Przegląd Strategiczny 2025, Issue 18

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DOI : 10.14746/ps.2025.1.22

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ENERGY SECURITY POLICY IN THE EUROPEAN UNION – THE EXAMPLE OF SPAIN. DEVELOPMENT OF RENEWABLE ENERGY – SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS IN GALICIA

INTRODUCTION

Energy security refers to a country's ability to secure the energy resources necessary to sustain its national power without undermining its foreign policy and economic, social, and environmental goals. The diversity in perceiving energy security is influenced by a considerable diversity in the global scale of energy systems, economic conditions and public policies implemented under different political systems. Energy security priorities and policies vary between countries. Energy security refers to the relationship between a nation's security and its access to natural resources for energy consumption, distinct from household energy insecurity. Europe heavily relies on imported energy, particularly natural gas and oil, from outside the continent. Overall, the European energy security is defined by the continent's efforts to balance the need for reliable, affordable energy with the imperative to reduce carbon emissions and the challenges posed by geopolitical dependencies Acknowledging the urgency of addressing climate change and the increasing emphasis on sustainability, the adoption of renewable energy sources has become essential. Wind energy, recognized as one of the most effective strategies for reducing greenhouse gas emissions and lessening reliance on fossil fuels, showing a significant potential for producing clean electricity. However, the expansion of onshore wind farms is limited by the availability of appropriate land and local weather conditions.

The implementation of floating wind technology may be with numerous advantages, but also brings with it significant socioeconomic and environmental challenges. The construction and operation of wind turbines in deep offshore waters can generate impacts on local fisheries, tourism, and marine biodiversity, which could affect the economic activities and well-being of surrounding communities. Therefore, it is crucial to address these issues in a comprehensive manner, considering adequate compensation to mitigate adverse effects and ensure sustainable development in impacted areas.

The aim of the study is to show the practical dimension of the implementation of the energy security strategy on the example of the use of offshore wind energy – projects implemented in the Spanish Galicia. It is not his aim to present the assumptions of the energy security strategy, as they are documented in the European Union documents related to this issue. The article is an interdisciplinary analysis, the authors move from energy security policy issues and analyze and characterize its assumptions using methods used in political science for the technical and economic analysis of projects implemented in Spain, in this case, they use methods used in economics. The main research question concerns the real possibilities of using wind energy – do ventures of this nature have economic justification for the implementation of the policy of diversifying energy sources? To what extent is this justified by the natural potential of the given country in the region? Can the diversification of energy sources using local potential be a stimulus for regional development? The research hypothesis assumes that the processes of diversifying energy sources should primarily utilize local environmental and production potential. This is where the priorities related to the implementation of energy security policy are combined with the interests of local communities based on local production potential.

For the purposes of this article and in relation to the general assumptions of the EU, we assume that energy security policy is defined as a set of actions and strategies aimed at ensuring stable, safe and economically justified energy supplies to the economy and citizens, while minimizing the negative impact of the energy sector on the natural environment and taking into account sustainable development and economic competitiveness.

In reference to EU documents, it should be emphasized that the EU energy policy is based on the principles of decarbonization, competitiveness, security of supply, and sustainable development. This policy is intended to ensure the proper functioning of the energy market and security of energy supply, as well as to promote energy efficiency and energy savings. It should also support the development of renewable energy and the creation of interconnections. Its most important element is the various measures that are to help complete the creation of the energy union.

AN OVERVIEW OF EU ENERGY SECURITY POLICY

At the beginning of the 21st century (May 2007), the European Council guided by coordinated energy and air energy, whose indication addresses energy challenges:

> “Energy is essential for Europe to function. But the days of cheap energy for Europe seem to be over. The challenges of climate change, increasing import dependence

> and higher energy prices are faced by all European Union members. Moreover the interdependence of European Union Member States in energy, as in many other areas, is increasing – a power failure in one country has immediate effects in others. Europe needs to act now, together, to deliver sustainable, secure and competitive energy. In doing so the European Union would return to its roots. In 1952 with the Coal and Steel Treaty and 1957 with the Euratom Treaty, the founding Member States saw the need for a common approach to energy. Energy markets and geopolitical considerations have changed significantly since then. But the need for European Union action is stronger than ever. Without this, the European Union's objectives in other areas, including the Lisbon Strategy for growth and jobs and the Millennium Development Goals, will also be more difficult to achieve. A new European Energy Policy needs to be ambitious, competitive and long-term – and to the benefit of all Europeans." (European Commission, 2007).

In 2014, the EU Energy Security Strategy was issued. The reasons behind the Energy Security Strategy were as follows:

> "The EU imports 53% of the energy it consumes. Energy import dependency relates to crude oil (almost 90%), to natural gas (66%), and to a lesser extent to solid fuels (42%) as well as nuclear fuel (40%). Energy security of supply concerns every Member State, even if some are more vulnerable than others. This is valid in particular for less integrated and connected regions such as the Baltic and Eastern Europe. The most pressing energy security of supply issue is the strong dependence from a single external supplier. This is particularly true for gas, but also applies to electricity: Six Member States depend from Russia as single external supplier for their entire gas imports and three of them use natural gas for more than a quarter of their total energy needs. In 2013 energy supplies from Russia accounted for 39% of EU natural gas imports or 27% of EU gas consumption; Russia exported 71 % of its gas to Europe with the largest volumes to Germany and Italy; for electricity, three Member States (Estonia, Latvia and Lithuania) are dependent on one external operator for the operation and balancing of their electricity network." (European Commission, 2014).

