OFFSHORE WIND ENERGY BRAZIL

Regulation and the Path Forward for Seabed Leasing

APRIL 2026

ALVAREZ & MARSAL

ABEEólica

PURPOSE OF THE REPORT

Methodological Note

This publication and the information contained therein are provided for informational and analytical purposes only. The institutions responsible for the preparation of this report — Alvarez & Marsal, in institutional partnership with ABEEólica — adopted reasonable procedures to verify the reliability, consistency and updating of the information presented, based on public sources, sectoral studies and national and international references.

The analyses presented here reflect the best interpretation of the information available at the time of publication. The report is the result of an independent technical effort and does not constitute public policy guidance or specific direction for government decisions related to offshore wind in Brazil.

The purpose of this document is to organize and qualify the sectoral debate, bringing together experiences, models and discussions observed in Brazil and internationally.

The opinions and analyses presented reflect the technical view of the teams involved in the preparation of the study and do not constitute a unified institutional position of all ABEEólica members or the institutions that contributed to its development. References to companies, projects, countries, regions or regulatory models is illustrative and analytical in nature and does not represent a preferential indication or exclusion of paths of a similar alternatives.

SUMMARY

INTRODUCTION

This report aims to present a structured and analytical view of the current stage of development of offshore wind energy in Brazil, placing the topic within the broader context of the national power sector, recent regulatory developments, and relevant international experience.

The document is not intended to advocate for specific models or single development pathways. Instead, it organizes information, data, and references that help explain Brazil's current position, the main drivers influencing offshore wind development, and the technical, economic, environmental, and institutional conditions shaping possible medium- and long-term scenarios.

1 BRAZIL OFFSHORE CONTEXT AND MARKET LANDSCAPE

In the first part, the report presents the context of the Brazilian electricity sector and discusses the insertion of offshore wind in the energy matrix, highlighting the technical potential identified, the interest expressed by the market and the challenges associated with the integration of generation into the electricity system. Legal and regulatory frameworks applicable to the technology are also addressed, as well as their current stage of implementation, including the main institutional topics under discussion.

2 AUCTION MODELS AND INTERNATIONAL EXPERIENCES

Building on this diagnosis, the report explores auction models and contracting arrangements adopted in different international markets, focusing on lessons drawn from the recent design of offshore wind tenders. These experiences are presented comparatively, highlighting the diversity of approaches observed and their implications for competition, risk allocation, and project deployment pace.

3 INTERNATIONAL LEARNINGS AND ELEMENTS FOR BRAZIL

Finally, the document brings together reflections on structuring paths and strategic elements for Brazil, considering the particularities of the national electricity sector and the energy transition horizon until 2040–2050. These reflections are informative and aim to qualify the sectoral debate, contributing to a broader understanding of the possible paths for offshore wind in the country.

1

BRAZIL OFFSHORE CONTEXT AND MARKET LANDSCAPE

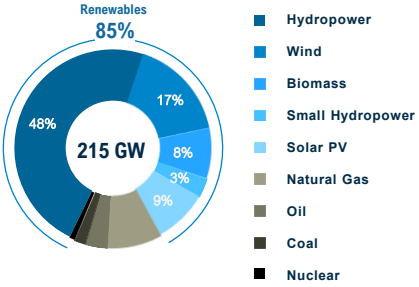
BRAZIL
OFFSHORE WIND CONTEXT AND SCENARIO

OVERVIEW OF THE BRAZILIAN POWER SECTOR AND OFFSHORE WIND INTEGRATION

Brazil has one of the cleanest and most competitive electricity matrices in the world, historically supported by hydroelectric generation and, more recently, by the rapid expansion of onshore solar and wind sources.

Currently, generation by hydraulic source accounts for approximately 50% of the installed capacity, while non-hydraulic renewable sources have consolidated themselves as relevant vectors of growth in installed capacity in the last two decades.

Brazilian Electric Matrix – GW
Source: ANEEL (November, 2025) | ABEEólica



Despite this trajectory, sector projections indicate that the additional expansion of hydropower expansion is likely to occur more gradually over the next 20 to 30 years, due to environmental and social constraints and the declining availability of economically viable sites.

At the same time, the growing share of intermittent onshore soures has increased the importance of operational flexibility, transmission adequacy, and temporal balancing between supply and demand. Brazil's wind industry accounts for a total of 35.9 GW of installed onshore wind capacity in operation.

Brazil's offshore wind resources are among the most significant globally, with an estimated technical potential of more than 1,200 GW, including approximately 480 GW in fixed foundation areas (up to 70 meters deep) and about 750 GW associated with floating technologies, in deeper water depths.

These resources have high consistency and wide geographical distribution along the coast, in regions relatively close to large cargo centers. The integration of offshore wind in the Brazilian electricity system is part of a broader movement toward diversification of the energy matrix, strengthen the supply of low-carbon energy and adapting the sector to a scenario of greater electrification of the economy in the medium and long term.

In this context, offshore wind energy emerges as a complementary vector for expanding renewable supply in Brazil, with technical characteristics distinct from the sources already consolidated in the country.

KEY REGULATORY MILESTONES

Offshore wind development in Brazil has advanced significantly in the regulatory and institutional sphere in recent years, although the sector remains at an early stage of maturity. The main legal and technical milestones highlighted below form the foundation for sector consolidation and support its implementation over the coming years.

2022

Initial Regulatory Framework Structuring

Decree No. 10,946/2022

Regulated the granting of rights to use federal public assets for offshore electricity generation, establishing the basis for the permitting process.

Ordinance nº 52/GM/MME/2022

Established guidelines and procedures for the processing of area assignment requests for offshore generation projects

Ordinance nº 3/2022 MME/MMA

Established coordination between the energy and environmental authorities for the offshore wind projects development

2023 - 2024

Technical Consolidation and Sector Planning

EPE Technical Notes (2023)

- Proposed methodology for selecting areas for offshore wind generation
- Considerations on the amount due to the Federal Government for the assignment of area
- Criteria for defining maximum assignable area limits

Creation of the Interministerial Committee

Institutional governance structure led by the Ministry of Mines and Energy (MME) to coordinate strategic guidelines and inter-agency alignment

Complementary studies by EPE and the World Bank

Assessment of technical potential, development models, and recommendations for structuring the Brazilian offshore market

2025

Establishment of the Legal Framework

Law No. 15,097/2025

Established the Legal Framework for Offshore Wind, establishing:

Rules for assignment of use of Union areas

Assignment models (planned offering and permanent/open-door offering)

Transition criteria for projects already filed

Legal certainty for the development of the sector

REGULATORY AND INSTITUTIONAL STAGE OF OFFSHORE WIND IN BRAZIL

In January 2025, Law No. 15,097/2025 was enacted, establishing the legal framework for the use of energy resources in maritime areas under national jurisdiction, including offshore wind power generation.

The law introduces the concept of energy zones, defined maritime areas designated for the development of generation projects, whose use depends on authorization through assignment of public-use rights.

The legal framework also establishes the basis for area assignment procedures, developers' rights and obligations, and coexistence principles with other activities that share the marine environment, such as navigation, oil and gas, fisheries, and environmentally sensitive areas.

From an institutional perspective, the Brazilian model provides for two main arrangements for making offshore areas available:

(i) Centralized Tender (Planned Offerings), in which the government conducts preliminary studies, defines energy zones, and promotes structured auctions
(ii) Open-Door Tender (Permanent Offerings), in which a developer requests the use of a specific area at its own risk, subject to qualification procedures and, where applicable, competitive allocation if multiple interested parties emerge.

	PLANNED OFFER	PERMANENT OFFER
Process	Government defines energy zones and launches auction notice Competition takes place from the outset through the auction process for predefined zones	Company requests use of a specific zone Public notice for at least 120 days. If no competing interest arises, authorization may be granted to the qualified applicant; otherwise, a competitive process is triggered
Award / Compensation	Signature bonus, occupancy fee and/or revenue-sharing conditions defined in the auction notice, plus guarantees	Without competition: qualification verification and occupancy fee With competition: auction criteria defined in the notice apply

Although the legal framework represents an important step toward reducing legal uncertainty and organizing maritime space use, its full operationalization still depends on further regulation, including the definition of area selection methodology, auction criteria, technical and economic qualification parameters, and integration rules with energy and transmission planning.

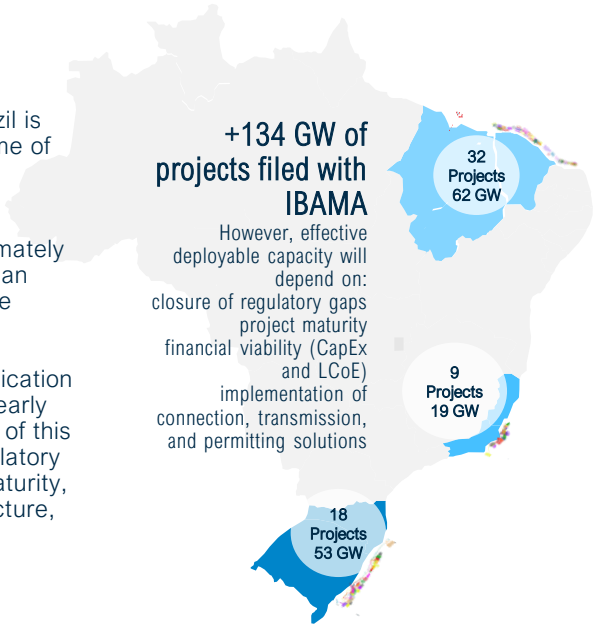
To date, public consultations conducted by EPE and the Ministry of Mines and Energy indicate progress in this direction, although final regulatory outcomes have not yet been formally published.

MARKET ENGAGEMENT AND EARLY STRUCTURING SIGNALS

Market interest in offshore wind in Brazil is clearly reflected in the significant volume of projects submitted for environmental licensing.

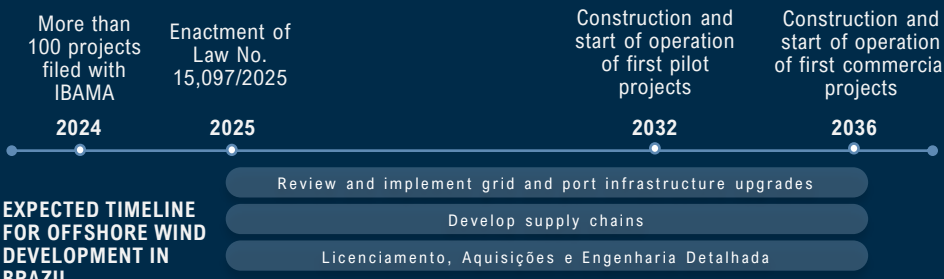
Currently, 59 projects totaling approximately 135 GW are under review at the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA).

This pipeline provides an important indication of developers' technical potential and early market mobilization. The consolidation of this capacity over time will depend on regulatory evolution, project techno-economic maturity, availability of grid connection infrastructure, and the development of contracting mechanisms compatible with the characteristics of the technology.



From a timing perspective, considering the typical offshore project development cycle - involving environmental studies, engineering, permitting, financial structuring, and construction - first commercial operations are expected to begin from the early 2030s onward. This timeline is consistent with international experience in markets that have recently moved from regulatory structuring to commercial deployment.

EXPECTED TIMELINE FOR OFFSHORE WIND DEVELOPMENT IN BRAZIL



In the short term, the coming years are expected to focus on defining guidelines by the National Energy Policy Council (CNPE), area mapping led by the Brazilian Energy Research Office (EPE) and IBAMA, and qualification frameworks for future auction participants.

After area assignment, a typical project cycle requires approximately 3 to 5 years of studies, permitting, contracting, and financing before construction begins, indicating first operations between 2030 and 2032.

