measures for offshore renewable energy sources. Yet, it is worth noting that the Low-Carbon Development Strategy mentions offshore wind farms as one of the technologies that could contribute to the decarbonization of Croatia's power system.

Figure 2. Specific Investment in RES Technologies according to the Croatian NECP[61]



Source: Integrated National Energy and Climate Plan for the Republic of Croatia.[62]

Regulatory framework

There is **no specific dedicated law or regulatory framework** exclusively for offshore wind energy projects in Croatia. Instead, these projects are required to adhere to the legal framework pertaining to all other renewable energy sources. The primary legislation governing projects in the energy sector is

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[61] Figure 2 displays curves depicting the projected decline in investment costs for renewable energy sources according to the Croatian NECP. Although the investment needs for utilising offshore wind energy are included in the illustration, further explanation or deployment targets are absent.

[62] Ministry of Environment and Energy, *Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030*, December 2019.

the *Energy Act*[63], which regulates the permitting process and the issuance of licenses for electricity generation.

The primary legislation that governs RES and promotes the generation of electricity and heat from renewables, with the aim of increasing their share in total final consumption, is the *Act on Renewable Energy Sources and High Efficiency*.[64] This legislation incorporates regulatory mechanisms to **encourage the production of electricity and heat from RES**. Moreover, offshore renewable energy projects must comply with procedures and requirements outlined in the *Act on Maritime Property and Sea Ports*[65], the *Act on Spatial Planning*[66], and the *Act on Concessions*.[67] These acts set out guidelines and regulations specific to maritime property, sea ports, spatial planning, and concession procedures, which are relevant to offshore wind energy developers in Croatia.

The first step in the development of offshore renewable energy sources in Croatia involves identifying suitable zones within the spatial plans. Croatia has **a hierarchical system of spatial planning**, consisting of various levels of planning regulations. The *Act on Maritime Property and Sea Ports* governs the utilization of maritime areas and the concession process related to them. The *Act on Spatial Planning* regulates the overall spatial planning system, including the formulation, adoption, and implementation of spatial plans. It also defines the procedures for obtaining location permits, which precede the concession process, and provides detailed guidelines for development within specific areas. Both of these acts are currently undergoing amendments, and the anticipated changes in the *Act on Spatial Planning* may have implications for offshore wind energy project development.

The law says that the maritime area is planned through **various spatial plans**, such as the National Spatial Development Plan, the Spatial Plan of the Exclusive Economic Zone, the plans of national parks and nature parks encompassing marine areas, county spatial plans, and municipal plans. The Ministry of Physical Planning, Construction, and State Assets, in collaboration with the Croatian Institute for Spatial Development, is currently developing the National Spatial Development Plan, which is expected to be finalized and adopted by the end of 2023.

At the county level, the spatial planning considers only the maritime area within the territorial waters of Croatia. The EEZ of the Adriatic Sea falls under the jurisdiction of the Croatian government and Parliament, while the territorial sea is governed by the Ministry of Maritime Affairs, Transport, and Infrastructure, when this applies to projects of national interest. County assemblies have jurisdiction over infrastructure within their respective county boundaries. However, the existing procedure for exploiting maritime areas in

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63 Croatian Parliament, *Energy Act* (In Croatian), October 2012.

64 Croatian Parliament, *Act on renewable energy sources and high efficiency cogeneration* (In Croatian), December 2021.

65 Croatian Parliament, *Act on Maritime Property and Sea Ports* (In Croatian), Official Gazette No. 158/03, 100/04, 141/06, 38/09, 123/11, 56/16, 98/19, 1 January 2020.

66 Croatian Parliament, *Act on Spatial Planning* (in Croatian), Official Gazette No. 153/13, 65/17, 114/18, 39/19, and 98/19), 29 June 2023.

67 Croatian Parliament, *Act on Concessions* (in Croatian), Official Gazette No. 69/17, 107/20), 10 October 2020.

Croatia is **complex and does not guarantee certainty for investors** in achieving their goals within the desired timeframe. In cases where the development of maritime areas involves construction, which requires additional permits, the procedure becomes even more complicated.[68]

The *Act on Concessions* regulates the process of obtaining concessions, including for maritime areas. Developers must also comply with the Maritime Code[69], which defines the Croatian EEZ and outlines regulations for activities in maritime areas. The Maritime Code grants Croatia exclusive rights within the economic zone, including the authority to build, permit, and regulate the construction, operation, and use of artificial islands, structures, and installations at sea, on the seabed, and beneath the seabed.

Maritime spatial planning

Croatia's Integrated National Energy and Climate Plan includes a measure that outlines **specific activities that need to be undertaken** to incorporate renewable energy sources into spatial planning requirements, including offshore wind:

- Analysis of the current state of spatial capacities, including the identification and mapping of spatial, environmental (bio-ecological, landscape, geological), and social (space utilization) constraints.
- Establishment of guidelines and criteria for the selection of areas suitable for RES exploitation, considering the identified constraints.
- Promotion of professional education and the encouragement of cross-sectoral cooperation among experts.
- Enhancement of existing information systems by incorporating the necessary data for identifying potential constraints.

The development of offshore wind energy in Croatia depends on the inclusion of suitable areas in county spatial plans as there is still no final Maritime Spatial Plan. It also **remains unclear whether offshore wind energy will be even incorporated** into the strategic planning document. Moreover, the available information on the wind energy potential is based on estimations, and detailed measurements are underway, conducted by the domestic oil and gas company INA (Industrija nafte d.d.).

The state-owned energy firm is conducting preparatory studies to evaluate the feasibility of a potential offshore wind farm with a capacity of approximately 300 MW in the Northern Adriatic coastal zone, situated between Croatia and Italy. The planned deployment area spans approximately 2,200 km^2 of sea, extending from the cities of Pula (Croatia) to Ravenna (Italy). These preparatory studies encompass various assessments,

[68] Neven Duić et al., *Action Plan for the Uptake of Offshore Renewable Energy*, May 2023.

[69] Croatian Parliament, *Maritime Code* (in Croatian), Official Gazette, No. 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19), 1 January 2020.

including resource evaluations, environmental and social impact screenings, financial and commercial evaluations, stakeholder engagement, and the potential implementation of an interconnection between Croatia and Italy.[70]

Environmental constrains and social acceptability

When selecting an appropriate location for an offshore wind park, it is crucial to consider different **geographic, environmental and social acceptance constraints**. For offshore wind turbines, in Croatia due to the social acceptance of offshore wind energy projects, a minimum installation distance of 22.2 km (equivalent to 12 nautical miles) from coast is required, t . Moreover, the maximum permissible sea depth for bottom-fixed turbines is limited to 50 meters. In the case of floating wind turbines, the same installation distance restrictions apply, while the maximum allowable sea depth is set at 1,000 meters.

It is imperative to ensure that the proposed wind farm does not interfere with **navigation routes** or encroach upon **ecologically protected areas** although in attempt to achieve the renewable energy objectives, it may be necessary to develop some of the offshore wind farms within protected areas. This does not preclude the fact that the construction, installation, and operation of these offshore power plants should **prioritize sustainability issues**. Around 37% of the country’s land area and 16.26 percent of its marine territory is covered by Natura 2000, the widest among all EU member states. However, many areas within the Natura 2000 network offer suitable conditions for wind energy development.

In the Adriatic Sea region of Croatia, **a total of six Natura 2000 areas** have been designated to safeguard the bottlenose dolphin population and their natural habitat, covering a total of 3 717 km^2:[71]

- Marine areas in Western Istria (762,77 km^2)
- Cres-Lošinj (525,62 km^2)
- Molat-Dugi-Kornat-Murter-Pašman-Ugljan-Rivanj-Sestrunj-Molat (608,430 km^2)
- Kornati National Park (215, 670km^2)
- Vis water area (518,880 km^2)
- Lastovo and Mljetski canal (1 085,55km^2).

70 CINEA, *CEF Energy: EU invests in preparatory studies for offshore wind farm in the Northern Adriatic Sea*, 8 May 2023.

71 EnergoVizija Ltd., *Guide for the Development and Implementation of Renewable Energy Projects in Croatia*, February 2022.

Figure 3. Natura 2000 Ecological Network in Croatia

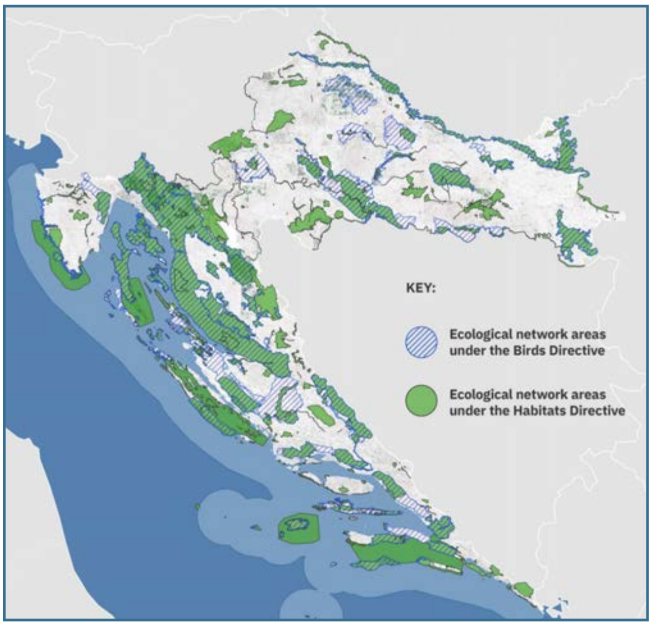


Figure 4. Natura 2000 – Protected Areas for Common Bottlenose Dolphin

Source: Institut Plavi Svijet[72]

While comprehensive studies on the social acceptability of renewable energy projects have not been conducted recently, it is encouraging to note that there have been **no reported conflicts between local communities and investors** in this sector thus far.