In 2019, the EU revamped its energy policy framework to facilitate the transition from fossil fuels to cleaner energy sources, with the specific aim of meeting its commitments under the Paris Agreement to reduce greenhouse gas emissions. The European Green Deal adopted by the European Commission in 2019 must be mentioned here. While primarily focused on sustainability, the Green Deal also includes measures that enhance energy security by promoting renewable energy, reducing dependency on fossil fuels, and improving energy efficiency (European Commision, 2019).

In 2022, the European Commission introduced the REPowerEU plan (European Commision, 2022), which outlines strategies to drastically cut Russian gas imports from the 2021 level of 155 billion cubic meters (bcm) by the end of the year, and to achieve full independence from Russian fossil fuels well before the end of the decade. The plan focuses on diversifying energy supplies, reducing demand, and significantly increasing the production of renewable energy within the EU. The 2022 Russian invasion of Ukraine highlighted the risks associated with dependence on a single supplier and accelerated efforts to diversify energy sources and reduce reliance on Russian fossil fuels through initiatives like the REPowerEU plan.

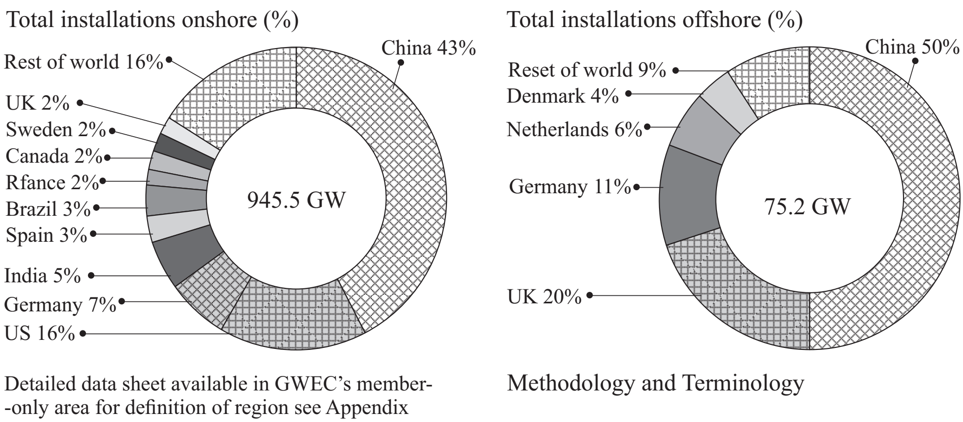
11 September 2024 – The State of the Energy Union 2024 report finds the EU has withstood critical risks to its security of energy supply, regained control over the

energy market and prices, and accelerated the transition towards climate neutrality (European Commision, 2024).

OFFSHORE WIND ENERGY DEVELOPMENT

According to Global Wind Energy Council (2024) the global capacity of onshore wind farms stands at 945.5 GW, with Spain contributing approximately 3% to this total. In contrast, offshore wind installations represent a relatively nascent technology, yielding a minimal percentage of total capacity compared to other nations. However, the global offshore wind market is projected to expand significantly, increasing from 10.8 GW in 2023 to an anticipated 37.1 GW by 2028. This growth is expected to elevate the share of offshore installations from the current 9% to 20% of new global installations by 2028. In 2023, the wind industry reached a new capacity of 117 GW, representing a 50% increase compared to 2022. This growth emphasized the need to triple renewable energy capacity by 2030. The report includes 54 countries which contributed to this growth, marking a significant international effort toward expanding wind power. For a detailed overview of the data, see Figure 1 and 2.

