Japan and Brazil

5 LESSONS FOR KNOWLEDGE TRANSFER AND EXPERIENCES IN OFFSHORE WIND

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CONTENTS

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DISCLAIMER

EXECUTIVE SUMMARY

This guideline paper addresses 5 lessons and experiences from Japanese offshore wind energy that can be materialized in knowledge transfer with Brazil and other emerging markets.

The Japanese offshore wind industry accounts for 288 MW of cumulative capacity from the 83 GW global offshore wind installations. The Japanese market is among the top 10 countries with the world's largest installed offshore wind energy capacity, moving towards technological scalability.

The question addressed in this material is, "Which factor is most critical for Brazil to prioritize in offshore wind?" In this context, this paper explores five lessons on how the Japanese offshore wind energy industry can transfer its knowledge to emerging offshore wind energy markets.

The information and lessons learned for the development of this work were obtained through interviews and questionnaires with more than 130 professionals from the offshore wind and renewable energy industry.

The lessons provided in this document are based on:

- **AREA SELECTION & BID PROCESS**
- **LOCAL SUPPLY CHAIN**
- **COMMUNITY & FISHER ENGAGEMENT**
- **MARKET OPENNESS**
- **FOUNDATION DESIGN**

INTRODUCTION

Which factor is most critical for Brazil to prioritize in offshore wind: Area selection and bid processes, Foundation design (fixed/floating), Local supply chain development, Community and fisher engagement, or Market openness?

While all factors are important for Brazil's offshore wind development, **area selection** and **transparent bid processes** should be the initial priority as they create the foundation for all subsequent steps.

Proper zoning ensures projects avoid **environmental sensitivities** and fishing grounds while maximizing wind potential, directly impacting both technical feasibility and social acceptance.

Clear bidding rules and **predictable auction schedules** provide the market certainty needed to attract investment and kickstart other critical elements like supply chain development.

That said, **local supply chain growth and community engagement must advance parallel to ensure long-term viability.**

Multiple experts noted that domestic manufacturing capabilities (inspired by Brazil's Oil & Gas experience) can **reduce costs** and **create jobs**, while **early dialogue** with fishers prevents conflicts. **Grid access,** though not listed among the original options, emerged as another urgent challenge, highlighting the need for integrated planning.

A phased approach is key: Start with robust area selection and bidding frameworks to de-risk projects, then **prioritize supply chain investments and stakeholder engagement as the market matures.**

This balanced strategy, coupled with **policy clarity** (like mid-term targets), would position Brazil to leverage its vast offshore potential while avoiding pitfalls seen in other emerging markets.

INTRODUCTION

This guideline paper aims to address 5 lessons and experiences from **Japanese offshore wind energy industry** that can be materialized in knowledge transfer with Brazil and other emerging markets.

The lessons presented in this document were collected from Japanese and Brazilian experts and professionals, based on the methodological application of **137 qualitative and quantitative interviews and questionnaires**. Quotes from the interviewees are presented throughout each of the sections of this material.

According to the latest report from Global Wind Energy Council (GWEC) the japanese offshore wind industry accounts with **288 MW** of cumulative capacity from the 83 GW of the global installations. The Japanese market is among the **top 10 countries** with the largest installed offshore wind energy capacity in the world, moving towards technological scalability [1].

Japan's key recommendation for Brazil is to develop a localized, responsible approach tailored to its unique conditions rather than copying foreign models.

Experts emphasize creating Brazil-specific LCOE (Levelized Cost of Energy) calculations using verifiable local data, fostering domestic turbine manufacturing capabilities, and ensuring project reliability through strict contract adherence.

Early engagement with coastal communities and investment in maritime workforce training are crucial for social license and long-term sustainability.

While local content policies should be balanced (learning from Brazil's FPSO experience), the priority is building in-country expertise rather than relying on imported knowledge.

Most importantly, Brazil must take ownership of its offshore wind development process, integrating local realities into every decision—from supply chain to stakeholder management—to ensure viable, context-appropriate growth.

INTERVIEW QUOTES

"Create your own LCOE curve with known local ingredients, instead of modifying a copied LCOE curve whose elements and formulas are unknown to Brazil, to take responsibility and awareness of all the consequences arising from the development process, thus involving people with local experience rather than people learning from the web."