Infrastructural readiness for accommodating offshore wind

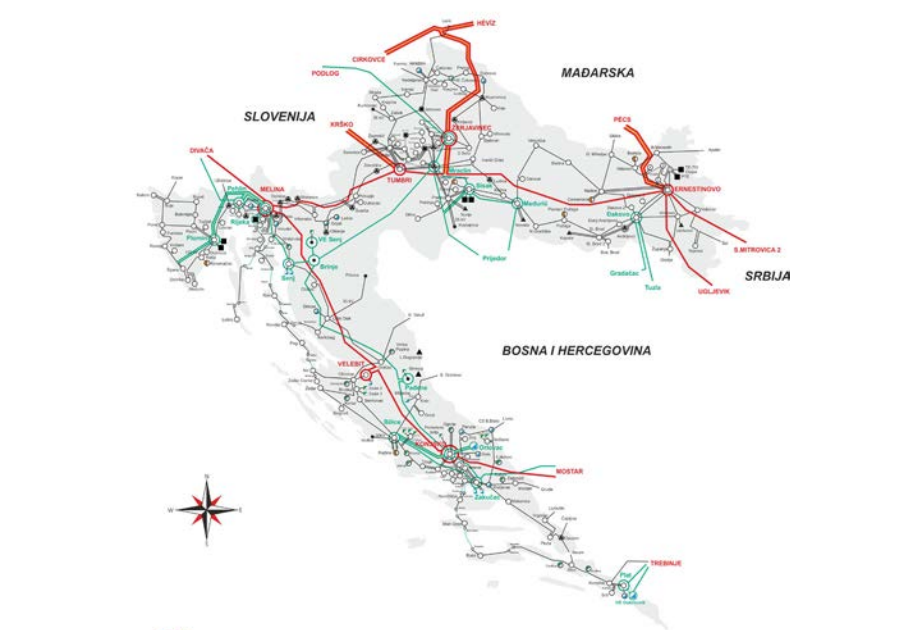
The Trans-European Networks for Energy (TEN-E) is a policy aimed at connecting energy infrastructure across EU countries. It identifies eleven priority corridors and three thematic areas. In the context of offshore grid development, the Croatian part of the Adriatic is included in the South and West offshore grids corridor (Mediterranean Sea, including the Cadiz Gulf and neighboring waters) and the South and East offshore grids corridor (Mediterranean Sea, Black Sea, and neighboring waters).[73]

Although there is a well-developed onshore electricity grid with potential for further expansion and improvement, there have been **so far no plans for developing an offshore power network**. The development of the latter will be demanding and costly, primarily due to the absence of relevant infrastructure, inexistent marine terminals that can support the construction of the offshore infrastructure. Currently, the most suitable options for repurposing are certain sections of cargo ports, such as the Port of Rijeka or the Port of Ploče, situated close to the zones with the highest offshore wind potential.

[72] Institut Plavi Svijet, *Marine protected areas and spatial planning at sea*.

[73] European Commission, *Trans-European Networks for Energy*.

Figure 5. Map of the Croatian Electric Power System



Source: HOPS Croatian Transmission System Operator Plc.[74]

Romania

Potential

Romania's **offshore wind potential** is estimated to be **between 77 and 94 GW**, with 22 GW of bottom-fixed turbines and the rest, of floating turbines.[75, 76] The wind speeds increase with the distance from shore, where a company is planning to develop a project. In the deep-water sector of Romania's EEZ, the central area reveals commercially viable wind speeds, reaching approximately 7 m/s. Wind speeds decrease in the South Eastern part of the EEZ. In terms of seasonal distribution, the marine areas experience **higher wind speeds during the winter months** ranging from 8-9 m/s. In the summertime, the maximum wind speed recorded in the North-Eastern part of the EEZ is around 7 m/s.

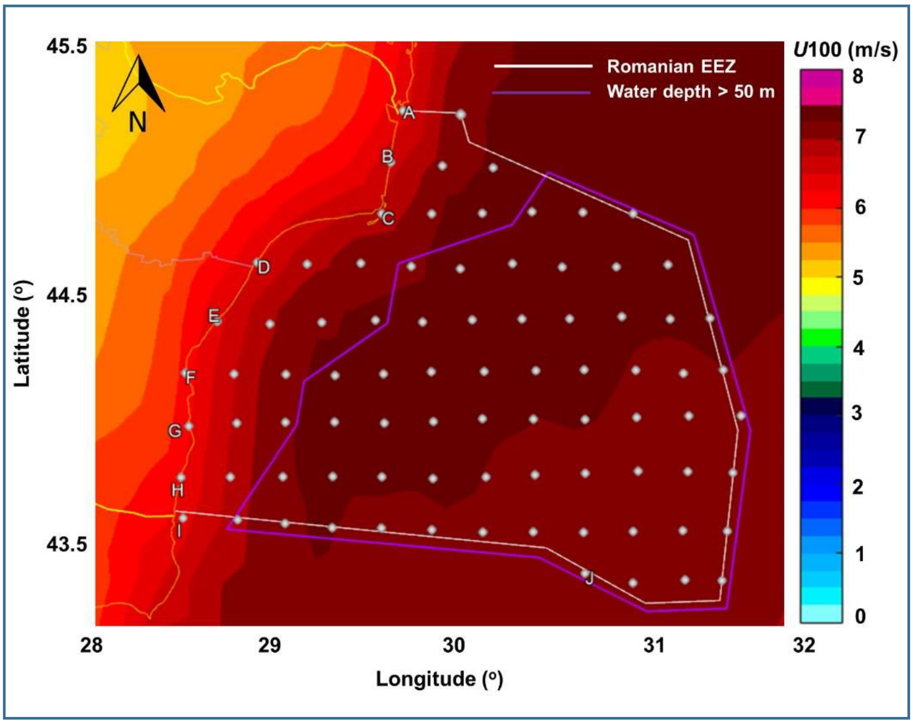
The majority of the Romanian EEZ has a depth that exceeds 50 meters, making it highly suitable for wind projects based on floating platforms. Although technological advancements and cost reductions have made deep-water areas increasingly accessible for floating wind turbines, the cost of mooring significantly increases in water depths exceeding 150 meters (LCOE estimates below).

74 HOPS, *Croatian Transmission System Operator Plc*, September 2022.

75 Energy Policy Group, *Romania's Offshore Wind Energy Resources: Natural potential, regulatory framework, and development prospects*, 2020.

76 World Bank, *Offshore Wind Technical Potential in Romania*, March 2020.

Figure 6. Average Wind Speed Measured at 100 m height (U100)



Source: EPG, 2021: Romania's offshore wind energy resources[77]

Table 3. Total Offshore Wind Natural Potential and Average Energy Production (GWh) of Romania

	Total	Fixed	Floating
Annual Electricity Production (GWh)	239 037	54 435	184 602
Total Capacity (GW)	94	22	72

Source: EPG, 2021: Romania's offshore wind energy resources[78]

Close to the shoreline, the capacity factor of a single turbine typically ranges from 24 percent to 28 percent, and it can reach up to 35 percent near the 50 m water depth line.[79] Capacity factors in deep waters increase to around 34-35% although the efficiency of offshore wind turbines can reach 47 percent in deep sea, and around 40.5 percent near the shoreline, particularly close to the Sacalin peninsula, south of the Danube Delta.

Considering the wind speed and water depth conditions, the most suitable area for development seems to be located close to the 50 m contour line (it

[77] Energy Policy Group, (Footnote № 79).

