Offshore wind energy in Rio Grande do Norte, Brazil: An assessment related to socio-economic and socio-environmental externalities

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Overview

Wind energy has rapidly developed worldwide to reduce Greenhouse Gas (GHG) emissions, accelerate the energy transition, diversify the global energy matrix, and mitigate climate change. Offshore wind energy emerges as a promising alternative in coastal areas. Brazil's extensive coastline presents excellent potential for deploying offshore wind farms, with some projects currently in development to meet energy demand. However, these projects are in the initial phase of environmental licensing, emphasizing the importance of public participation and careful analysis. Installing offshore wind farms in the North Sea revealed socio-environmental impacts, necessitating mitigation and monitoring plans for seabirds and marine mammals. Onshore wind energy projects in Brazil also identified challenges, including more support for local communities and environmental interventions. Despite the urgency to combat emissions, decision-making in energy planning should consider all socio-environmental externalities in these projects located in areas of conservation importance for coastal birds and migrating cetaceans in Rio Grande do Norte.

The State of Rio Grande do Norte presents an extremely favourable wind profile. The region is characterized by trade winds, which exhibit a constant frequency throughout the year [25]. In the areas of the state where offshore wind farms are being planned, the average wind speed varies between 7 and 11 m/s at 100 meters height, depending on the time of the year [26]. In addition to the well-established onshore wind scenario in the state, several actions are positioning Rio Grande do Norte as one of the leading players in the country's offshore wind energy race. These actions include the acceleration project for renewable energy businesses and partnerships with international organizations.

The Brazilian Energy Research Company [21] listed the main challenges and actions for offshore wind energy development in the country, including uncertainties regarding potential socioeconomic conflicts between offshore wind activity and other activities [21]. From this perspective, it becomes indispensable to identify the areas frequently used by the fishing community. Additionally, it is crucial to investigate areas that play a fundamental role in the feeding, reproduction, birth, and spawning of marine species and regions that harbour coral reef ecosystems. Simultaneously, it is essential to establish appropriate means for the decarbonisation of the Brazilian energy matrix to occur in harmony with the traditional, cultural, and socioeconomic activities intrinsic to the region. Despite the existence of 74 offshore wind projects in the Environmental Licensing Process (PEO) phase, totalling over 12,500 registered towers and a total potential of 182,988 MW, the socio-environmental criteria necessary for a better definition of the installation areas of these towers are still not clearly established. This lack of clarity results in a gap in the scientific literature that addresses the relationship between the implementation of these ventures, marine biota, and the existing human occupation on the Cost of the State of Rio Grande do Norte and along the entire Brazilian coast. In this context, there needs to be more knowledge about the alterations and responses of marine fauna to the installation and operation of these projects. Additionally, there needs to be more understanding regarding the impacts of these alterations on the benefits and ecosystem services for coastal communities in the state, especially considering the various socio-environmental conflicts faced by traditional fishermen over the years.

A literature review conducted by Sovacool critically analysed the connections between low-carbon energy transition and degradation, dispossession, and destruction in a set of 198 studies. The three most prominent technologies examined were wind energy (present in 50% of the articles), solar energy (present in 38% of the articles), and hydropower (present in 20% of the articles). The results showed that the group most frequently affected by climate mitigation efforts was non-human species (77.3% of the articles), followed by host communities or families (76.8%), farmers (37.4%), rural populations (36.9%), occupational workers (36.4%), indigenous groups or ethnic minorities (35.9%), and fishermen and water resource users (25.8%).

Methods

The methodology adopted in this study was predominantly qualitative, characterized by a descriptive and applied nature, composed of two complementary stages. The first stage involved obtaining data and information through a literature review using a critical analysis of the selected materials. In this first stage, analyses were conducted based on a comprehensive review of scientific literature, focusing on studies published in high-impact scientific journals. This review allowed for obtaining updated and relevant information on various aspects of international and onshore-offshore wind farm projects in Rio Grande do Norte.

Furthermore, international, and national reports published by specialized organizations were considered, providing a broader perspective on the energy sector and biodiversity. In the second stage, the main technical characteristics, agreements between entrepreneurs and IBAMA (Brazilian Institute of Environment and Renewable Natural Resources), and the results of initial environmental studies in the environmental licensing processes of the 8 (eight) registered offshore wind projects in the SEI! The system (a digital platform used by the management and processing of administrative processes) for the Rio Grande do Norte region was presented. Additionally, georeferenced data on the location of wind turbines were considered to map their spatial distribution and identify areas of migratory routes, reproduction, and feeding of marine fauna and avifauna to analyze possible impacts. For this purpose, databases containing relevant information on these species' presence and movement patterns were utilized.

