Kong Mukwele and Tambo
Marine Development (2026) 4:11
https://doi.org/10.1007/s44312-026-00082-9

MARINE DEVELOPMENT

RESEARCH

Open Access

Achieving energy security in the Gulf of Guinea: harnessing ocean energy through regional cooperation

Sheila Kong Mukwele[1*] and Erick Gankam Tambo[2]

Abstract

Energy poverty remains a critical challenge in Africa, particularly in the Gulf of Guinea (GoG) subregion, where reliance on hydropower, fossil fuels, and limited solar photovoltaic capacity fails to meet the rapidly increasing energy demands of urban and industrial centers. This paper investigates the potential of marine renewable energy (MRE) as a sustainable approach to the GoG's energy deficit, emphasizing the importance of transnational cooperation among the region's coastal states. Drawing on comparative and empirical methods, the study examines successful European models of MRE development, focusing on the North Sea and Baltic Sea macro-regions, to identify lessons that can be adapted to the GoG context. The findings indicate that coordinated regional efforts to harness offshore wind, wave, tidal, and floating solar energy—when tailored to local geography and climate—can significantly enhance energy security, reduce costs, and drive the blue economy. The paper concludes with policy recommendations for strengthening subregional collaboration, fostering technology transfer, and aligning initiatives with international frameworks to accelerate the development and deployment of sustainable ocean energy in the GoG.

Keywords Gulf of Guinea, Marine renewable energy, Energy poverty, Blue economy, Transnational cooperation

1 Introduction

Energy crises persist as a global challenge, affecting both industrialized and developing regions with varying degrees of severity (Browne & Cumming, 1984; IEA, 2022; IRENA, 2022). In Africa, access to reliable, affordable, and sustainable energy remains unequal and structurally constrained (IRENA & AfDB, 2022; Filho et al., 2024). Within the Gulf of Guinea (GoG) subregion, energy poverty continues to undermine socioeconomic development, industrial expansion, and human security. Despite abundant natural resources (Odido & Mazzilli, 2009), most coastal states in the subregion still rely heavily on hydropower and fossil fuels—mainly oil and natural gas—supplemented only recently by limited solar photovoltaic deployment. However, these energy sources have failed to meet rapidly increasing demand driven by urbanization, population growth, and industrial expansion (Kidmo et al., 2021).

The structural weaknesses of this energy model are increasingly evident. Hydropower generation is highly vulnerable to climate variability, including factors such as prolonged droughts and shifting rainfall patterns (Nonki et al., 2021). At the same time, global commitments to decarbonization (The Global Climate & Health Alliance, 2022) and the phasing out of fossil fuels—supported by institutions such as the International Energy Agency and International Renewable Energy Agency (IRENA)—raise pressing questions about the long-term sustainability of hydrocarbon-dependent systems (Cevik, 2022). With Africa's population projected to double by 2050 (Paice, 2022) and with many GoG states aspiring to emerging

*Correspondence:
Sheila Kong Mukwele
kongmukwelesheila@rocketmail.com
[1] Ministry of External Relations of Cameroon, Yaounde, 18, Cameroon
[2] United Nations University - Institute for Environment and Human Security, Bonn 53113, Germany

Springer

economy status, depending solely on conventional energy sources is unlikely to secure future energy stability.

In this context, renewable energy has emerged as a central pillar of continental development policy. Guided by the African Union, Agenda 2063 calls for harnessing Africa's diverse energy resources by strengthening national and regional energy pools (African Union Commission and African Union Development Agency – NEPAD, 2022). However, most renewable initiatives remain focused on land-based projects, overlooking the vast potential of Africa's marine and coastal domains (Purdy, 2019). This oversight is particularly striking in the GoG, a region characterized by extensive exclusive economic zones, favorable wind regimes, wave energy potential, and substantial offshore resource endowments.

Marine renewable energy (MRE)—covering offshore wind, tidal, wave, and floating solar technologies—offers a promising but largely untapped opportunity to diversify the regional energy mix and promote sustainable ocean governance (H.E. The Deputy Chairperson of the African Union Commission, 2010). Globally, MRE is increasingly recognized as a strategic response to growing energy insecurity and the urgent need for climate change mitigation. However, within the GoG subregion, progress remains minimal, hampered by limited technological capacity, financial constraints, regulatory fragmentation, and a lack of awareness among stakeholders (Belletti & McBride, 2021; Kenfack et al., 2011).

Given the high costs and technical complexity of marine renewable infrastructure, individual national efforts are often economically unsustainable. This paper argues that transnational cooperation provides the most viable pathway for developing and deploying MRE in the GoG. By pooling resources, harmonizing regulatory frameworks, and leveraging shared marine ecosystems, coastal states can lower costs, reduce risks, and accelerate innovation while strengthening regional integration.

1.1 Methodology

This study utilized qualitative, comparative, and interdisciplinary research design, combining doctrinal legal analysis, policy reviews, and comparative regional assessment.

First, a desk-based review of primary and secondary sources was conducted, including regional treaties, institutional mandates, policy strategies, and energy governance frameworks relevant to the GoG. The study evaluated the institutional architecture of subregional cooperation, focusing specifically on the Economic Community of West African States (ECOWAS), the Economic Community of Central African States (ECCAS), and the Gulf of Guinea Commission (GGC). This institutional mapping enabled an assessment of current governance capacities and identified potential pathways for MRE integration.

Second, the paper applied a comparative analytical method by examining established models of transnational MRE cooperation in Europe, particularly within the North Sea and Baltic Sea macro-regions. These regions offer real-world examples of cross-border offshore wind development, integrated grid systems, coordinated maritime spatial planning, and shared regulatory standards. Through structured benchmarking, the study identified transferable legal, financial, and governance mechanisms that can be adapted to the geopolitical and economic realities of the GoG.

Third, the analysis was framed within a governance-oriented and blue economy perspective, evaluating how regional cooperation in MRE can drive sustainable development, energy security, and marine-based economic transformation. Moving beyond simple technical feasibility, the study situated MRE within broader regional integration and ocean governance dynamics.

1.2 Objectives of the study

The overarching objective of this paper was to examine how transnational cooperation can facilitate the sustainable development and deployment of MRE in the GoG subregion. Specifically, the study sought to

(1) assess the MRE potential of the GoG, including offshore wind, waves, tidal, and floating solar technologies;
(2) analyze the institutional and legal capacities of subregional actors to support coordinated MRE governance;
(3) evaluate current regional and continental policy frameworks that may enable or constrain MRE development;
(4) identify best practices from European macro-regional cooperation models that may be tailored to the GoG context;
(5) assess how MRE can advance the blue economy agenda, enhancing energy security and reducing energy poverty in the subregion.

1.3 Research questions

To achieve these objectives, the study addressed the following research questions:

(1) What is the technical, geographical, and economic potential of MRE in the GoG?
(2) What institutional and legal frameworks currently support coordinated MRE development at the subregional level?
(3) What lessons can be drawn from established transnational cooperation models in MRE development,

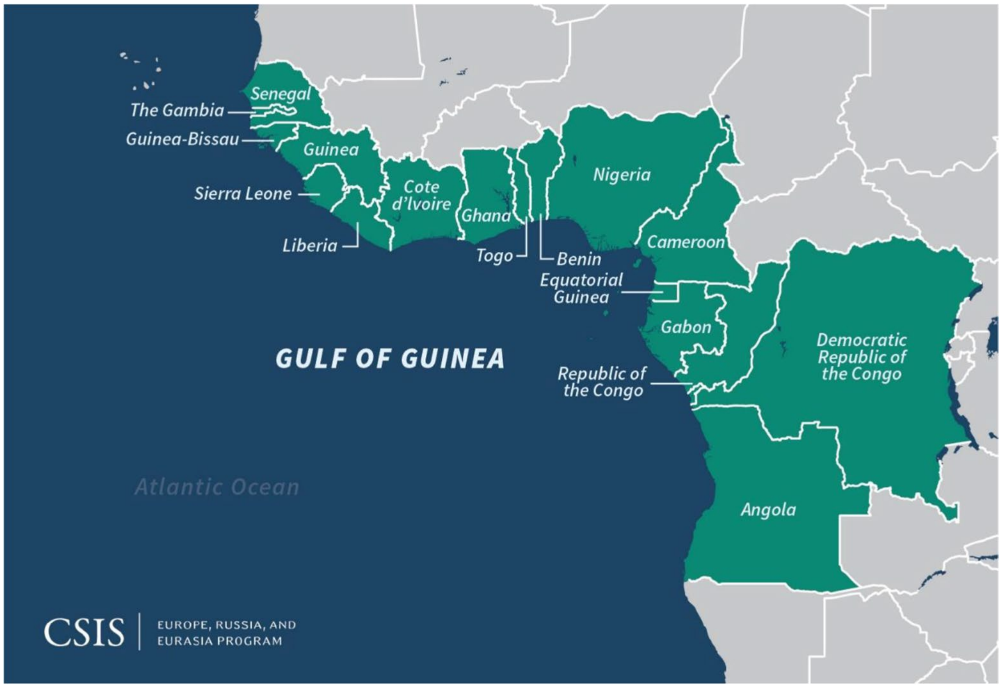

Fig. 1 Map of the GoG. Source: Morcos (2021)

particularly within European macro-regions such as the North Sea and Baltic Sea?