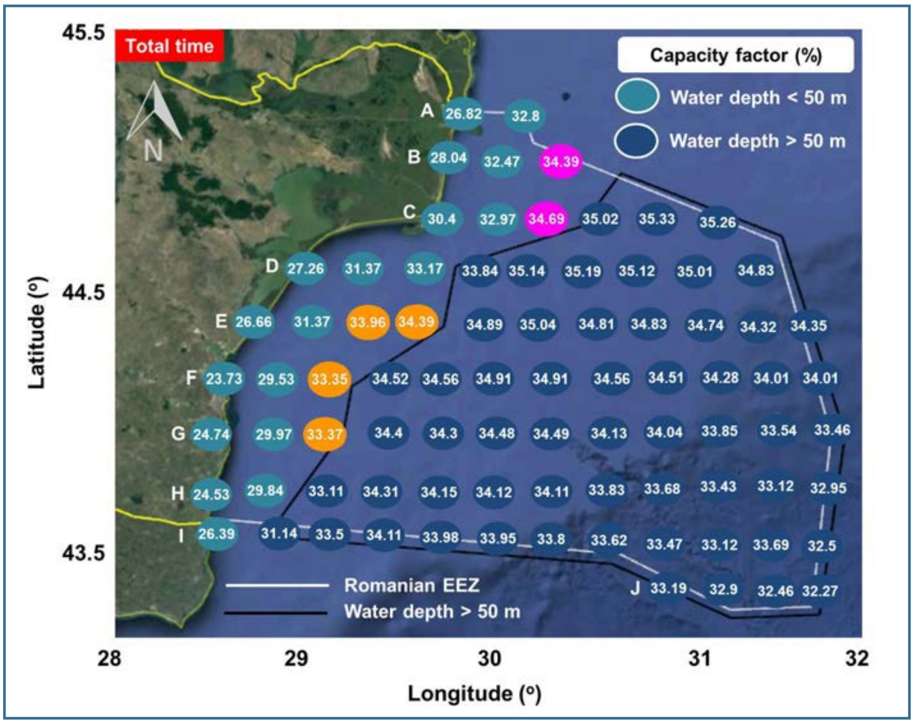
[78] Energy Policy Group, (Footnote № 79).

[79] The methodology is described within EPG's first report on offshore wind from 2020. Energy Policy Group (Footnote № 79).

also avoids conflicts with shipping routes and port activities). Based on this information, there are **two potential clusters** with most favourable conditions: one with capacity factors between 33-35 percent, in water depths below 50 m at 40-60 km from the shore, and another area with marginally better wind resources, where, however, the existing onshore power transmission line is further inland meaning that the grid connection would have to be extended through the Danube Delta – a protected area.

As presented in Figure 7, the orange cluster – containing four 400 km^2 squares, each with capacity factors between 33-35 percent, in water depths below 50 m and situated between 40-60 km from the shore, it should provide the best available balance between wind resource and cost of the offshore grid, particularly given the possibility to inject the power output in the Constanța Sud power substation. The pink cluster – marginally the best offshore wind development area with respect to the wind resource, with two 400 km^2 squares averaging a capacity factor above 34 percent and located at about 40 km from the shoreline.

Figure 7. Most Promising Development Areas based on Average Capacity Factor (in percentages)



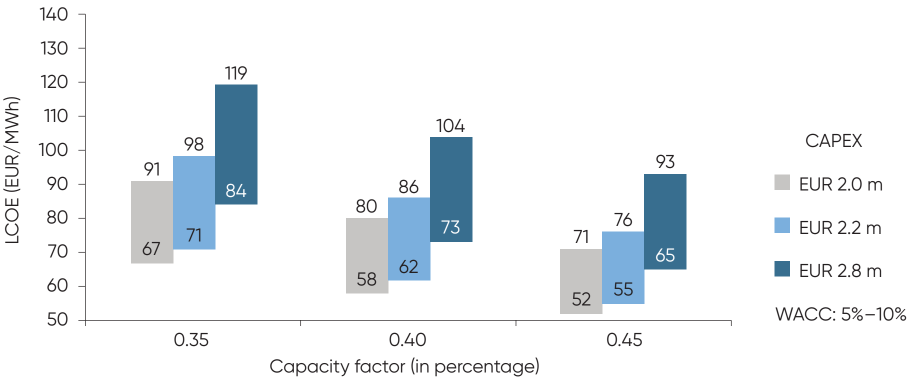
Source: EPG assessment based on calculations prepared by Dunărea de Jos University and EPG[80]

The **LCOE of fixed offshore wind** in the Romanian region of the Black Sea has a wide range between 52 and 119 EUR/MWh.[81] At the same time for floating offshore wind the LCOE is ranging from 82 to 163 EUR/MWh (Figure 8).

[80] Energy Policy Group, (Footnote № 79).

[81] Energy Policy Group, *Offshore wind – the enabler of Romania's decarbonisation*, 2022.

Figure 8. LCOE Variation of Fixed Offshore Wind in the Black Sea depending on CAPEX, capacity factor and WACC

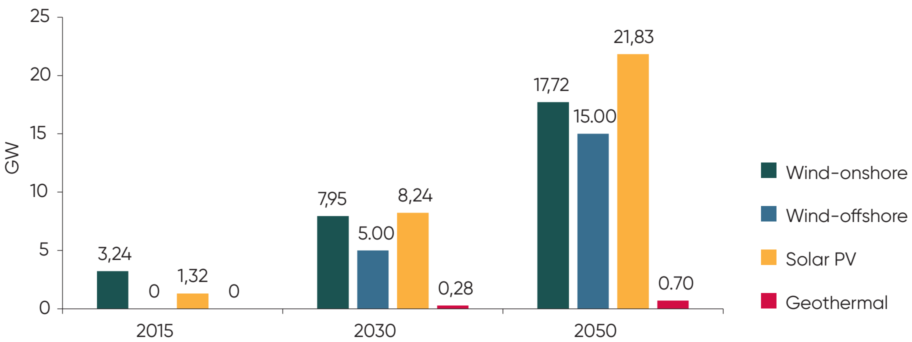


Source: EPG assessment[82]

Strategic fit

Offshore wind plays a **strategic role in Romania's decarbonization efforts**. Modelling exercises[83] indicate that the transition to a decarbonized electricity supply in the country will heavily rely on a significant increase in solar and wind energy capacity. By 2050, Romania will need to reach over 53 GW of renewable energy capacity. An important component of this low-carbon boom is the development of offshore wind projects in the Black Sea. In all scenarios, around 15 GW of offshore wind capacity can be installed by 2050, with **an initial target of 5 GW by 2030**. Notably, offshore wind emerges as the largest contributor to electricity production, accounting for over 40 percent of total electricity generation in some scenarios by 2050.

Figure 9. Installed Renewable Capacities by 2050 (GW)



Source: Climact, 2050 Pathways Explorer, EPG calculations[84]

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[82] Energy Policy Group (Footnote № 85).

[83] Energy Policy Group, *Recommendations for Romania's Long-Term Strategy: Pathways to climate neutrality*, December 2022. EPG used the 2050 Pathways Explorer developed by CLIMACT. The Pathways Explorer is a full-fledged simulation model at the national level for all European countries. It is a fully comprehensive and dynamic model, covering all sectors of the economy emitting GHG emissions and all energy vectors, connecting the sectors dynamically between one another.

[84] Energy Policy Group, (Footnote №85).

Despite these prospects, the national strategic documents for the future of the Romanian energy sector currently **lack specific targets for offshore wind development**. There has been a significant delay in adopting the NECP [85], which was published in October 2021, almost two years later than expected. Even at the time of its adoption, the Plan was considered outdated as it did not incorporate important reforms outlined in the National Recovery and Resilience Plan, such as the coal phase-out by 2032.

The current Romanian NECP lacks information about the country's offshore wind potential, and there is a notable absence of an adequate regulatory and financial framework to support the development of such projects. The strategic document notes that offshore wind energy can be considered a highly uncertain sector due to the limited information on technology development and the associated logistical issues. The plan merely acknowledges the long-term cost reduction potential of offshore wind technology. However, Romania is required to adopt a revised NECP by July 2024, which will lead to adjustments in all national strategic measures related to that document.

In April 2023, the Romanian Ministry of Environment released the draft of the *Long-Term Decarbonisation Strategy*[86] for public consultation. This strategy highlights that Romania has the potential to achieve climate neutrality by 2050 through the expansion of renewable energy capacities. According to the most feasible scenario proposed, wind energy is expected to grow from the current installed capacity of approximately 3 GW to 7 GW by 2030 and 14 GW by 2050. However, the document **does not provide a specific breakdown between onshore and offshore wind**.

To date, only the national Transmission System Operator (TSO) has provided **official estimates of the growth of offshore wind capacities**. Based on the 2030 targets outlined in the current NECP, the TSO's Ten Year Network Development Plan (2020-2029) anticipates an installed capacity of 500 MW, to be connected to the onshore grid via the Constanța Sud electrical substation by 2030.[87]

Regulatory framework

Since 2019, Romanian lawmakers have been discussing two different draft laws for establishing an offshore wind regulatory framework.

First draft law on offshore wind introduced by members of the Parliament (2020)

In July 2020, the Romanian Senate approved **a draft law addressing the necessary measures for the exploitation of offshore wind energy**.[88] The legislation came in response to the growing public interest in the offshore

85 *Integrated National Energy and Climate Change Plan for 2021 – 2030*, 2021.

