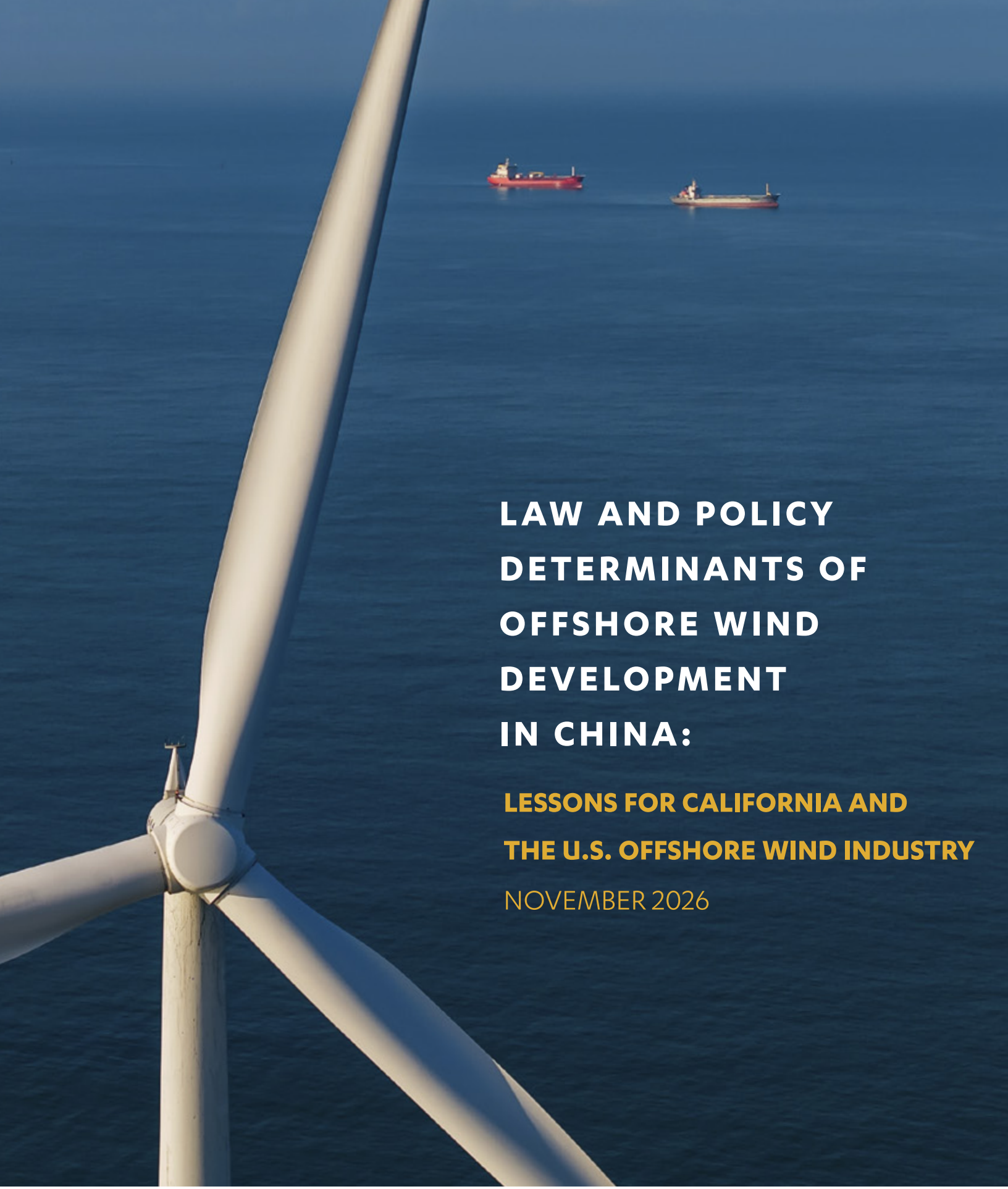

LAW AND POLICY DETERMINANTS OF OFFSHORE WIND DEVELOPMENT IN CHINA:

LESSONS FOR CALIFORNIA AND THE U.S. OFFSHORE WIND INDUSTRY

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ABBREVIATIONS

Abbreviation	Full Term
BOEM	Bureau of Ocean Energy Management
CAISO	California Independent System Operator
CCER	China Certified Emission Reduction
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CfD	Contract for Difference
CGN	China General Nuclear
CNOOC	China National Offshore Oil Corporation
CPUC	California Public Utilities Commission
CTG	China Three Gorges Corporation
CWEA	China Wind Energy Association
DRC	Development and Reform Commission
DWR	Department of Water Resources
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EnWG	Energiewirtschaftsgesetz (German Energy Act)
EPC	Engineering, Procurement, and Construction
FiT	Feed-in Tariff
IBank	California Infrastructure and Economic Development Bank
IEA	International Energy Agency
IRA	Inflation Reduction Act
IRP	Integrated Resource Planning
ITC	Investment Tax Credit
LCOE	Levelized Cost of Energy
MEE	Ministry of Ecology and Environment
MIIT	Ministry of Industry and Information Technology
MNR	Ministry of Natural Resources
MOST	Ministry of Science and Technology
NDC	Nationally Determined Contribution
NDRC	National Development and Reform Commission
NEA	National Energy Administration
OCS	Outer Continental Shelf
PPA	Power Purchase Agreement
PTC	Production Tax Credit
REITs	Real Estate Investment Trusts
RMB	Renminbi
RPS	Renewable Portfolio Standard
SDGs	Sustainable Development Goals
SOA	State Oceanic Administration
SOE	State-Owned Enterprise
SPIC	State Power Investment Corporation
VAT	Value-Added Tax