LESSON 1: AREA SELECTION & BID PROCESS

The strategic selection of offshore wind development areas and a well-designed bidding process are critical drivers for the global energy transition. Governments can maximize project efficiency and investor confidence by identifying optimal sites with high wind potential, minimal environmental impact, and robust grid integration.

Competitive auctions ensure cost-effectiveness, innovation, and scalability—key lessons from leading markets like Europe are now being adopted in Japan.

Japan's approach, seen in Akita and Chiba auctions, highlights how transparent bidding accelerates renewable capacity while balancing local needs [2].

This framework not only supports national decarbonization but also contributes to worldwide offshore wind growth, setting benchmarks for emerging markets.

Figure 1: Potential Project Areas for General Sea Areas designated by the Marine Renewable Energy Act, as September 1st, 2023

Areas				
Promotion Areas	fixed	①Nagasaki Pref., Goto (small floating)		
		②Akita Pref., Noshiro, Mitane, Oga		Round 1 Projects (②-④)
		③Akita Pref., Yurihonjo		
		④Chiba Pref., Choshi		
	Auction	⑤Akita Pref., Happo, Noshiro		Round 2 Projects (⑤-⑧)
		⑥Nagasaki Pref., Saikai		
		⑦Akita Pref., Oga, Katagami, Akita		
		⑧Niigata Pref., Murakami, Tainai		
Prospective Areas		⑨Hokkaido Pref., Ishikari		
		⑩Hokkaido Pref., Gannu, Minami Shiribeshi		
		⑪Hokkaido Pref., Shimamaki		
		⑫Hokkaido Pref., Hiyama		
		⑬Hokkaido Pref., Matsumae		
		⑭Aomori Pref., Sea of Japan (North)		
		⑮ Aomori Pref., Sea of Japan (South) ⑯ Yamagata Pref., Yuza		Round 3 Projects (⑮-⑯)
		⑰Chiba Pref., Kujukuri		
		⑱Chiba Pref., Isumi		
Preparatory Areas		⑲Aomori, Mutsu	㉒Fukui, Awara	
		⑳Iwate, Kuji (floating)	㉓Fukuoka, Hibikinada	
		㉑Toyama East (fixed/floating)	㉔Saga, Karatsu	

Source: [2]

INTERVIEW QUOTES

"After coordinating with early users, such as fishermen, the government designates promotion areas to promote offshore wind power generation projects. It allows power generation companies selected through public bidding to occupy the sea areas for up to 30 years. Three public biddings have been conducted, and 10 sea areas and companies have been selected"

LESSON 1: AREA SELECTION & BID PROCESS

Japan's offshore wind area selection process follows a meticulous three-stage approach to balance technical feasibility with stakeholder interests. The process begins with "preparation zones," where local governments initiate preliminary discussions with stakeholders, even if areas don't yet meet full development criteria.

These potentially advance to "promising zones" after thoroughly evaluating wind resources, oceanographic conditions, and compatibility with existing marine activities like fishing and shipping.

Final "promotion zones" are officially designated by national ministries only when strict criteria are met, including stakeholder consensus through established councils and compliance with the Marine Renewable Energy Utilization Act.

This phased approach systematically addresses technical requirements and local concerns before projects proceed.

Though with notable complexities, the bidding process emphasizes long-term viability and cost competitiveness. Selected through public tenders, operators must demonstrate their ability to deliver stable, efficient projects for up to 30 years.

While three bidding rounds have successfully awarded 10 projects totaling 4.6GW, the process reveals a unique dynamic: though formally top-down, proposals often originate from local coordination with fishing associations, creating a hybrid bottom-up element.

However, critics highlight inefficiencies, particularly an overemphasis on price evaluation that may inadvertently complicate bids.

The government's central role in surveys and final approvals ensures standardization but can also slow implementation.

CASE STUDY: JAPANESE FRAMEWORK AND LOCAL ENGAGEMENT

While Japan's framework shows progress, challenges remain in streamlining processes and maintaining local engagement. The system has successfully designated 5.5 GW of "promising zones" and established clear legal guidelines, yet the pace of development reflects ongoing tensions between national energy goals and regional interests.

Future success will likely depend on refining the balance between rigorous technical standards and flexible community negotiation, ensuring offshore wind expansion aligns with Japan's decarbonization targets and the socioeconomic needs of coastal communities.

As the industry matures, lessons from early projects may help simplify bureaucratic hurdles while preserving the inclusive stakeholder approach that defines Japan's distinctive model.