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STRATEGIC VECTORS

Offshore wind presents attributes that strengthen its long-term potential role in the Brazilian power system, contributing to diversification of the energy matrix and reinforcing the supply of low-carbon energy.

PROXIMITY OF GENERATION TO DEMAND CENTERS

The installation of generation capacity closer to demand centers — particularly in the Southeast region — may, under certain configurations, contribute to optimizing transmission infrastructure use and improving the balance between supply and demand, especially when integrated with long-term grid expansion planning.

INTEGRATION WITH EMERGING INDUSTRIAL VALUE CHAINS

Brazil has announced targets for the development of emerging markets, particularly low-carbon hydrogen and its derivatives (such as e-fuels), with emphasis on major port hubs. Offshore wind, due to its scale potential and generation predictability, is regarded as one of the energy sources capable of supporting projects aimed at both domestic demand and export markets, especially in the medium and long term.

COMPLEMENTARITY WITH OTHER ENERGY SOURCES

The expansion of offshore wind can act as a complementary element to hydropower generation and onshore renewables, contributing to diversification of the temporal supply profile. In certain regions, the interaction between offshore wind regimes, hydropower generation, and industrial demand may enhance system operational efficiency, depending on local conditions and available evacuation infrastructure.

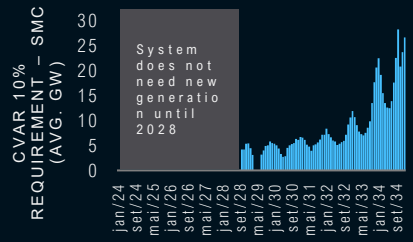
OSW
BRAZIL

STRUCTURAL FACTORS

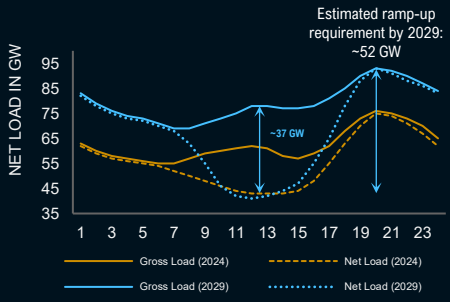
Considering the identified technical potential, offshore wind development in Brazil takes place within a broader systemic context marked by the accelerated expansion of renewables and the growing relevance of operational flexibility. This environment is shaped by a set of technical, environmental, and economic conditions that influence both the pace and the pathway of technology deployment in the country.

Rapid renewable growth has created structural energy oversupply in recent years

Energy cost requirement based on CVaR — Operation Marginal Cost (CMO) metric ≤ 800 R$/MWh, monthly average, in GW



Meeting peak demand will require greater system flexibility, increasing the role of intermittent sources such as onshore and offshore wind



EPE (PDE 2034), ONS (PAR/PEL 2024)

HIGHER INVESTMENT COSTS

From an economic perspective, offshore wind projects tend to involve investment structures distinct from those of already established technologies in Brazil. At the current stage, gradual development of local supply chains, specialized infrastructure, and technical capacity will be necessary, with observed costs likely exceeding those of international markets during the initial deployment phases.

GRID INTEGRATION AND AVAILABLE TRANSMISSION CAPACITY

From an infrastructure perspective, integrating significant offshore generation volumes will require coordination with transmission expansion planning. The combined evolution of supply, grid reinforcement, and demand dynamics will be central to maximizing system efficiency as new capacity is incorporated.

PORT AND LOGISTICS ADAPTATIONS

The Brazilian port sector has significant relevance along the national coastline. Offshore wind deployment may require, over time, local adaptations to port logistics demands associated with the technology, particularly during construction, assembly, and commissioning phases, in line with international experience observed in markets that have undergone similar development processes.

TOPICS UNDER CONSOLIDATION AND KEY ISSUES UNDER DISCUSSION

Given the institutional advances observed in recent years, offshore wind development in Brazil is entering a continuous process of regulatory and structural consolidation. This process is associated both with broader dynamics of the power sector and with the evolution of institutional arrangements specific to the technology.

Among the main issues currently under discussion is the design of energy contracting mechanisms, particularly in a context of accelerated supply expansion in the short term and increasing relevance of system flexibility.

The integration of significant offshore generation volumes reinforces the importance of instruments that consider not only supply expansion, but also compatibility with demand profiles and system response capacity.

Another central issue concerns selection criteria in future offshore area allocation and auction processes, including the relative weight of financial and non-financial factors, the internalization of externalities, and incentives for industrial development associated with the offshore value chain.

International experience suggests that multiple approaches may coexist, each with different implications for the degree of competition, investor attractiveness, and project deployment pace.

Across all dimensions, coordination between power sector planning, maritime spatial organization, transmission infrastructure expansion, and industrial policy constitutes a central element for the efficient consolidation of offshore wind in Brazil.

The integrated evolution of these vectors over the coming years will be decisive for the incorporation of the technology into Brazil's energy matrix over the 2040–2050 horizon. In this context, although Brazil has made institutional progress with the approval of Law No. 15,097, enacted in January 2025 and establishing the legal framework for offshore wind, the regulatory complement required for its effective implementation remains under development.

Key pending elements include regulatory instruments, resolutions, and operational schedules that will enable offshore area auctions to take place.

The absence of clear signaling regarding these next steps reduces process predictability and affects the planning capacity of economic agents in a sector characterized by high upfront investment and long maturation cycles.

Although competent authorities have already initiated technical discussions related to implementation of the legal framework, the remaining regulatory gaps keep the issue open and continue to influence perceptions regarding the pace of offshore wind development in Brazil in the short and medium term.

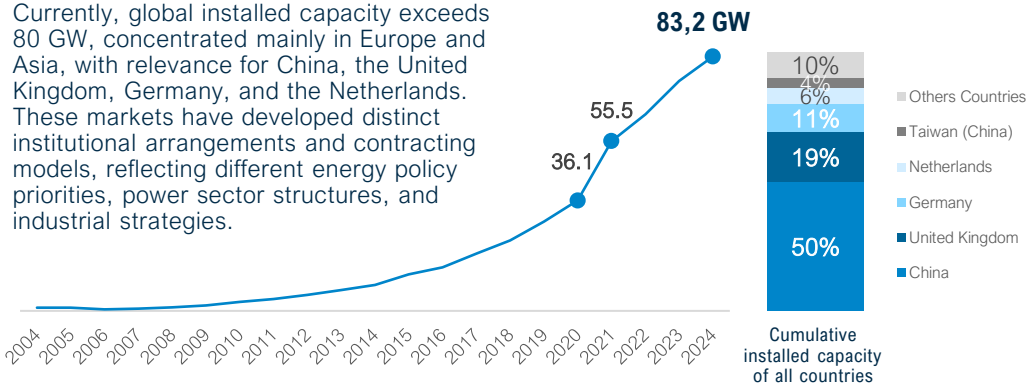
2 AUCTION MODELS AND INTERNATIONAL EXPERIENCE

AUCTION MODELS GLOBAL EXPERIENCE

OFFSHORE WIND CONTEXT AND MARKET LANDSCAPE

Offshore wind has consolidated over the past two decades as one of the main drivers of renewable generation expansion worldwide. The combination of larger installed capacity, increasing project scale, and turbine technology advancement has strengthened the competitiveness of this source, particularly in countries facing strong decarbonization targets and limited space for onshore expansion.

Currently, global installed capacity exceeds 80 GW, concentrated mainly in Europe and Asia, with relevance for China, the United Kingdom, Germany, and the Netherlands. These markets have developed distinct institutional arrangements and contracting models, reflecting different energy policy priorities, power sector structures, and industrial strategies.



Historical cumulative offshore wind installations (GW)
Source: Global Wind Energy Council – Global Wind Report 2025 (Year 2024)

Cumulative installed capacity of all countries with offshore wind (GW)15th ranking

At the same time, international experience provides important references regarding area auction models, energy remuneration mechanisms, risk allocation, and the role of the State in offshore supply chain development — central elements for structuring new markets.

AUCTION MODELS GLOBAL EXPERIENCE

OFFSHORE AUCTION CONCEPTS AND STRUCTURES

International experience shows that offshore wind auctions can adopt different approaches for project selection and seabed area allocation. In general, models vary according to market maturity, the level of state intervention in seabed planning, and the remuneration structure applied to generated electricity. In simplified terms, three main structures are commonly observed across offshore markets:

PRICE-BASED AUCTIONS

Selection is based on the lowest energy price offered or the lowest subsidy requirement. This model is more common in mature markets, where major structural risks have already been mitigated by the State.

HYBRID MODELS (PRICE + QUALITATIVE CRITERIA)

In addition to the financial bid, technical and public policy criteria are also considered, such as contribution to the supply chain, environmental impact, or technological innovation.

PROCESSES PRIMARILY BASED ON QUALITATIVE CRITERIA

More common in early-stage market development, these models prioritize technical experience, financial capability, and industrial commitments, with lower relative weight assigned to price.

Regardless of the approach adopted, auction processes usually include technical, economic, and legal prequalification stages to ensure that only developers with demonstrated execution capacity participate in the competition.

AUCTION MODELS GLOBAL EXPERIENCE

OFFSHORE AUCTION ARCHITECTURES OBSERVED INTERNATIONALLY

International experience shows that countries have adopted different institutional architectures to structure seabed area allocation and energy procurement for offshore wind projects. These variations reflect market maturity, the degree of state-led seabed planning, and the allocation of risks between governments and investors.

In simplified terms, global models can be grouped into three main architectures, which differ mainly in the role of the State in area development and in the structuring of competitive processes.

Market Architecture	Model Characteristics	Representative Countries	Implications for Market Development
CENTRALIZED MODEL (Areas pre-developed by the Government)	The government leads maritime spatial planning, environmental and technical studies, and seabed area definition before the auction. Competition takes place after the main structural project risks have been mitigated	Denmark, Netherlands, Germany, France, Belgium	Reduction of significant investor risks and greater regulatory predictability, fostering auction competitiveness and lower long-term energy costs
AREA AUCTION MODEL (Market-driven)	The government defines large maritime zones and grants development rights through auctions. Developers assume a greater share of risks associated with project development and energy commercialization.	United States, United Kingdom (partially)	Greater private sector role and lower direct state intervention, but with higher investor exposure to market, infrastructure, and grid connection risks.
EMERGING MODEL /GRADUAL MARKET DEVELOPMENT	Countries in early-stage development adopt progressive approaches, often combining market consultation, pilot projects, or qualitative selection criteria to reduce institutional and regulatory risks	Canada, Colombia, some Asian markets	Enables regulatory learning and institutional adaptation before large-scale expansion, reducing systemic risks during the initial offshore market development phase

The comparative assessment of these models shows that successful offshore markets tend to combine state-led area planning, stable revenue mechanisms, and balanced risk allocation between governments and investors. In this context, relevant international benchmarks were selected, including countries with different maturity levels and institutional arrangement.