86 Ministry of Environment, *Long term strategy of Romania*, April 2023.

87 The updated plan (2022-2031) no longer provides estimations for the development of offshore wind capacities.

88 Senate of Romania, *First Romanian draft law on offshore wind* (In Romanian), August 2020.

wind potential of the Black Sea and the increasing promotion of the sector across the EU. Given the lack of a special regulatory framework for such operations, the legislative proposal aimed to address various aspects related to licensing procedures, construction and operation authorizations, land access, expropriation, subsidy schemes, bonuses for offshore wind power generation, allocation of costs for offshore power networks, decommissioning obligations, as well as penalties and fines.

Despite the good intentions, the hasty nature of the legislative process and the lack of a comprehensive public consultation process, the draft law was **not adequately designed** and contained unclear and controversial aspects. The proposed law introduced **two distinct procedures for awarding offshore wind concessions**. The first was a **competitive bidding** procedure, where the government organizes a tender process for predefined offshore areas and wind power capacities, with projects awarded based on the lowest price offered in a CfD – ensuring the lowest possible level of state aid. The second procedure was an open one, where project developers could request to obtain a development license for an **individually-determined project location and capacity**. For the open procedure, the draft law established a premium of up to 0.025 EUR/kWh on top of the market price, with a maximum limit of 0.060 EUR/kWh. Additionally, the state was supposed to provide 0.020 EUR/kWh for up to 20 years from the grid connection for the coverage of "balancing costs". However, the draft law did not include a quantitative analysis explaining the chosen subsidy values, nor did it provide an explanation of what "balancing costs" entails.

The draft law included a provision regarding offshore wind parks developed through the open procedure, which introduced a questionable requirement. According to this provision, owners of parks located within a distance of less than 16 km from the coastline were obligated to offer the option to local residents residing within 4.5 km from the wind park or in a locality with coastlines within 16 km from the wind park to acquire 20 percent of the **ownership shares**. The specific figures mentioned in the provision appeared arbitrary, and there was a lack of clarity regarding the pricing mechanism for the sale of shares and what would happen if the residents were not interested in the offer. These uncertainties surrounding the provision raised concerns about the lack of careful consideration or, at worst, the possibility of self-serving decision-making in the drafting of the law. Therefore, **the draft law[89] received negative opinion** from the government and has been blocked by the Chamber of Deputies (the lower house) since 2020.

Second draft law on offshore wind initiated by members of the Parliament (2022)

A second draft law concerning offshore wind concessions was passed by the Romanian Senate in June 2022.[90] The main focus of this document is the description of **a competitive bidding procedure** for awarding offshore wind

[89] Camera Deputatilor, *Plx. 648/2020 Proiect de Lege privind măsurile necesare pentru realizarea de operaţiuni pentru exploatarea energiei eoliene offshore* (In Romanian), October 2020.

[90] Camera Deputatilor, *Plx. 646/2022 Propunere legislativă privind măsurile necesare pentru realizarea de operaţiuni pentru exploatarea energiei eoliene offshore* (In Romanian), October 2022.

concessions, involving a tender process organized by the government for predefined offshore areas and offered wind power capacities. Additionally, the draft law includes a provision for a minimum royalty of 1.5 percent of the annual gross revenues generated from the traded or sold electricity produced by the offshore wind park.

However, the draft law received **a negative opinion from the government**. It cited several reasons for not supporting the document, including the lack of provisions regarding the establishment of the predefined areas, the lack of correlation between the draft law, Maritime Spatial Planning, and the draft legislation on CfD, developed by the Ministry of Energy, and the insufficient description of the roles and responsibilities of the institutions responsible for offshore wind developments in Romania. It was also mentioned that a CfD scheme, which includes offshore wind among the targeted technologies, is expected to contribute to the development of the sector. The adoption of an amended version of the legislation was expected by the end of June 2023 as part of the country's NRRP but the government decided to develop a new version initiated by the energy ministry.

Third draft law on offshore wind initiated by the Ministry of Energy and published for consultation in 2023

In July 2023, the Ministry of Energy published for consultation a new draft law on offshore wind. The document is well structured and incentivises the offshore wind development through a CfD mechanism, thus, representing an important step in developing the national offshore wind market, especially within the EU context and decarbonisation objectives.

However, according to the draft law, Romania **aims to develop up to 3 GW of offshore wind capacities until 2035**, thus lacking an ambition in sync with the estimate of the potential. Also, the draft law envisages long deadlines for the adoption of the secondary legislation (almost 3 years), which means that the exploration stage cannot start before 2027. The draft law states that the offshore wind projects can be developed only through a CfD scheme, eliminating the possibility for an open investor-led procedure. The new draft law is expected to be passed by the end of 2023.

Maritime spatial planning

The Romanian Ministry of Development published for consultation the draft MSP[91] at the end of September 2022. The document has **not been approved yet**, as it did not pass the environmental evaluation, with the Ministry of Environment determining that a more thorough assessment is required. The document includes limited information regarding offshore wind development. It references the estimated offshore wind potential in Romania, as assessed by the World Bank (77 GW) and provides a brief overview of the advantages of offshore wind farms as well as the challenges associated with network connection.

[91] Ministerul Dezvoltării, Lucrărilor Publice și Administrației, *Planul de amenajare a spațiului maritim*, August 2022.

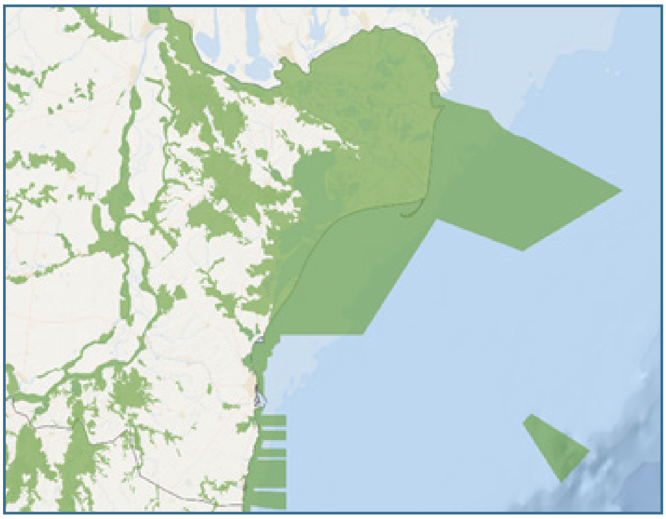
Despite providing an overview of activities in the Black Sea, the **MSP does not specify the specific areas suitable for offshore wind development**. Furthermore, the document emphasizes that the zoning of offshore wind perimeters should be addressed within the legislative and regulatory framework for offshore renewable energy development.

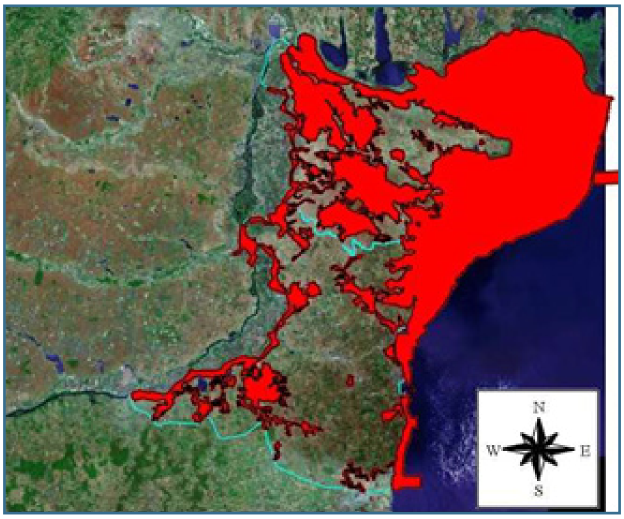
The strategic document says that nascent sector should **anticipate and address potential conflicts** by providing information about overlapping uses, although it does not specify the intensity, frequency, or magnitude of these interactions. The MSP presents a spatial analysis that covers various aspects such as protected natural areas, coastal zone protection infrastructure, transportation infrastructure (cables, pipelines, maritime routes, ports), fishing areas, and mineral resource exploitation and exploration. The overlapping of these activities can potentially lead to conflicts between different types of uses and the conservation and protection objectives of biodiversity and marine habitats.

Environmental constraints and social acceptability

The Romanian area of the Black Sea is confronted with several issues, in particular **nature protection and recreation** under the Habitats Directive.[92] The Habitats Directive's Annexes I and II[93] list 58 habitat types, 79 animals, and 6 plants found in the Black Sea, including marine species like the Black Sea bottlenose dolphin. Additionally, there are 40 coastal *Sites of Community Importance*. The Black Sea is considered one of the water bodies most at risk of severe negative environmental impact in Europe, as it is a "closed" water basin with unique, dynamic, and sensitive ecosystems that are threatened by continental pressures and conflicting coastal and maritime activities.

Figure 10. Dobrogea and Danube Delta





Source: Natura 2000 Viewer.