LESSON LEARNED

Defining criteria that consider the characteristics of the areas that should be selected for the bidding process is essential for future projects. Establishing criteria such as area limits and power density can help with competitiveness and avoid imbalances in the market. Using lessons from past projects is a great opportunity to improve engagement with communities and define criteria for each bidding round.

LESSON 2:
LOCAL SUPPLY CHAIN

The offshore wind supply chain—encompassing construction, installation, maintenance, and decommissioning—is a critical challenge globally, requiring specialized vessels, ports, and skilled labor.

While Europe and China benefit from mature supply chains, Japan faces bottlenecks due to limited local infrastructure and high costs, slowing project scalability.

In contrast, Brazil holds a strategic advantage through its well-established oil and gas industry, which offers transferable expertise in offshore operations, fabrication, and logistics.

By leveraging this existing industrial base, Brazil could develop a competitive offshore wind supply chain more efficiently than Japan, positioning itself as a key player in the global energy transition while addressing Japan's current limitations

Figure 2: Phases of Hibiki FOWT life: Construction, Installation, and Operation

Source: [3]

INTERVIEW QUOTES

"Currently, there are major suppliers in Japan, but there are no large wind turbine manufacturers, so nurturing wind turbine manufacturers is a challenge. For floating offshore wind turbines, rapid mass production, transportation, and construction are necessary to reduce costs."

LESSON 2: LOCAL SUPPLY CHAIN

Japan's offshore wind supply chain remains underdeveloped, posing significant challenges to the country's ambitious renewable energy goals. Despite government targets for 10GW of offshore wind capacity by 2030 and 30- 45GW by 2040, the domestic supply chain has failed to meet project demands. The fundamental issue stems from Japan's lack of experience in offshore construction at scale - unlike European and Brazilian markets that leveraged existing oil/gas infrastructure, Japan must build its offshore wind ecosystem from scratch.

Critical gaps exist across the value chain: no domestic wind turbine manufacturers capable of mass production, a severe shortage of specialized installation vessels, and insufficient port infrastructure for handling large components. These limitations force developers to rely heavily on expensive imports and foreign expertise, undermining the economic and energy security benefits promised by offshore wind expansion [3].

Workforce shortages and technological gaps represent the twin crises constraining supply chain development. The industry faces an acute skilled labor shortage, with declining orders in traditional shipbuilding reducing opportunities for younger workers to gain relevant experience. This human capital deficit affects all project phases - from manufacturing and installation to operations and maintenance. While Japan possesses strong industrial capabilities in related sectors like steel production and precision engineering, the specialized knowledge required for offshore wind remains concentrated among a few professionals.

The situation is particularly challenging for floating wind technology, where Japan aims to be a global leader but currently lacks the infrastructure for cost-effective mass production. Compounding these issues is the chicken-and-egg problem of limited project volume (only eight installations to date) failing to stimulate sufficient private investment in supply chain development.

CASE STUDY: LOCAL CONTENT AND CLEAR TARGETS

The government's 60% local content target by 2040 appears increasingly ambitious without more decisive intervention. While incremental progress is being made, the lack of a clear, long-term development roadmap creates uncertainty for investors.

Cultural preferences for domestic products ("made in Japan") may eventually help nurture local suppliers, but immediate solutions will likely require strategic partnerships with experienced foreign firms.

Recent initiatives like the government's "Green Innovation Fund" and proposed tax incentives aim to stimulate supply chain growth. However, experts agree that overcoming Japan's offshore wind bottlenecks will demand coordinated action across workforce development, port modernization, and technology transfer programs to build a sustainable domestic industry.

LESSON LEARNED

Avoid inflexible rules and requirements for local content in bidding rounds, discouraging global players' entry, and supporting the reduction of technological costs. Investing in industrial training programs and learning while considering knowledge and experience from different countries is necessary. Establishing geographic partnerships with international organizations and alternative financing options for infrastructure can strengthen the local supply chain.

LESSON 3: COMMUNITY & FISHER ENGAGEMENT

Engaging fishermen and coastal communities is critical for successful offshore wind development globally, where social acceptance directly impacts project timelines and viability.

Japan's government plays a key mediating role, implementing compensation schemes, fisheries coexistence policies, and environmental safeguards to address livelihood concerns, mirroring EU and US approaches.

Transparent stakeholder dialogue helps mitigate conflicts over marine ecosystem impacts while ensuring equitable benefits.