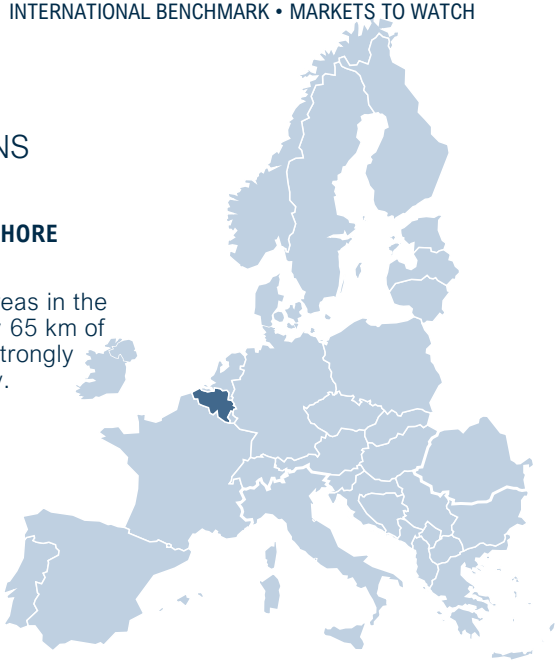
AUCTION MODELS GLOBAL EXPERIENCE

Country	Auction model / institutional arrangement	Installed Capacity (GW)*	Key message for Brazil
	Area first, with two variants: (i) areas not pre-investigated under dynamic bidding / negative bidding(ii) pre-investigated areas with additional qualitative criteria.	9,2	Brazil can draw from Germany's de-risking logic, but not necessarily from its highly aggressive area payment approach
	Area + energy together, with future tender under CfD through the Princess Elisabeth Zone (PEZ)	2.3	The main lesson is that bankability matters, but legal certainty and realistic schedule are as important as the CfD itself
	Area first, phased process: Call for Information → prequalification → Call for Bids → submerged land permit	0	A strong benchmark for early-stage development: prequalify, map, hear stakeholders, and only then tender
	State-led planning / provincial model, historically supported by FiTs/subsidies, with recent tenders driven by provinces and more competitive mechanisms	42,7	The lesson is not to replicate the auction itself, but the scale logic, supply chain coordination, and state orchestration
	Area first, through TOP (Temporary Occupancy Permit); maritime permit precedes the competitive process, while energy monetization is handled in parallel	0	Colombia shows the value of an institutionally clear maritime-first model: qualification, nomination, validation, then competition
	Project + energy together, historically subsidy-free, then tested competitive tendering, and later returned to CfD-based support	2,6	A key lesson: avoid launching tenders too early under purely economic risk
	Area first, energy later: BOEM auction for seabed lease; revenues later via PPAs/ORECs and state-level solicitations under a separate federal arrangement	0.174	Brazil can leverage the "area first" logic, but should avoid depending solely on area auctions without prior coordination
	Project + energy together, via AO (appels d'offres), with specific rounds for fixed-bottom and floating offshore wind	1,6	France shows the value of combining formal maritime planning, public consultation, and visible auction pipeline
	Area first, with strong state de-risking, TSO-led connection and tendering with or without subsidy depending on market cycle	4,7	Probably the most replicable benchmark: strong public data + state-led grid connection
	Area first, energy later: seabed leasing via The Crown Estate / Crown Estate Scotland, followed by CfD for revenue	15	The UK shows that a two-step model works well, provided CfD does not excessively capture leasing value

Reference data as of end-2024

BELGIUM

OFFSHORE WIND AREA AUCTIONS



MARKET | SIZE, MATURITY SCALE, AND OFFSHORE RELEVANCE

Belgium has one of the smallest maritime areas in the North Sea (~3,454 km²), with approximately 65 km of coastline. This geographical limitation has strongly shaped offshore development in the country.

BELGIUM OFFSHORE WIND DEVELOPMENT STATUS (MW)

9 Wind Farms

~2.26GW installed

The Belgian market is considered mature and highly structured, with high generation density per km². Despite spatial limitations, offshore wind has become a strategic pillar of the energy transition, currently accounting for approximately 10% of the country's total energy mix, complementing a matrix historically based on nuclear and gas.

The next phase of expansion is concentrated in the Princess Elisabeth Zone, with an estimated additional potential of ~3.5 GW, nearly doubling current capacity and reinforcing the country's position as an energy hub in the North Sea.

INSTITUTIONAL AND REGULATORY MODEL

Belgium adopts a centralized federal model, with a clear division of responsibilities among maritime spatial planning, energy regulation, and grid operation.

FEDERAL PUBLIC SERVICE ECONOMY

Responsible for federal energy policy and the organization of site auctions, including the definition of award criteria and CfD structure.

FEDERAL PUBLIC SERVICE HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT

Conducts environmental impact assessments and issues environmental permits.

REGULATORY COMMISSION FOR ELECTRICITY AND GAS

Supervises tariff and regulatory aspects of the electricity system.

BELGIUM

OFFSHORE WIND AREA AUCTIONS

STRUCTURE OF SEABED AREA AUCTIONS

Pre-auction planning is strongly guided by maritime spatial planning. Zone definition occurs in a centralized manner, with a high level of technical detail, reflecting both geographic constraints and the need to optimize the use of maritime space.

What is granted to the investor is not only the right to occupy a maritime area, but a package that includes construction authorization, operation, and the corresponding economic framework.

There is no separation between site auctions and energy contracting, as occurs in the United States.

AUCTION PROCESS

Project selection combines price criteria (offered strike price), technical qualification, and public policy requirements, reflecting stronger state direction over the final outcome. Prior to the opening of each round, the State conducts strategic environmental studies, technical modeling of zone layouts, and detailed LCOE estimates.

In the case of the Princess Elisabeth Zone, prior analyses indicated indicative strike price ranges, used as a reference to calibrate the auction design and reduce uncertainties. The auction structure first seeks to mitigate structural risk (defined area, planned grid connection), and then promote economic competition.

The logic is clear: first reduce structural risk; then promote economic competition.

OBSERVED RESULTS | RECENT AUCTIONS

- In the initial projects, support through Green Certificates reached approximately €107/MWh, a value corresponding to 3 to 4 times the spot price at the time (reflecting the need to make the business viable).
- In the current phase, studies indicate significantly lower strike prices, around €79/MWh.
- For the first round of the Princess Elisabeth Zone (700 MW), the Belgian government established a strike price cap of up to €95/MWh, as part of the CfD model, aiming to reduce costs for society and guide competition.

ELEMENT	ESTIMATED / DEFINED VALUE
Strike price cap – Princess Elisabeth Zone (CfD)	€95/MWh
Historical strike prices (previous projects)	~€79/MWh (Northwester 2, Mermaid, Seastar)
C-Power (first offshore wind auction – 2009)	~€107/MWh

BELGIUM

OFFSHORE WIND AREA AUCTIONS

REMUNERATION AND ENERGY CONTRACTING

Belgium evolved from an initial model based on Green Certificates to a more sophisticated design, currently centered on the discussion and implementation of two-sided Contracts for Difference (CfD). The main objective is to stabilize revenues, reduce financing risk, and protect consumers from price volatility.

2009 - 2013

Smaller projects with lower-capacity turbines were used to develop local industrial and operational capabilities, test the regulatory framework, and reduce risks before large-scale expansion.

The subsidy was initially high, based on Green Certificates with guaranteed purchase at a fixed price, reflecting the early stage of the technology.

2014 - 2022

The Green Certificate model was maintained, but with a gradual reduction in the level of support.

The decline in LCOE and the maturation of the supply chain enabled progressive adjustments without institutional discontinuity.

APÓS - 2023

From 2023 onwards, the transition to a double-sided CfD model begins, especially in the context of the new expansion zone.

SUPPLY CHAIN AND INFRASTRUCTURE

The initial strategy of smaller-scale projects allowed Belgium to develop a robust offshore cluster. Ports such as *Ostend* and *Antwerp-Bruges* have become relevant logistics hubs in the North Sea.

Proximity to the Netherlands, Germany, and the United Kingdom favors regional integration and supply chain sharing. The country now operates not only as a domestic market, but as part of a transnational offshore ecosystem.

RISK ALLOCATION

The main structural risk remains spatial limitation. High generation density may intensify maritime use conflicts and increase the complexity of future integration. There is also macroeconomic risk associated with cost volatility and interest rates, as observed in other European markets. However, regulatory risk is considered low, given institutional stability and the incremental evolution of the model.

OSW

MARKETS TO WATCH

BELGIUM

Even in a mature market, Belgium faced challenges related to the evolution of the regulatory framework and the need to adjust support mechanisms. The experience has shown that abrupt changes can compromise timelines, reinforcing the importance of gradual transitions.

The main lesson from Belgium for Brazil lies not in market size or installed volume, but in the institutional architecture of offshore development.

THE BELGIAN TRAJECTORY DEMONSTRATES THAT:

- Risk should be reduced before being transferred
- Planning should precede competition
- Infrastructure should be centrally coordinated
- Model evolution should be gradual and technically grounded.

For Brazil, replication is not literal, but conceptual: institutional design precedes economic success.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Regulatory predictability is more decisive than initial competitive aggressiveness in consolidating an emerging market.

Smaller-scale pilot projects can reduce systemic risk, enabling regulatory, environmental, and grid connection learning before large-scale expansion in Brazil.

Auctioning the site together with the right to build increases predictability, reduces risks, and can avoid overlaps between maritime concession, generation authorization, and environmental licensing.

Pre-auction technical studies and clear definition of economic parameters increase predictability and reduce cost of capital.

CANADA

OFFSHORE WIND AREA AUCTIONS

MARKET | SIZE, MATURITY STAGE, AND OFFSHORE RELEVANCE

Canada is at an early stage in offshore wind development, with no commercial-scale projects currently in operation. The first competitive process is being structured with a focus on the coast of Nova Scotia, in federal waters, marking the country's formal entry into the offshore segment.

The technical potential is significant, both on the Atlantic coast (Nova Scotia and Newfoundland) and on the Pacific coast (British Columbia, with potential for floating projects).However, the regulatory model is still under development, with the government adopting an incremental and consultative approach before launching a formal auction.

Offshore wind is seen as a strategic alternative to onshore wind, which faces challenges related to land use and social acceptance.

INSTITUTIONAL MODEL

The process is being led by the Canada–Nova Scotia Offshore Energy Regulator (CNSOER), with strategic guidelines jointly issued by the federal and provincial governments. Regulation follows the existing offshore oil and gas model, adapted for renewables, with federal jurisdiction over the seabed in offshore waters. The institutional design is shared between federal and provincial levels, requiring political coordination from the outset of the process.

AUCTION PROCESS

Canada has opted for a progressive approach, structuring the market before defining rigid rules.

STEP 1
Strategic Direction Letter

Formal document that authorizes the regulator to initiate the process, indicating initial volumes (3–5 GW) and establishing general guidelines, with emphasis on social and environmental engagement.

STEP 2
Call for Information (current phase)

Open process to capture market interest and collect contributions on auction design, criteria, local content, and regulatory structure. The government deliberately avoided defining rigid requirements before hearing from the market.

STEP 3
Mapping and pre-selection of areas

Prior technical and environmental mapping has already resulted in the intention to contract 2 out of the 5 initially analyzed areas, reducing future regulatory risk.

STEP 4
Pre-qualification

Parallel process to identify companies with financial and technical capacity, functioning as a real appetite thermometer.

STEP 5
Call for Bids

The formal auction will only be launched after consolidating feedback and defining clear rules and timeline, possibly in 2026.

OSW

MARKETS TO WATCH

CANADA

The Canadian case demonstrates a cautious and incremental approach to structuring offshore wind, prioritizing broad market consultation, federal–provincial coordination, and social engagement before the final definition of rules.

In markets that compete globally for capital, institutional clarity and timeline predictability become as relevant as the economic design of the auction.