EXECUTIVE SUMMARY

Offshore wind is set to become a significant component of California's clean energy portfolio. Yet despite abundant technical potential, California today remains at the early stages of offshore wind development, and the United States overall accounts for less than 2% of global installed offshore wind capacity. With the industry still nascent domestically, California stands to benefit from the accumulated experience of jurisdictions that have already built substantial offshore wind sectors. This report examines the policy and governance frameworks behind the world's leading offshore wind market, China, with a detailed case study of Guangdong Province, and draws comparative lessons from Europe, Japan, and South Korea as well to inform California's approach.

This report aims to explain how China and other committed jurisdictions have built out offshore wind in a relatively short period of time. We identify the key governance mechanisms at play and provide granular detail on core national and subnational policies. Given the high level of uncertainty surrounding offshore wind in the United States, particularly regarding federal leasing and permitting, we offer policies for consideration, rather than firm recommendations. Our central recommendation is a broader one: successful offshore wind jurisdictions have combined price support, state-led site development, administrative streamlining, and stable long-term targets. California and the United States should find a path through current political divisions and begin the build-out of this important source of clean energy.

FINDINGS

Why offshore wind, and where California stands (Section 1). Offshore wind is expected to play a distinctive role in California's clean energy mix, complementing the state's existing reliance on solar, batteries, and onshore wind. Under AB 525 (2021), the California Energy Commission adopted planning goals of 2-5 GW by 2030 and 25 GW by 2045 of offshore wind – targets projected to power millions of homes and supply a meaningful share of the state's total electricity by mid-century. Yet California has yet to bring a single commercial-scale project online. This gap motivates this report's central comparative inquiry: what combination of policy tools has actually driven successful deployment?

China's national offshore wind strategy (Section 2). China is currently the global leader in installed offshore wind capacity, with roughly half of the world's total. The report traces this growth to a deliberate, evolving national and subnational strategy built around five interlocking governance functions: long-term strategic planning embedded in successive five-year plans; a fiscal and tax incentive regime that has shifted over time from guaranteed feed-in tariffs toward competitively bid pricing (most recently under 2025's Document 136 reform); administrative streamlining and spatial coordination across a fragmented permitting landscape; deliberate technology and supply-chain policy aimed at building a domestic manufacturing base; and close coordination between grid companies and developers to improve offtake certainty. The report is equally attentive to the limitations of this approach – including concerns regarding adequate evaluation of ecological

risks, unresolved military-use conflicts in coastal waters, persistent grid integration constraints, and the absence of a clear decommissioning framework.

Guangdong as a case study in subnational implementation (Section 3). Because China's offshore wind build-out has been substantially shaped by provincial and municipal actors, the report undertakes a detailed case study of Guangdong Province – China's leading offshore wind province. The case study traces Guangdong's evolution through four pricing and allocation regimes, from (i) an early fixed feed-in-tariff period, through (ii) a transition phase that introduced competitive bidding and stepped-down state support, (iii) a grid-parity period pegged to the coal-fired power benchmark, and (iv) since 2025, provincial implementation of Document 136's stock/incremental split with its two-sided contract-for-differences settlement mechanism. It documents the province's efforts to build out industrial clusters through land and tax incentives, and government-guided investment funds, among other tools. As national and provincial subsidies have phased down, Guangdong developers, like their counterparts elsewhere in China, have increasingly turned to demand diversification – direct sales to large industrial users, coordination with data-center demand, offshore hydrogen production facilities, marine aquaculture, and other "blue" economy strategies – to sustain project economics under tighter, more market-exposed pricing.

International comparisons: Europe, Japan, and South Korea (Section 4). The report extends the comparison beyond China to the leading European actors (United Kingdom, Germany, Denmark, the Netherlands) and up-and-coming Asian players (Japan and South Korea). Two lessons stand out. First, price support through contract-for-difference mechanisms has played a critical role in growing European offshore wind. Recent European experience shows what happens when governments withdraw price support too quickly: unsubsidized auctions in Germany and Denmark both failed to attract a single bid within the same eighteen-month period, and both governments have since moved back toward contract-for-differences structures that shift price risk onto the state. Second, the leading European markets have each centralized pre-construction planning – site surveys, environmental assessment, and transmission planning – to some degree, such that sites are more "shovel-ready" by the time they are offered for lease. South Korea took a similar approach in 2025. Together, these cases highlight the importance of derisking capital and administrative streamlining in offshore wind development across jurisdictions.