Results

The results indicate a significant gap in assessing socio-environmental externalities from installing offshore wind farms, especially concerning communities and families directly exposed to these structures. Concerning the environmental licensing processes for offshore wind projects, it is essential to highlight that they are still in the early stages, considering that the first submission of documentation to IBAMA occurred in November 2020. In this context, public participation and Careful analysis by the licensing body are crucial and must be present at all stages of these processes.

Conclusions

The offshore wind energy market has experienced significant growth in Brazil, covering virtually the entire length of the coast. In response to the need to reduce greenhouse gas emissions and meet energy demand, socio-environmental impacts must be considered from the outset to develop and implement adequate mitigation plans. In addition to the observed impacts on tree species and bats, there was a consistent pattern in the social impacts of installing wind farms on land. Several communities have complained about the need for more support from entrepreneurs and the misperception regarding generating jobs since job opportunities are often temporary.

All projects under analysis are subject to certain environmental restrictions, making rigorous and complete studies essential. These studies must be carried out judiciously, respecting the environmental assessment steps and not allowing economic issues to override due to environmental care and the time required for proper assessments.

References

IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

RUGGIERO, L. et al. Antarctic permafrost degassing in Taylor Valley by extensive soil gas investigation. Science of The Total Environment, *[S. l.]*, v. 866, p. 161345, 2023. DOI: 10.1016/j.scitotenv.2022.161345.

MARZEION, Ben; KASER, Georg; MAUSSION, Fabien; CHAMPOLLION, Nicolas. Limited influence of climate change mitigation on short-term glacier mass loss. Nature Climate Change, *[S. l.]*, v. 8, n. 4, p. 305–308, 2018. DOI: 10.1038/s41558-018-0093-1.

UNFPA. Population trends. 2023. Disponível em: https://pdp.unfpa.org/apps/0aeda6af00dd4544ba50452da2dda474/explore. Accessed on January 8, 2023.

MUNIR, Qaiser; LEAN, Hooi Hooi; SMYTH, Russell. CO_2 emissions, energy consumption and economic growth in the ASEAN-5 countries: A cross-sectional dependence approach. Energy Economics, *[S. l.]*, v. 85, p. 104571, 2020. DOI: 10.1016/j.eneco.2019.104571.

FURNESS, Robert W.; WADE, Helen M.; MASDEN, Elizabeth A. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management, *[S. l.]*, v. 119, p. 56–66, 2013. a. DOI: 10.1016/j.jenvman.2013.01.025.

BARRIOS, Luis; RODRÍGUEZ, Alejandro. Behavioral and environmental correlates of
soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology, *[S. l.]*, v. 41, n. 1, p. 72–81, 2004. DOI: 10.1111/j.1365-2664.2004.00876. x.

POLLOCK, Christopher J.; LANE, Jude V.; BUCKINGHAM, Lila; GARTHE, Stefan; JEAVONS, Ruth; FURNESS, Robert W.; HAMER, Keith C. Risks to different populations and age classes of gannets from impacts of offshore wind farms in the southern North Sea. Marine Environmental Research, *[S. l.]*, v. 171, p. 105457, 2021. DOI: 10.1016/j.marenvres.2021.105457.

PALECZNY, Michelle; HAMMILL, Edd; KARPOUZI, Vasiliki; PAULY, Daniel. Population Trend of the World's Monitored Seabirds, 1950-2010. PLOS ONE, *[S. l.]*, v. 10, n. 6, p. e0129342, 2015. DOI: 10.1371/journal.pone.0129342.

DIERSCHKE, Volker; FURNESS, Robert W.; GARTHE, Stefan. Seabirds and offshore Wind 69 farms in European waters: Avoidance and attraction. Biological Conservation, *[S. l.]*, v. 202, p. 59–68, 2016. DOI: 10.1016/j.biocon.2016.08.016.

SÁNCHEZ., E. L. Avaliação de impacto ambiental. 3. ed. [s.l.]: Oficina de Texto, 2020. 46. HOFSTAETTER., M. ENERGIA EOLICA: ENTRE VENTOS, IMPACTOS E VULNERABILIDADES SOCIOAMBIENTAIS NO RIO GRANDE DO NORTE. 2016. Universidade Federal do Rio Grande do Norte, Rio Grande do Norte, 2016.

COSTA., F. R. Ventos que transformam? Um estudo sobre o impacto econômico e social da instalação dos parques eólicos no Rio Grande do Norte. 2015. UFRN, Natal, 2015.

CRUZ, K. D. B. Os impactos da instalação de parques eolicos nas comunidades urbanas e rurais da Serra De Santana/RN. 2016. Universidade Federal do Rio Grande do Norte, Natal, 2016.

IMPROTA, R. L. Implicações socioambientais da construção de um parque eólico no município de Rio de Fogo-RN. 2008. Universidade Federal do Rio Grande do Norte, Natal, 2008.