LESSONS LEARNED

- Initiating the process with a Strategic Direction Letter and Call for Information allows testing market appetite before consolidating rigid rules
- Parallel pre-qualification acts as a credibility filter and a thermometer for pipeline attractiveness
- Coordination between federal government and provinces is a structural element of the model, reducing future legal risks
- Early engagement with Indigenous communities and stakeholders seeks to mitigate litigation risk and delays

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Early market consultation can better calibrate regulatory design, reducing the need for later adjustments

Coordination between federal and state levels is critical in offshore models with overlapping competencies

Early social engagement reduces the risk of legal challenges in large-scale projects

A clear and predictable schedule is essential to compete for international capital, especially against already mature European markets

CHINA

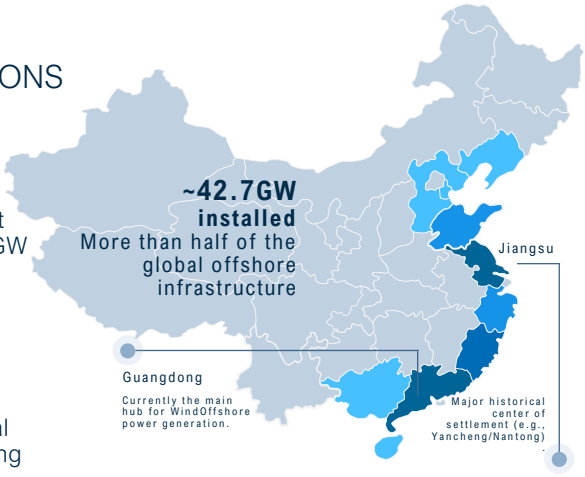
OFFSHORE WIND AREA AUCTIONS

MARKET | SIZE, MATURITY STAGE, AND OFFSHORE RELEVANCE

China is the largest offshore wind market in the world, with approximately 42–45 GW installed capacity and consistent leadership in annual additions (in 2024 accounting for about half of global new installations).

This growth has been driven by national energy transition targets, active industrial policy, and strong domestic manufacturing capacity.

Development is concentrated in coastal provinces such as *Guangdong, Jiangsu, Fujian, Zhejiang, and Shandong*, where there is integration between wind farms, industrial hubs, and major load centers. Unlike Europe, Chinese offshore wind has a strong focus on generation close to coastal demand and thermal substitution.



CHINA OFFSHORE WIND DEVELOPMENT STATUS

Province	Characteristics	Capacity (GW)
Guangdong	Largest current market	10+
Jiangsu	Pioneer (first offshore projects)	10+
Fujian	Deeper waters and rapid expansion	3+
Zhejiang	Strong recent industrial growth	2+
Shandong	Emerging offshore hub	2+

China did not develop its offshore sector nationally in a homogeneous way; growth occurred through provincial industrial clusters.

The market is currently in transition: after a strong subsidized cycle until 2021, it has entered a grid parity phase, with increasing exposure to the electricity market and provincial contracts.

INSTITUTIONAL AND REGULATORY MODEL

The model is centralized and guided by state planning.

- A *National Energy Administration (NEA)* defines national targets and coordinates sector policies.
- A *National Development and Reform Commission (NDRC)* structures tariff and economic guidelines
- Provincial governments: play a central role in area allocation and project organization
- State-owned enterprises *such as China Three Gorges Corporation, China General Nuclear Power Group (CGN) e State Power Investment Corporation (SPIC)* lead development.

The system is highly coordinated, with strong state presence in financing, construction, and operation.

CHINA

OFFSHORE WIND AREA AUCTIONS

STRUCTURE OF AREA USE AND DEVELOPMENT

China does not adopt the classic European model of competitive offshore site auctions with payment for concession rights.

- Areas are defined through provincial maritime spatial planning, aligned with national targets
- Allocation occurs via administrative processes or simplified provincial competitive calls, often restricted to state-owned enterprises and dependent on state plan approval

In summary: this is a planned and coordinated allocation model between national and provincial governments, not a pure concession-based market model.

STEP 1

National Planning

Five-year plans and definition of capacity targets by province.

STEP 2

Maritime Zoning

Provincial governments define areas and conduct environmental studies, issuing Occupation and Development Plans.

STEP 3

Developer Selection

Administrative or simplified competitive process, generally favoring state-owned enterprises.

STEP 4

Developer Approval

Facilitated access to state financing and domestic supply chain.

STEP 5

Operation and Grid Integration

Sale through regulated tariffs, provincial contracts, or spot market (post-subsidy model).

REMUNERATION AND ENERGY CONTRACTING

The tariff evolution in the Chinese offshore wind market occurred in three main phases:

2010 -2020

Regulatory framework, planning, and granting of development rights

Definition of offshore Feed-in Tariff (FiT) model

Tariffs in the range of ~0.75–0.85 RMB/kWh (~€90–110/MWh at the time)

2020-2021

Announcement of the end of FiT and transition to “grid parity”

Construction boom before the end of incentives

POST- 2022 [GRID PARITY]

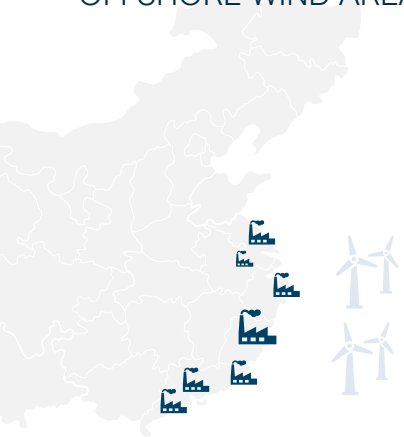
New projects must compete in the market

Some provinces offer local incentives and regional PPAs gain relevance

Projects operate close to local thermal tariffs (~0.35–0.45 RMB/kWh), depending on the province

CHINA

OFFSHORE WIND AREA AUCTIONS



SUPPLY CHAIN AND INFRASTRUCTURE

Over the past decade, China has developed the most integrated and vertically structured offshore supply chain in the world.

The rapid expansion of installed capacity has been accompanied by a deliberate strategy to strengthen domestic industry, including **turbine manufacturers, monopile and jacket foundation producers, subsea cable suppliers, offshore substations, specialized installation vessels.**

Domestic companies such as *MingYang, Goldwind, and Dongfang Electric* lead the development of large-scale turbines (12–18 MW), while local shipyards and suppliers ensure high serial production capacity.

Port infrastructure has also evolved in a coordinated manner, with expansion of logistics bases in provinces such as *Guangdong, Jiangsu, and Fujian*.

These ports operate as integrated hubs for assembly, pre-commissioning, and O&M, supported by a domestic installation fleet.

The result is a highly resilient, large-scale, and nationally integrated industrial ecosystem.

RISK ALLOCATION

Historically, market risk was reduced through national Feed-in Tariffs; with the transition to grid parity, there is greater exposure to the provincial electricity market, albeit still within a regulated environment.

Construction risk is mitigated by the vertical integration of the domestic supply chain.

Regulatory risk is low in terms of strategic direction but subject to abrupt public policy adjustments.

OSW

MARKETS TO WATCH

CHINA

The Chinese experience demonstrates that the accelerated expansion of offshore wind can be enabled by strong state coordination, regional planning, and integration with industrial and port policies. However, the Chinese model is heavily anchored in state-owned enterprises and a centralized decision-making structure, which differs significantly from the Brazilian institutional reality. Even so, several elements observed in China's trajectory offer relevant lessons for Brazil, both as replicable best practices and as warnings regarding potential risks.

LESSONS LEARNED

- Early regional planning and the definition of offshore zones prior to auctions reduced conflicts with fishing, navigation, and other maritime uses.
- Integration between energy policy, port infrastructure, and industrial policy enabled the acceleration of supply chain development and reduced costs/risks.
- An initial phase with economic support and strong state coordination allowed for the reduction of technological risk and rapid industry development.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

From a Brazilian perspective, the Chinese case reinforces that:

Coastal port and industrial clusters can reduce costs and accelerate sector development, highlighting the importance of offshore logistics hubs in Brazil.

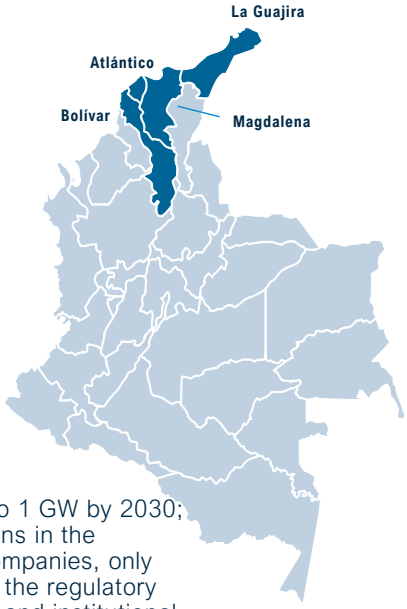
Institutional coordination between the federal government, states, ports, and environmental agencies will be critical, given the multiplicity of stakeholders in Brazil's maritime licensing process.

The Chinese model shows limits in terms of direct replication, indicating that Brazil should prioritize competition and private sector participation, avoiding excessive state centralization.

Regional development based on coastal industrial clusters and a strategy focused on market consolidation and scalability.

COLOMBIA

OFFSHORE WIND AREA AUCTIONS



MARKET | SIZE, MATURITY STAGE, AND OFFSHORE RELEVANCE

Colombia is the most advanced Latin American country in structuring a regulatory model for offshore wind, having launched its first site allocation round at the end of 2023.

The technical potential is concentrated in the Colombian Caribbean, especially in the northern region, but the market remains at a pre-commercial stage, with no projects under construction or in operation.

The government has set an indicative target of up to 1 GW by 2030; however, the first round revealed important limitations in the model's attractiveness. Of the eight pre-qualified companies, only one submitted a final bid, highlighting challenges in the regulatory design, the definition of remuneration mechanisms, and institutional coordination.

Additionally, the Colombian energy context—marked by recent constraints in natural gas supply—increases the strategic relevance of offshore wind but also raises sensitivity to price risks and regulatory stability.

AUCTION PROCESS

In designing its model, Colombia assessed two international references: the integrated model adopted by ***Denmark*** and the ***Netherlands***, and the two-stage model from the United Kingdom.

Considering the emerging nature of the market and the need for institutional maturity, the British structure was selected.

1 LEASE PHASE – TEMPORARY OCCUPATION PERMIT

2 CONCESSION PHASE AND RIGHT TO BUILD

Pre-Auction Phase (~10 months)

nitial Development Phase (up to 8 years)

Long-Term Phase (~30 years)

PRE-QUALIFICATION	AREA DESIGNATION	BID SUBMISSION AND SELECTION	TEMPORARY OCCUPATION PERMIT	MARITIME CONCESSION
			Pre-feasibility studies, social engagement, grid connection (National Interconnected System – SIN) and environmental licensing	Construction and Operation

COLOMBIA

OFFSHORE WIND AREA AUCTIONS

AUCTION PROCESS

During the lease phase, which can last up to eight years, the developer assumes technical, environmental, and social obligations before obtaining authorization for construction. The final concession may reach up to 30 years of operation.

The institutional structure involves multiple entities — the Ministry of Mines and Energy, DIMAR, environmental authorities, and electricity sector agencies — requiring strong coordination across different levels of government.

SELECTION CRITERIA AND ECONOMIC MECHANISM

The first round prioritized qualitative criteria rather than price competition. Minimum financial requirements, technical qualification, and proven offshore wind experience were required. The objective was to structure a robust project pipeline and reduce execution risks.

The government indicated its intention to adopt Contracts for Difference (CfD) as the main economic support mechanism. Although a conceptual framework was presented, several key aspects remained undefined, such as:

- methodology for defining the strike price
- responsibilities for grid connection
- guarantee structure
- allocation of grid-related risks

This lack of detail contributed to the low level of final participation in the tender.

SUPPLY CHAIN AND INFRASTRUCTURE

The Colombian offshore supply chain is still incipient, although the country has relevant experience in the oil and gas sector. Ports such as Cartagena and Barranquilla may play a strategic role but could require adaptations to meet the scale and specific requirements of offshore wind.

Transmission infrastructure in the northern region of the country represents a critical bottleneck and may require structural reinforcements to accommodate utility-scale projects.

OSW

MARKETS TO WATCH

COLOMBIA

The Colombian experience highlights the challenges and lessons inherent to structuring an offshore wind market at an early stage. The first cycle of site allocation demonstrated the importance of aligning regulatory design, economic mechanisms, and institutional coordination to consolidate the model's attractiveness over time.