(4) How can these comparative lessons inform context-sensitive cooperative frameworks for the GoG?

(5) How does MRE development advance the blue economy agenda, strengthen regional integration, and address energy poverty?

Thus, this paper focuses on the role of transnational cooperation in enabling the development and deployment of MRE within the GoG subregion. It contends that through collaborative frameworks, countries of this subregion of Africa can capitalize on their shared marine resources, pool their financial and technical capacities, and together drive sustainable energy production to meet the needs of both current and future generations.

2 MRE in the GoG subregion: potential, opportunities, and challenges

2.1 The GoG and its marine and coastal environment

This section provides an overview of the GoG (Fig. 1) and its marine and coastal environment to support a clearer understanding of its potential for MRE development (Mensah & Quaatey, 2002), and the strategic importance of the development and deployment of this source of energy through the mechanism of transnational cooperation.

The GoG is a subregion of Africa situated in the southeastern Atlantic Ocean, along the western coast of the continent. It extends westward from Cape López, near the Equator, to Cape Palmas at approximately 7° west longitude (Britannica, 2023). Its eighteen countries slide from Senegal down to Angola (Morcos, 2021). The GoG is typically categorized into West and Central African macro-regions due to geographical, political, and ethnocultural factors (Adewumi et al., 2022). While each macro-region has its own distinct institutional and economic identity, the countries across these borders share many historical, cultural, and environmental ties. These commonalities provide a strong foundation for building interregional cooperation (Adewumi et al., 2022).

In contrast to the broader Eastern African coastline and the Indian Ocean subregions, the GoG features a relatively narrow coastal strip—widening to about 160 km only between Sierra Leone and the Bijagós Archipelago, Guinea-Bissau, and within the Bight of Biafra (Britannica, 2023). Despite its narrow coastal strip, the subregion boasts an extensive coastline of approximately 6,000 km (EEAS, 2021). Its waters support heavy maritime traffic and a range of marine activities, ranging from oil and gas transport to commercial shipping and fishing.

Data from the EEAS (2021) highlights the GoG as one of the world's busiest shipping routes, supporting nearly 1,500 vessels daily. While every GoG country has at least one major seaport, maritime activities are largely restricted to shipping, oil and gas exploration, and artisanal fishing. Most coastal zones remain underdeveloped, with minimal infrastructure—largely due to a lack of reliable power. This situation underscores the strategic importance of exploring MRE as a sustainable energy alternative that could catalyze coastal development and energy access across the subregion.

2.2 The resource potential of the GoG for MRE development and sustainable management

This section builds upon existing scholarly works on offshore renewable energy potential across Sub-Saharan Africa (Sitoe et al., 2023) and the African continent more broadly, focusing on the GoG's West and Central African macro-regions (AfDB, 2021).

Existing research and institutional reports have generally evaluated African MRE potential at the continental or subregional levels before assessing potential within macro-regions such as those that constitute the GoG (AfDB, 2021; Sitoe et al., 2023). According to the United Nations Environment Programme (UNEP, 2017), Africa's vast renewable energy resources (H.E. The Deputy Chairperson of the African Union Commission, 2010), including ocean energy, are unevenly distributed. Specifically, the GoG's macro-regions are considered comparatively disadvantaged due to their geographical positioning along the Atlantic coastline (UNEP, 2017).

Indeed, both the Central and West African macro-regions of the GoG subregion exhibit relatively low MRE potential compared to other African macro-regions (AfDB, 2021). Moreover, Central Africa is presented as having the lowest potential, primarily because of its narrow coastline (Britannica, 2023). However, some countries in the area do demonstrate higher localized potential (AfDB, 2021).

This imbalance could prompt some states to prioritize onshore renewables, potentially overlooking shared marine and coastal resources that could be harnessed collectively for regional energy generation. Nonetheless, the AfDB (2021) highlights that the GoG retains substantial overall potential across several MRE types, including wave energy, tidal stream power, ocean currents, ocean thermal energy conversion (OTEC), offshore wind, and floating photovoltaic (FPV) systems.

Existing scholarly works suggest that the technologies currently used to assess MRE potential in the subregion are often ill-suited to its specific oceanographic and climatic conditions. For example, the AfDB (2021) noted that wave energy potential assessments for West and Central Africa relied on converters designed for high-energy marine environments, leading to an underestimation of what energy the calmer waters of the GoG can produce. By contrast, with appropriately adapted technologies, countries in both macro-regions could harvest considerably higher levels of MRE (Sitoe et al., 2023). For Sitoe and colleagues, 'technical viability encompasses the amount of energy and availability, adequacy and suitability of the technology' (p. 31). This serves as a reminder that technology selection must be context-sensitive.

The issue, therefore, is not the existence of MRE resources in the GoG, but the accuracy of assessing them using suitable technologies. Furthermore, it must be determined whether development will take place in coastal waters (internal waters and territorial seas) or in offshore exclusive economic zones.

A comparative analysis of Sitoe et al. (2023) and the AfDB (2021) confirm significant disparities in estimated MRE potential across the GoG. Both assessments indicate that MRE resources are more varied and abundant in the western macro-region. Conversely, Central Africa's potential is more restricted and localized, primarily in the form of ocean current energy, OTEC, and salinity gradient resources along the Gabon–Congo–Angola coastal corridor. Although offshore wind and FPV systems are acknowledged in both studies as components of Africa's broader MRE portfolio, neither Sitoe et al. (2023) nor the AfDB (2021) identifies statistically significant or spatially distinct offshore wind or FPV potential within the GoG. Consequently, these resource types are excluded from the map, which focuses on MRE resources exhibiting identifiable geographic concentration according to current assessment methodologies. This omission does not imply that offshore wind or FPV resources are absent from the subregion; instead, it indicates that they are classified as low-intensity, diffuse, or below prevailing commercial viability thresholds used in existing assessments.

Furthermore, the lack of focus on offshore wind and FPV raises broader concerns regarding the accuracy and completeness of prevailing MRE assessment approaches in the GoG. As noted by Studzieniecki and Palmowski (2022), using assessment technologies and performance thresholds designed for high-energy marine environments can lead to systematic underestimation of renewable energy potential in lower-energy but technologically adaptable areas such as the GoG.

For example, the AfDB (2021) identifies Senegal and Cabo Verde, and São Tomé and Príncipe in West Africa, and the Republic of the Congo in Central Africa, as possessing comparatively promising wave energy potential. Beyond these sites, other tropical coastal states in the GoG exhibit calmer but still viable wave regimes. These could be harnessed effectively using appropriately adapted technologies instead of converters designed for high-energy ocean conditions.

Lastly, as in other regions of the world, MRE technologies are still emerging and require high capital investment, particularly for developing coastal states in the GoG. Because pursuing MRE development individually would pose significant economic and technical challenges, subregional collaboration and coordinated governance frameworks are essential to facilitate the efficient, equitable, and sustainable development and deployment of MRE technologies across the GoG.

2.3 Opportunities in developing and deploying MRE in the GoG

From the above analysis, even though the potential in MRE in this sub-region from existing studies is low in comparison with other African sub-regions, the development and deployment of blue energy in the GoG present immense opportunities for overcoming energy poverty and advancing the subregion's blue economy agenda.

Governments throughout the GoG are showing a growing commitment to expanding electricity access, increasing power generation capacity, and creating jobs, while ensuring the sustainable use of their maritime domains. These objectives align closely with the blue economy's potential, particularly through one of its central pillars, blue energy. Consequently, the success of the blue economy agenda in the GoG relies on the efficient and equitable development of MRE resources.

According to the Africa Blue Economy Strategy (AU-IBAR, 2019), the energy sector is currently one of the least developed employment generators among blue economy sectors, highlighting an urgent need for greater investment in ocean-based energy. This trend is evident in the GoG, where, despite abundant coastal and offshore resources, there has been very little progress in harnessing marine energy potential.

Energy generation, particularly from ocean sources, intersects with all other blue economy sectors and can unlock significant synergies for subregional development. Many GoG countries, such as Cameroon (Vision 2035), Côte d'Ivoire (Plan Stratégique CI-2030), and Gabon (Emerging Gabon 2025 Plan), have set ambitious national targets for industrialization, poverty alleviation, and sustainable development. Incorporating ocean-generated energy into these frameworks could speed up their progress (Gilau & Failler, 2020; Hafner, et al., 2018).

Harnessing MRE in the GoG could bring several benefits:

- the development of designated coastal zones and promotion of blue growth;
- increased wealth generation from marine and coastal environments (African Union, 2012; AU-IBAR, 2019);
- a thriving and sustainable maritime economy;
- economic exploitation of ocean energy resources;
- job creation for coastal and inland populations;
- coastal tourism and infrastructure development;
- regional energy sharing across communities and national borders;
- advancement of ocean-related education, research, and innovation;
- contributions to GDP growth and inclusive socioeconomic development.