This process is vital not only for Japan's energy transition but also for setting precedents in balancing renewable expansion with ocean conservation and community rights—a challenge facing coastal nations worldwide as offshore wind scales up.

Figure 3: Fisher community interaction in the proximity of an offshore wind farm

Source: [4, 5, 6]

INTERVIEW QUOTES

"In the process of selecting sites and moving forward to "promising areas," a council is required to be established with members from the Japanese government, prefectures, municipalities, relevant fishing associations, and other stakeholders, as well as academic experts, to hold discussions regarding the acceptance of offshore wind power."

LESSON 3: COMMUNITY & FISHER ENGAGEMENT

Engaging fishermen and coastal communities in offshore wind projects in Japan involves a delicate balance of negotiation, legal frameworks, and stakeholder collaboration. The process typically begins with direct discussions between developers and local fishermen.

However, prefectural governments often set the rules for engagement, sometimes even controlling how fishermen are approached, as seen in Yamagata and Kuji [6].

To ensure structured dialogue, multi-stakeholder councils—including government bodies, fishing associations, and academic experts—are formed during site selection to address concerns and build consensus [4].

However, resistance remains strong, particularly from fisheries associations, who are wary of disruptions to their livelihoods despite potential benefits like improved infrastructure and job creation [5].

The Japanese government has played a key role in formalizing this process through legislation and gradual legal improvements. The Law on Marine Use of Renewable Energy provides a structured approach to consensus-building, though societal expectations around fair compensation for fishing rights have grown stricter over time.

Unlike in the past, where fishermen's demands were often fully accommodated, negotiations now require more compromise.

While Japanese communities generally respect legal processes, the fishing industry's technological and managerial lag compared to European counterparts complicates efforts to demonstrate tangible benefits from offshore wind projects.

CASE STUDY: SOCIAL ACCEPTANCE

Despite these challenges, Japan is making incremental progress in fostering acceptance. The government's role in mediating discussions and refining laws has been crucial, but persistent gaps in trust and visibility of local benefits remain obstacles.

As experience grows in negotiating with fishermen, drawing from past coastal development disputes, there is cautious optimism that a combination of legal compliance, economic incentives, and long-term community engagement can pave the way for smoother offshore wind adoption.

However, the process remains complex, requiring patience and adaptive strategies to align national energy goals with local interests.

LESSON LEARNED

Engaging communities and organizations in advance is essential in selecting areas. Fishing compensation schemes, policies for coexistence between fishermen and energy production, and environmental health and safety guidelines are crucial to democratizing knowledge about offshore wind. Transparent dialogue with communities about its benefits and impacts is key to technological success. Government mediation through public consultations can be a positive alternative.

LESSON 4: MARKET OPENNESS

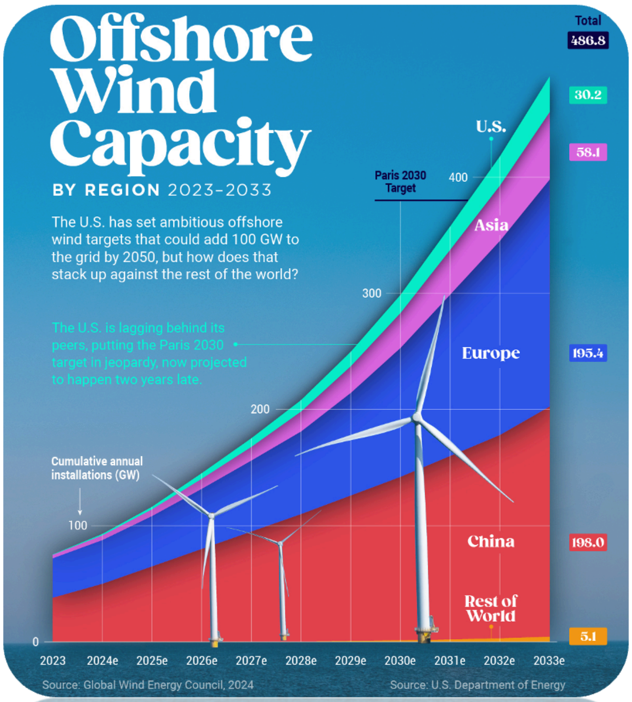
Market openness to foreign expertise and investment is crucial for accelerating offshore wind development globally, as demonstrated by Europe's success through cross-border collaboration.