LESSONS LEARNED

- The adoption of a two-stage model (lease + right to build) allows for the progressive maturation of projects, although it requires strong coordination among the involved entities.
- The prioritization of qualitative criteria contributes to building a technically robust pipeline, especially in markets still under consolidation.
- The evolution of the economic mechanism (including CfDs) and greater detail regarding grid connection are expected to strengthen the model's predictability in future cycles.
- Structured social engagement proves to be a central element in regions with specific territorial and community characteristics.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Clarity regarding the economic model is essential to stimulate consistent competition.

Interinstitutional coordination reduces uncertainties and strengthens the perception of regulatory stability.

Continuous dialogue with the market helps calibrate guarantees, risks, and expectations.

Integration of social aspects and local development from the early stages increases the sustainability of the model.

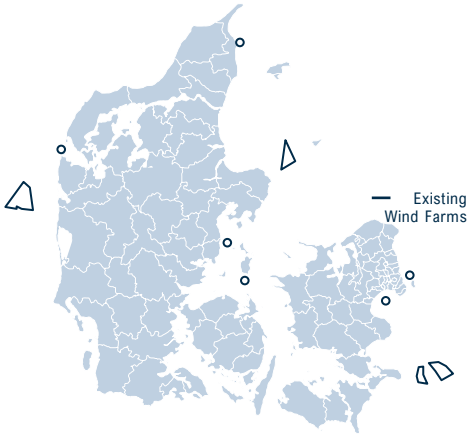
DENMARK

OFFSHORE WIND AREA AUCTIONS

MARKET | SIZE, MATURITY STAGE, AND OFFSHORE RELEVANCE

Denmark is one of the pioneering offshore wind markets in the world, having developed its first commercial projects as early as the early 2000s.

Currently, the country has approximately 2.6 GW installed, with new projects under development and ambitious expansion targets in the North Sea and the Baltic Sea.



Offshore wind has become a central pillar of Denmark's energy strategy, contributing to the decarbonization of the power system and positioning the country as a global reference in the planning and governance of large-scale maritime projects.

Future expansion includes projects such as Thor (1 GW) and new areas planned for upcoming auction rounds, with COD estimated between 2032 and 2033, reinforcing the role of offshore wind in the European energy transition.

INSTITUTIONAL AND REGULATORY MODEL

The Danish model is characterized by strong state coordination and early-stage planning, with a clear division of institutional responsibilities throughout the process.

DANISH ENERGY AGENCY (DEA)

Responsible for offshore planning, auction organization, and licensing coordination. The agency acts as a one-stop shop, centralizing coordination among different authorities and reducing administrative complexity for investors.

ENERGINET TRANSMISSION SYSTEM OPERATOR (TSO)

Responsible for integrating offshore generation into the national power system, including planning and coordination of connection infrastructure.

MINISTRIES AND SECTOR AUTHORITIES

Participate in environmental assessment, maritime spatial planning, and the management of conflicts with other sea uses, such as navigation, fishing, defense, and environmental conservation.

DENMARK

OFFSHORE WIND AREA AUCTIONS

STRUCTURE OF OFFSHORE SEABED AUCTIONS

Unlike some offshore markets, Denmark does not adopt a “pure” maritime site leasing model. Competitive processes typically combine, within a single auction, both the concession of the offshore area and the remuneration mechanism for the energy generated.

Under this integrated model, the winner simultaneously obtains the right to develop the wind farm in the designated area and the project’s economic framework, historically structured through Contracts for Difference (CfD) or equivalent revenue support mechanisms.

Thus, Danish auctions essentially function as block auctions with an associated energy contract, reducing revenue uncertainty for developers and contributing to the viability of capital-intensive projects.

AUCTION PROCESS

The development of offshore projects in Denmark follows a structured process strongly driven by the State, in which a significant portion of technical, environmental, and regulatory uncertainties is addressed prior to the competitive phase. This approach aims to reduce development risks and improve the quality of bids submitted by investors.

STEP 1
Maritime Spatial Planning

The government identifies potential offshore generation areas considering environmental constraints, shipping routes, fishing activities, defense, submarine cables, and integration with the power system.

STEP 2
Preliminary Technical and Environmental Studies

Detailed studies are conducted on seabed conditions, wind resources, biodiversity, and environmental impacts. These studies allow projects to reach a higher level of maturity before the auction.

STEP 3
Strategic Environmental Assessment

The Danish Energy Agency conducts broad environmental assessments (Strategic Environmental Assessment), which serve as the basis for subsequent project licensing.

STEP 4
Auction Design

Based on the studies carried out, the government defines the auction parameters, including the area to be offered, estimated project capacity, remuneration structure, and participation rules..

STEP 5
Competitive Process

Investors submit proposals for project development. The competitive criterion generally involves the level of support required (strike price or subsidy) or, in more recent models, other economic parameters defined in the tender documents.

DENMARK

OFFSHORE WIND AREA AUCTIONS

REMUNERATION AND ENERGY CONTRACTING

Historically, Denmark has used Contracts for Difference (CfD) as the main economic support mechanism for offshore projects. Under this model, the government establishes a reference price (strike price), and the producer receives a premium when the market price falls below this level, ensuring greater revenue predictability.

Support is typically limited to a defined volume of generation corresponding to approximately a decade of operation. Over time, the reduction in technology costs has allowed for a gradual decrease in the level of public support, reflecting the increasing maturity of the European offshore supply chain.

OBSERVED RESULTS | RECENT AUCTIONS

2021 Thor ~1 GW

Intense competition led to extremely low bids (~DKK 0.01/kWh) under a two-way CfD model, reflecting the high level of maturity of the European offshore market at that time.

2024 North Sea ~3GW

The auction, structured without subsidies, received no bids, highlighting a misalignment between risk allocation, recent offshore supply chain costs, and investor return expectations.

2025-2026 New Design

The government announced a new round with subsidies and greater contractual flexibility, aiming to rebalance risk allocation and restore competitiveness to the bidding process.

SUPPLY CHAIN AND INFRASTRUCTURE

The Danish strategy has contributed to consolidating a highly competitive offshore industrial cluster, including turbine manufacturers, engineering companies, maritime operators, and specialized service providers.

Ports such as *Esbjerg* have become strategic logistics hubs for the installation and maintenance of offshore wind farms in the North Sea. Proximity to Germany, the Netherlands, and the United Kingdom also favors regional supply chain integration at scale.

RISK ALLOCATION

The Danish model has historically sought to reduce uncertainties prior to the auction, with the government conducting preliminary environmental and technical studies. This strategy reduces development risks and contributes to greater competition among investors.In recent years, however, changes in risk allocation, including increased developer responsibility for grid connection, have sparked discussions regarding the balance between public and private risk.

OSW

MARKETS TO WATCH

DENMARK

Even as one of the most mature offshore wind markets in the world, Denmark continues to adjust its development model to balance competitiveness, costs, and risk allocation.

The Danish experience demonstrates that the success of offshore wind depends not only on the quality of wind resources, but primarily on institutional planning, regulatory coordination, and predictability for investors.

LESSONS LEARNED

- Auctions that combine site allocation and energy remuneration mechanisms reduce revenue uncertainty, allowing investors to assess projects in an integrated manner and submit more competitive bids.
- Early state-led planning of offshore areas, along with the execution of technical and environmental studies prior to auctions, helps reduce development risks and increase predictability in the competitive process.
- Centralized institutional coordination, with a single agency responsible for planning and licensing, can simplify governance and accelerate offshore project development.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Early maritime spatial planning can reduce conflicts with other sea uses and better guide area selection.

Government-led technical and environmental studies can enhance predictability and reduce the cost of capital.

Clear institutional coordination among entities responsible for licensing, maritime planning, and the power system is essential to avoid regulatory fragmentation.

The evolution of the offshore model tends to be gradual and based on institutional learning, combining public policies, technological development, and market maturity.

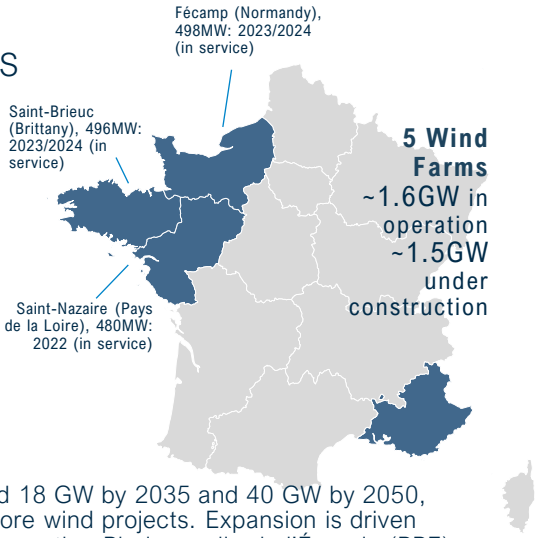
FRANCE

OFFSHORE WIND AREA AUCTIONS

MARKET | SCALE, MATURITY STAGE AND OFFSHORE RELEVANCE

France has established itself as one of Europe's most structured offshore wind markets, adopting a centralized model strongly coordinated by the State.

Although installed capacity currently remains relatively limited (~1.6 GW in operation), the contracted pipeline and official targets indicate significant expansion toward 2035 and 2050.



The country has set ambitious targets: around 18 GW by 2035 and 40 GW by 2050, including both fixed-bottom and floating offshore wind projects. Expansion is driven through multi-year planning under the Programmation Pluriannuelle de l'Énergie (PPE), which defines auction schedules and capacity volumes in advance, providing visibility to the market.

France stands out for combining strong state planning, upfront risk mitigation and a structured remuneration mechanism, resulting in competitive pricing in recent auction rounds.ciclos mais recentes.

AUCTION MODEL

In France, auctions combine area allocation + price competition. The State defines the area in advance, conducts environmental and technical studies, and only then launches the competitive tender.

The model is conducted by Commission de régulation de l'énergie, while the State coordinates area selection and preparatory studies. The winner is selected based on the lowest offered price (€/MWh), within a CfD mechanism with subsidy support, guaranteeing a long-term contract of approximately 20 years.

SUPPLY AND PORTS

France has developed a local industrial policy and supporting infrastructure. Ports such as Port of Saint-Nazaire, Port of Le Havre and Port of Brest have become strategic hubs for manufacturing, pre-assembly and installation. Industrial policy is integrated into the auction model, encouraging domestic manufacturing and job creation without compromising price competitiveness.

FRANCE

OFFSHORE WIND AREA AUCTIONS

PROCESS AND PLANNING

The French model is highly centralized and based on advance state planning. Before launching each auction round, the government strategically selects the offshore areas, conducts environmental and technical studies, and organizes public consultations, integrating projects into the national energy planning framework (Programmation Pluriannuelle de l'Énergie – PPE). This preparatory phase may take one to two years before the competitive tender is launched.

1 GOVERNMENT STUDIES

- strategic selection of offshore areas
- maritime spatial planning studies
- environmental assessments
- integration with national energy planning (PPE)
- definition of maritime boundaries
- coordination with the offshore grid operator (RTE)

PUBLIC CONSULTATION

2 AUCTION

AUCTION LAUNCH

BID SUBMISSION

DEFINIÇÃO DO VENCEDOR – MENOR PREÇO

SIGNATURE OF THE CFD CONTRACT

3 CONSTRUCTION AND OPERATION

DEVELOPMENT, CONSTRUCTION AND OPERATION PHASE

Long-term concession (~20 anos)

OBSERVED RESULTS | RECENT AUCTION ROUNDS

- **2011–2014** (AO1–AO2): higher initial prices reflecting the early stage of market development and higher regulatory risk
- **2019** (AO4 – Dunkerque): significant price decline driven by sector maturation and the transfer of offshore grid connection responsibilities to the French TSO (RTE)
- **2022–2023** (AO8 – Centre Manche 2): competitiveness maintained, although results already reflect global inflation and supply chain pressures.

From 2016 (AO3) onwards, offshore grid connection became the responsibility of the French TSO (RTE), reducing grid-related risks for developers and contributing to lower auction prices.