[92] European MSP Platform, *Maritime Spatial Planning Country Information Profile Romania*, April 2023

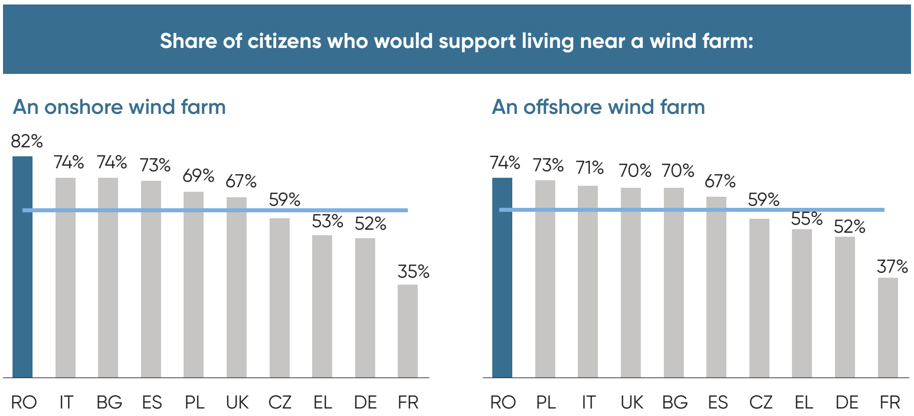
[93] Council of the European Union, *European Council Directive 92/43/EEC*, May 1992.

The proposed Natura 2000 sites cover a total area of 17.84 percent of Romania's territory. Near the Black Sea, the region of Dobrogea boasts high biodiversity and serves as an essential transit area for migratory birds nesting in Eastern Europe. This region is home to the Danube Delta, which has been recognized as a UNESCO World Heritage Site since 1991. The Danube Delta Biosphere Reserve, defined by law, spans approximately 580,000 hectares, where around 9 percent consists of strictly protected areas where plant and animal species, as well as their habitats, remain unmodified or minimally influenced by human activity.

The **barriers to renewable energy adoption** are predominantly administrative in nature, in contrast to the situation in many other EU members where "not-in-my-back-yard" sentiments among citizens often cause significant delays in the permitting process. Romania actually stands out with the **widespread public support for renewables**, which has served as a strong reason for the expediting of the deployment process. The robust popular support for the sector was highlighted in a 2021 survey[94], which positions Romanians among the most progressive Europeans in this regard:

- Romania exhibited the highest level of support for additional renewable energy projects compared to the surveyed countries.
- A remarkable 74 percent of Romanians surveyed expressed willingness to live near an offshore wind farm, surpassing the lower average in other countries.
- Romanians overwhelmingly expressed their readiness to generate their own wind and solar electricity, and they believed that public authorities should provide knowledge and financial support to facilitate this endeavor.[95]

Figure 11. Social Acceptability Towards Wind Energy in Romania, Bulgaria and Poland



Source: EPG based on YouGov Survey.

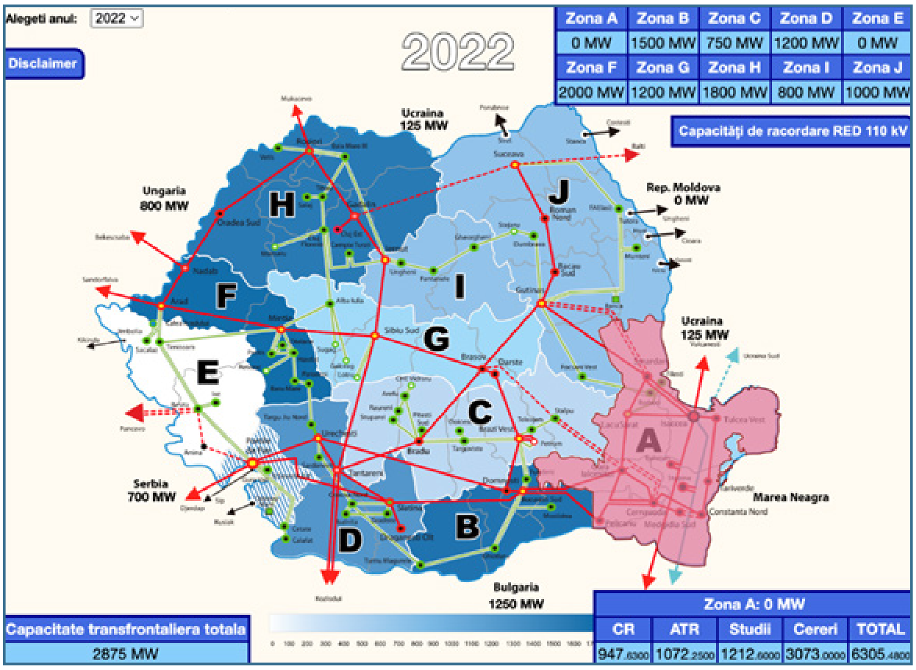
[94] European Climate Foundation, (Footnote № 52).

[95] Energy Policy Group, *What's holding back large-scale renewable deployment in Romania*, November 2022.

Infrastructural readiness for accommodating offshore wind

The development of offshore wind sector in Romania faces a significant barrier due to the current **state of the power grid**. The majority of Romania's renewable energy capacities, particularly wind energy, is located in the South Eastern region, where plans for additional renewables are underway. However, the available transmission capacity in the Dobrogea area, which already hosts 3,000 MW worth of projects, has not undergone substantial expansion until recently.

Figure 12. New Connection Capacities Available to the Transmission Power Grid in Dobrogea Area (Zona A)



Source: Romanian TSO – Transelectrica.[96]

The TSO has imposed a restriction on installing any new renewable energy plants in the region until new grid capacities are completed. Two **critical transmission power lines** are nearing completion, and they are expected to increase the capacity in the Dobrogea area by almost 1,000 MW:

- The Cernavodă-Stâlpu 400 kV HVAC (double-circuit, 159 km) power line, which will enable the evacuation of an additional installed power of 452 MW from Dobrogea to western Romania.
- The Gutinaș-Smârdan 400 kV HVAC (double-circuit, 140 km) power line, which will facilitate the electricity evacuation of an extra installed power of 424 MW from Dobrogea to northwestern Romania. The construction of this power line is scheduled to be completed by the end of 2024.

[96] Transelectrica, *Map of available connections*.

- According to Transelectrica's Ten Years Development Plan (TYNDP)[97] for 2022-2031, the ongoing power grid development projects in Dobrogea will significantly enhance the integration of new wind capacities, adding a total of 2,008 MW. Most of these projects are expected to be commissioned between 2023 and 2026.

Furthermore, Transelectrica has recently secured financing contracts worth EUR 424 million from the Modernisation Fund for nine strategic projects. These initiatives will **increase the transmission capacity** in the Romanian power system by 1,700 MW through the construction of 480 km of new power lines, refurbishment of electrical substations, and the implementation of new technologies.

As outlined in the TEN-E Regulation, the **Black Sea Basin is identified as a priority offshore grid corridor at the EU level** for offshore grid development. The significant wind potential can be effectively harnessed through the construction of an energy island project to benefit both the EU countries (Romania and Bulgaria) and non-EU countries (Turkey, Georgia, Ukraine), as well as the broader EU internal market. According to the agreement on South-East offshore corridor, which was adopted in January 2023 under Article 14(1) of the TEN-E Regulation 2022/869, Romania puts forward a non-binding target of 1 GW of installed capacity by the years 2030, 2040 and 2050.[98]

Box 3. Port of Constanta's Readiness to Accommodate the Offshore Wind Industry

The Port of Constanța, ranking among the largest ports in the Black Sea and the top twenty in Europe, is a critical hub with essential infrastructure for fostering offshore wind capacity development. Informal discussions with representatives from the Ministry of Energy have underscored the port's significance in the onshore development of wind energy, as evidenced by the transportation of most turbines into the country through Constanța.

Currently, **Romania's offshore wind value** chain is in its nascent stages, with the presence of only one segment—foundations—courtesy of GSP (Grup Servicii Petroliere Offshore), a company specializing in offshore integrated services, particularly drilling rigs for the oil and gas industry. Notably, Damen Shipyards Mangalia, in March 2023, announced its involvement in two HVDC offshore transmission projects, signaling a strategic move into the expanding realm of offshore wind. Earlier, in September 2022, Damen Shipyards Mangalia had revealed plans for a new vessel class designed to support the deployment of large-scale, floating offshore wind turbines, emphasizing the company's anticipation of significant opportunities in the burgeoning floating wind sector.

Indications show that a joint project between Romania and Bulgaria, incorporating the costs of HVDC connections to the Constanta Sud station into the LCOE for fixed offshore wind platforms would result in a total cost

[97] Transelectrica*Planul de Dezvoltare RET 2022 – 2031* (In Romanian), 2020.

[98] Directorate-General for Energy, *Member States agree new ambition for expanding offshore renewable energy*, January 2023.

of 79 EUR/MWh for a 3 GW installed capacity.[99] Furthermore, introducing an artificial Energy Island, designed for the same 3 GW installed capacity, would only marginally increase the total levelized cost to 85 EUR/MWh. This assumes an equal capital investment split between Romania and Bulgaria. The estimated annual energy production of this project is 9.8 TWh.