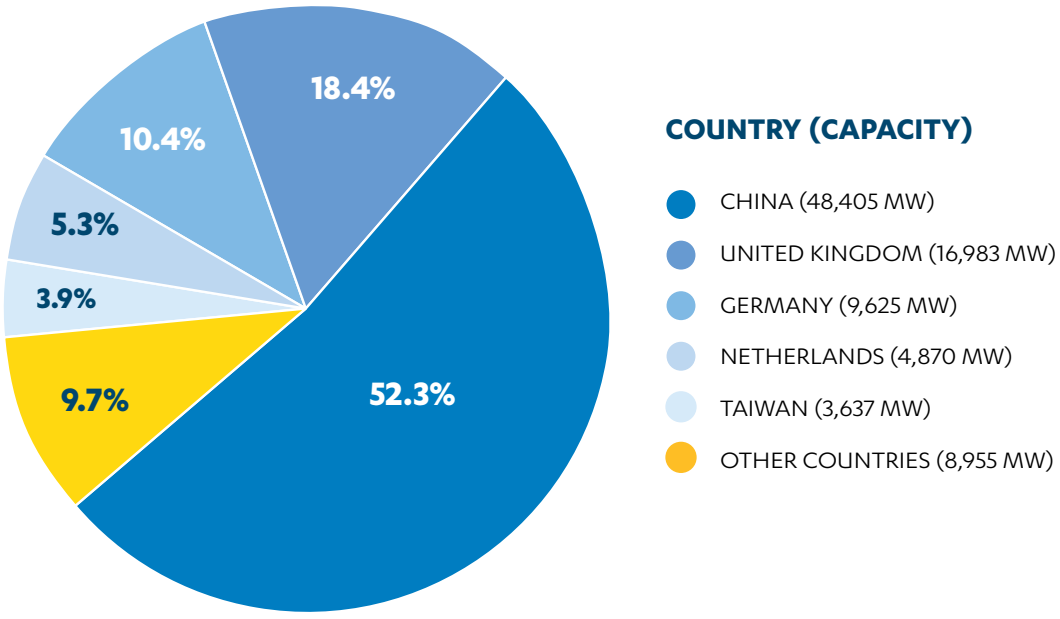
Policies for consideration (Section 5). Drawing on these comparative findings, the report identifies a selection of policy approaches for California and federal policymakers to consider further. These are organized around five themes: (A) financial and legal instrument design, including stabilizing California's project subsidy stack and exploring supply-chain financing tools; (B) planning and permitting, including state-funded pre-leasing site characterization; (C) demand diversification and market development; (D) durability of offshore wind targets; and (E) environmental review and tribal consultation guardrails. We highlight the governance approach, along with a preliminary assessment of transferability and magnitude/cost, and possible California or U.S. adoption pathways where appropriate.

1. INTRODUCTION

Offshore wind power promises to be an important component of electricity systems in jurisdictions around the world. In California, it is expected to play a significant complementary role in diversifying a broad portfolio of clean energy resources dominated by solar, batteries, and onshore wind as California pursues its 2045 goal of 100% clean energy.[1] The California Energy Commission (CEC) has set targets for offshore wind off California's coast of 2-5 GW by 2030 and 25 GW by 2045, pursuant to California Assembly Bill 525 passed in 2021. Offshore wind is expected to power 25 million homes and provide a significant 13% of California's total electricity supply by 2045.[2]

Despite these aspirations, California remains at the initial stages of planning and implementation for offshore wind, and the U.S. overall only accounts for a modest 1.8% (1.67 GW as of May 2026)[i] of global offshore wind capacity (roughly 93 GW, end of 2025).[3] Just as it dominates deployment of solar and onshore wind power, China is the leading country in offshore wind capacity by far – with approximately half of global capacity (about 48 GW). European countries collectively account for about 42% (around 39 GW) – led by the United Kingdom, Germany, the Netherlands, Denmark, and Belgium.[4] Asian jurisdictions like Vietnam, Taiwan, Japan, South Korea, and India are at the early stages of offshore wind development, but each has ambitious goals and national policies supportive of offshore wind with early projects completed or in the works.