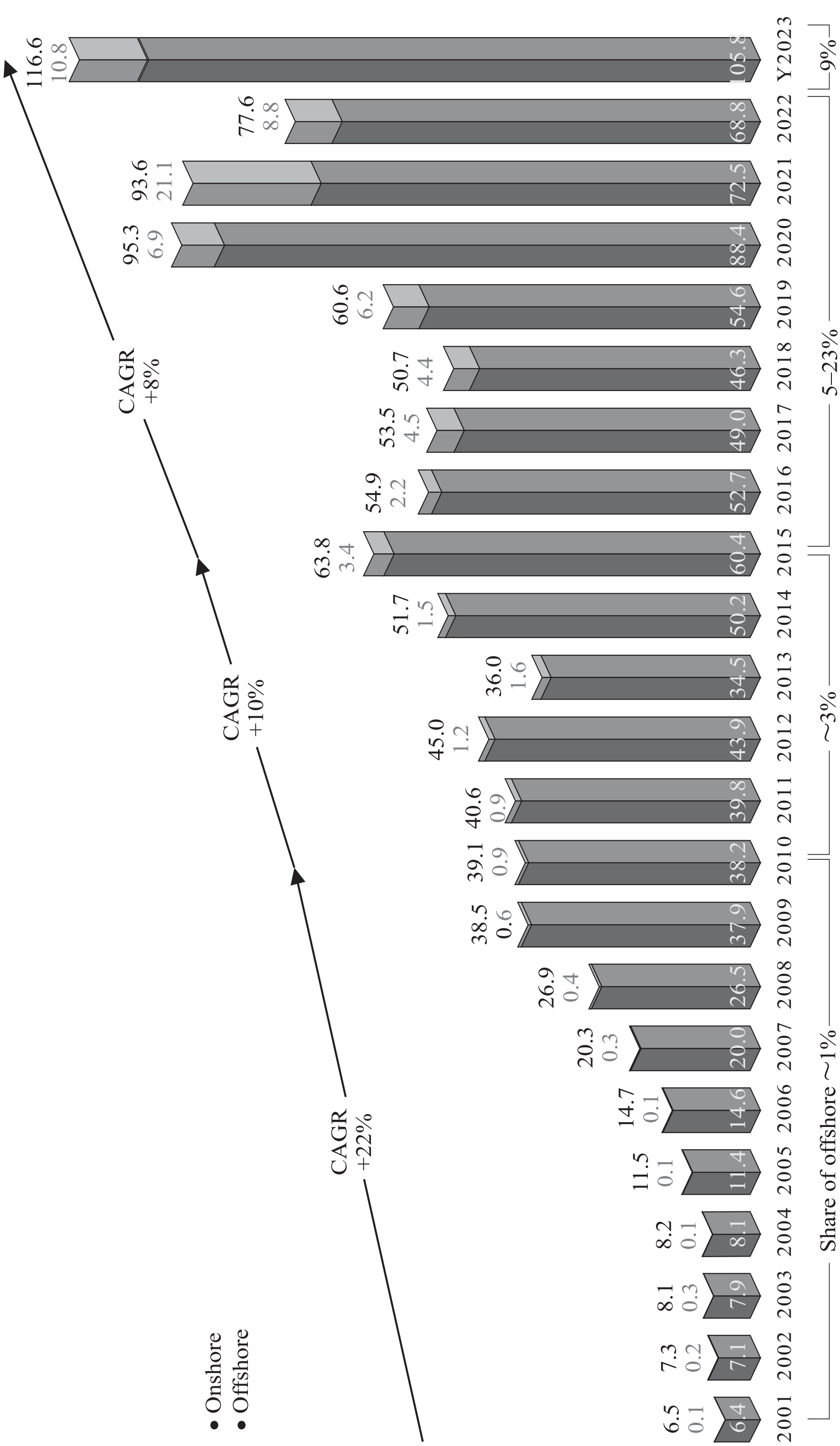
Figure 1. Total installations for Offshore and Onshore wind farms



Source: Global Wind Energy Council, 2024.

Renewables Energies (2023) reflects the proposed National Integrated Energy and Climate Plan (PNIEC) 2023–2030 for Spain outlines significant targets for renewable energy adoption. By 2030, the plan aims for 48% of the total energy consumption to come from renewable sources, along with 81% of electricity generation being sourced from renewables. These targets reflect Spain's commitment to transitioning towards a more sustainable energy model. No later than 2030, Spain's installed wind power capacity is projected to exceed 50 GW due wind power is growing from 50 GW to 62 GW, including 3 GW of offshore wind power. Also Spain has made significant advances in floating wind energy technology, establishing itself as a leader in the inter-

Figure 2. Historic development of new installations (GW)



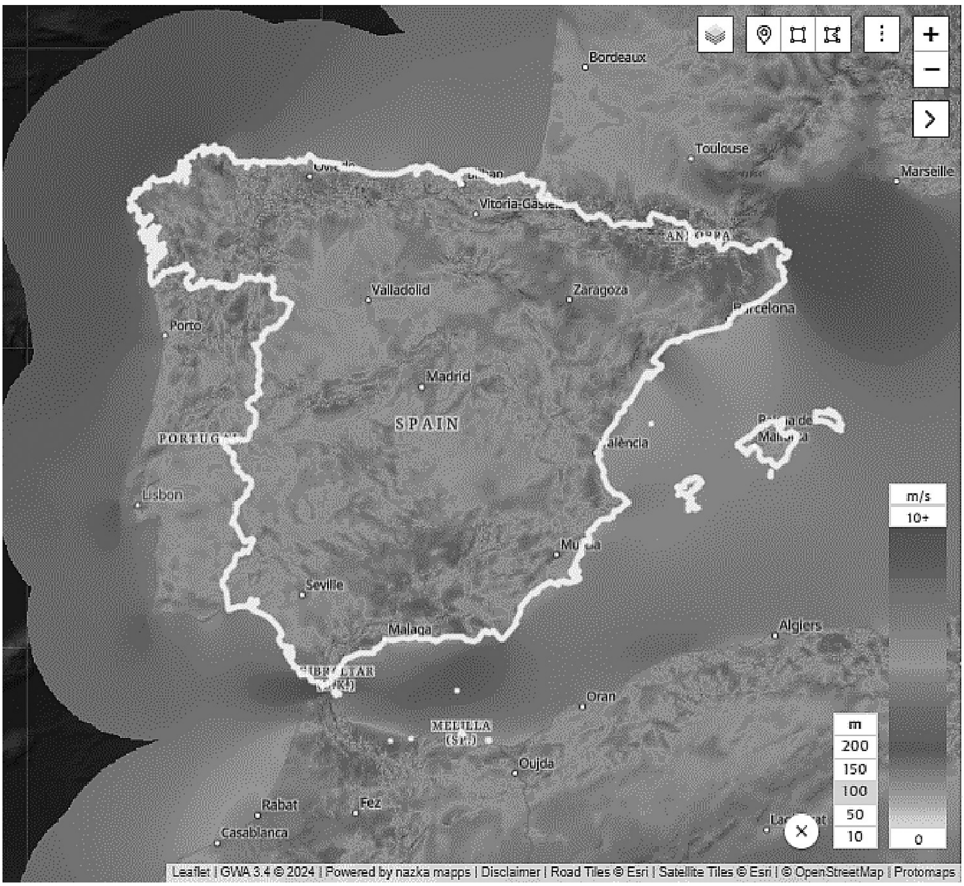
Source: Global Wind Energy Council, 2024.