Therefore, it is crucial to establish **joint regional planning and development efforts for offshore wind between Romania and Bulgaria**. This collaborative approach is essential to achieve the necessary scale for cost-effectiveness in the Black Sea Basin. The additional interconnection capacity would also improve the region's energy security and market prices. It would also provide alternative import routes for clean energy, reducing the dependence on predominantly fossil-based energy imports from Ukraine or Serbia.

Bulgaria

Potential

Offshore wind power presents **a promising opportunity** for renewable energy and can make a significant contribution to Bulgaria's energy mix. A recent study[100] has evaluated the technical potential of both fixed and floating offshore wind turbines within the EEZ and the suitable deployment areas based on various criteria.

The study employed GIS and the Global Wind Atlas to evaluate the entire geographic area within the boundaries of the Bulgarian EEZ, applying various exclusion filters to estimate the gross potential resource. These filters excluded areas with wind speeds below 7 m/s at a height of 150 m. The identification of technically viable locations for fixed foundation offshore wind considered average wind speeds exceeding 7 m/s and water depths less than 60 m, while floating wind energy was considered for water depths ranging from 60 m to 1,000 m. Additional restrictions on the resulting geographic area were factored in including conflicting uses such as security and logistical concerns, environmental protection, and the presence of man-made objects like undersea cables, pipelines, or archaeological artifacts and coral reefs.

The study's findings revealed the **technical offshore wind energy potential** in the Bulgarian section of the Black Sea to be **approximately 116 GW**. Of this total capacity, around 26 GW (one-fifth) could be achieved using mature bottom-fixed technology, while the remaining capacity would necessitate floating power plants. The area with the best wind resource and the largest deployment potential is situated in the northernmost part of the Bulgarian EEZ, along the border with Romanian territorial waters. Covering an effective area of 405 km^2, with wind speeds ranging between 7.6 and 8 m/s at a height of 150 m, this specific section of the Black Sea has a maximum depth of 60 m, making the installation of fixed platforms viable due to reduced technological costs. The **total technical offshore wind resource capacity in this area is estimated to be in the range of 4.3 to 5 GW**, with a capacity factor between 45

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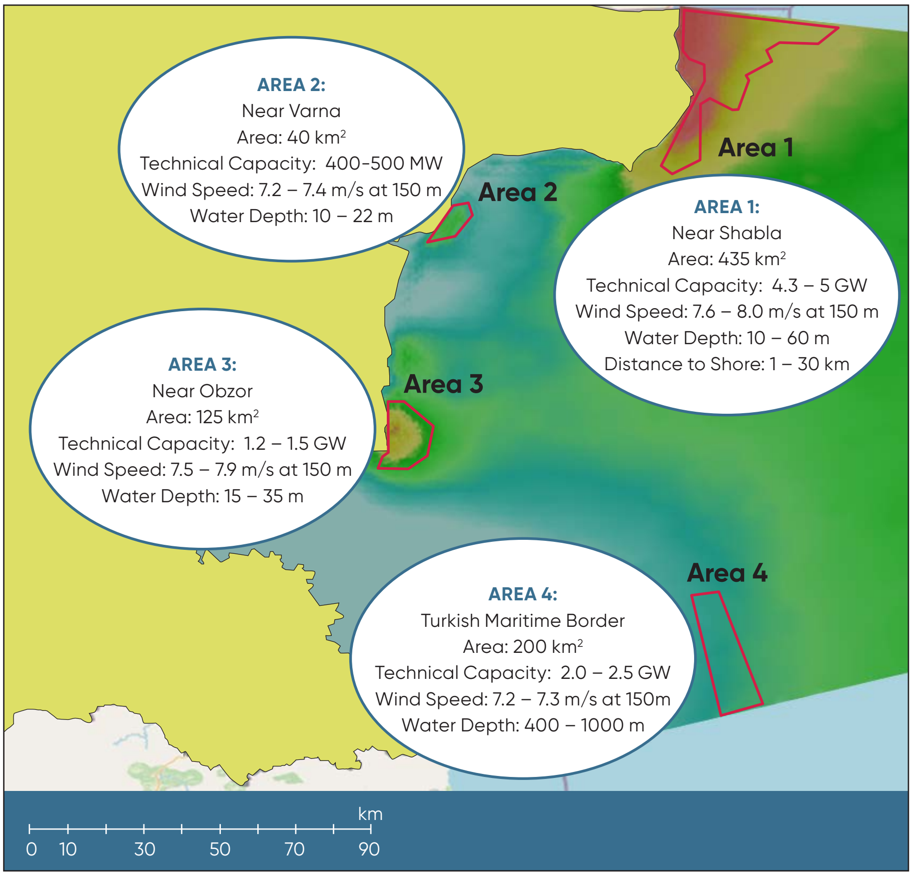
99 Energy Policy Group, (Footnote № 79).

100 Center for the Study of Democracy, *Wind Power Generation in Bulgaria*, September 2021.

percent and 48 percent. The potential for offshore wind generation in terms of full load hours in Bulgaria is calculated at 2,593 h/a.[101]

Although offshore wind energy currently remains relatively more expensive compared to conventional and other renewable power sources, the study estimates the cost of generating electricity from bottom-fixed installations to be in the range of EUR 62-90/MWh, which is expected to be **competitive with average power market prices within the next 10 years**. The average cost for generating electricity from floating installations is estimated to be around EUR 120-158/MWh.

Figure 13. Pre-Selected Prospective Areas for the Deployment of the Offshore Wind Projects in Bulgaria



Source: CSD.

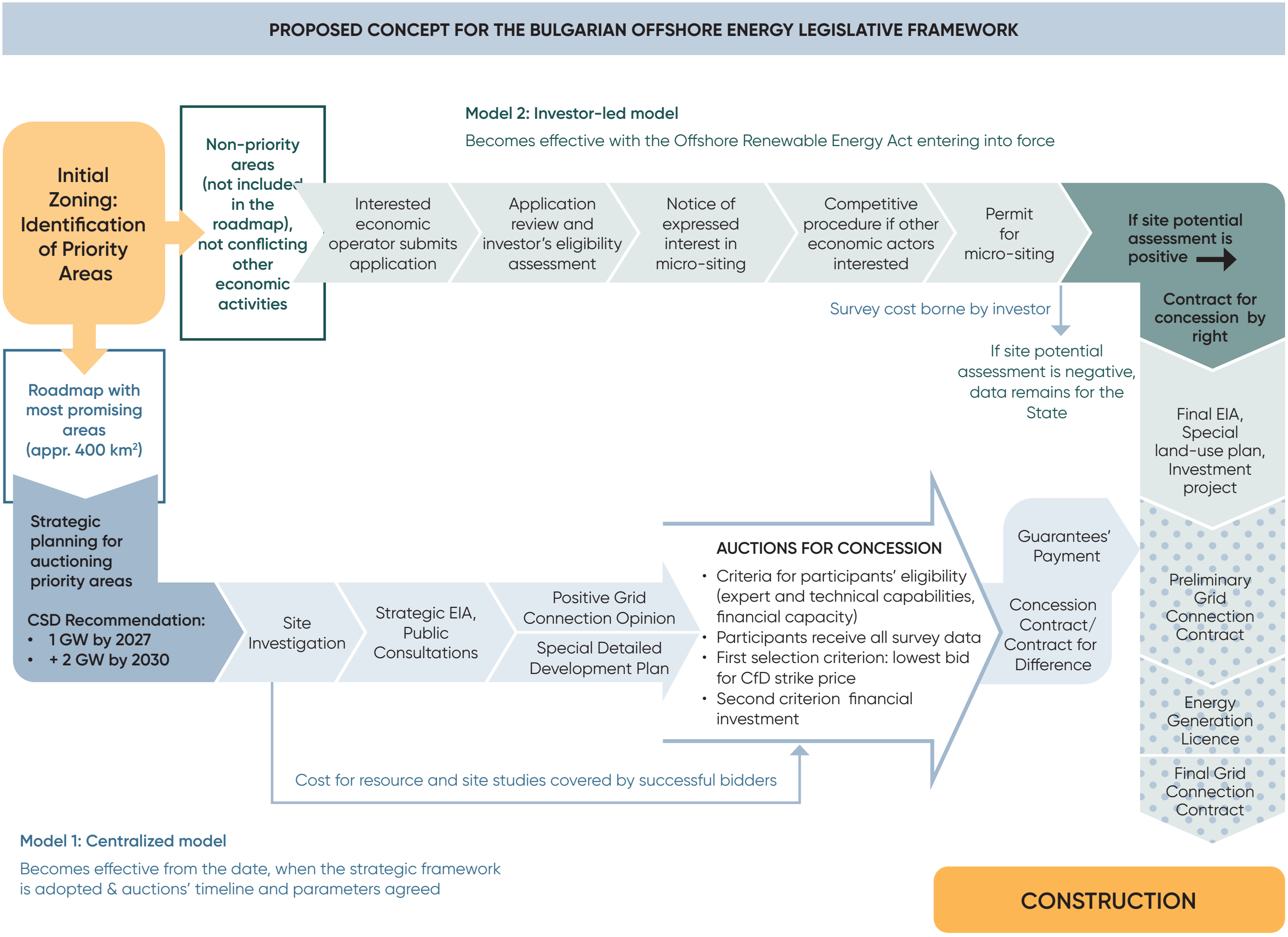
Strategic fit

The Russian invasion of Ukraine has prompted Bulgarian policymakers to **prioritise energy independence from Russia** and explore alternative options for large-scale decarbonisation of the country's power and industry sectors.