In Ghana, for instance, early efforts in wave energy development highlight the subregion's potential. If blue energy were to account for 5% of total energy contribution by 2030 and 7% by 2063, its GDP impact could reach USD 1.6–2.3 billion (AU-IBAR, 2019; Gilau & Failler, 2020). Establishing a coordinated transnational mechanism for MRE development would thus significantly advance the blue economy agenda while bolstering subregional energy security and economic resilience (Hafner et al., 2018; Owusu & Asumadu-Sarkodie, 2016).

2.4 Challenges in developing and deploying MRE in the GoG

Despite these opportunities, several challenges still hinder the growth of MRE in the GoG.

Early initiatives—such as Ghana's 2015–2016 tidal power trials—stalled due to technical and structural barriers (Egbetokun et al., 2016; Gilau & Failler, 2020; UNEP, 2017). A primary reason for these failures lies in a technological mismatch: Imported MRE systems are often ill-suited to the subregion's unique geographical and climatic conditions. As IRENA (2020a) notes, 'the theoretical potential for electricity generation differs among technologies and their geographical contexts', emphasizing the need for subregional adapted solutions.

Financial barriers constitute another major obstacle. Prohibitive capital costs for offshore wind, tidal, wave, and OTEC technologies persist, even for advanced macro-regions like the North Sea and Baltic Sea (IRENA, 2020a; Amoah et al., 2025; Studzieniecki & Palmowski, 2022). Consequently, GoG states struggle to mobilize sufficient investment to scale MRE projects, particularly given competing fiscal priorities and limited access to concessional capital (Egbetokun et al., 2016; Onu, 2021; Sitoe et al., 2023).

Social acceptance and community participation are indispensable components of MRE deployment. Without awareness and inclusion of coastal populations, MRE initiatives may face local resistance. As Evans et al. (2023) and Bennett et al. (2019) emphasized, ensuring respect for human rights and environmental justice is essential to sustainable marine development. Lack of awareness of the socioeconomic benefits and environmental impacts of MRE further contributes to market hesitancy and elevated perceptions of risk (Onu, 2021).

Lastly, competing uses for marine space present significant challenges. Although the GoG is less congested than other regions, existing activities, such as fishing, shipping, conservation, and naval operations, require careful coordination. Without proper consultation and planning, MRE installations risk interfering with or disrupting these activities, exacerbating tensions (Bennett et al., 2019; Novaglio et al., 2022).

3 Other key considerations in the development and deployment of MRE through transnational cooperation in the GoG

3.1 Achieving the sustainable development of the blue economy agenda

According to the World Bank's Blue Economy for Resilient Africa Program, Africa's blue economy generated nearly USD 300 billion in 2018 and created approximately 49 million jobs. In West Africa, coastal zones contributed roughly 56% of regional GDP (World Bank, 2021). However, these figures do not fully account for the potential of MRE—often referred to as blue energy—which remains an underdeveloped element of the region's ocean economy.

The African Union's Africa Blue Economy Strategy identifies sustainable energy production as a pillar for achieving inclusive growth and environmental resilience under 'Agenda 2063: The Africa We Want' (AU-IBAR, 2019). Despite this, MRE in the GoG remains largely in the conceptual stage, hindered by technical, financial, and policy challenges (Egbetokun et al., 2016; Sitoe et al., 2023). Unlocking this potential would not only diversify the subregion's energy mix but also drive socioeconomic transformation, improve energy security, and create new employment opportunities—particularly within the blue economy's emerging blue jobs sector (AfDB, 2026; World Bank, 2022, 2025). Therefore, integrating MRE into the broader blue economy framework of the GoG is both a strategic and developmental imperative.

3.2 The role of marine spatial planning in the development and deployment of MRE through transnational cooperation

The deployment of MRE as a pillar of the blue economy in the GoG is closely linked to the effective management of marine space (Ehler & Douvere, 2009). Sectoral conflicts and competing maritime uses necessitate an integrated governance approach, for which marine spatial planning (MSP) provides an essential framework (O'Hagan, 2020).

Mami Wata (2018) define MSP as 'a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives specified through a political process'. Adopting this globally recognized framework for balancing environmental, economic, and social interests would offer the GoG a practical pathway toward integrated ocean management (Bennett et al., 2019).

Implementing MSP under the Abidjan Convention could transform it from a policy concept into a practical tool for guiding MRE deployment (Mami Wata, 2018). Doing so would secure ecological balance while fostering peaceful coexistence among different maritime sectors.

The integration of MSP in MRE planning can ensure:

- long-term sustainability of blue economy initiatives;
- conflict prevention by managing overlapping or competing claims;
- project alignment with ecosystem-based and participatory management principles;
- advancement of UN SDG 7 ('Affordable and Clean Energy') through regional energy pooling and cross-border grids (African Union Commission, 2015; African Union Commission and African Union Development Agency – NEPAD, 2022).

To achieve these outcomes, GoG countries must embed MSP as a cross-cutting, transboundary, and adaptive governance tool. As Mami Wata (2018) highlights, MSP is 'ecosystem-based, area-based, integrated, adaptive, strategic, and participatory'. Applying this framework to MRE development and deployment will ensure coherence across policies, strengthen subregional cooperation, and anchor blue energy as a catalyst for sustainable growth in the GoG.

Thus, effective MSP, underpinned by transnational cooperation, environmental safeguards, and inclusive stakeholder participation, is essential. This approach ensures the sustainable and peaceful development of MRE projects by balancing energy objectives with ecological and socioeconomic priorities (AU-IBAR, 2019; World Bank, 2022).

4 Examining the strength of transnational cooperation in driving MRE: a case study of Europe and some of its macro-regions

This section examines how transnational cooperation has been used in Europe to drive MRE development both at the regional level and within selected macro-regions. The methodology relies on a desktop analysis of both primary and secondary sources. Primary sources include official documents and digital materials from the European Union (EU) and its Baltic Sea and North Sea macro-regions. Secondary sources comprise relevant scholarly literature and institutional reports.

4.1 EU efforts to implement cohesion policy through transnational cooperation in MRE development

Several scholarly works have identified the origin of transnational cooperation within the EU—also known as European Territorial Cooperation (ETC)—as being rooted in its Cohesion Policy (Palmowski, 2021; Studzieniecki & Palmowski, 2022). This cooperation framework acts as a strategic instrument to accelerate the development and deployment of MRE across the EU and its macro-regions (Prieto & Caldés, 2016).

The EU has established a policy roadmap similar to the African Union's Agenda 2063, emphasizing key domains that underpin its economic, environmental, and energy security objectives. A central pillar of this strategy is the creation of a robust and sustainable renewable energy framework that enables Member States to collaborate on efficient clean energy production. This cooperation drives socioeconomic development while reinforcing diplomatic and institutional ties across the region.

According to Prieto and Caldés (2016), this EU transnational mechanism 'allows partners of different regions and countries to identify and implement good practices, develop joint approaches and define methodologies around sustainable energy'. As a result, EU-level policy development exerts a strong influence on the macro-regional policy frameworks that underpin energy cooperation (Piria, 2014). This mirrors Africa's continental strategies, such as the 2050 Africa's Integrated Maritime Strategy (2050 AIM Strategy) and the African Union Blue Economy Strategy, which also encourage subregional collaboration in marine resource utilization and MRE production.

4.2 Transnational cooperation and MRE development in the Baltic Sea Region

The Baltic Sea macro-region comprises 11 countries sharing the marine and coastal areas of the Baltic Sea, namely, Poland, Denmark, Sweden, Norway, Finland, Lithuania, Latvia, Estonia, Iceland, parts of Russia and Germany (Studzieniecki & Palmowski, 2022). Like the GoG, it is economically and environmentally diverse, with varying MRE potential among its members. However, while the GoG's MRE potential remains largely unquantified, the Baltic Sea Region has a well-documented understanding of its resources, yet only about 15% of its offshore wind potential is currently exploited (Interreg Baltic Sea Region, 2018). The underutilization of this potential stems from gaps in energy interconnections, research and technology deficits, and insufficient transnational coordination (Interreg Baltic Sea Region, 2018; Studzieniecki & Palmowski, 2022). To address these challenges, the region has turned to several ETC-supported projects designed to foster collective renewable energy development.

This analysis draws on studies by Studzieniecki et al. (2022) and by Studzieniecki and Palmowski (2022), which emphasize the role of territorial cooperation in the Baltic Sea Region's energy transition. These studies highlight the EU Strategy for the Baltic Sea Region, implemented through Interreg initiatives, that connect energy operators, industries, policymakers, authorities, and academia to plan a coordinated offshore grid. These initiatives demonstrate how transnational cooperation can mitigate infrastructural constraints, promote environmental sustainability, and bolster energy security (Federal Ministry for Economic Affairs & Energy, 2022).