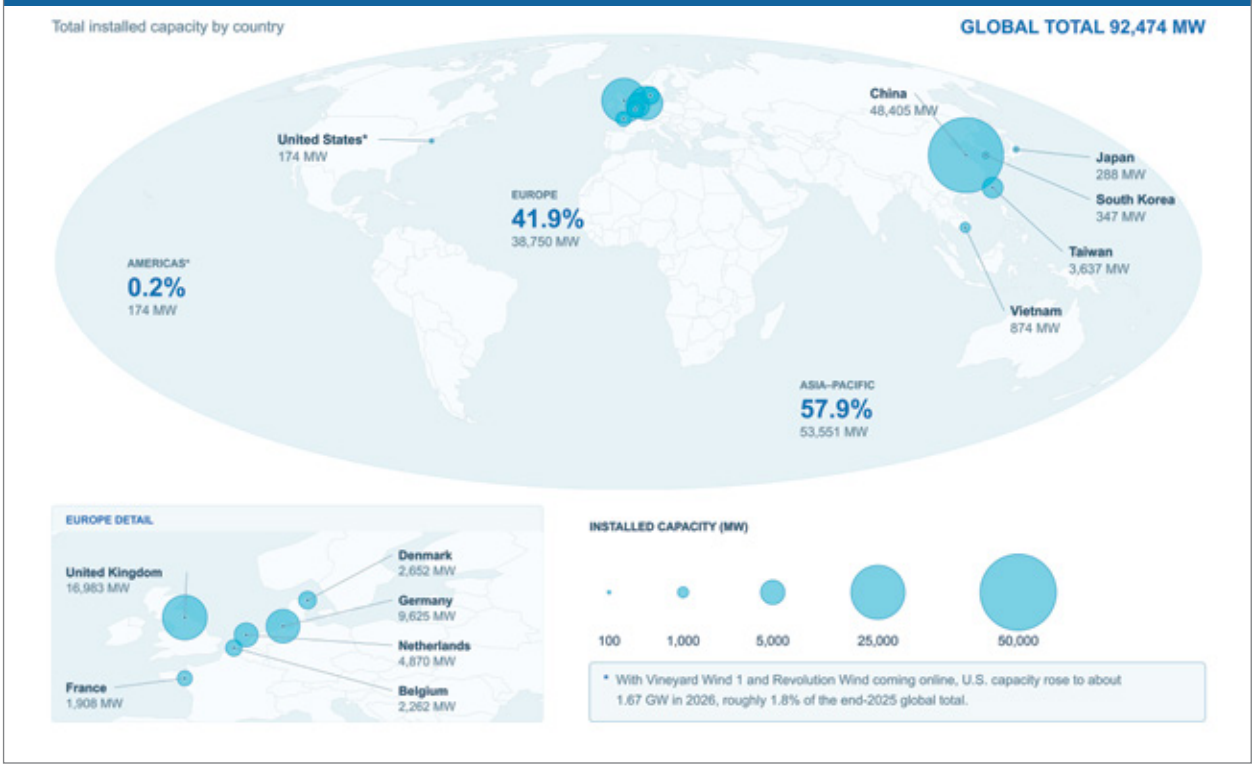
Fig. 1 / Share of Global Offshore Wind Operating Capacity by Country (Dec. 2025)



Source: GWEC, Global Wind Report, 2026.

i As of this writing, there are 5 operational offshore wind projects in the U.S.: the 30 MW Block Island, Rhode Island project; the 12 MW Coastal Virginia pilot project; the 132 MW South Fork, New York project; the 700 MW Revolution Wind, Rhode Island project, and the 800 MW Vineyard Wind project. An additional three projects are in varying stages of development. See *Offshore Wind California, U.S. East Coast Offshore Wind – Recent Court Rulings & Project Status*, https://www.offshorewindca.org/maps (May 2026).

Fig. 2 / Offshore Wind Operating Capacity by Country (Dec. 2025)



While other jurisdictions have recognized the value of offshore wind and are moving forward to develop the resource, the U.S. has suffered from policy whiplash at the national level – with strong support from the Obama and Biden administrations, and unprecedented opposition under the second Trump administration. Since early 2025, the Trump administration has effectively shut down the federal pipeline for U.S. offshore wind, first by withdrawing all Outer Continental Shelf (OCS) areas from wind leasing and ordering a moratorium on new or renewed approvals, then by rescinding designated wind energy areas, cutting hundreds of millions of dollars in project funding, and suspending leases for several gigawatts of East Coast projects under the banner of national security.[5] After courts curtailed the Trump administration's efforts to void prior offshore wind approvals, the Interior Department and DOJ adopted a buyout strategy—using nearly $4 billion in public funds to reimburse companies like TotalEnergies (NY, Carolinas), Bluepoint Wind and Golden State Wind (NY/NJ and California-Morro Bay, respectively), RWE (NY Bight, California, Louisiana), and Invenergy (NY Bight, California-Morro Bay, and Gulf of Maine) for canceling their leases and redirecting investments toward fossil fuels instead.[6]

At the subnational level, early mover states such as New York, New Jersey, Massachusetts, Rhode Island, Connecticut, Maryland, and Virginia have continued to pursue offshore wind development despite these extraordinary headwinds.[7] California, Hawaii, Maine, North Carolina, and Delaware are also advancing policies and planning efforts related to offshore wind.[8] Yet without a reversal in federal opposition, scaling offshore wind projects beyond a handful of legacy developments will be extraordinarily difficult in the near term.

Thus, the United States has struggled to move offshore wind beyond a few early demonstration and first wave commercial projects, despite abundant technical potential[9] and supportive state-level policies. Beyond inconsistent political support for offshore wind, a fragmented permitting system—spanning multiple federal statutes and agencies, layered with state coastal and environmental review, transmission siting challenges, and frequent litigation—has made it difficult to permit, finance, and construct large projects on predictable timelines. These structural frictions have left the U.S. as an outlier among major economies in translating offshore wind targets into steel in the water.

In support of California and U.S. efforts to develop offshore wind, this report examines the policy and governance frameworks in China, the dominant global jurisdiction for offshore wind development, describing key policy and legal measures and approaches that have allowed it to pursue offshore wind development at speed and scale. The report also presents a detailed case study of Guangdong, the fastest-developing province for offshore wind in China, to illustrate ground-level implementation and interactions with national policy. The report further notes key developments in Europe, Japan, and South Korea for comparison. Finally, the report distills implications and recommendations for U.S. actors (particularly in California) interested in advancing offshore wind development.

1.1 - WHY OFFSHORE WIND?