national arena. Companies in the country are actively participating in the development of prototypes and floating platforms that have the potential to be industrialized.

Universitat Politècnica de Catalunya. (2023) exposes the relevance of floating wind power for Spain is evidenced by its goal of installing 3,000 megawatts of capacity in its waters by 2030. This effort could consolidate Spain as a benchmark in this emerging technology, given that the country is home to eight of the 34 prototypes under development globally, giving the possibility of large operating areas, higher wind speeds, less turbulence, less wind variation with height.

Power is associated with wind speed, the main wind production regions in Spain include Castilla y León, Galicia, Castilla-La Mancha, Andalucía and Aragón. See Figure 3.

Figure 3. Wind speed in Spain



Source: Global Wind Atlas, 2024.

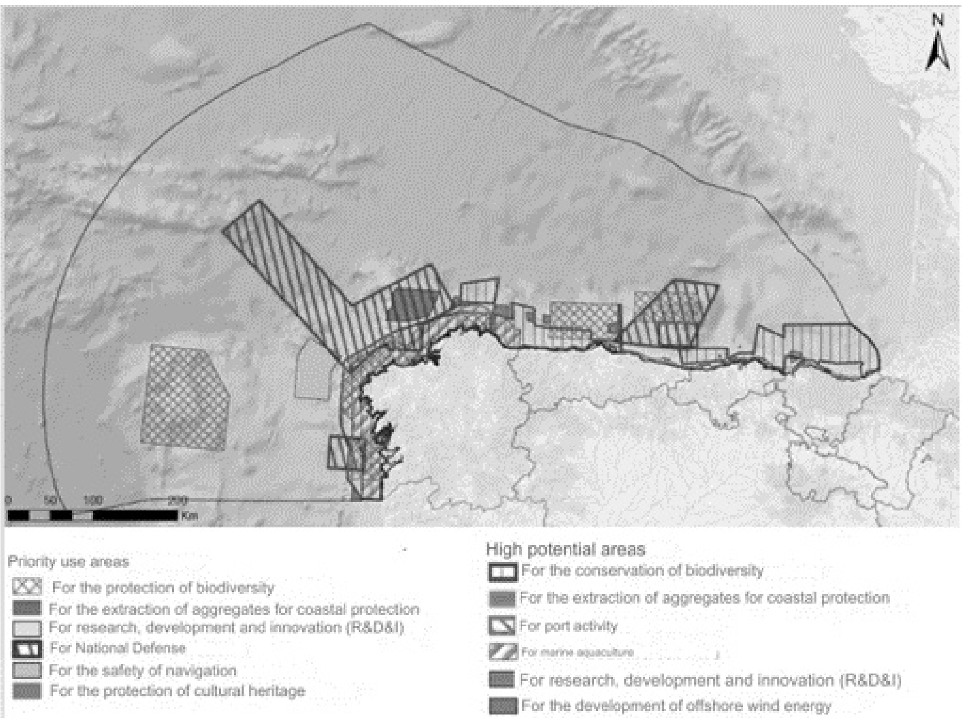
Special Areas of Conservation (SACs) are specific designations established by EU Member States, drawing upon Sites of Community Importance (SCIs) that have been endorsed by the European Commission, alongside Special Protection Areas for Birds

(SPAs). These classifications aim to safeguard valuable habitats and species across Europe. As detailed in an article from the Ministry for Ecological Transition and the Demographic Challenge (2021), the implementation of marine spatial planning (POEM) serves a critical role in identifying appropriate locations for the development of offshore wind farms. This strategic planning is crucial in ensuring that the deployment of renewable energy sources minimizes negative impacts on other maritime activities and the surrounding environment, thereby facilitating sustainable regional development.

The Plans for the Organization of Maritime Space (POEM) are integral to achieving the goals outlined in Spain‘s National Integrated Energy and Climate Plan (PNIEC), particularly concerning the advancement of marine renewable energy projects, which include offshore wind and other marine energy sources. POEM focuses on pinpointing areas with significant potential for offshore wind energy and establishing designated priority use zones to foster these developments. This initiative promotes the responsible growth of marine renewable energy while maintaining a balance between environmental preservation and the variety of activities occurring in maritime spaces.

Recent approvals have designated three offshore areas along the coast of Asturias, two in the western region and one near Gijón. Additionally, five offshore zones have been earmarked off the coast of Galicia, one in the south of Pontevedra, three near Mariña in Lugo, and one close to Ferrol. See Figure 4.