This multidimensional cooperation allows stakeholders to tackle common challenges while improving the region's overall sustainability (Hermanson, 2018; Palmowski, 2021; Studzieniecki & Palmowski, 2022; Studzieniecki et al., 2022). In this regard, Member States have also pursued bilateral and sub-national collaborations to complement regional efforts. A key example is Denmark and Germany's agreement to develop the Bornholm Energy Island project—an offshore wind energy hub with a planned capacity of up to 3 GW, to be operational by 2030. The agreement, concluded ahead of the 2022 Baltic Energy Security Summit in Copenhagen, commits both countries to share the green electricity generated and the infrastructure costs (Federal Ministry for Economic Affairs & Energy, 2022). This example demonstrates how transnational energy cooperation in the Baltic Sea Region strengthens regional relations, reduces reliance on fossil fuel imports, and secures a sustainable energy future (Hermanson, 2018; Palmowski, 2021; Studzieniecki & Palmowski, 2022; Studzieniecki et al., 2022).

4.3 Transnational cooperation driving MRE development in the North Sea

The North Sea macro-region provides another example of transnational cooperation for MRE development. The North Seas Energy Cooperation (NSEC)—comprising Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, Sweden, and the United Kingdom, along with the European Commission—was established in 2016 through a joint political declaration

(European Commission, (n.d.); Palmowski, 2021). The NSEC aims to facilitate the cost-effective deployment of offshore renewable energy, particularly wind, while improving interconnections between participating states to drive economic growth (North Seas Energy Cooperation, 2022). Its long-term strategy involves building a shared offshore energy grid that serves as a foundational component of a future European super-grid—supporting both energy security and affordability for households and industries (Russell, 2022). At the North Sea Summit in May 2022 in Esbjerg, Denmark, Member States reaffirmed their commitment to accelerating the deployment of regional offshore renewable energy, recognizing its strategic role in ensuring sustainability and security of supply (North Seas Energy Cooperation, 2022; Palmowski, 2021).

The NSEC operates within a broader institutional framework embedded in decades of North Sea energy collaboration. This framework includes regional sea-basin mechanisms, multilateral energy agreements, energy trade bodies, stakeholder forums, and EU-funded projects promoting offshore energy development (North Sea Region, (n.d.)). It illustrates an array of institutions supporting transnational ocean energy cooperation in the North Sea Region. It also reflects a multilevel, multisectoral approach that balances regional and national interests while ensuring collective energy sustainability. The GoG subregion could benchmark such practices effectively to foster its own transnational cooperation mechanisms for MRE development.

4.4 Discussion of European examples of transnational cooperation and their applicability to the GoG

This section discusses how European experiences in transnational cooperation for MRE can inform similar efforts in the GoG. While the GoG currently lacks the robust cooperative mechanisms seen in the European case studies used for benchmarking, this work argues that the subregion possesses significant untapped blue energy potential. The successful governance of these resources would benefit from such already established and ongoing transnational cooperation. Given the limited theoretical and technical advancement of MRE in the GoG, there is an urgent need for targeted policy innovation, political commitment, and the active involvement of diverse stakeholders to initiate a coordinated regional effort that can strengthen over time.

European successes in the North Sea and Baltic Sea Regions demonstrate that the sustainable development of MRE is best achieved through multilevel and multisectoral cooperation between energy and non-energy actors. The GoG can similarly adopt joint frameworks for developing and deploying MRE infrastructure, whether through a single interconnected grid for the entire subregion or smaller grids shared among neighboring countries. These models reveal that no single nation can pursue large-scale MRE development effectively in isolation. Instead, cooperative approaches yield greater and more enduring benefits, enhancing energy security, affordability, and sustainability. Thus, while European states are more technologically advanced, the underlying principle—that shared energy challenges demand shared solutions—is equally relevant for developing regions like the GoG.

Based on these scenario-building models (Fig. 2), a transnational institutional architecture for MRE needs not rely on creating entirely new organizations. Instead, existing regional institutions can be utilized by adopting or adapting supportive policies to facilitate inter-institutional coordination. A clear understanding of current MRE-related institutions and their mandates will be essential to avoid duplication or institutional fragmentation. Strengthening these existing frameworks through harmonized policy instruments and coordinated governance can lay the foundation for an effective transnational MRE regime in the GoG.

5 Leveraging institutional frameworks to enhance transnational cooperation in advancing viable ocean energy development in the GoG

The GoG has a history of adopting regional cooperative and collaborative mechanisms addressing various marine and coastal issues in the Southeast Atlantic. Although these regionalization efforts have not always yielded optimal efficiency (Becker-Weinberg, 2014), their existence demonstrates a growing commitment by Member States to sustainable development and the welfare of their populations. This institutional foundation provides a promising platform for developing and expanding transnational MRE partnerships.

This section evaluates how transnational cooperation can foster efficient and feasible ocean energy development within the GoG. Understanding existing forms of cooperation and the key factors that enable cross-border MRE governance is critical to designing a strategic framework for blue energy deployment in the subregion.

Indeed, the GoG subregion exhibits several layers of transnational cooperation that can be leveraged for MRE development. Rather than creating new institutional structures, the focus should be on optimizing existing mechanisms already engaged in renewable energy governance and broader regional integration efforts.

5.1 Political and economic cooperation

The GoG spans two major macro-regions—West Africa and Central Africa—each with established regional

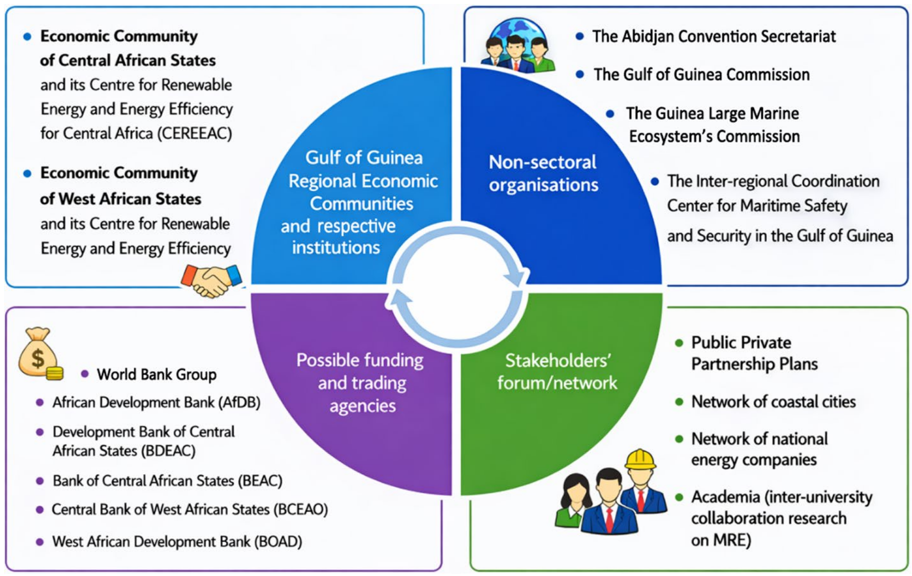

Fig. 2 Scenario model of the GoG-MRE transnational cooperation institutional framework. Source: Author's own study

economic communities. In West Africa, the ECOWAS and the West African Economic and Monetary Union play central roles, while in Central Africa, cooperation is structured through the ECCAS and the Central African Economic and Monetary Community (CEMAC) (FAO, 2003). These organizations, established in pursuit of Africa's broader economic self-sufficiency agenda outlined in the 1980 Lagos Plan of Action aim to foster regional integration, sustainable development, and collective prosperity.

Access to 'affordable and clean energy' (UN SDG 7) remains essential for achieving these goals. To that end, ECOWAS and ECCAS have each established institutions dedicated to renewable energy and energy efficiency.

- The ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), created in 2008, supports member states in implementing regional energy policies, fostering sustainable industrial strategies, and promoting environmental conservation (ECREEE, (n.d.)).
- The ECCAS Centre for Renewable Energy and Energy Efficiency for Central Africa (CEREEAC), established in 2021, addresses policy and capacity barriers to regional energy integration through knowledge sharing, cross-border methodologies, and partnership facilitation (Global Network for Regional Sustainable Energy Centers, (n.d.)).

Both ECREEE and CEREEAC were inspired by the EU's regionalization model, which underscores the importance of collective action in advancing renewable energy adoption. Their mandates—emphasizing integration, joint learning, and shared infrastructure—position them as key institutional vehicles for scaling MRE initiatives in the GoG. Consequently, strengthening coordination between these centers could create a cohesive transnational mechanism capable of advancing offshore wind, wave, and tidal energy projects across the subregion.

5.2 Socioenvironmental cooperation

The GoG subregion hosts several socioenvironmental cooperative institutions that, while not directly mandated to develop or deploy MRE, possess significant potential to catalyze transnational collaboration for ocean-based energy initiatives. These institutions' mandates to protect and manage marine and coastal environments align naturally with MRE sustainability objectives, particularly regarding ecosystem integrity, resource efficiency, and climate resilience (AfDB, 2026; Giannopoulos, 2020; Proskuryakova, 2018; United Nations, 1982; World Bank, 2025). Their presence thus constitutes an enabling governance infrastructure through which blue energy development can be mainstreamed into broader regional sustainability agendas.