Offshore wind is a valuable, untapped clean energy resource. The World Bank estimates global offshore wind technical resource potential at 71,000 GW in 115 countries.[10] The U.S. National Renewable Energy Laboratory (NREL) estimates offshore wind potential in the U.S. at 2,000 GW nationwide, and 200 GW in California alone.[11]

Beyond resource potential, offshore wind offers several advantages as a complement to a broader portfolio of renewable resources. Offshore wind can help smooth variability across renewable resources; whereas onshore wind generation typically peaks at night and solar peaks during midday, offshore wind production often peaks in the late afternoon and early evening.[12] Offshore wind is also characterized by higher power density than onshore wind, due to greater average wind speeds and more persistent winds, a dynamic further enhanced by the larger average size of offshore wind turbines.[13] Especially when sited farther from shore, offshore projects may face less local community opposition and avoid some of the most acute land use conflicts that constrain rapid development of onshore wind and utility-scale solar power.[14] In many regions, offshore wind lease areas are also located closer to major coastal urban load centers, whereas utility-scale solar and onshore wind projects are typically sited in more remote inland areas. This siting pattern can, at least in principle, reduce some of the obstacles to transmission development associated with patchwork property rights, complex right-of-way regulations, and cumbersome certification procedures for interregional transmission lines that complicate renewable energy development in places like the United States.

Offshore wind is also a potential driver of economic growth. In California, for example, development of floating offshore wind in Morro Bay and Humboldt Bay could create and support an estimated 169,000 construction job-years and nearly 6,000 operations and maintenance jobs, with total economic benefits from just these two sites estimated at $45 billion.[15] In Europe, the wind sector already supports more than 440,000 jobs, and recent analyses project substantial additional job growth in the sector.[16] Because the components involved are so large, localizing manufacturing and assembly can be cost-effective, further contributing to job creation and regional economic development. In the United Kingdom, for example, original equipment manufacturers (OEMs) such as Siemens and Vestas operate domestic manufacturing centers for turbine components, and Siemens Gamesa operates plants in Germany that serve the German market.[17]

Offshore wind and the potential to localize wind manufacturing offer further benefits for energy security and resilience against supply chain disruption. In Europe, Russia's invasion of Ukraine and the resulting instability in natural gas markets have created a geopolitical impetus for expanding domestic renewable energy production. In the United States, recent conflicts in the Middle East have contributed to volatility in oil markets and reinforced the appeal of renewables as a hedge against fuel price shocks. At the same time, geopolitical competition and security concerns have made reliance on Chinese-made technologies more politically fraught. Localization of manufacturing offers potential economic opportunities and partial insulation from trade conflicts or COVID-era-style supply chain disruption. Wind energy thus offers the twin benefits of a domestically available resource and the prospect of developing a domestic manufacturing sector.

Offshore wind's levelized cost of energy has fallen significantly over the past decade,[ii] although it is not yet cost-competitive with utility-scale solar, onshore wind, or natural gas.[18] Under stable policy and financing conditions, levelized cost is expected to continue declining in the longer term as turbine sizes grow, supply chains mature, and permitting frameworks stabilize.[19] In well-situated projects with strong wind resources and adequate transmission, projected levelized cost trajectories suggest that offshore wind can approach parity with new conventional generation.[20] This is particularly the case when accounting for system-level benefits such as proximity to coastal load centers, higher capacity factors, and reduced exposure to volatile fuel prices.[21]

1.2 - CALIFORNIA'S EFFORTS TO PROMOTE OFFSHORE WIND

California has adopted ambitious medium- and long-term offshore wind targets. Pursuant to Assembly Bill 525, the California Energy Commission (CEC) in 2022 established planning goals of 2–5 GW of installed offshore wind capacity by 2030 and 25 GW by 2045, and in

ii IRENA estimates 2025 global weighted-average levelized cost of energy (LCOE) at approximately USD 78/MWh for offshore wind, USD 44/MWh for utility-scale solar PV, and USD 33/MWh for onshore wind. Lazard separately estimates a 2025 LCOE range of USD 48–109/MWh for natural-gas combined-cycle generation.

2024 issued an AB 525 Offshore Wind Energy Strategic Plan detailing the transmission, port, and permitting actions needed to realize those goals.[22]

California has worked with the U.S. federal government to develop offshore wind leases, but more recent federal headwinds have created tremendous uncertainty. On the federal side, the Bureau of Ocean Energy Management (BOEM) in December 2022 auctioned five leases off Humboldt and Morro Bay to private developers[iii] with a combined technical potential of approximately 4.6 GW.[23] Three of these leases were subsequently terminated in deals negotiated with the Trump administration in 2026.[iv] [24] The remaining lessees are now undertaking multiyear site assessment surveys and environmental review, and BOEM and state agencies anticipate that commercial-scale construction will not begin before the early 2030s.