Countries like the UK have actively leveraged international partnerships, attracting technology leaders like Denmark's Ørsted to drive cost reductions and innovation.

For Japan, which faces domestic supply chain constraints and high costs, greater market openness could similarly fast-track progress by integrating global best practices and capital.

As offshore wind becomes increasingly competitive worldwide, Japan's ability to embrace international players may determine its position in the race for clean energy leadership, mirroring transformative models seen in other mature markets.

Figure 4: Offshore wind capacity by region



Source: [7]

INTERVIEW QUOTES

"Not just openness, but bilateral openness is important for Japan to accelerate progress in offshore wind: "I buy from you, you buy from me". Most countries involved in offshore wind cannot have their full-fledged supply chain due to their scale and efficiency, so creating a bilateral supply chain system can help connected countries grow together - in reality, it should be multilateral."

LESSON 4: MARKET OPENNESS

Market openness and international collaboration are critical for Japan to accelerate its offshore wind development and overcome domestic supply chain limitations. Given Japan's lack of experience in large-scale offshore projects and absence of domestic turbine manufacturers, strategic partnerships with more experienced countries could provide vital technology transfer, cost reduction, and knowledge sharing.

With their mature offshore wind industries and established supply chains, European nations like the UK, Norway, and the Netherlands emerge as natural partners, particularly for floating wind technology, where Japan aims to lead.

The U.S. also offers valuable collaboration potential through its growing offshore wind sector and experience with turbine technology [7].

However, actual progress requires bilateral or multilateral cooperation where Japan learns from and contributes to global offshore wind development, rather than simply importing foreign technology.

Japan's unique geographical and cultural challenges complicate international partnerships and create specialized collaboration opportunities. The country's deep waters, seismic activity, and typhoon risks mean European solutions cannot be directly copied, requiring adaptation of foreign technology to local conditions.

This creates potential for joint innovation, where Japan could partner with European firms to develop typhoon-resistant turbines or hybrid floating platforms suited to Asian conditions.

However, Japan's distinct business culture and regulatory environment have historically hindered foreign participation in infrastructure projects. Overcoming these hurdles will require regulatory alignment with global standards and more flexible approaches to international joint ventures and technology sharing.

CASE STUDY: DOMESTIC PRIORITIES AND STRATEGIC GLOBAL ENGAGEMENT

While Japan understandably wants to build local capabilities (reflected in its 60% local content target), the government's observation about economic rationality is crucial. Some components may always need to be sourced globally for cost-effectiveness.

Near-term partners like South Korea and Taiwan could be particularly valuable due to geographical proximity and shared regional challenges.

Ultimately, Japan's offshore wind success will depend on creating a more open ecosystem that combines international best practices with localized solutions, while developing mutually beneficial partnerships beyond simple technology transfer to include joint R&D, workforce training, and shared infrastructure development across Asia.

LESSON LEARNED

Encourage market globalization and attract foreign direct investment to different stages of the production chain. Create international partnerships to meet the limitations of the production chain, boosting the market through investment mechanisms, tax reductions, and industrial incentives. Make local content rules more flexible, seeking to promote partnerships with local markets to exchange innovations and infrastructure capabilities.

LESSON 5: FOUNDATION DESIGN

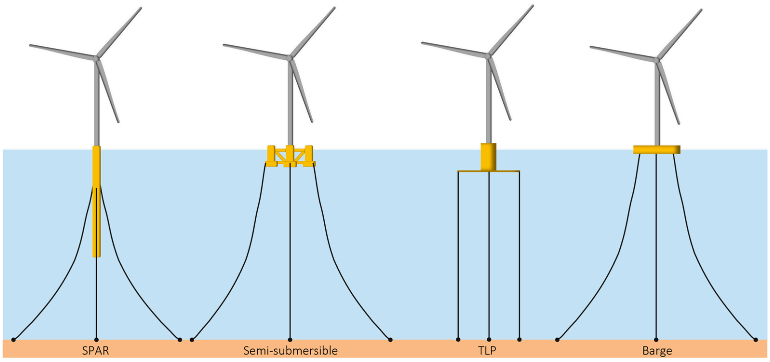
Selecting optimal foundation designs - fixed-bottom or floating - is pivotal for offshore wind success, balancing technical feasibility, cost efficiency, and site-specific conditions.

Globally, fixed foundations dominate shallow waters (e.g., Europe's North Sea projects and China's Jiangsu coast), while floating solutions unlock deep-water potential (Scotland's Hywind and France's Provence Grand Large).