The first of these is the Abidjan Convention Secretariat, the executive organ of the Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region. Encompassing approximately 14,000 km of coastline from Mauritania to South Africa, the Convention offers a cohesive legal and institutional framework for marine environmental governance across 22 coastal states (UNEP, 2022). Its Secretariat, based in Abidjan, Côte d'Ivoire, carries the mandate to 'protect, conserve and develop the Abidjan Convention area and its resources for the benefit and well-being of its people' (Abidjan Convention, (n.d.)). This framework serves as a cornerstone for marine protection while providing a flexible platform for integrating MRE into existing marine management strategies. The Secretariat's operational mechanisms—ranging from policy harmonization to ecosystem-based management—could anchor MRE governance within a regional environmental protection framework, aligning renewable energy deployment with ecological sustainability and coastal resilience (AU-IBAR, 2019; UNECA, 2016).

Complementing this institution is the GGC, established by treaty in Libreville, Gabon, on 3 July 2001. Its member states—Angola, Cameroon, Congo, the Democratic Republic of Congo, Gabon, Ghana, Equatorial Guinea, Nigeria, and São Tomé and Príncipe—share a mission to strengthen cooperation and solidarity in the sustainable exploitation of marine resources while promoting peace, economic development, and environmental stewardship (Embassy of the Republic of Ghana in Angola, (n.d.); Global Civil Society Database, (n.d.); UNEP, 2022). The GGC's institutional structure supports diplomatic dialogue and coordination on transboundary marine governance, positioning it as a viable platform for MRE cooperation. By extending its mandate to include ocean energy governance, the GGC could play a key role in advancing integrated blue energy infrastructure and regional energy market linkages, in alignment with the World Bank's Mission 300 strategy for regional sustainable energy access (AfDB, 2026; IRENA, 2020b; World Bank, 2025).

Indeed, the GGC's core mission—to transform the subregion into a 'Zone of Peace and Sustainable Development' (Embassy of the Republic of Ghana in Angola, (n.d.))—underscores its potential to link energy security with environmental governance. By working in tandem with the Abidjan Convention and complementary frameworks such as ECOWAS and ECCAS, these institutions can facilitate multilevel governance arrangements that embed MRE into the subregion's sustainable development architecture. Their collective focus on marine conservation, resource governance, and regional integration makes them indispensable to the establishment of a cooperative regime for blue energy development in the GoG (AfDB, 2026; AU-IBAR, 2019; IRENA, 2020b; World Bank, 2025).

Analytically, socioenvironmental cooperation in the GoG thus provides more than institutional support; it offers a normative and operational pathway toward a just energy transition. By integrating MRE into these existing frameworks, the region can reinforce a 'blue governance' model where renewable energy contributes simultaneously to ecological resilience, socioeconomic equity, and regional security.

5.3 Academic cooperation

Hermanson (2018) asserted that 'energy policymaking is open to networks with different stakeholders involved, e.g., national authorities, business organizations, associations, firms, and academia'. In the context of the GoG, this observation underscores the strategic role of academia as both a knowledge generator and a governance enabler. The relative scarcity of empirical and policy-oriented research on MRE in the subregion signals a significant epistemic gap that impedes evidence-based policymaking and technology localization (IRENA, 2020b; WASCAL, (n.d.)). Academic cooperation, therefore, emerges as an essential mechanism for fostering innovation (Egbetokun et al., 2016), regional integration, and human capital development in ocean energy governance.

The GoG subregion already benefits from a constellation of regional academic institutions that promote cross-border collaboration in maritime and environmental studies. A primary example is the Regional Maritime University (RMU) in Accra, Ghana—a joint initiative by Cameroon, The Gambia, Ghana, Liberia, and Sierra Leone—which serves as a hub for advanced training in maritime affairs and port governance. Similarly, the International School of Security Forces (EIFORCES) in Awaé, Cameroon, provides regional capacity-building in security and crisis management, including maritime safety.

Additionally, research institutions such as the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) and the Regional Master's Programme on Integrated Coastal and Marine Environment Management (jointly hosted by universities in Cameroon and Gabon) are important contributors to the advancement of ocean science and climate governance throughout the subregion (UNECA, 2016; WASCAL, (n.d.)).

However, despite these academic efforts, a conspicuous gap remains in the domain of MRE. The absence of dedicated MRE curricula and research hubs reflects a structural disconnect between energy innovation and ocean governance. To address this, regional academic cooperation could evolve toward establishing interdisciplinary centers of excellence, joint degree programs, and innovation incubators that bring together universities, industry, and policymaking institutions (Egbetokun et al., 2016; IRENA, 2020b; Sitoe et al., 2023). Such academic–industrial partnerships would enable the co-design of technology tailored to local marine and climatic conditions while fostering regional expertise in ocean energy engineering, policy development, and environmental impact assessment.

Beyond building capacity, academic cooperation functions as a governance mechanism by integrating scientific evidence and foresight into regional energy policymaking. By prioritizing joint research, data sharing, and technology transfer, universities in the GoG can strengthen the institutional ability to evaluate, monitor, and implement MRE systems. This aligns with global recommendations (World Bank, 2025) for science–policy interfaces that underpin sustainable ocean governance. Ultimately, making academic cooperation a core part of the regional MRE framework would foster both technological innovation and the epistemological sovereignty of African coastal states as they shape the future of their blue economies.

6 Results: Scenario model illustrating the interlinkages between the blue economy, MRE, and the GoG

The analytical framework developed in this study demonstrates that MRE is a vital link between the GoG's pursuit of energy security, sustainable economic growth, and the realization of its blue economy agenda. By comparing the North Sea and Baltic Sea macro-regions, this study identifies a transnational cooperation model—integrating institutional, technological, and policy dimensions—that can be adapted to the GoG.

The proposed scenario model (Fig. 3) conceptualizes the interlinkages between MRE development, blue economy sectors, and regional cooperation mechanisms in the GoG. The model highlights four core components that together advance sustainable ocean-based development in the subregion.

(1) Energy Transition Nexus–MRE contributes directly to energy diversification and decarbonization, reducing dependence on fossil fuels while supporting climate resilience (Hafner et al., 2018; IRENA, 2020a).
(2) Economic Integration and Blue Growth–Offshore wind, wave, and tidal projects generate employment, stimulate innovation, and reinforce mari-

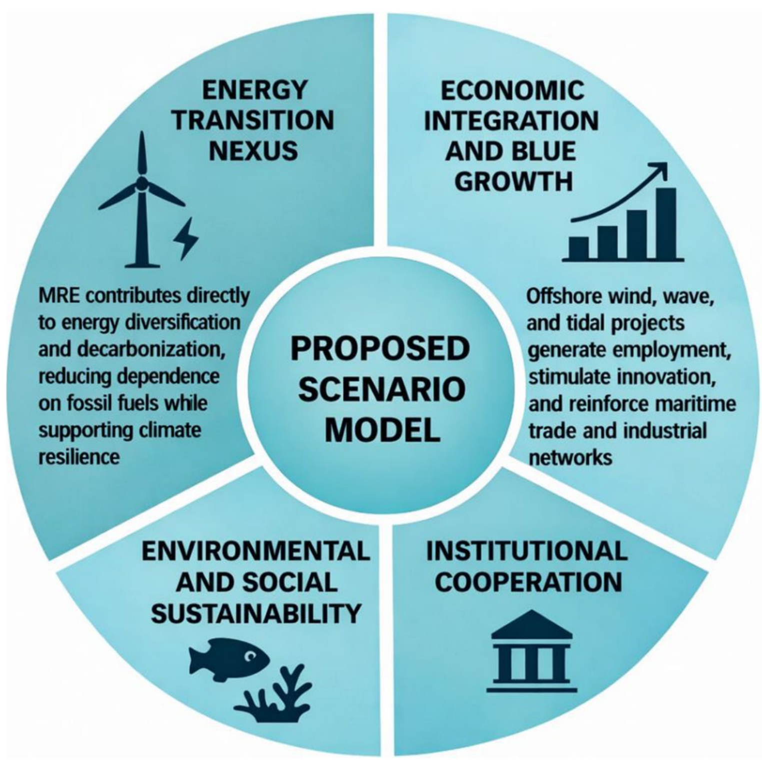

Fig. 3 Conceptualization of the interlinkages between MRE development, blue economy sectors, and regional cooperation mechanisms in the GoG. Source: Author's own analysis

time trade and industrial networks (Adesanya et al., 2021; AU-IBAR, 2019; European Commission, 2023; Gilau & Failler, 2020; World Bank, 2022).

(3) Institutional Cooperation–Regional bodies such as the Abidjan Convention Secretariat and the GGC act as coordination platforms, ensuring policy alignment, capacity building, and conflict prevention (African Union Commission, 2015; AU-IBAR, 2019; Sitoe et al., 2023).

(4) Environmental and Social Sustainability–The integration of MSP ensures that MRE deployment aligns with ecosystem-based management principles, minimizing sectoral conflicts and safeguarding community livelihoods (Bennett et al., 2019; FAO, 2003; Mami Wata, 2018; O'Hagan, 2020; UNESCO-IOC, (n.d.); UNESCO-IOC, 2021).