California has begun to establish critical legal and policy foundations for offshore wind development, but more will be needed to respond to current challenges. To support this build-out, the CEC has been implementing an Offshore Wind Port Development Program funded by Proposition 4 (approved November 2024).[25] SB 105 (September 2025) appropriated $225.719 million for the program, of which the CEC awarded roughly $42.75 million in initial grants for waterfront facility upgrades in October 2025, retaining some $183 million for subsequent port development rounds. The California Public Utilities Commission (CPUC), exercising its integrated resource planning and procurement authority, adopted a decision in 2024 to procure up to 7.6 GW of offshore wind to be online by 2037, a target that, with two leases in Morro Bay and one in Humboldt now cancelled, is no longer achievable from the leases currently in hand and likely needs to be revisited. That could change if California's legal challenges to the lease cancellations succeed.[26]

California offshore wind projects will need to rely on floating offshore wind technologies, given water depths at lease areas. The California lease areas lie in waters roughly 1,640 to 4,265 feet deep, by far the deepest sites selected for commercial-scale offshore wind development in the United States to date.[27] At those depths, conventional fixed-bottom foundations are infeasible, and all projects are expected to employ floating platforms and mooring systems, making California's program a crucial early testbed for floating offshore wind technology at scale.[28]

Because California's offshore wind strategy depends entirely on deepwater floating projects, state and federal officials may find value in understanding China's early experience with floating offshore wind technologies and typhoon-exposed offshore wind, particularly its approaches to port investment, transmission planning, and public–private risk-sharing, to inform more durable policy and infrastructure decisions in California. China's own experience with floating offshore wind remains nascent: its deepest floating offshore wind project to date, the 16 MW Haiyou

iii The developers were RWE; Equinor; Invenergy; Copenhagen Infrastructure Partners (whose project is being developed by Vineyard Offshore, under the name California North Floating); and Ocean Winds (under the name Golden State Wind).

iv The Interior Department reached a $120 million buyout agreement with Golden State Wind (Ocean Winds) in April 2026, and a $765 million buyout covering Invenergy's Morro Bay, New York, and Maine leases followed in June 2026, each conditioned on the developer reinvesting an equivalent amount in fossil-fuel infrastructure and forgoing further U.S. offshore wind development. Another project off Humboldt County was terminated after the federal government reached a $1.22 billion settlement with RWE in August 2026 to end its offshore wind projects across the U.S. and reinvest the funds in gas projects. California has sent a notice to sue the federal government over these agreements.

Anlan project, sits in only 136 meters of water. This tension-leg platform turbine was built by the Chinese state-owned oil company CNOOC to provide power to the Lufeng offshore oilfield and entered commercial operation in August 2026.

1.3 - WHAT THIS REPORT ARGUES

- Our study of China's offshore wind development highlights the critical role of integrated planning, government-backed risk mitigation, and strong industrial policy in scaling offshore wind rapidly while advancing industrial and supply chain development. This includes the essential roles of national and subnational policy and fiscal support.

- The most significant risks of the Chinese model include potentially inadequate consideration of ecological and social conflicts, as well as insufficient transparency and limited investment in ecological research and information development. Important implementation challenges, such as in grid integration and resolution of conflicts with military uses of maritime space, also remain.

- California, and the U.S. in general, can draw lessons from China on long-term commitment, grid and transmission co-planning, and industrial policy without replicating potential governance and ecological shortcomings of China's approach.

Some of our top-line findings on key governance style, main policy levers, and key risks are summarized in Fig. 3 below. We note that California law and policy have already taken many of the types of steps that have been essential to Chinese and European offshore wind build-out, including long-term planning and targets, offtake assurances, support for port and workforce development, early transmission planning, and administrative streamlining. Nonetheless, California should look to extend and deepen these policies, and can still look to China's example as evidence of the benefits of more aggressive subsidies for developers and supply chain development during early stages of industry development. At the same time, California can share its expertise and strengths in environmental impact assessment, public participation, and community benefit sharing with Chinese counterparts, while engaging in collaborative projects to investigate best practices in balancing the speed and scale of offshore wind deployment with environmental, social, and governance integrity.

Fig. 3 / Offshore Wind in China, the EU, and the U.S.[29]				
Jurisdiction	**Offshore capacity (2025-26)**	**Key governance style**	**Main policy levers**	**Headline risks**
China	~48 GW (~50% of global)	Central targets + provincial implementation	Five-year plans, subsidies, guaranteed offtake, streamlined approvals, industrial cluster development	Ecological underassessment, curtailment, military conflicts
EU + UK	~39 GW collectively (~42% of global)	EU targets + national central planning	Contracts for Difference (CfDs), anticipatory site preparation & transmission planning, auction design	Cost inflation, local opposition
U.S.	1.7 GW operating (~2% of global)	Fragmented, litigation-prone, federal–state friction	Tax credits, BOEM leases, state offtake	Permitting times, political swings, supply chain risk

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A note on methodology. The description and analysis in this report are based primarily on a review of primary and secondary sources, including plans, policy documents, laws and regulations, academic literature, media reports, and other commentary. We supplemented this review with approximately a dozen interviews with industry and academic experts who spoke on the condition of anonymity to better understand dynamics on the ground in China. We have tried to assess both policies on paper and practices on the ground, but recognize that gaps between the two may not always be captured here. We view this report as an initial inquiry and treat it as a working paper subject to future revision.

2. OFFSHORE WIND DEVELOPMENT IN CHINA

Over the past decade, China has become the world's largest and fastest-growing offshore wind market, with a rapidly developing ecosystem of developers and manufacturers that is increasingly competitive globally. China's first offshore wind turbine was put into service in 2007 in the Bohai Bay and the country's first offshore wind farm, the 102 MW Shanghai Donghai Bridge project, began operation in 2009.[30] By 2010, China's offshore wind capacity stood at roughly 150 MW—just slightly less than U.S. offshore wind capacity in early 2025.