[101] Directorate-General for Energy (European Commission), *Study on the Central and South Eastern Europe energy connectivity (CESEC) cooperation on electricity grid development and renewables*, March 2022.

In light of the ongoing war in Ukraine and the increasing energy and climate security risks in Europe, unlocking the offshore wind power generation potential will enhance Bulgaria's energy independence and improve the resilience of its energy system. To advance the deployment of offshore wind energy projects, Bulgarian MPs from various political parties expressed their support for **the creation of a new special legislative framework** during a parliamentary hearing of the Energy Committee in March 2022.[102] Over the next six months they worked on the development of a special legal framework, which passed at first reading in the energy committee in September, 2022, but failed to pass in the Parliament as the political instability led to snap elections and the dissolution of the Parliament. A revised version of the Law is expected to be tabled in Parliament for a new vote in 2023.

Figure 14. Site-development Models in the Proposed Concept for Offshore Energy Legislation in Bulgaria



Source: CSD.

[102] Center for the Study of Democracy, *Energy Transition and Energy Security in Europe: Offshore Wind Energy Development in the Black Sea*, Event 9 March 2022.

However, despite the recognition among national policymakers of the future role of marine renewable energy in Bulgaria, the current version of Bulgaria's National Energy and Climate Plan[103] sets a **target for renewable energy to account for only 27 percent of gross final energy consumption by 2030**. The NECP's focus is primarily on a modest increase in onshore wind capacity from around 0.7 GW to 0.89 GW by 2030, with an additional 3.35 GW planned until 2050.

Offshore wind additions are not considered in the Plan. Embracing large-scale offshore wind energy deployment in Bulgarian territorial waters could help achieve the NECP's objectives by promoting low-carbon economic development, facilitating the uptake of competitive and secure energy sources, and reducing the country's dependence on fossil fuel imports. The revised NECP should align with the higher renewables and energy efficiency targets proposed by the European Commission in July 2021, as well as the REPowerEU objectives. The updated document is expected not earlier than the Spring of 2024.

Another document guiding Bulgaria's long-term decarbonization efforts is the National Recovery and Resilience Plan (NRRP).[104] **Simplification of licensing and permitting procedures** for renewables investments, including shorter response deadlines and streamlined grid connection timelines, dedicated areas for onshore wind, and a comprehensive offshore special planning and grid development plan for the coastal area, are among the proposed measures in the last version of the NRRP. Additionally, the plan includes targets for installing 3.5 GW of new RES by mid-2026, co-located with storage; pilot projects for green hydrogen, biogas, and geothermal electricity generation; and an increase of 1 200 MW in net interconnection capacity with Romania and Greece compared to 2020 levels. Due to the country's unstable political situation and the frequent changes in government over the past three years, the implementation of the NRRP has been significantly delayed.

Bulgaria **missed the opportunity to establish specific targets for offshore wind** development in the non-binding agreements adopted in January 2023 under Article 14(1) of the TEN-E Regulation 2022/869. As a result, it is currently the only country without any official plans in place. While these agreements are non-binding, they hold the potential to provide support for securing funding and influencing grid infrastructure planning in the region.[105]

The discussions within the Energy Transition Commission, a specialized sub-commission under the Consultative Council for the European Green Deal at the Council of Ministers have **added estimates for offshore wind deployments in the Climate Neutrality Roadmap** voted in by the Parliament. The deployment target for offshore wind is between 500 MW and 1,000 MW in an accelerated scenario by 2030, and 2,500 MW by 2040.

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[103] Ministry of Energy & Ministry of Environment and Water of Republic of Bulgaria, Национален план Енергетика и климат [National Energy and Climate Plan], 2020, (in Bulgarian).

[104] Council of Ministers, *Национален план за възстановяване и устойчивост [National Recovery and Resilience Plan of Republic Bulgaria],* Version 1.5, April 2022.

[105] Directorate-General for Energy, (Footnote № 102).

Regulatory framework

There is currently **no specialized regulatory framework for offshore wind** roll-out. This results in lengthy administrative procedures, unclear competencies and responsibilities for government authorities during project implementation and decommissioning. To address this legal gap, a the ***Bulgarian Offshore Renewable Energy Act*** has been submitted in the National Parliament in September 2022.[106]

The draft law introduces minimum deployment targets, outlining plan auctions for areas with a minimum capacity of 1 GW by 2027 and an additional 2 GW by 2030. To maximize the societal and economic benefits of offshore wind energy, the draft law proposes integrating two site-development approaches. Given the limited size of easily developable areas in Bulgaria's section of the Black Sea, the **most promising zones would be auctioned off**. This approach allows potential investors to propose the development of areas at the lowest possible costs for electricity generation.

Under the **centralised model**, Ministry of Energy, in collaboration with other competent authorities, would identify priority areas and manage grid access before auctioning the site. Developers would enter the process at the pre-construction phase by submitting the lowest strike price in CfD auctions for a specific area. Eligible participants, based on pre-defined financial, economic, and technical criteria, would receive project documentation, including data collected by the investors during micro-siting. Entry barriers for competitors would be eliminated, as all participants gain access to the same information. Costs for resource and site-specific studies, proportionate to the auctioned area's size and incurred by government authorities, would be compensated by successful bidders.

Under the **open-door procedure**, offshore wind developers would conduct preliminary studies for areas without priority status. Exclusive rights for development and operation would be granted if the studies confirm site feasibility. The holder of the site investigation permit would have the exclusive right to become a concession holder if feasibility is confirmed.

This proposed legal framework encourages competition for the most attractive slots in Bulgaria's Black Sea areas and attracts experienced technology companies to develop offshore wind projects at competitive prices. The open-door procedure allows simultaneous site investigation and project implementation in non-priority areas, aligning with legislatively advanced neighboring countries. This strategy enables interested project developers to participate in the regional expansion, capitalizing on economies-of-scale for equipment purchasing and transportation to the emerging Black Sea markets.

[106] Find more at National Assembly of The Republic of Bulgaria: *https://www.parliament.bg/en.*

Maritime spatial planning

The Minister of Regional Development and Public Works oversees maritime spatial planning activities, coordinating the development and implementation of the Maritime Spatial Plan. This plan, extending until 2035, seeks to assess the compatibility of economic, archaeological, and other activities with ecosystems, geological and hydrogeological characteristics, and cultural and historical heritage. Scheduled for revision every decade, it may be updated sooner in response to significant socio-economic changes. However, the Bulgarian government faced delays in adopting the current version of the plan, finalizing it in the spring of 2023.

Notably, the latest version of the plan, as adopted, **excludes offshore wind energy development activities and fails to designate specific areas** for projects. To address this, an updated version of the Bulgarian Maritime Spatial Plan should incorporate priority areas for offshore wind development. Simultaneously, the proposed Offshore Energy Site Development Plan, outlined in the Draft Offshore Renewable Energy Act for Bulgaria, should allocate reserved areas for commercial-scale concessions.

The Black Sea, as outlined in the National Marine Spatial Plan, exhibits limited biodiversity, especially in its central regions. Protected areas under the Biodiversity Act, encompassing various species along the adjacent coastal areas, have been designated along the Eastern European migration route passing over the Bulgarian coast and marine territories. Consequently, these coastal sites are subject to strict restrictions on investment activities to **preserve biodiversity**. To avoid conflicts between planning instruments, ensuring a harmonized approach to offshore wind development is crucial, incorporating designated areas into updated maritime spatial planning frameworks.

Environmental constrains and social acceptability

The social acceptance of offshore wind energy investments depends on the coexistence of these projects with ecological, economic, and societal interests. Investments in offshore wind energy facilities must assess the impact on species, as required by the EU Nature Directives, to prevent potential risks such as death or injury, disturbance during breeding, rearing, hibernation, and migration, or the deterioration or destruction of breeding sites or resting places of protected species.