Figure 4. Galicia and the distribution of areas according to their possible use and protected areas



Source: Renewables Energies (2023).

The case of offshore wind energy with high potential areas follows technical criteria by Ministry for Ecological Transition and the Demographic Challenge (2021) : The wind resource within the specified marine areas is considered suitable for commercial exploitation, as it achieves wind speeds exceeding 7.5 meters per second at a height of 100 meters in the four peninsular marine demarcations and 140 meters in the Canary Islands Marine Demarcation. The depth in these regions does not exceed 1,000 meters. Furthermore, wherever feasible, these sites are situated in close proximity to onshore areas equipped with adequate electrical infrastructure to facilitate the evacuation of the generated energy. These areas have been clearly delineated in the pertinent planning documents.

ENVIRONMENTAL IMPACT OF OFFSHORE WIND FARMS

According to National Renewable Energy Laboratory (2023) it is considered a useful life of the wind turbine between 20–25 years since there are mechanical parts that represent a fatigue over time due to the conditions that are exposed to these structures with high humidity, corrosion by saltpeter and temperature changes. Its design is based on the IEC 61400 standard with requirements that ensure the integrity of the prototypes.

The European Commission (2024a) showed that most countries set up restricted or banned zones around offshore wind farms to minimize the risk of accidents and protect both the infrastructure and the safety of sailors. The UK, Sweden, Denmark, and Norway are the only European countries without mandatory safety zones around operational offshore installations. The stages of offshore wind farm development – construction, operation, and decommissioning – create environmental impacts that can affect fish and shellfish populations both immediately and long-term consecuences, in terms of distribution, abundance, and overall health of marine species populations near the wind farm area. Meanwhile the underwater noise generated by pile driving has the potential to induce either temporary or permanent auditory damage. These are the potential environmental impacts of offshore wind farm:

Visual Impact

Sullivan et al. (2013) indicate that under optimal conditions, the visibility of offshore wind turbines can extend up to 42 kilometers (approximately 26 miles) from the coast. Furthermore, turbines may be perceived from distances exceeding 39 kilometers (about 24 miles), while specific movements of the turbine blades can be detected even at closer proximities. Turbines are often considered a major visual focus at distances up to 16 kilometers (10 miles) and can be noticed by casual observers from nearly 29 kilometers (18 miles) away.

Marine Ecosystem and Fishing

Wind Energy Business Association (2022) answered about offshore wind energy in Spain expressing the Maritime Spatial Planning takes into consideration the international routes, so it would not hinder navigation, a minimum safety distance of 500 meters is expressed between the future location of a wind farm and any nearby maritime route.

Scientific studies by the Bureau of Ocean Energy Management (2020), which is the agency in charge of managing energy resources in U.S. offshore waters, have investigated the acoustic impact of offshore wind farms. The results indicate that the noise pollution generated by these farms is virtually undetectable from shore when measured at a distance of 500 meters. This suggests that the noise does not have a significant impact on coastal areas. The wind turbines do not add a perceptible noise level in the environment, because at 50 meters from the wind turbines, it is observed that the sound produced by the operation of the turbines is masked by the ambient noise. Underwater noise pollution are included within the TTS (Threshold Shift) and PTS (Permanent Threshold Shift) limits defined by the National Marine Fisheries Service (NMFS), indicate that the noise does not represent a significant risk to the health of fish and marine mammals.

NOAA Fisheries (2024) The construction, operation and maintance of offshore wind turbines reflects several potential impacts on commercial, recreational, and tribal fishing. These include economic losses for communities, provoking a displace of fishermen from traditional fishing grounds and altering fish populations. In addition. It can create confusion and increase accidents in poor weather or low-visibility conditions because wind farm turbine structures may interferece with radar system and damage fishing gear.

The region of Galicia has a rich fishing activity, and trawling is common, which can negatively impact the marine ecosystem. Therefore, when planning the location of offshore wind farms, it is crucial to avoid fishing areas so as not to affect local fishermen or force them to seek new fishing grounds, which could be less sustainable. This aligns with the regulations set out in Royal Decree 1028/2007 (Sanchis, 2021)

POTENTIAL BENEFITS FOR LOCAL COMMUNITIES

Atlantic Coast States (2023) consider potential compensation for areas impacted by offshore wind (OSW) development, it is essential to consider various losses and costs. Future compensation for gear loss during construction and operational phases, alongside the environmental costs associated for fish populations. Aditionally, investment in research to understand and mitigate these impacts is crucial. Indicating the possible compesations: Collaborative research, local seafood marketing campaigns, fishery enhancement funding, development of port infrastructure, safety technology and training, supportive infrastructure investments, innovation in gear and vessels, participation in management processes, business devaluation offset funding, permit banks, resource enhancement initiatives, scholarships and internships. Working together with solutions can ease the complexities of future processes with affected communitie.