The introduction of supportive national and subnational policies, subsidies, administrative streamlining, and low-cost capital, as well as support for supply chain and industrial cluster development, led to a dramatic ramp-up in Chinese offshore wind development, with a peak in deployment in 2021 as developers rushed to commission projects before the phase-out of a national benchmark feed-in tariff. By the end of 2025, China had installed more than 48 GW of cumulative offshore wind capacity, more than half of the 93 GW of global offshore wind capacity at the time.[31] In 2025 alone, China added 5.6 GW of new offshore wind, accounting for more than two-thirds of global additions that year.[32]

Fig. 4 / New and Cumulative Installed Offshore Wind Capacity in China (GW)[33]

Year	Newly installed capacity	Cumulative capacity
2016	0.56	1.62
2017	1.18	2.8
2018	1.73	4.53
2019	2.49	7.03
2020	3.85	10.87
2021	14.48	25.35
2022	5.16	30.51
2023	7.18	37.7
2024	5.62	43.32
2025	5.6	48.92

China has ranked first globally in annual offshore wind installations for eight consecutive years and in cumulative capacity for five consecutive years.[34] Installations are geographically concentrated: Guangdong and Jiangsu together account for about 55% of total national capacity,

while Shandong, Zhejiang, and Fujian contribute more than 32%.[35] With more than 7,200 turbines in operation, China now operates the world's largest offshore wind fleet, underpinned by the most extensive supply chain support system in the sector.[36]

Fig. 5 / Offshore Wind in China by Province

Operating and prospective wind capacity, in gigawatts (GW), as of July 2025 (in order of total est. capacity – present & future)[37]

Province	Operating	Prospective	Total
Guangdong	11.4	32.5	43.9
Jiangsu	12.6	2.9	15.5
Fujian	3.9	8.5	12.4
Zhejiang	4.5	5.3	9.8
Shandong	6	3.2	9.2
Hainan	2.4	6	8.4
Liaoning	1.2	2.9	4.1
Shanghai	0.7	1.1	1.8
Hebei	0.3	0.8	1.1
Guangxi	0.7	0	0.7
Tianjin	0.1	0.2	0.3
TOTAL	**43.8**	**63.4**	**107.2**

2.1 - OVERVIEW OF KEY CHINESE ACTORS

Government Actors. Within China, the following national-level government actors and their provincial counterparts are responsible for rulemaking and supervision of offshore wind. Project-level EIA approval, sea-use approval, maritime-safety authorization, and overall project approval are generally handled by the counterpart authorities at the provincial level.

- **National Development and Reform Commission (NDRC):** China's macroeconomic planning agency, charged with integrating high-level clean energy goals into national five-year Plans that provinces are bound by. Directs how much offshore wind, roughly where, and under what economic terms (with NEA). Provincial counterparts generally handle project approval with support from the subnational NEA counterpart agencies.

- **National Energy Administration (NEA):** Develops specific offshore wind capacity targets based on guidance from the NDRC, oversees grid connections, sets technical priorities (e.g. focusing on deep-water development).

- **Ministry of Natural Resources (MNR):** Determines where in the sea development occurs. Allocates coastal resources, harmonizes use for offshore wind with other maritime uses.

- **Ministry of Ecology and Environment (MEE):** Sets overall environmental constraints or guardrails. Operates the China Certified Emission Reduction (CCER) carbon market. Provincial counterparts generally handle Environmental Impact Assessment approval.

Other relevant agencies include the **Ministry of Science & Technology (MOST)**, which is responsible for R&D funding, technology development, promotion of innovation capacity (guides direction of technology development), and the **Ministry of Industry & Information Technology (MIIT)**, which is responsible for equipment standards and industrial policy formation (influences which industrial actors are involved).

Grid Companies. State Grid and China Southern Power Grid (and their provincial subsidiaries) are responsible for grid connection and integration, system planning and curtailment risk management, and implementation of national policy mandates.

OEMs & Developers. A handful of firms dominate the market for offshore wind development. Manufacturing of turbines is controlled mainly by Chinese OEMs. The six largest manufacturers by newly installed capacity in 2025—Goldwind, Mingyang, Windey, Envision, Sany Heavy, and Dongfang Electric—together accounted for 91% of installed turbine capacity (onshore and offshore) within China in 2025.[38] Domestic manufacturers are also active in supplying turbine foundations, with mainland Chinese manufacturers consistently supplying more than half of all globally installed turbine foundations.[39] That sector is dominated by Dajin Heavy Industry, Haili Wind Power (specialized in foundations for the offshore market), Titan Wind Energy, and Taisheng Wind Energy.

Development of offshore sites is primarily done by large state-owned enterprises (SOEs), at times in collaboration with smaller manufacturers. This is in line with China's energy sector more broadly, which is dominated by SOEs.[40] Top developers include: China Three Gorges Corporation (CTG), China Huaneng Group, China Energy Investment Corporation (CHN Energy), China National Offshore Oil Corporation (CNOOC), State Power Investment Corporation (SPIC), China General Nuclear / CGN New Energy, and provincial players such as Guangdong Energy Group.