Japan's mountainous seabed and deep coastal waters present unique challenges, making floating turbines increasingly attractive despite higher initial costs.

As technology advances, floating foundations demonstrate superior versatility for harsh environments and deeper sites, positioning them as the future backbone of offshore wind expansion in Japan and beyond [8].

Figure 5: FOWT Design Concepts



Source: [8]

Table 1: FOWT Design Concepts installed in Japan

Feature	Fukushima 2 MW	Fukushima 5 MW	Fukushima 7 MW	Fukushima Substation	Hibiki 2 MW
Foundation Type	Semi-sub (4-column)	L-shaped Semi-sub	Advanced Spar	Semi-sub	Barge-type
Developer	Marubeni / Hitachi	MHI	MHI + JMU	Hitachi / Toda	Toda / Hitachi Zosen
Turbine Capacity	2 MW	5 MW	7 MW	66 kV Substation	2 MW
Water Depth	~100 m	~120 m	~120 m	~120 m	~110 m
Design Focus	Stability	Motion reduction	Deep-water optimization	Grid integration	Low-cost fabrication
Mooring System	Catenary (4-point)	Catenary (6-point)	Taut-leg (6-point)	Catenary (4-point)	Catenary (4-point)
Material	Steel	Steel	Hybrid design	Steel	Concrete + Steel
Operational Period	2013–2018	2015–2018	2015–2018	2013–2018	2018–present
Key Innovation	1st Japan semi-sub	Asymmetric stability	Advanced Spar	First floating subst.	Economical barge

Source: [8]

INTERVIEW QUOTES

"This process is still ongoing in Japan. The first annual rounds was bottom-fixed type before the floating tenders come around 2030. There is no conclusion on floating design in Japan yet, but many are considered."

LESSON 5: FOUNDATION DESIGN

Japan's approach to foundation selection for offshore wind projects reflects its unique maritime conditions and evolving technological landscape.
Unlike some European markets where monopile foundations dominate, Japan has adopted a flexible, developer-driven approach where project sponsors can choose between fixed (bottom-mounted) and floating designs based on site-specific conditions.

Water depth is the primary determining factor, with fixed foundations (typically monopiles or jackets) preferred for shallower waters up to 50 meters.

At the same time, floating structures are being considered for deeper offshore sites that characterize much of Japan's viable wind areas. This pragmatic approach acknowledges Japan's complex seabed topography and typhoon risks, though it has led to a more fragmented technological pathway than standardized European models.

The selection process remains largely market-driven, with limited government intervention in technical specifications.
As noted by experts, the public sector has avoided mandating specific foundation types, instead allowing developers to propose optimal solutions during the bidding process.

Current projects in development feature fixed foundations, particularly for near-term developments in relatively shallow waters like the Akita and Noshiro projects.

However, with about 80% of Japan's offshore wind potential located in deeper waters beyond 50 meters, the industry is preparing to transition to floating wind technology. Pilot projects like Fukushima FORWARD, Hibiki project, and Goto City's floating demonstration provide valuable operational data, see Table 1, though commercial-scale floating tenders aren't expected until after 2030, creating a phased technological transition.

CASE STUDY: TECHNOLOGY X FOUNDATIONS

Japan faces unique challenges in foundation technology that require customized solutions. The country's seismic activity, typhoon exposure, and deep coastal waters necessitate more robust (and costly) foundation designs than the North Sea. While monopiles dominate globally for fixed foundations, Japan's projects frequently employ jacket structures to withstand seismic loads better.

For floating technology, multiple designs - including semi-submersible, spar, tension-leg platform and barge-type platform- remain under consideration, with no apparent industry consensus yet emerging. The government's recent "Green Transformation" policy includes support for floating wind R&D, recognizing that successful commercialization will require overcoming current construction cost barriers through technological innovation and domestic supply chain development.

As Japan's offshore wind market matures, foundation selection will increasingly balance technical feasibility, cost competitiveness, and local content requirements.

LESSON LEARNED

Considering the technical characteristics and maritime studies of the selected areas is strategic when choosing the type of foundation design. The foundation design will impact the scalability of the technology and the LCOE reduction in the medium and long term. R&D&I projects and policies are essential to improving knowledge of the selected areas. In addition, deep-water locations should consider floating foundation technology to better use the wind resource, and FOWT appears as a solution for mass production.

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