Auction	Year	Capacity	€/MWh
AO1–AO2	2011–2014	~3.0 GW	~110 - 120
AO4 (Dunkerque)	2019	~0.6 GW	~44
AO8 (Centre Manche 2)	2022	1.5 GW	~66

OSW

MARKETS TO WATCH

FRANCE

Although the French model is institutionally robust, some auction rounds have shown that site selection and the specific context of each project remain decisive for competitive outcomes.

In AO7 (Île d'Oléron), the absence of bids indicated that factors such as environmental sensitivity, competing sea-use interests (tourism and fisheries), and higher technical complexity can reduce investor appetite even in mature markets. These episodes reinforce that centralized planning alone is not sufficient: auction design requires continuous calibration, particularly regarding risk allocation, timing and economic attractiveness.

In response, the French government has progressively adjusted qualification criteria and preparatory phases to preserve competitiveness and maintain alignment with long-term policy targets.

LESSONS OBSERVED

- Advance government planning, including area definition and environmental studies, reduces uncertainty and supports price-based competition
- The transfer of offshore grid connection responsibility to the TSO (RTE) was decisive in mitigating technical and financial risks, contributing to structural price reductions
- The integrated model (area + CfD) increases revenue visibility and facilitates investment decisions in capital-intensive projects
- Industrial policy can coexist with competitiveness when aligned with long-term targets and supply chain maturity.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Advance definition of areas and environmental studies reduces information asymmetry and improves competitive pipeline quality

Integration between energy planning and transmission expansion is essential to mitigate grid risk and enable large-scale projects

A revenue stabilization mechanism (CfD or equivalent) is a central factor for attracting capital and reducing financing costs

Multi-year auction planning, with a predictable schedule, increases investor visibility and stimulates industrial supply chain development

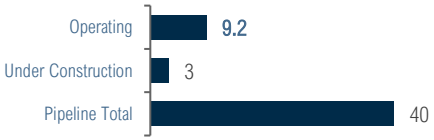
GERMANY

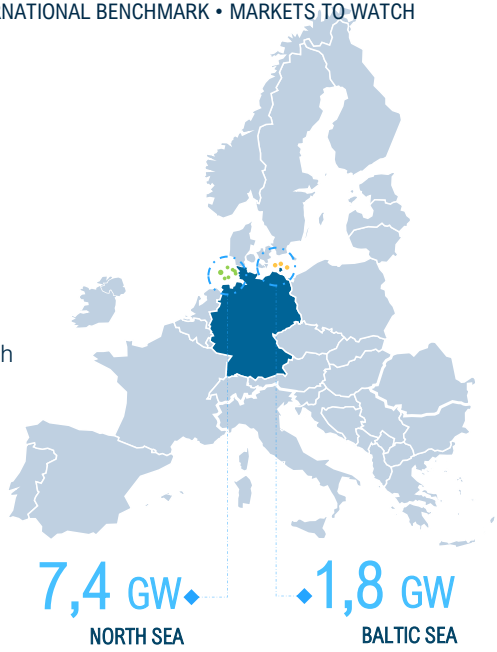
OFFSHORE WIND AREA AUCTIONS

MARKET | SIZE, MATURITY SCALE, AND OFFSHORE RELEVANCE

Germany is the largest offshore wind market in continental Europe and the second largest in Europe overall; it is a mature offshore market, with governance geared to scaling volumes with predictability and reducing development risks through a centralized model.

GERMANY OFFSHORE WIND DEVELOPMENT STATUS (GW)





In recent cycles, the country became known for intense competition, including "zero-subsidy" bids in certain categories. More recently, experience shows the need to recalibrate design when market conditions (CAPEX, supply chain, costs) change, including rounds that attracted no bids for some sites.

INSTITUTIONAL AND REGULATORY MODEL

Germany combines two institutional pillars:

- BNetzA (Bundesnetzagentur): runs auctions and publishes results, differentiating processes for non-pre-investigated and centrally pre-investigated sites.
- BSH: conducts centralized preliminary investigations (environmental, geotechnical, and sea-use constraints), producing a public information package that reduces asymmetries and improves comparability among bidders.

STRUCTURE OF SEABED AREA AUCTIONS

The German model is regulated by the Offshore Wind Energy Act (WindSeeG), operating in a centralized and state-led manner, where the government auctions the right to develop pre-planned maritime areas rather than energy. The Federal Maritime and Hydrographic Agency (BSH) defines areas and performs preliminary studies, providing data via SEA/Site investigations. Grid connection is planned by TenneT (North Sea) and 50Hertz (Baltic Sea), mitigating regulatory and grid risks before auctions.

GERMANY

OFFSHORE WIND AREA AUCTIONS

AUCTION PROCESS

Auctions are fundamentally a financial competition for the right to develop a given offshore area. In prevailing models, the central award criterion is the economic value offered by the developer to the German state. Unlike traditional tariff support schemes, the winner does not receive a guaranteed price for the generated energy.

Instead, the winner pays substantial amounts for site rights ("negative bidding"/onerous concession). Project revenues thus depend entirely on wholesale merchant exposure or private bilateral contracts (corporate PPAs), with no public price stabilization mechanisms.

- For **non-centrally pre-investigated sites**, there can be multiple online bidding rounds.
- For **centrally pre-investigated sites**, procedures include qualitative criteria (e.g., project decarbonization and more environmentally friendly foundations) in addition to the economic bid.

The arrangement is enabled by a very mature power market, high liquidity, and well-capitalized utilities (e.g., RWE, EnBW). However, high area payments increase implicit CAPEX and make projects sensitive to power prices, cost of capital, and macroeconomic conditions, raising debate about long-term sustainability.

OBSERVED RESULTS | RECENT AUCTIONS

2023 First dynamic online bidding for non-centrally pre-investigated sites

BNetzA reported that this was the first time it conducted dynamic online procedures for offshore sites that had not been pre-investigated, totaling €12.6 billion in revenues.

2024 Multiple online bidding rounds

For sites N-11.2 and N-12.3, BNetzA explicitly reported that there were 46 rounds (N-11.2) and 55 rounds (N-12.3) in the online process.

2024 Centrally pre-investigated sites with qualitative criteria

BNetzA confirms the use of qualitative criteria (decarbonization and more "environmentally friendly" functions), in addition to willingness to pay.

GERMANY

OFFSHORE WIND AREA AUCTIONS

REMUNERATION AND ENERGY CONTRACTING

The German experience has been marked by periods in which competition reached "zero-subsidy" bids and, when necessary, the selection can shift to mechanisms for capturing the value of development rights (site payment). The recent design adds qualitative criteria to align expansion with environmental and technological objectives, which influences investor costs and timelines.

SUPPLY CHAIN AND INFRASTRUCTURE

Germany has highly specialized port infrastructure supporting offshore wind, especially along the North Sea. Ports such as *Cuxhaven and Bremerhaven* host manufacturing, pre-assembly, storage, and shipment of large components, with reinforced quays and extensive industrial backlands. The integration of port, industry, and operators reduces logistics costs, shortens mobilization timelines, and increases project reliability.

However, Germany is not fully self-sufficient. Despite incumbents like *Siemens Gamesa* and a consolidated industrial base, some components and structures are made in the Netherlands, Denmark, and Asia. There is also dependence on specialized installation vessels (WTIVs), with a limited fleet operated by international players, creating exposure to global bottlenecks.

RISK ALLOCATION

Technical risks are allocated to the public sector; economic risks to investors. The state, via BSH, undertakes planning and environmental studies, while TenneT and 50Hertz handle grid connection, reducing regulatory and grid risk. Developers pay for the area, finance the project, and assume execution risk.

Revenue is mainly merchant, without CfD/public guarantees, increasing exposure to price volatility and capital costs. While Germany benefits from specialized ports and a robust industrial chain, it still depends on global suppliers and vessels. The model is efficient for a mature market but more sensitive to economic shocks.

OSW

MARKETS TO WATCH

GERMANY

The German experience demonstrates that the success of offshore wind depends on early centralized planning, regulatory clarity, and robust infrastructure prior to the auctions. The prior definition of areas, strategic environmental studies, and coordination with grid operators reduce initial risks and increase attractiveness for investors.

LESSONS LEARNED

- A robust pre-auction package (data + maps) increases comparability, reduces asymmetry, and tends to improve the quality of the competitive process.
- Qualitative criteria (decarbonization, more environmentally friendly foundations) reinforce sustainability, but increase governance, auditing, and execution requirements.
- A fully merchant arrangement, as in Germany, requires a liquid market, abundant capital, and risk appetite; otherwise, revenue stabilization mechanisms may be necessary in the initial phase.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Regulatory predictability and industrial/market robustness are more valuable and attractive than subsidies.

The German model transfers price risk to the investor; in Brazil, the maturity of the electricity market should guide the acceptable level of merchant exposure.

Germany's port infrastructure robustness preceded large-scale expansion; in Brazil, the development of logistics hubs should accompany, not follow, auctions.

Multi-year auction predictability provides long-term signaling, which is essential to attract the global supply chain.

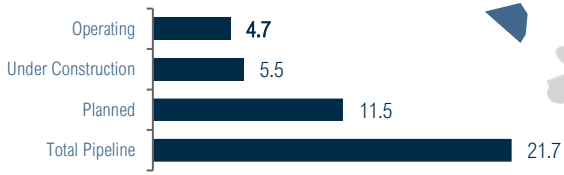
NETHERLANDS

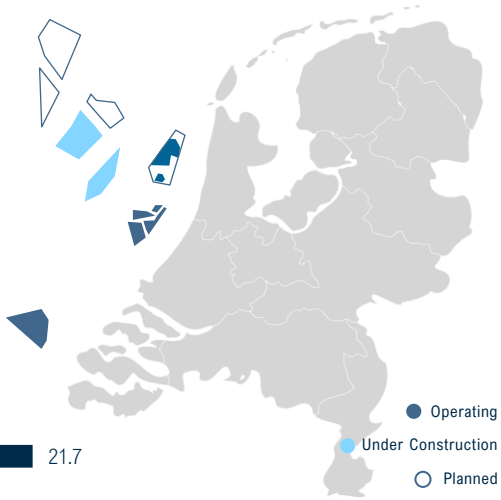
OFFSHORE WIND AREA AUCTIONS

MARKET | SCALE, MATURITY STAGE AND OFFSHORE RELEVANCE

The Netherlands is one of the most mature offshore wind markets in the North Sea, with approximately 4.7 GW installed and a target exceeding 21 GW by 2030 under its national climate plan, with offshore zones already mapped in the North Sea.

NETHERLANDS OFFSHORE WIND DEVELOPMENT STATUS (GW)





One of the most sophisticated offshore area auction benchmarks, the Dutch market evolved rapidly after 2013, shifting from a decentralized model toward coordinated state planning, enabling several auction rounds without direct subsidies in certain cycles.

At the same time, recent rounds (e.g. Nederwiek I-A, 2025) have faced reduced participation proposals, indicating macroeconomic pressure on the zero-subsidy model and the need for adjustments to address rising costs, systemic risks and new ambitions such as hydrogen integration and accelerated grid expansion.

INSTITUTIONAL AND REGULATORY MODEL

The turning point came with the Energy Agreement for Sustainable Growth (2013), which centralized offshore planning.

Ministry of Economic Affairs and Climate Policy (EZK)
Defines policy, targets and implementation roadmap.

Netherlands Enterprise Agency (RVO)
Organizes tenders, public rules, studies and award processes

TenneT (TSO)
Responsible for offshore grid connection, developed in advance or in parallel with project execution

This institutional tripartite structure (government + agency + TSO) is one of the main differentiators of the Dutch model.

NETHERLANDS

OFFSHORE WIND AREA AUCTIONS

AUCTION PROCESS

The Netherlands adopts a competitive seabed concession model, closely integrated with national energy policy.