Xunta de Galicia (2024) recently approved on July 22, 2024, the construction of 69 new wind farms in the Community of Galicia, with the possible approval of another wind farm in process, indicating an investment of more than 1,800 million euros and a capacity of 1,824.6 MW. In order to maintain a balance, the creation of a law is being evaluated. The Simplified Environmental Administration Law is fundamental to promoting sustainable and efficient development in Galicia, facilitating the transition to a productive model that respects the environment while boosting investment and economic activity. By providing greater legal certainty to projects, the law seeks to create a clear and stable framework that fosters investor and business confidence. The regulation has the potential to unify and update environmental regulations, adapting them to European standards and new climate challenges, ensuring economic development in harmony with the protection of the natural environment. Furthermore, it will also contribute to preserving natural resources and the quality of life of local communities, promoting development that is sustainable in the long term.

Xornal de Vigo (2024) Galicia is in a favorable position internationally, with three of the only five floating wind farms in Europe using technology developed in the region, but The Platform in Defense of Fishing and Marine Ecosystems has raised significant concerns regarding the newly implemented regulation for offshore wind farms. They argue that this regulation poses a substantial risk not only to marine ecosystems but also to the fishing industry, which is vital for the livelihoods of many local communities. They emphasizes the need for a thorough assessment of the potential environmental impacts before proceeding further with the regulatory process, and advocating for a temporary suspension of the implementation of these regulations until comprehensive scientific data can be gathered to better understand the potential consequences of offshore wind installations on marine life and fishing activities.

On December 31, 2022, the European Commission (2024) showed data from the Spanish fishing fleet which consists of 8,657 vessels, with a total tonnage of 328 492 gross tons (GT) were a total of 7 635 active vessels. Small-scale vessels, which measure less than 12 meters, represent 71.46% of the fishing fleet. On the other hand, 19.83% of the vessels are in the 12 to 24 meter length category, while only 8.71% correspond to those larger than 24 meters in length, with smaller vessels predominating in the fishing fleet.

The proposed offshore wind farm has a total capacity of 500 MW, consisting of 50 wind turbines, each with a capacity of 10 MW. The selected wind turbines are of the Siemens Gamesa SG 10.0-193 DD model, known for their efficiency and advanced design. This project will be located at coordinates 43.840469, -7.439589 in the north of Galicia, at a distance of approximately 5 to 10 km from the coast, which optimizes the capture of wind resources and minimizes the visual impact on coastal communities. This initiative represents a significant step towards harnessing renewable energy in the Galicia region. The actual price per kW by REE (2023) is 0.14 € and the wind hours per year is 3,093.48 hours calculated by Weibull distribution and 10MW power curve.

A financial study was conducted for the proposal for 25 years. Based on the necessary components and systems: wind turbine material, electrical system, platform, type of anchoring to the seabed and labor with an initial investment of 996,752,000 €. A maintenance of 3% of the total investment during an operation period of 20 years, the cost amounts to 1,503,404.25 €, without considering dismantling costs. It is also recommended that a specialized team be hired for processing and permitting, which will generate administrative costs totaling €5,517,500.

It is proposed that 70% of the investment will be financed by the bank, while the remaining 30% will be obtained from equity, resulting in amounts of €697,726,400 and €299,025,600, respectively.

Regarding Esade (2024) inflation in Spain has slowed down, with an average year-on-year rate of 3.2%. This figure represents a notable decrease compared to the 8.3% recorded in 2022. A decline from 8.3% to 3.2% indicates that economic conditions have improved, as the COVID-19 pandemic caused disruptions in supply chains and an increase in demand. The economic recovery and stability of markets by adjusting supply and demand have been determinants for the decline in inflation in Spain in 2024.

Cash flows work significantly in a company to achieve evaluate the profitability of its projects or investments for this purpose, future estimates are made by calculating metrics such as Net Present Value (NPV), Internal Rate of Return (IRR) and Modified Internal Rate of Return (MIRR). It also evaluates the Weighted Average Cost of Capital (WACC) where it considers both debt and equity, weighting each according to its share of total financing:

$$NPV = -Initial\ Investment + \Sigma \frac{CF_t}{(1 + WACC)^t} + \frac{terminal\ value}{(1 + WACC)^n} \quad (1)$$

where: CF – Cash Flow estimated in feasibility projection for year t; $WACC$ – weighted average cost of capital; Terminal value – the estimated value of assets in the last projection year.

$$WACC = \frac{k_E \times E + k_D \times D}{E + D} \quad (2)$$

where: E – the value market of Equities or shares; D – the value market of Debts from liabilities; K_E – the cost of equities; K_D – the cost of debt.

$$0 = Initial\ Investment + \Sigma \frac{CF_t}{(1 + IRR)^t} + \frac{terminal\ value}{(1 + IRR)^n} \quad (3)$$

where: IRR – the estimated internal rate of return.

$$-Initial\ Payment + \frac{CF_1(1+i_{reinvestment})^{n-1} + CF_2(1 + i_{reinvestment})^{n-2} + ... + CF_n}{(1 + MIRR)^n} = 0 \quad (4)$$

where: $i_{reinvestment}$ – reinvestment rate for future cash flow in next years; $MIRR$ – the modified internal rate of return under the hypothesis of a reinvestment rate lower than initially estimated IRR; CF – the free cash flow for shareholders.