This scenario highlights that synergistic policy design, regional governance, and academic cooperation are essential to unlocking the GoG's blue energy potential (Gilau & Failler, 2020; Sitoe et al., 2023; UNEP, 2022). If coordinated effectively, these elements can transform the sub-region into a model of sustainable ocean-based energy governance in Africa (AU-IBAR, 2019; IRENA, 2020a; World Bank, 2022).

Feedback loops between these pathways illustrate how regional governance, technological adaptation, and policy alignment reinforce each other to build a resilient and integrated blue energy ecosystem. The model emphasizes that successful MRE deployment in the GoG relies on synchronized efforts across these four domains, transforming ocean resources into a driver of sustainable energy security and economic prosperity (Browne & Cumming, 1984; Sitoe et al., 2023; World Bank, 2022, 2025).

7 Enabling factors and policy recommendations for sustainable cross-border MRE cooperation in the GoG

7.1 Factors enabling cross-border MRE cooperation in the GoG

Several enabling factors can facilitate effective transnational cooperation for MRE in the GoG.

First, policy harmonization between ECOWAS and ECCAS is crucial for aligning national energy strategies with regional priorities. Streamlining these policies can encourage private-sector participation, lower investment risks, and promote joint financing mechanisms for major offshore projects (AU-IBAR, 2019; World Bank, 2025).

Second, institutional capacity-building must be prioritized. Since the subregion currently lacks technical expertise in oceanographic mapping, offshore engineering, and environmental impact assessment, regional training programs and academic–industrial partnerships modeled on the EU's Horizon and Blue Energy initiatives can help bridge this gap (European Commission, (n.d.); Hermanson, 2018; Sitoe et al., 2023).

Third, data sharing and knowledge networks are essential. Creating a shared regional data repository on wind, tidal, and wave resources would support evidence-based investment decisions and optimize site selection (UNESCO-IOC, (n.d.); IRENA, 2020b; UNECA, 2016).

Fourth, financial and technological cooperation with global partners such as the World Bank, the AfDB, and IRENA can help mobilize resources for pilot projects and infrastructure (AfDB, 2021, 2023, 2026; IRENA, 2020b).

Lastly, public awareness and political commitment are indispensable. By holding high-level regional summits that present blue energy as a driver of economic diversification and energy independence, the region can reinforce momentum for transnational action (AU-IBAR, 2019).

Together, these enabling factors will lay the groundwork for an integrated blue energy market in the GoG, fostering energy security and economic resilience while aligning the region with the African Union's Agenda 2063 and the UN 2030 Agenda for Sustainable Development.

7.2 Policy recommendations for strengthening transnational MRE governance

Realizing the MRE potential of the GoG requires a coordinated governance framework that integrates regional cooperation, policy coherence, and ecosystem-based management. This study proposes six interlinked policy priorities to support scalable and sustainable MRE deployment.

First, regional policy alignment is essential. ECOWAS and ECCAS should jointly develop a GoG Ocean Energy Strategy to harmonize objectives, regulatory standards, and investment priorities across the subregion (AU-IBAR, 2019; IRENA, 2020b). Embedding MRE within national development and blue economy strategies, such as Cameroon's Vision 2035 and Côte d'Ivoire's CI-2030, would strengthen coherence with Agenda 2063 and reduce regulatory fragmentation (African Union Commission and African Union Development Agency – NEPAD, 2022; African Union Commission, 2015; Hafner et al., 2018; Sitoe et al., 2023).

Second, institutional coordination should be strengthened by establishing a joint ECREEE–CEREEAC Blue Energy Task Force. Building on existing renewable energy mandates, this platform could support cross-border planning, prioritize pilot projects, and facilitate technology transfer, while complementing the roles of the GGC and the Abidjan Convention (Bennett et al., 2019; ECREEE, (n.d.); UNECA, 2016).

Third, transboundary MSP is critical for managing spatial interactions between offshore energy, fisheries, conservation, and maritime transport. Harmonized MSP frameworks would minimize use conflicts, enhance regulatory certainty, and promote ecosystem-based governance in shared marine areas (Failler et al., 2020; AU-IBAR, 2019; African Union Commission and African Union Development Agency – NEPAD (2022); Jay et al., 2016; UNESCO-IOC, (n.d.)).

Fourth, addressing the high upfront costs of offshore energy requires investment mobilization and risk mitigation mechanisms. A regional blue energy financing facility—potentially anchored within the AfDB or supported by the ECOWAS Bank for Investment and Development, ECOWAS Bank for Investment and Development and ECCAS Bank of Central African States—could deploy blended finance and guarantees. Public–private partnerships and blue and green bond initiatives can also serve as vehicles to channel international climate and blue finance into MRE infrastructure (AfDB, 2023; Gilau & Failler, 2020; Studzieniecki & Palmowski, 2022; World Bank, 2022).

Fifth, technology partnerships and capacity development should be prioritized to build local expertise and innovation ecosystems. Regional centers of excellence, notably ECREEE and CEREEAC, can coordinate applied research, pilot projects, and technical training, while partnerships with European offshore energy consortia (e.g., North Sea cooperation) can accelerate technology transfer and contextual adaptation (European Commission, (n.d.); European Commission, 2023; Evans et al., 2023; O'Hagan, 2020).

Lastly, legal and regulatory reforms are necessary to integrate MRE formally into national and regional energy frameworks. By updating regional instruments under the Abidjan Convention and aligning national laws with international obligations—particularly UNCLOS and the Paris Agreement—policymakers can improve legal certainty, environmental safeguards, and investor confidence (Giannopoulos, 2020; Proskuryakova, 2018; United Nations, 1982).

By implementing these measures, the GoG can establish a resilient and inclusive governance framework for MRE. The combination of institutional synergy, policy coherence, and stakeholder collaboration will ensure that blue energy becomes a cornerstone of the region's sustainable development (African Union, 2012; AU-IBAR, 2019; Failler et al., 2020; IRENA, 2020b).

8 Conclusions

This study concludes that MRE holds transformative potential for alleviating energy poverty (Cevik, 2022) and accelerating sustainable development in the GoG. With the right blend of appropriate technology, skilled human capital, and institutional frameworks to sustain strong transnational cooperation, MRE can serve as a cornerstone for regional energy transition and blue economy growth (African Union, 2012; AU-IBAR, 2019; Failler et al., 2020; IRENA, 2020a; World Bank, 2022).

The research confirms that the GoG possesses significant untapped marine energy potential. By drawing on successful European models such as the North Sea and Baltic Sea macro-regions (Hafner et al., 2018; Studzieniecki & Palmowski, 2022), the research demonstrates the strategic value of regional cooperation. These examples highlight how collective action and harmonized policy implementation can foster technological innovation, attract investment, and promote inclusive growth across borders (Mami Wata, 2018; O'Hagan, 2020; UNEP, 2017).

Despite challenges—ranging from limited financial capacity and technological adaptation to governance and community engagement—MRE remains a viable pathway for advancing the blue economy agenda in the GoG. As Sitoe et al. (2023) and Onu (2021) observe, the realization of this potential depends on effective policy coherence and the creation of enabling environments for private and public investment. Moreover, the integration of MSP at both national and subregional levels is essential to prevent conflicts among maritime stakeholders and ensure sustainable, multisectoral use of marine spaces (Bennett et al., 2019; Novaglio et al., 2022; O'Hagan, 2020).

Ultimately, the GoG's transition toward blue energy must be driven by adaptive governance, regional solidarity, and knowledge co-production—linking governments, research institutions, and coastal communities. If implemented effectively, MRE can become a pillar of Africa's Blue economy transformation, driving both environmental sustainability and socioeconomic resilience in alignment with the African Union's Agenda 2063 and the UN Sustainable Development Goals (African Union Commission, 2015; African Union, 2012; AU-IBAR, 2019; Failler et al., 2020; World Bank, 2022).

A cooperative, regionally integrated approach to MRE development provides the GoG with a viable and sustainable roadmap for achieving energy security, environmental protection, and economic prosperity for both its coastal and inland populations (African Union Commission, 2015; Failler et al., 2020; World Bank, 2022, 2025).

Acknowledgements

The authors first and foremost acknowledge the Alexander von Humboldt Foundation for funding this research through its sponsorship for alumni of the fellowship and award programmes for researchers from abroad (Humboldt Research Return Stay). Its funding made the return research stay feasible. Secondly, the authors acknowledge the hosting of the United Nations University Vice-Directorate in Europe (UN-ViE) through its Pan African Cooperation and Educational Technologies (PACET) program, and the hospitable staff. The contents of this paper are solely the outputs of the analysis of the authors. Finally, the authors acknowledge the scholarly works used as primary and secondary source for this research.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Sheila Kong Mukwele. The first draft of the manuscript was written by Sheila Kong Mukwele, and all authors commented on previous versions of the manuscript. The second author also served as host and supervisor during the Humboldt Research Return Stay. All authors read and approved the final manuscript.

Funding

This study was funded by the Alexander von Humboldt Foundation through its sponsorship for alumni of the fellowship and award programmes for researchers from abroad.

Data availability

All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 29 October 2025 Revised: 24 May 2026 Accepted: 26 May 2026
Published online: 03 June 2026

References

Abidjan Convention. (n.d.). Convention for cooperation in the protection, management and development of the marine and coastal environment of the Atlantic coast of the West, Central and Southern Africa region. United Nations Environment Programme. https://www.unep.org/abidjan-convention. Accessed 9 May 2026.