STAGE 1

State Planning

Definition of offshore zones within the North Sea spatial plan

STAGE 2

Pre-Auction Studies

Government conducts environmental, geotechnical and preliminary layout studies

STAGE 3

Tender Publication

Definition of award criteria (financial and qualitative)

STAGE 4

Submission and Evaluation

Technical, environmental and financial assessment of bidders

STAGE 5

Award and Construction

Long-term concession contract (approximately 40 years)

OBSERVED RESULTS | RECENT AUCTION ROUNDS

2018-2020
SUBSIDY-FREE CYCLE

The Netherlands became a benchmark by awarding several offshore areas without direct subsidies, supported by:

- robust public studies
- offshore grid connection delivered by the TSO
- favorable macroeconomic environment.

Area / Project	Capacity	Subsidy
Hollandse Kust Zuid I–IV	~1,5 GW	€0/MWh
Borssele III–IV	~700 MW	€0/MWh
Borssele I–II	~750 MW	Low CfD support

2021 – 2025
HYBRID MODEL

Post-2022 recalibration

With rising costs and expansion toward more complex offshore areas, new tenders began incorporating additional criteria and obligations, such as:

- offshore hydrogen integration
- system stability requirements
- non-price criteria (ecology, innovation)

In 2024–2025, the government announced that not all future auctions will remain subsidy-free, signaling flexibility similar to Denmark

The absence of bids in at least one lot (1 GW) indicates economic non-viability under current conditions (inflation, interest rates and elevated CAPEX)

NETHERLANDS

OFFSHORE WIND AREA AUCTIONS

REVENUE MECHANISM AND ENERGY CONTRACTING

Historically, the Netherlands used CfDs (SDE+) in the early auction rounds and later transitioned to subsidy-free tenders as market maturity allowed. The key point is that area auctions are not standalone: they are accompanied by guaranteed grid connection, public data availability and clear dispatch rules.

In recent cycles, policy has acknowledged that subsidies are not taboo, but rather a contingent instrument to be used when necessary to ensure project execution.

SUPPLY AND INFRASTRUCTURE

The Netherlands operates as a major logistics hub in the North Sea, with Port of Rotterdam standing out as one of Europe's main offshore assembly and transshipment ports. Proximity to Germany, Belgium and the United Kingdom supports regional supply chain integration. However, port availability must be secured ahead of construction, and logistical bottlenecks have already affected recent project timelines.

Offshore grid connection is the responsibility of TenneT, but delays in transmission infrastructure delivery have reduced deployment pace, highlighting the model's sensitivity to grid coordination.

The Netherlands is a benchmark for the TSO-led connection model: TenneT develops offshore platforms and export cables, while the developer connects its wind farm to a ready-made offshore socket. This reduces risk, capital intensity and schedule uncertainty.

RISK ALLOCATION

The model reduces development risk through technical and environmental studies conducted in advance by the government, lowering uncertainty and accelerating permitting. Grid connection risk is largely borne by TenneT, mitigating investor exposure.

During subsidy-free auction rounds, market risk was fully transferred to developers, who depended on corporate PPAs to secure financing. This structure proved efficient in a low-interest-rate environment, but became sensitive to CapEx escalation and higher financing cost. Regulatory risk has remained relatively low and predictable since the 2013 reform, although the recent reintroduction of subsidies suggests that economic sustainability depends on adjustments to macroeconomic conditions.

OSW

MARKETS TO WATCH

NETHERLANDS

The main lesson from the Dutch model is that state coordination reduces structural risk, but economic sustainability depends on balancing competition with regulatory support.

For Brazil, the challenge is not only to design area auctions, but to synchronize maritime planning, grid connection, revenue design and industrial policy within an integrated framework.

LESSONS OBSERVED

- Brazil must decide whether to prioritize public revenue capture (German model) or industrial development and gradual market expansion (early Dutch model)
- Area auctions disconnected from energy contracting increases risk; clarity on the revenue mechanism (regulated PPA, CfD or merchant market) will be essential
- Auction timing must reflect supply chain maturity and grid readiness; launching areas without supporting infrastructure may lead to unsuccessful rounds, as recently observed in the Netherlands

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Clear definition of offshore grid connection is essential.

The TSO-led model reduced investor risk in the Netherlands; in Brazil, uncertainty over who finances offshore connection may limit competitiveness

Area auctions do not replace revenue design.

Dutch projects became viable through corporate PPAs; in Brazil, clarity on the contracting mechanism will be decisive.

Regulatory flexibility is critical

The reintroduction of subsidies in the Netherlands shows that auction models require adjustment mechanisms in response to cost shocks.

Institutional coordination reduces systemic risk

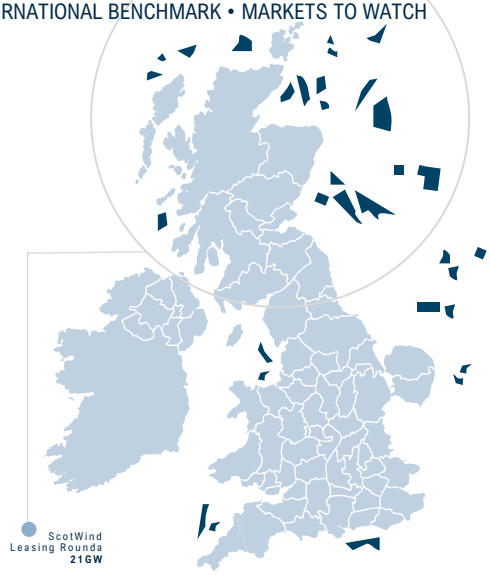
Strong integration between government, regulator and grid operator was central in the Netherlands; in Brazil, fragmentation among institutions may increase structural risk.

UNITED KINGDOM

OFFSHORE WIND AREA AUCTIONS

MARKET | SCALE, MATURITY STAGE AND OFFSHORE RELEVANCE

The United Kingdom is one of the most mature offshore markets in the world, combining large installed capacity (~15 GW) with a stable regulatory framework and a structured expansion pipeline targeting 50 GW by 2030. The sector is a central pillar of the country's energy security and net-zero strategy, reducing dependence on natural gas and strengthening electricity integration with continental Europe.



Expansion has been progressive and coordinated since the 2000s, through successive leasing rounds (Rounds 1 to 4), which established a predictable project pipeline. Complexes such as Hornsea Wind Farm and Dogger Bank Wind Farm positioned the country as a leader in large-scale projects, with strong economies of scale and technological standardization.

The market is currently undergoing an adjustment phase: after record-low CfD prices, rising CapEx and financing costs led to tariff cap revisions, showing both market maturity and sensitivity to macroeconomic conditions.

INSTITUTIONAL AND REGULATORY MODEL

THE BRITISH MODEL COMBINES AREA LEASING SEPARATED FROM ENERGY CONTRACTING.

- The Crown Estate administers the seabed and conducts area auctions in England, Wales, and Northern Ireland
- Crown Estate Scotland is responsible for Scottish waters
- Department for Energy Security and Net Zero defines energy policy
- Ofgem regulates the electricity sector. National Grid supports transmission coordination
- National Energy System Operator (ESO) coordinates system operation

The model is considered stable, with strong regulatory predictability and clear separation between territorial allocation and revenue support mechanisms.

UNITED KINGDOM

OFFSHORE WIND AREA AUCTIONS

AUCTION STRUCTURE

The United Kingdom model separates territorial competition from revenue competition, allowing public value maximization while preserving project bankability.

STAGE 1

AUCTION STRUCTURE

The Crown Estate defines areas based on maritime spatial planning.

STAGE 2

Seabed Lease Auction

The government carries out environmental, geotechnical, and preliminary layout studies.

STAGE 3

Development and Permitting

Environmental studies and construction authorizations.

STAGE 4

Energy Auction (CfD Round)

Participation in Contract for Difference auction rounds.

STAGE 5

Award and Construction

The two-step separation (area + energy) is a central feature of the British model.

TWO STAGE COMPETITION MODEL

SEABED LEASE
Area Competition

- Annual payment per MW
- Territorial risk borne by the developer
- No automatic revenue guarantee

CfD AUCTION
Energy Price Competition

- CfD auction
- Competitive strike price
- Revenue stabilized for 15 years

For granting seabed use rights, the area auction is conducted as a financial competition for development rights. Winners pay annual option fees per reserved MW until construction starts and, subsequently, lease payments proportional to installed capacity.

This model generates significant public revenue, but transfers future viability risk to the developer, since obtaining the area does not guarantee success in the energy auction (CfD), requiring strong financial and strategic capability from bidders.

OPTION FEE (PRE-CONSTRUCTION PHASE)

Developers pay an annual fee per reserved MW (£/MW/year) until Final Investment Decision (FID).

In Round 4, values ranged approximately between £76,000 and £154,000 per MW/year.

LEASE RENT (OPERATIONAL PHASE)

After operations begin, payment no longer follows a fixed rate per MW.

It becomes proportional lease rent linked to installed capacity (or generated revenue).

UNITED KINGDOM

OFFSHORE WIND AREA AUCTIONS

OBSERVED RESULTS | RECENT AUCTIONS

The United Kingdom applies an annual fee per MW awarded until lease rights are converted into construction rights.

In Round 4 (2021), resulting from seabed rights auctions for nearly 8 GW, developers offered significant option values:

- RWE: approximately £76,203/MW/year and £88,900/MW/year for two 1.5 GW sites
- Green Investment Group / TotalEnergies: £83,049/MW/year
- EnBW & BP: £154,000/MW/year (highest observed value)

The total option fee paid by Round 4 winners reached approximately £879 million per year, representing substantial public revenue generated by seabed rights even before construction begins.

More recent prices and new leases: in Round 5 offshore leasing (including floating wind areas in the Celtic Sea), option fees were set at approximately £350/MW/year under lease agreements for projects of around 1.5 GW, following recent concessions by The Crown Estate.

Energy is subsequently auctioned through Contracts for Difference (CfD) conducted by the government via competitive rounds. CfD operates as a 15-year bilateral contract: if the market price falls below the strike price, the government pays the difference to the generator; if the market price exceeds it, the generator returns the surplus.

SUPPLY CHAIN AND INFRASTRUCTURE

The United Kingdom has developed relevant industrial hubs, especially in Hull and Teesside, supported by investments linked to global manufacturers. However, part of the supply chain, including critical components, still depends on European and Asian production.

The offshore transmission model is distinctive: the developer builds transmission assets and, after energization, these assets are transferred to OFTO operators regulated by Ofgem. This structure promotes tariff efficiency but also adds contractual complexity.

The country seeks to expand local content, while facing strong global competition for port capacity, vessels, and components.

OSW

MARKETS TO WATCH

UNITED KINGDOM

For Brazil, the main strategic decision will be whether offshore wind should emerge as a coordinated industrial and energy policy or as a revenue-driven model with full market exposure.

KEY LESSONS OBSERVED

The British model shows that:

- Territorial competition and revenue stability can coexist
- Bankability is as important as public revenue capture
- Continuous regulatory adjustment is essential for market sustainability

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Before adopting a two-step model, it is necessary to assess in depth the maturity of the financial market and the developers' capacity to assume high upfront risk without automatic revenue guarantees.

If the primary objective is to develop industry and consolidate an emerging market, prioritizing public revenue may compromise initial bankability.

A revenue stabilization mechanism (CfD or equivalent) may be more relevant in the early market phase than maximizing territorial competition.

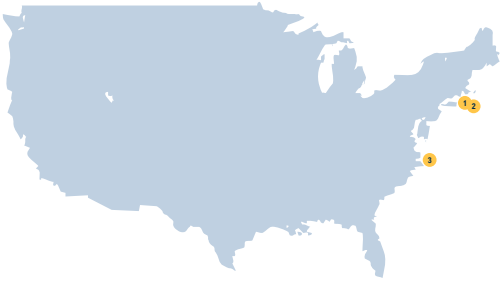
Regulatory design should include recalibration mechanisms (indexation, periodic reviews), avoiding unsuccessful auction rounds that may undermine market credibility.