The financing proposal obtains a cash flow that moves according to the agents involved. Associated by the cash flow estimation and the operating cash flow connected with the company's ability to sustain its main operations, excluding investment and financing expenses.

$$Cash\ Flow\ Estimatiion = EBITx(1 - tax\ rate) + Amortization\ \&\ Depreciation \quad (5)$$

where: $EBIT$ – Earnings Before Interest and Taxes excluding the effects of financing and tax burden.

$$Operating\ Cash\ Flow = -Inwestments\ in\ assets + reductiions\ in\ assets \quad (6)$$

where: Investmets in assests – money spent on acquiring fixed or current assets; reduction in assets – money generate income for the company.

Furthermore, the Investment Cash relates cash movements to the purchase and sale of long-term assets linked to a project, which includes investments in fixed assets and intangible assets, as well as income from the sale of assets. It also considers interest and financial expenses and the amortization of loans.

$$\begin{aligned}&\textit{Investment Cash Flow} = -\textit{Interest and financial expenses} - \textit{Loan Amortization} + \\&+ \textit{Increases in Equity and liabilites} + \textit{Interests in financial expenses} * \textit{tax rate}\end{aligned} \tag{7}$$

The corporate income tax rate in Spain is information established by the Spanish Tax Agency and is regulated by the Corporate Income Tax Law (2014). According to this law, the general corporate income tax rate is 25%. This rate applies to companies in general, including those operating in sectors such as offshore wind energy.

A MIRR of 2% was considered for This approach is more conservative, oriented towards long-term growth and lower financial volatility. Therefore, we obtain for the shareholder an IRR of 43.23% and MIRR of 11.17%, and for the company an IRR of 15.21% and MIRR of 6.75%. while the Net Present Value shows a a 1,240,475,699.03 € for the shareholder and 1,394,307,620.67 € for th company, a positive value for a future profitability.

The project offers future profitability for shareholders and supports regional economic development and environmental sustainability along with the attractive IRR and positive NPV of the offshore wind farm project in Galicia position it as a highly beneficial investment opportunity. The IRR provides shareholders can expect attractive profits relative to their initial investment and the NPV shows the project's capability to produce more revenue than incurred costs, reinforcing its financial viability.The generation of wind turbines can enhance energy generation efficiency and support the long-term sustainability of the project due high energy conversion efficiency, reduction of carbon emissions and promotion of energy independence but the financial aspect offers a competitive cost with stable and predictable revenue streams over their operational lifetimes.This growing market demand for renewable energy sources enhances the attractiveness of offshore wind projects to investors.

Comparing it with the study of Sanchís (2021) for the feasibility with projects in the Alboran and Balearic Sea. The NPV is expressed positive obtaining significant benefits of 445,424.095 and an IRR of 14.1% indicating that 7% is the minimum IRR that should be required to have a profitable investment. The Balearic Sea offered similarities with a van of 385,509,836 and an IRR of 12.6%. In both situations it demonstrates the technical and economic commitment for the realization of an offshore wind farm, obtaining a return on the initial investment from year 15.

CONCLUSIONS

Spain has set ambitious targets for renewable energy adoption by 2030, particularly through increasing offshore wind installations, which could lead to a sustainable energy future. However, careful consideration of the socio-economic and environmental impacts of these projects is essential, concerning local communities dependent on fishing, technical requirements of the places and structures and marine ecosystems.

The operational noise from wind farms tends to be masked by the surrounding natural ambient sounds, which minimizes the risk to marine mammals and fish populations, preserving the health of marine ecosystems while progressing towards renewable energy goals.

Tools such as Net Present Value (NPV) and Internal Rate of Return (IRR) are commonly used to evaluate financial viability contributing along with a long-term strategic planning and valuating the risk management for a successful project execution for both the shareholder and the company an attractive Modified Internal Rate of Return (MIRR) of 11.17% and MIRR of 6.75% respectively is offered, along with a positive NPV in both cases.

A future compensation strategy is crucial. These allocations aim to enhance community development, support local fisheries, and fund infrastructure improvements, thereby mitigating potential disruptions from offshore wind projects.

The integration of floating wind technology could position Spain as a leader in renewable energy, contributing to sustainable economic growth. Collaborative efforts among government, industry, and local communities will be critical in achieving a harmonious balance between advancing renewable energy goals. Combining renewable energy with circular economy establishes a model that maximizes resource use, minimizes waste and good improvement of technologies which promotes sustainability in all aspects of the project, from energy production to community development and ecosystem conservation.

Overall, both Europe and Spain are actively pursuing strategies to enhance energy security, reduce dependence on specific suppliers, and integrate more diverse and sustainable energy sources. These efforts reflect a broader trend towards achieving greater energy resilience in response to evolving geopolitical and economic challenges.

The article allowed for the verification of the hypothesis and the achievement of the research goal. It has been proven that implementing energy security policy based on local production potential (wind energy) is justified both strategically and economically, while contributing to the development of the region.