Adesanya, A., Misra, S., Maskeliunas, R., & Damasevicius, R. (2021). Prospects of ocean-based renewable energy for West Africa's sustainable energy future. *Smart and Sustainable Built Environment, 10*(1), 37–50. https://doi.org/10.1108/SASBE-05-2019-0066

Adewumi, I. J., Suárez de Vivero, J. L., & Iglesias-Campos, A. (2022). The salient dynamics of cross-border ocean governance in a regional setting: An evaluation of ocean governance systems and institutional frameworks in the Guinea Current Large Marine Ecosystem. *Frontiers in Marine Science, 8*, 674804. https://doi.org/10.3389/fmars.2021.674804

African Union. (2012). 2050 Africa's integrated maritime strategy. https://au.int/sites/default/files/documents/30929-doc-2050_aim_strategy_eng_0.pdf. Accessed 9 May 2026.

African Union Commission. (2015). Agenda 2063: The Africa we want (popular version). https://au.int/sites/default/files/documents/36204-doc-agenda2063_popular_version_en.pdf. Accessed 5 Dec 2025.

African Union Inter-African Bureau for Animal Resources (AU-IBAR). (2019). Africa blue economy strategy. https://www.au-ibar.org/resources/africa-blue-economy-strategy. Accessed 9 May 2026.

African Development Bank (AfDB). (2021). Assessing the potential of offshore renewable energy in Africa: A background paper. https://www.afdb.org/ar/documents/assessing-potential-offshore-renewable-energy-africa. Accessed 5 Dec 2025.

African Development Bank (AfDB). (2023). Climate change and green growth at the African Development Bank. https://www.afdb.org/sites/default/files/documents/publications/afdb_climate_change_and_green_growth_2023_annual_report.pdf. Accessed 5 Dec 2025.

African Development Bank (AfDB). (2026). Mission 300. https://www.afdb.org/en/topics-and-sectors/initiatives-and-partnerships/mission-300. Accessed 20 Apr 2026.

African Union Commission and African Union Development Agency – NEPAD. (2022). AUC & AUDA-NEPAD second continental report on the implementation of Agenda 2063. https://au.int/sites/default/files/documents/41480-doc-2nd_Continental_Progress_Report_on_Agenda_2063_English.pdf. Accessed 9 May 2026.

Amoah, A., Amoah, B., Kwablah, E., & Kweku Asiama, R. (2025). Renewable energy transition and climate finance nexus in sub-Saharan Africa. *Global Environmental Change Advances, 4*, 100013. https://doi.org/10.1016/j.gecadv.2025.100013

Becker-Weinberg, V. (2014). Maritime safety and security in the Gulf of Guinea. https://idi.mne.gov.pt/images/docs/conferencias/guine/007.pdf. Accessed 24 Jul 2023.

Belletti, E., & McBride, M. (2021). Against the tide: Potential for marine renewable energy in Eastern and Southern Africa. *Consilience: The Journal of Sustainable Development, 23*, 1–14. https://doi.org/10.7916/consilience.vi23.7198

Bennett, N. J., Cisneros-Montemayor, A. M., Blythe, J., Silver, J. J., Singh, G., Andrews, N., et al. (2019). Towards a sustainable and equitable blue economy. *Nature Sustainability, 2*, 991–993. https://doi.org/10.1038/s41893-019-0404-1

Britannica. (2023). Gulf of Guinea (gulf, Atlantic Ocean). https://www.britannica.com/place/Gulf-of-Guinea. Accessed 27 Jun 2023.

Browne, R. S., & Cummings, R. J. (1984). *The Lagos Plan of Action vs. The Berg Report: Contemporary Issues in African Economic Development*. Brunswick Publishing Co, Lawrenceville.

Cevik, S. (2022). Climate change and energy security: The dilemma or opportunity of the century. https://www.imf.org/-/media/files/publications/wp/2022/english/wpiea2022174-print-pdf.pdf. Accessed 23 Apr 2026.

European Commission. (n.d.). The North Seas Energy Cooperation. https://energy.ec.europa.eu/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en. Accessed 22 Aug 2023.

European Commission. (2023). The EU blue economy report 2023. https://maritimecyprus.com/wp-content/uploads/2023/08/EU-blue-economy-report-2023.pdf. Accessed 6 May 2026.

ECREEE (n.d.). Overview. https://www.ecreee.org/overview/. Accessed 15 May 2026.

Egbetokun, A., Atta-Ankomah, R., Jegede, O., & Lorenz, E. (2016). Firm-level innovation in Africa: Overcoming limits and constraints. *Innovation and Development, 6*(2), 161–174. https://doi.org/10.1080/2157930X.2016.1224619

Ehler, C., & Douvere, F. (2009). Marine spatial planning: A step-by-step approach toward ecosystem-based management. https://unesdoc.unesco.org/ark:/48223/pf0000186559. Accessed 23 Apr 2026.

Embassy of the Republic of Ghana in Angola. (n.d.). The Gulf of Guinea Commission. https://luanda.mfa.gov.gh/ghana-and-the-gulf-of-guinea-commission/the-gulf-of-guinea-commission/. Accessed 30 Jul 2023.

Evans, L. S., Buchan, P. M., Fortnam, M., Honig, M., & Heaps, L. (2023). Putting coastal communities at the center of a sustainable blue economy: A review of risks, opportunities, and strategies. *Frontiers in Political Science, 4*, 1032204. https://doi.org/10.3389/fpos.2022.1032204

Failler, P., Karani, P., Gilau, A. M., Hamukuaya, H., & Diop, S. (2020). *Africa Blue Economy Strategy Implementation Plan 2021–2025*. The African Union Inter-African Bureau for Animal Resources.

FAO. (2003). Chapter 6. Regional integration in Africa. https://www.fao.org/3/y4793e/y4793e0a.htm#TopOfPage. Accessed 26 Jul 2023.

Federal Ministry for Economic Affairs and Energy. (2022). Baltic energy security summit: Agreement on cooperation to strengthen energy security in the Baltic Sea Region and on a specific German-Danish offshore project. https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/08/20220830-baltic-energy-summit.html. Accessed 27 Aug 2023.

Filho, W. L., Gatto, A., Sharifi, A., Salvia, A. L., Guevara, Z., Awoniyi, S., et al. (2024). Energy poverty in African countries: An assessment of trends and policies. *Energy Research & Social Science, 117*, 103664. https://doi.org/10.1016/j.erss.2024.103664

Giannopoulos, N. (2020). International law and offshore energy production: Marine environmental protection through normative interactions. PhD thesis, Utrecht University.

Gilau, A. M., & Failler, P. (2020). Economic assessment of sustainable blue energy and marine mining resources linked to African Large Marine Ecosystems. *Environmental Development, 36*, 100548. https://doi.org/10.1016/j.envdev.2020.100548