UNITED STATES

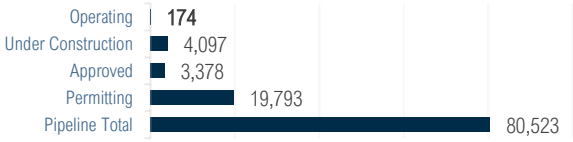
OFFSHORE WIND AREA AUCTIONS

MARKET | SCALE, MATURITY STAGE AND OFFSHORE RELEVANCE

The U.S. offshore wind market is characterized by large-scale potential, with a total development pipeline of approximately 80.5 GW



US OFFSHORE WIND DEVELOPMENT STATUS (MW)



	PROJECT	STATE	CAPACITY (MW)
1	Block Island	Rhode Island	30
2	South Fork	Nova York	132
3	CVOW Pilot	Virginia	12

The United States operates under a dual institutional model, in which the federal government auctions seabed rights, while energy contracting typically occurs separately at the state level. This creates strong dependence on coordination across different levels of government.

Although the pipeline and scale potential are significant, recent experience shows that offshore project viability in the U.S. depends less on market appetite alone and more on whether the institutional and delivery model adequately supports execution.

INSTITUTIONAL AND REGULATORY MODEL

The federal government organizes and auctions offshore areas through the definition of Wind Energy Areas (WEAs) by Bureau of Ocean Energy Management. Meanwhile, individual states play a decisive role in project bankability, particularly through energy contracting mechanisms.

This structure reinforces that a federal lease alone does not guarantee revenue, making alignment with state-level policy essential.

STRUCTURE OF THE LEASE AUCTIONS

Federal offshore lease auctions adopt a competitive price-based mechanism (cost breaker) with multiple bidding rounds until a winner is defined, similar to other asset auctions, including Brazil. Beyond price, Bureau of Ocean Energy Management also applies bidding credits linked to specific commitments. Recent experience shows, however, that auction design alone does not ensure project attractiveness when contractual models and infrastructure arrangements are not aligned with offshore complexity.

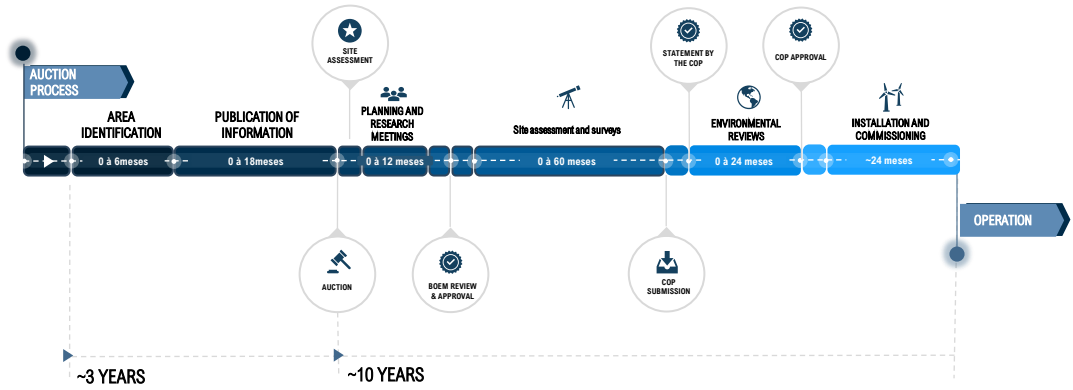
UNITED STATES

OFFSHORE WIND AREA AUCTIONS

AUCTION PROCESS

The pre-auction phase is extensive and may last approximately three years. During this period, activities include area planning and definition, preliminary coastal impact studies, institutional consultations and the initial licensing process. Only after this maturation phase are offshore areas effectively offered in federal lease auctions.

The full process - from initial design to commercial operation - is long and phased, with the complete cycle from lease award to commercial operation taking approximately ten years.



OBSERVED RESULTS | RECENT AUCTION ROUNDS

- **2022** - New York Bight - record-breaking revenue generation
- **2023** - Gulf of Mexico - limited interest, partly influenced by political timing, showing that even mature markets may face reduced competitive participation when timing and visibility are weak
- **2024** - First commercial floating-ready sale on the Atlantic Coast.

Auction	Year	Region	Total BID (US$)	Area (km²)	US$/acre
New York Bight	2022	Northeast Atlantic	4.37 bi	~1,975	**~2,212,000**
California	2022	Pacific	757 mi	~1,509	**~501,000**
Gulf of Mexico	2023	Gulf	5.6 mi	~413	**~13,600**
Central Atlantic	2024	Atlantic	92.6 mi	~1,121	**~82,600**
Gulf of Maine	2024	Atlantic	21.9 mi	~3,870	**~5,700**

UNITED STATES

OFFSHORE WIND AREA AUCTIONS

REVENUE MECHANISMS AND ENERGY CONTRACTING

In the U.S., there is no single remuneration model linked to federal offshore lease auctions. Energy contracting occurs predominantly at the state level, through PPAs, ORECs or similar mechanisms. This separation means that project economics depend heavily on alignment with state-level policy frameworks.

Mechanism	Description	Positive Points	Negative Points	Analysis
Fixed OREC	Fixed payment per MWh through OREC over the contract term	Simplicity; revenue predictability	Does not protect against inflation or macro shocks; contracts may fall below breakeven	Suitable in the initial market phase; showed fragility after 2021
Bundled PPA	Integrated contract combining energy and environmental attributes	Strong revenue hedge; scalable structure	Complex; requires financially strong utilities	Performs well in mature markets, but reduces flexibility
Utility-Owned Generation	Project developed and operated by a regulated utility	Lower cost of capital; greater stability	Lower competition; risk of inefficiency	Politically sensitive; may reduce market dynamism
Split PPA	State-paid OREC plus separately marketed energy	Commercial flexibility; separates risks	Exposure to power market volatility; higher complexity	Intermediate model, but with relevant residual risk
Market OREC	Floating OREC linked to energy market prices	Partial hedge; market alignment	High volatility; elevated developer risk	Less suitable for capital-intensive projects
Index OREC	OREC indexed to inflation, commodities or other variables	Reduces volatility; improves bankability	Higher regulatory complexity	Natural evolution of the New York model; institutional upgrade
Forward OREC	OREC contracted in advance for future delivery	Early revenue visibility; partial hedge	Limited liquidity; complex pricing	Useful as a complementary mechanism, not as the main structure

SUPPLY AND INFRASTRUCTURE

The supply chain is evolving and receiving significant investment, although constructability still depends heavily on European offshore expertise.

Infrastructure delivery may be public, private or hybrid, often negotiated case by case between government and developers, and strongly linked to regional industrial strategy. The absence of integrated regional planning for offshore transmission and port infrastructure has resulted in underutilized assets and structural increases in connection and schedule costs.

RISK ALLOCATION

The absence of a federal revenue stabilization mechanism provides flexibility, but also means that macroeconomic shocks, regulatory delays and cost escalation are largely absorbed by developers, reducing predictability and investor appetite. Extreme weather events, regulatory uncertainty and politically unfavorable timing directly affect investor appetite and competitive dynamics.

OSW

MARKETS TO WATCH

UNITED STATES

The contrast between the U.S. model and other international experiences reinforces the importance of institutional coordination, advance infrastructure planning and deliberate risk allocation, especially in capital-intensive projects with high execution complexity such as offshore wind

LESSONS OBSERVED

- Separating area auctions from energy contracting provides flexibility, but increases coordination complexity and exposure to risks — critical factors for maintaining market attractiveness
- Lease auctions using bidding credits can support industrial and port policy objectives, while also reducing conflicts with ocean users
- Structured processes combining public consultation and environmental assessment reduce risk and increase project attractiveness.

REFLECTIONS FOR THE BRAZILIAN CONTEXT

Regulatory and political volatility can directly affect investor appetite and pricing

Area auctions may be structured independently from the revenue mechanism (PPA / CfD / merchant market), avoiding excessive linkage between seabed policy and energy procurement

Non-price criteria (bidding credits) may help induce port development, supply chain localization, workforce qualification and coexistence with fisheries and other sea users

Coordination between federal and subnational entities in Brazil (União × states × ports × IBAMA) will be decisive for the model's success

3

INTERNATIONAL LESSONS AND STRATEGIC ELEMENTS FOR BRAZIL

PATHWAYS FOR STRUCTURING BRAZIL

The benchmark analysis shows that there is no single correct model for offshore wind development, but rather different institutional architectures shaped by each country's regulatory, energy, and industrial characteristics.

Still, international experience reveals convergence around some structural elements: prior seabed planning, regulatory predictability, clear project selection mechanisms, definition of responsibilities for critical infrastructure, and consistent market signaling.

In markets that have reached greater maturity, offshore sector consolidation occurred gradually, combining coordinated public sector action, progressive regulatory evolution, and risk mitigation instruments capable of attracting investors to a capital-intensive industry with long development cycles.

In this context, Brazil is beginning to assemble unprecedented institutional conditions to advance the structuring of its offshore market.

The approval of Law No. 15,097/2025 establishes the initial legal framework for the technology, but international experience indicates that effective sector consolidation over the coming years will depend on the country's ability to transform this legal basis into clear regulatory, operational, and competitive instruments.

INSTITUTIONAL STRUCTURING AND REGULATORY PREDICTABILITY

Benchmarks show that regulatory predictability has been a decisive factor for portfolio formation, investor mobilization, and offshore supply chain development.

In virtually all markets analyzed, sector maturation followed a coordinated sequence of legal, regulatory, and administrative instruments, enabling economic agents to anticipate stages, obligations, and investment conditions.

In Brazil's case, although legal approval represents an important institutional milestone, relevant definitions remain pending regarding infra-legal regulation, administrative coordination among competent authorities, and the implementation timeline of the next instruments required to make competitive market development viable.

AREA LEASING AND ORGANIZATION OF THE COMPETITIVE PROCESS

International experience shows that area leasing is one of the central pillars of offshore market architecture. Regardless of the model adopted — centralized, hybrid, or market-driven — successful countries structured transparent mechanisms for area definition, selection criteria, and access rules for competitive processes.

In more mature European markets, greater state involvement is observed in the pre-development of areas, including environmental studies, technical surveys, and maritime spatial planning. In markets with greater investor risk transfer, such as the United States, the competitive process is more concentrated on granting development rights, with greater private responsibility for project maturation.

For Brazil, the execution of the first seabed auction cycle tends to represent a strong market signal, not only because of potential fiscal revenues, but mainly because it establishes a tangible institutional environment of continuity. The publication of tender documents, combined with objective participation criteria, tends to function as a retention mechanism for the interest of agents already positioned in the country.

FINAL CONSIDERATIONS ON BRAZIL'S DEVELOPMENT PATH

International experience shows that offshore wind development does not result from a single regulatory instrument, but from the progressive construction of an institutional environment capable of reducing uncertainty, organizing responsibilities, and structuring long-term investments.

Across the markets analyzed, regardless of the design adopted for area leasing or energy contracting, sector consolidation has been associated with regulatory predictability, prior seabed planning, coordination among public authorities, and gradual definition of mechanisms compatible with the maturity stage of each market.

In Brazil, the approval of Law No. 15,097/2025 marks a new phase for the technology by establishing the initial legal framework for its integration into the national power matrix. Market consolidation will depend, however, on the country's ability to translate this legal milestone into regulatory, operational, and competitive instruments that provide clarity to implementation processes and signal institutional continuity to economic agents.

In this context, more than replicating international experiences, Brazil will need to build its own trajectory, aligned with its regulatory, energy, and industrial characteristics.

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