However, the negative impact on biodiversity can sometimes be mitigated, as demonstrated by Bulgaria's 15 years of experience with onshore wind development. The assessment of significance should be done on a case-by-case basis and consider the species and habitats potentially affected, including population size, distribution, range, reproductive strategy, and lifespan. **Wind risk assessment maps** should be used to identify areas of importance to birds that should be avoided or approached with caution by wind energy developers. The potential impact on bird populations should be considered during the investment decision process to avoid negative consequences for the wind farm's profitability which could be diminished if a systemic suspension of the operation of the park becomes necessary to reduce the risk of collision of birds with turbines. Although research on bird migration, nesting, and feeding on Bulgarian territory has focused on onshore zones, additional in-depth impact assessment is vital for locating offshore wind energy sites. The latest Ornithological Monitoring in the Integrated System for Protection of Birds in the highly dense-situated wind parks of Kaliakra (close to the most promising offshore wind areas in the North-East part of the country) found no effect on sensitive bird species using migratory upward airflows during the 5-years monitoring of seasonal migration periods.[107]

The social acceptance and attitudes of the local community play a vital role in the development of offshore wind projects in Bulgaria, as organized opposition can hinder their progress. In North Eastern Bulgaria, where most onshore wind power plants would be located, citizens have shown **higher levels of awareness and readiness to support renewable energy** technology deployment compared to other regions of the country.[108] Results of the YouGov pool also support similar conclusions, as 70 percent of Bulgarian survey participants, expressed willingness to live near an offshore wind farm against 18 percent who would oppose it.[109]

Box 4. First Offshore Renewable Energy Installations in the Black Sea

An important development that will serve as a test of the reactions of the coastal population in the North-East of Bulgaria towards offshore wind turbines will be the implementation of a Horizon-funded demonstration project at the natural gas exploration platform in the Black Sea Galata, operated by Petroceltic. According to the project outline, within the next two years, a single 5-MW floating wind turbine will be installed in the section of the Bulgarian EEZ, marking the first wind turbine in the Black Sea. This project will provide valuable insights into public acceptance and the technical feasibility of offshore wind energy in the region.[110]

The North Eastern region of Bulgaria has significant potential for the development of local supply chains, which could create new green job opportunities for small businesses. Additionally, the Bulgarian Maritime University, located in Varna, produces well-trained maritime specialists who can be employed in the construction and maintenance of onshore wind farms. VESTAS, the largest European manufacturer, installer, and service provider for the wind turbine industry, has a subsidiary operating in the region, which provides a skilled workforce for the maintenance of wind farms in Bulgaria and Romania. As a result, the project is expected to generate local employment opportunities in all phases of the project lifecycle, particularly in the construction and installation of the wind park (over 1 000 local employees per GW installed capacity), operations and maintenance (approximately 250 workers per GW), and project development and management (approximately 200 workers per GW). [111]

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107 Find more at *https://kaliakrabirdmonitoring.eu/*

108 Trifonova, M., *Социална приемливост на енергийните технологии в България [Social acceptance of energy technologies in Bulgaria]*, Sofia University St. Kliment Ohridski, 2020.

109 European Climate Foundation, (Footnote № 52).

110 Balkan Green Energy News, *BLOW project – pioneering 5 MW floating offshore wind turbine in Black Sea*, February 2023.

111 Trifonova, M. and Vladimirov, M., *Wind Power Generation in Bulgaria. Assessment of the Black Sea Offshore Potential,* Center for the Study of Democracy (CSD), September 2021.

Social acceptance can vary significantly from project to project, and so far, Bulgarians have not enthusiastically embraced the development of renewable energy sources in the country. The development of renewable power plant projects in Bulgaria is still considered too expensive, only driven by centralised EU policy, and another opportunity for corruption by well-connected private interests. The notion that renewable energy projects only benefit large international investors and promote local corruption schemes has dominated the public discourse for a long time.

Infrastructural readiness for accommodating offshore wind

The successful implementation of offshore wind projects heavily relies on the presence of the corresponding infrastructure. To establish any new project, it is crucial to connect it to a high voltage transmission grid. In the north-eastern part of Bulgaria, the substations at Dobrudzha (located approximately 50 km from the shore) and Varna (about 70 km away) offer **possible transmission injection points**. Furthermore, a 440 kV substation situated near Shabla (15 km away from the shore) is currently under development. In the Southern part of the Bulgarian Black Sea, the substation at Burgas provides a viable connection option as well. Initial analysis and consultations with experts from the TSO suggest that **the national transmission grid has the capacity to accommodate up to 4 GW** in new energy projects in the area. The Bulgarian government plans to fully digitise the national high and medium voltage network in the latest version of the NRRP. This initiative will expand the interconnection capacity with neighbouring countries by an additional 200 MW, allowing investors to sell electricity from renewable energy sources outside the country on power exchanges.

The intricate process of **acquiring permits and approvals for grid connections poses a significant challenge** to offshore wind energy development in Bulgaria. Addressing this challenge requires adopting the renewable energy resource zone planning concept, a strategic tool for mapping areas designated for transmission development in support of renewable energy generation. This approach streamlines plant connection assessments during the investment planning phase, allowing for the installation of necessary transmission infrastructure during wind park construction.

Port infrastructure also plays a pivotal role, facilitating the storage, unloading, and equipment installation processes. To optimise construction processes and minimise costs, assembling turbines at the nearest port, thereby avoiding seasonal weather limitations, is recommended. Operational ports can serve as bases for equipment storage and maintenance, necessitating specific criteria such as high load capacity, deep seaport design, and adequate storage and assembly areas. Currently, Bulgaria’s main ports, Varna and Burgas, primarily support cargo delivery and shipment.

Capitalising on the European Green Deal’s financial mechanisms provides **opportunities to transform ports into decarbonization hubs**, benefiting shipbuilding companies and industrial zones nearby. Offshore wind farms, besides contributing to the low-carbon energy supply, can also support nearby electrolysers for hydrogen production, a crucial fuel for regional industries.

To unlock Bulgaria's offshore wind energy potential, establishing a fair cost allocation between network and power plant operators for offshore grid infrastructure construction is paramount. This requires introducing a legislative framework that encourages offshore energy development, assigning onshore and offshore grid planning responsibility to the national Transmission System Operator (TSO) in alignment with offshore wind site development plans.

Incorporating the EU's recent announcement on **cross-border offshore grid corridors** into current grid development planning is essential. To overcome the challenges of slow grid development in Bulgaria, **a developer-led model for offshore infrastructure provision** is recommended. Concession operators should build the necessary network infrastructure at their own expense, adhering to technological parameters and TSO guidelines. The TSO retains the right to purchase the offshore network infrastructure at a fair cost, necessitating clear compensation rules in legislative documents.

NEXT STEPS: ENABLING BLUE ENERGY IN EUROPE'S EAST

The burgeoning offshore wind markets in Poland, Croatia, Romania, and Bulgaria share **common challenges** as they embark on developing a robust offshore wind industry. These challenges encompass the imperative to establish and harmonize legislative and regulatory frameworks, foster communities of practice to share knowledge, explore cross-border projects, enhance ports as decarbonization hubs, and conduct information campaigns to raise public awareness. By collaboratively addressing these challenges, these nations can fully **unlock the potential of offshore wind energy**, aligning with the European Union's clean energy transition.

A crucial upcoming task for these countries is **enacting laws that support the sector** based on transparent, competition-friendly principles with a clear allocation of risks, costs, and responsibilities among stakeholders. Consistent policies will foster a stable investment environment, attract private investments, and streamline permitting processes. By **minimizing political and regulatory risks**, governments can reduce the overall deployment cost. Drawing insights from mature offshore wind markets like the United Kingdom, Germany, and Denmark, CEE countries can establish robust frameworks that encourage long-term growth and ensure sustainable development.

Establishing communities of practice, exemplified by the **Black Sea Renewable Energy Coalition** launched in the summer of 2023, is another pivotal step in accelerating the offshore wind sector's development. This coalition will bring together stakeholders from Romania, Bulgaria, Ukraine, and Turkey to exchange knowledge, share best practices, and build a common understanding of challenges. This network-building effort can collectively address technical, environmental, and social barriers and benefit capacity building in the regional markets for offshore low-carbon energy and coal-dependent energy systems' decarbonization.

Exploring **opportunities for cross-border projects** is essential for maximizing the region's offshore wind energy potential. Collaborative initiatives between neighbouring countries can efficiently use resources, optimise grid integration, and enhance energy security. By establishing interconnection mechanisms and developing joint offshore wind projects, countries can leverage strengths, attract larger investments, and achieve economies of scale. The Italy-Croatia cross-border project in the Adriatic Sea serves as a model that could be replicated in the Black Sea region, drawing financial support and technical assistance from the Connecting Europe Facility.

Transforming ports into decarbonisation hubs is a crucial aspect of offshore wind industry development. Upgrading port infrastructure to support the construction, operation, and maintenance of offshore wind farms will generate job opportunities and boost local economies. Ports can also serve as **centers for manufacturing**, assembly, and supply chain activities, further stimulating renewable energy sector growth and employment.

Information campaigns play a vital role in **raising public awareness and garnering support** for offshore wind energy. Engaging with local communities, addressing concerns, and highlighting the environmental and economic benefits can help build social acceptance. Promoting transparency, providing accurate information, and involving stakeholders in decision-making processes ensure a smooth and inclusive energy transition.

Looking ahead, the future of offshore wind in Poland, Croatia, Romania, and Bulgaria holds great promise. Abundant wind resources, coupled with the increasing need for decarbonisation and energy independence, present a significant opportunity for sustainable and green growth. By implementing the outlined next steps, these countries can **cultivate a thriving offshore wind industry**, contributing to climate targets, enhancing energy security, and generating socio-economic benefits for their countries.