Global Civil Society Database. (n.d.). Gulf of Guinea Commission. https://uia.org/s/or/en/1100041261. Accessed 30 Jul 2023.
Global Network for Regional Sustainable Energy Centers. (n.d.). The Centre for Renewable Energy and Energy Efficiency for Central Africa (CEREEAC). Content. https://www.gn-sec.net/content/centre-renewable-energy-and-energy-efficiency-central-africa-cereeac. Accessed 15 May 2026.
Hafner, M., Tagliapietra, S., & de Strasser, L. (2018). *Energy in Africa: Challenges and Opportunities*. Springer Cham. https://doi.org/10.1007/978-3-319-92219-5
H.E. The Deputy Chairperson of the African Union Commission. (2010). The geostrategic importance of Africa's maritime domain: Opportunities and challenges. https://au.int/sites/default/files/newsevents/workingdocuments/27459-wd-keynote_address_of_h.e._the_dcp-1_0.pdf?utm_source=chatgpt.com. Accessed 28 Apr 2026.
Hermanson, A. S. (2018). Energy security in a multi-level governance perspective. *Marine Policy, 98*, 301–308. https://doi.org/10.1016/j.marpol.2018.09.025
International Energy Agency (IEA). (2022). World energy outlook 2022. https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf. Accessed 4 Jun 2023.
International Renewable Energy Agency (IRENA). (2020a). Fostering a blue economy: Offshore renewable energy. https://doi.org/10.13140/RG.2.2.16215.19362. Accessed 7 May 2026.
International Renewable Energy Agency (IRENA). (2020b). Innovation outlook: Ocean energy technologies. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Dec/IRENA_Innovation_Outlook_Ocean_Energy_2020.pdf. Accessed 7 May 2026.
International Renewable Energy Agency (IRENA). (2022). World energy transitions outlook 2022. https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022. Accessed 26 Jun 2023.
Interreg Baltic Sea Region. (2018). Things to know about transnational cooperation in the Baltic Sea Region. https://interreg-baltic.eu/wp-content/uploads/2021/07/Things_to_know_about_TN_cooperation_in_the_BSR.pdf. Accessed 10 Aug 2023.
IRENA & AfDB. (2022). Renewable energy market analysis: Africa and its regions. https://www.irena.org/%20%20%20%20publications/2022/Jan/Renewable-Energy-Market-Analysis-Africa. Accessed 7 May 2026.
Jay, S., Alves, F. L., O'Mahony, C., Gomez, M., Rooney, A., Almodovar, M., et al. (2016). Transboundary dimensions of marine spatial planning: Fostering inter-jurisdictional relations and governance. *Marine Policy, 65*, 85–96. https://doi.org/10.1016/j.marpol.2015.12.025
Kenfack, J., Fogue, M., Hamandjoda, O., & Tatietse, T. T. (2011). Promoting renewable energy and energy efficiency in Central Africa: Cameroon case study. *World Renewable Energy Congress 2011*. https://ep.liu.se/ecp/057/vol10/042/ecp57vol10_042.pdf
Kidmo, D. K., Deli, K., & Bogno, B. (2021). Status of renewable energy in Cameroon. *Renewable Energy and Environmental Sustainability, 6*, 1–11. https://doi.org/10.1051/rees/2021001
Mami Wata. (2018). A marine spatial planning (MSP) framework for the Abidjan Convention countries: Guidance and examples. https://mamiwataproject.org/2019/03/01/msp-framework/. Accessed 30 Jun 2023.
Mensah, M. A., & Quaatey, S. N. K. (2002). An overview of the fishery resources and fishery research in the Gulf of Guinea. *Large Marine Ecosystems, 11*, 227–239. https://doi.org/10.1016/S1570-0461(02)80039-8
Morcos, P. (2021). A transatlantic approach to address growing maritime linsecurity in the Gulf of Guinea. https://safety4sea.com/a-transatlantic-approach-to-address-growing-maritime-insecurity-in-the-gulf-of-guinea/. Accessed 19 Apr 2026.
Nonki, R. M., Lenouo, A., Tchawoua, C., Lennard, C. J., & Amoussou, E. (2021). Impact of climate change on hydropower potential of the Lagdo dam, Benue River Basin, Northern Cameroon. *Proceedings of the International Association of Hydrological Sciences, 384*, 337–342. https://doi.org/10.5194/piahs-384-337-2021
North Seas Energy Cooperation. (2022). Joint statement on the North Seas energy cooperation. https://energy.ec.europa.eu/system/files/2022-09/220912_NSEC_Joint_Statement_Dublin_Ministerial.pdf. Accessed 9 May 2026.
North Sea Region. (n.d.). Transnational energy cooperation between North Sea countries. https://northsearegion.eu/northsee/e-energy/transnational-energy-cooperation-between-north-sea-countries/. Accessed 20 Apr 2026.
Novaglio, C., Bax, N., Boschetti, F., Emad, G. R., Frusher, S., Fullbrook, L., et al. (2022). Deep aspirations: Towards a sustainable offshore blue economy. *Reviews in Fish Biology and Fisheries, 32*, 209–230. https://doi.org/10.1007/s11160-020-09628-6
O'Hagan, A. M. (2020). Marine spatial planning and marine renewable energy. In A. E. Copping & L. G. Hemery (Eds.), *OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World* (pp. 214–241). https://tethys.pnnl.gov/sites/default/files/publications/OES-Environmental-2020-State-of-the-Science-Ch-11_final_hr.pdf
Odido, M., & Mazzilli, S. (2009). African oceans and coasts. https://www.fust.iode.org/en/african-oceans-and-coasts-book. Accessed 7 May 2026.
Onu, K. O. (2021). Mitigating the effects of climate change through marine renewable energy development in Nigeria: Law, issues and prospects. *Afronomics Law*. https://www.afronomicslaw.org/category/analysis/mitigating-effects-climate-change-through-marine-renewable-energy-development. Accessed 23 Jun 2023.
Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering, 3*, 1167990. https://doi.org/10.1080/23311916.2016.1167990
Paice, E. (2022). By 2050, a quarter of the world's people will be African – this will shape our future. *The Guardian*. https://www.theguardian.com/global-development/2022/jan/20/by-2050-a-quarter-of-the-worlds-people-will-be-african-this-will-shape-our-future. Accessed 23 June 2023.
Palmowski, T. (2021). The European Union strategy for the Baltic Sea Region and accomplishments. *Baltic Region, 13*(1), 138–152. https://doi.org/10.5922/2079-8555-2021-1-8
Piria, R. (2014). EU and regional policies for offshore wind: Creating synergies. https://www.offshore-stiftung.de/sites/offshorelink.de/files/documents/2014_4POWER_SOW_EU_and_Regional_Policies_for_Offshore_Wind_Creating_Syne....pdf. Accessed 9 May 2026.
Prieto, J. G., & Caldes, N. (2016). MED programme and transnational cooperation contributions to marine renewable energy in the Mediterranean area: What next? *International Journal of Ocean and Climate Systems*, 1–5. https://doi.org/10.1177/1759313116645822
Proskuryakova, L. (2018). Updating energy security and environmental policy: Energy security theories revisited. *Journal of Environmental Management, 223*, 203–214. https://doi.org/10.1016/j.jenvman.2018.06.016
Purdy, R. (2019). Incorporating resilience and sustainability in renewable energy development: A Cameroon case study. MSc Thesis, School of International Development & Global Studies in Ottawa.
Russell, T. (2022). North Seas Energy Cooperation raise offshore wind goals. https://www.4coffshore.com/news/north-seas-energy-cooperationa0raise-offshore-wind-goals-nid26302.html?gad=1&gclid=CjwKCAjwloynBhBbEiwAGY25dIgLo_pcrREDvYAKllyYwf984JGzr7FLKtyWYkzR107y2_Qi5FNI5xoC7mYQAvD_BwE. Accessed 22 Aug 2022.
Sitoe, A. F., Hoguane, A. M., & Haddout, S. (2023). The ocean as a source of renewable energy in sub-Saharan Africa: Sources, potential, sustainability and challenges. *International Journal of Sustainable Energy, 42*(1), 436–460. https://doi.org/10.1080/14786451.2023.2204378
Studzieniecki, T., & Palmowski, T. (2022). Renewable energy sources in transnational cooperation in the Baltic Sea Region. *Bulletin of Geography. Socio-Economic Series, 56*, 7–21. https://doi.org/10.12775/bgss-2022-0010
Studzieniecki, T., Palmowski, T., & Joeck, R. (2022). Territorial cooperation—a factor stimulating Baltic Sea Region energy transition. *Energies, 15*(2), 436. https://doi.org/10.3390/en15020436
The European External Action Service (EEAS). (2021). EU maritime security factsheet: The Gulf of Guinea. https://www.eeas.europa.eu/eeas/eu-maritime-security-factsheet-gulf-guinea_en. Accessed 15 May 2026.
The Global Climate and Health Alliance. (2022). International health organizations call for fossil fuel non-proliferation treaty to protect lives of current and future generations. https://climateandhealthalliance.org/press-releases/international-health-organizations-call-for-fossil-fuel-non-proliferation-treaty-to-protect-lives-of-current-and-future-generations/. Accessed 26 Jun 2023.
UNESCO-IOC. (2021). Marine spatial planning and the sustainable blue economy: Policy brief. https://unesdoc.unesco.org/ark:/48223/pf0000375720. Accessed 12 Jun 2025.
UNESCO-IOC. (n.d.). Guidance for marine spatial planning. https://www.ioc.unesco.org/en/guidance-marine-spatial-planning. Accessed 7 May 2026.

United Nations. (1982). United Nations Convention on the Law of the Sea (UNCLOS). https://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm. Accessed 1 Jan 2024.
United Nations Economic Commission for Africa (UNECA). (2016). Africa's blue economy: A policy handbook. https://archive.uneca.org/sites/default/files/PublicationFiles/blue-eco-policy-handbook_eng_1nov.pdf. Accessed 12 Jun 2025.
United Nations Environment Programme (UNEP). (2017). Atlas of Africa energy resources. https://www.unep.org/resources/report/atlas-africa-energy-resources. Accessed 20 Dec 2025.
United Nations Environment Programme (UNEP). (2022). Contributions of regional seas conventions and action plans to a healthy ocean. https://library.sprep.org/sites/default/files/2022-05/Regional_Seas_Conventions-2022.pdf. Accessed 20 Dec 2025.
West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL). (n.d.). Graduate studies programme. https://wascal.org/graduate-studies-programme/. Accessed 20 Sep 2023.
World Bank. (2021). GDP per capita (current US$) - Sub-Saharan Africa. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=ZG. Accessed 25 Jun 2023.
World Bank. (2022). Blue economy in Africa: A synthesis. https://thedocs.worldbank.org/en/doc/213a25f8770328e39b2ef15e7104a136-0320012022/original/Overview.pdf. Accessed 7 May 2026.
World Bank. (2025). Mission 300 is powering Africa: Connecting 300 million people to electricity. https://thedocs.worldbank.org/en/doc/1970c2730f67dfad84ed66cfdb14b43a-0360012025/mission-300-is-powering-africa-connecting-300-million-people-to-electricity. Accessed 20 Apr 2025.

Publisher's Note