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ABSTRACT

Energy security remains a multifaceted and dynamic concept influenced by a variety of factors, including geopolitical developments, technological advances, and environmental considerations. The field continues to evolve, addressing new challenges and striving to balance competing objectives for a resilient and sustainable energy future. Traditional approaches to state security usually focus on military, political, economic, social, and environmental threats. The analysis of offshore wind energy technology, particularly floating wind farms, presents critical insights into how this sector can stimulate economic growth, enhance local employment opportunities, and foster sustainable community development. The exploration of Spain's ambitious energy goals, in the context of its National Integrated Energy and Climate Plan, highlights the economic strategies employed to transition toward a sustainable energy model. The development of offshore wind energy in Spain reflects a commitment to increasing renewable energy production while considering the potential impacts on local communities, marine transportation and navigation in the territory. Spain's ambitious goals include generating 48% of its energy consumption from renewable sources by 2030, alongside a significant push for offshore wind capacity with plans to install 3,000 megawatts of floating wind capacity, Spain has a target to become a leader in this sector. However, managing offshore wind projects requires careful planning to mitigate disruptions to submarine noise and marine ecosystems considering locations fo wind resource, permissions, technical knowledge and strategical structures. Proposed allocations from wind farm revenues include funding for community projects, support for the investments in sustainable infrastructure. Offshore wind energy can contribute significantly to environmental sustainability while fostering socioeconomic development, promoting a balanced approach to renewable energy initiatives with an attractive financial plan.

Keywords: Energy security, Energy security policy, Renewable energy transition, Maritime Resource Management, Environmental Impact Assessment, Marine Spatial Planning, Circular Economy

POLITYKA BEZPIECZEŃSTWA ENERGETYCZNEGO W UNII EUROPEJSKIEJ – PRZYKŁAD HISZPANII. ROZWÓJ ENERGETYKI ODNAWIALNEJ – SKUTKI SPOŁECZNO-GOSPODARCZE I ŚRODOWISKOWE W GALICJI

STRESZCZENIE

Bezpieczeństwo energetyczne pozostaje pojęciem wieloaspektowym i dynamicznym, na które wpływ ma wiele czynników, w tym rozwój sytuacji geopolitycznej, postęp technologiczny i względy środowiskowe. Dziedzina ta stale się rozwija, stawiając czoła nowym wyzwaniom i dążąc do zrównoważenia konkurujących ze sobą celów na rzecz odpornej i zrównoważonej przyszłości energetycznej. Tradycyjne podejście do bezpieczeństwa państwa zwykle koncentruje się na zagrożeniach militarnych, politycznych, gospodarczych, społecznych i środowiskowych. Bezpieczeństwo energetyczne UE stało się niezwykle kluczowym zagadnieniem w związku z zagrożeniami, jakie przyniosła państwom członkowskim wojna na Ukrainie. Uświadomiła ona, iż nadmierne uzależnienie od jednego dostawcy, w tym wypadku Rosji może być niebezpieczne. Stąd sukcesywnie UE skupia swoją uwagę na innych sposobach pozyskiwania energii. Przykład Hiszpanii, wykorzystania jej podencjału w obszarze energii odnawialnej, jest przedmiotem analizy, stanowiącej zawartość tego artykułu. Multidyscyplinarny charakter tej analizy, rozszerza jej wątki z perspektywy geopolitycznej na aspekty ekonomiczne oraz technologiczne, a nawet ekologiczne. Podstawowe pytania badawcze nie dotyczą tylko i wyłącznie aspektów bezpieczeństwa energetycznego UE, dotyczą one również innych jego wymiarów. Analiza technologii morskiej energetyki wiatrowej, w szczególności pływających farm wiatrowych, przedstawia kluczowe informacje na temat tego, w jaki sposób sektor ten może stymulować wzrost gospodarczy, zwiększać lokalne możliwości zatrudnienia i wspierać zrównoważony rozwój społeczności. Analiza ambitnych celów energetycznych Hiszpanii w kontekście Krajowego Zintegrowanego Planu na rzecz Energii i Klimatu podkreśla strategie gospodarcze stosowane w celu przejścia na zrównoważony model energetyczny. Rozwój morskiej energetyki wiatrowej w Hiszpanii odzwierciedla zaangażowanie w zwiększenie produkcji energii ze źródeł odnawialnych, biorąc pod uwagę potencjalny wpływ na społeczności lokalne, transport morski i nawigację na tym terytorium. Ambitne cele Hiszpanii obejmują wytwarzanie 48% energii ze źródeł odnawialnych do 2030 r., a także znaczny nacisk na moce morskiej energetyki wiatrowej z planami zainstalowania 3 000 megawatów pływających mocy wiatrowych, Hiszpania ma cel, aby stać się liderem w tym sektorze. Zarządzanie projektami morskiej energetyki wiatrowej wymaga jednak starannego planowania w celu złagodzenia zakłóceń w hałasie podmorskim i ekosystemach morskich, biorąc pod uwagę lokalizacje zasobów wiatrowych, pozwolenia, wiedzę techniczną i struktury strategiczne. Proponowane środki z dochodów z farm wiatrowych obejmują finansowanie projektów wspólnotowych, wsparcie inwestycji w zrównoważoną infrastrukturę. Morska energia wiatrowa może w znacznym stopniu przyczynić się do zrównoważenia środowiskowego, jednocześnie wspierając rozwój społeczno-gospodarczy, promując zrównoważone podejście do inicjatyw w zakresie energii odnawialnej wraz z atrakcyjnym planem finansowym.

Słowa kluczowe: bezpieczeństwo energetyczne, polityka bezpieczeństwa energetycznego, transformacja energetyki odnawialnej, zarządzanie zasobami morskimi, ocena oddziaływania na środowisko, morskie planowanie przestrzenne, gospodarka o obiegu zamkniętym

Article submitted: 16.04.2025; article accepted: 09.09.2025.