2.2 - KEY POLICY AND GOVERNANCE DRIVERS OF OFFSHORE WIND EXPANSION

China has been able to deploy offshore wind rapidly and at scale due to a combination of long-term national planning coupled with subnational (provincial/municipal) elaboration and implementation; evolving financial and tax incentives; policies to promote domestic supply chains and industrial cluster development; administrative streamlining to accelerate project deployment; and grid connection incentives.

2.2.1. Long-term strategic planning

China's policy with regards to wind energy has evolved steadily over time. Each iteration of the central government's national five-year plan since 2006 has discussed wind energy in some form.

In 2006, the 11th Five-Year Plan directed developers to scale up onshore wind projects, and to begin piloting some offshore developments. From 2010 to 2024, China took affirmative steps to develop its near-shore, shallow wind resources. Under the so-called "double-ten" policy, projects were required to be sited in waters deeper than 10 meters and farther than 10 kilometers from shore. Jiangsu Province, which has an abundance of relatively shallow waters along its coastline, was an important early mover in the sector.

Since 2024, Chinese policy has shifted to require that new projects be located more than 30 km away from shore or in waters deeper than 30 m to promote development of offshore wind in what Chinese documents term "deep-" or "far-sea" locations.

The following is a more detailed discussion of this trajectory:

- The **11th Five-Year Plan (2006-2010)** emphasized the scaling up of onshore wind power with initial pilot projects for offshore wind. China's 2005 Renewable Energy Law established a legal foundation for wind development in China. This was also a period in which China's solar PV manufacturing sector began its rapid ascent to global dominance.

- The **12th Five-Year Plan (2011-2015**) called for the construction of 2 coastal and offshore large wind power "bases" (基地), or regional groupings of wind projects and co-located manufacturing or industrial supply chain clusters (Jiangsu and Shandong). A 2012 NEA sectoral planning document set targets of 5 GW of offshore wind by 2015 and 30 GW by 2020 and emphasized the development and scaling up of domestic offshore wind manufacturing capacity.[41] By 2015, China had only achieved about 1.06 GW of offshore wind. Sources cite to high cost of construction/maintenance, inadequate subsidies, grid connection challenges, an immature domestic developer and manufacturing base, and bureaucratic disagreement over sea use as reasons for the missed target.[42]

- The **13th Five-Year Plan (2016-2020**) revised China's offshore wind goals to 10 GW "under construction" and at least 5 GW grid-connected by 2020.[43] China's offshore wind capacity at the end of 2020 was approximately 10 GW, placing it behind only the UK that year, and China was responsible for half of the new installed offshore wind globally in 2020.[44] As discussed below, a policy shift to eliminate feed-in tariffs spurred a rapid build-out of projects to be completed by the end of 2021 (14.48 GW in new capacity, more than doubling China's total installed capacity).[45]

- The **14th Five-Year Plan (2021-2025)** and subsequent implementation documents emphasized the development of five 10 GW offshore wind bases,[46] policy promotion of deep- and far-sea projects, and greater integration of offshore wind with other marine and energy uses, such as oil and gas platforms, desalination, hydrogen, marine ranching/fisheries, even data centers (often referred to in policy discourse as "energy islands"); industrial policy support for larger turbine development; and a shift to unsubsidized "grid parity" electricity pricing benchmarked to coal-fired power prices.

- **NDRC/NEA's "15th Five-Year Plan for Renewable Energy Development"** (issued pursuant to the 15th Five-Year Plan (2026-2030)) sets a target for offshore wind power to reach 100 GW by 2030, organizes offshore wind development around four maritime areas (the Bohai Sea, Yellow Sea, East China Sea, and South China Sea), within which it identifies several specific deep-water and far-offshore wind bases for prioritized development, along with near-shore development across eleven provinces.[47] The plan explicitly directs "vigorous" advancement of deep-water, far-offshore wind base layout and construction.[48]

Over time, China's energy and industrial five-year plans have accelerated offshore wind development and deployment by setting headline national goals developed at the national level in coordination with the provinces.

These plans also provide the strategic signal for follow-on policies: they guide the issuance of supporting regulations, grid connection rules, and subsidies, and they influence how state-owned banks and other financial institutions allocate credit to priority sectors such as offshore wind. In practice, once a technology is written into a five-year plan with specific quantitative targets, it can become easier for developers to secure project approvals, access favorable land and sea-use rights, and obtain financing on concessional terms. Developers also benefit from the signal of long-term state support these five-year plans send because long-term planning reduces the risk of sudden policy priority shifts that could negatively impact offshore wind development, granting developers more certainty that their investments will come to fruition.

The provinces identified as key regions for green and low carbon energy transformation in the 14th Five-Year Plan for Building a Modern Energy System—Guangdong, Fujian, Zhejiang, Jiangsu, and Shandong—are now the core coastal jurisdictions hosting most of China's large-scale offshore wind projects, illustrating how planning designations and target-setting translate into concrete spatial patterns of deployment.

2.2.2. Fiscal, tax, and market-based incentives

The Chinese government has offered an evolving suite of fiscal and tax incentives to promote domestic offshore wind development. Incentives have included feed-in tariffs, a VAT rebate for sellers of self-produced wind power, a time-limited income tax exemption for certain projects, and provincial-level support of various kinds. Green certificate and emission reduction credit systems potentially provide additional revenue for project developers/operators.

- **Feed-in Tariff.** A 0.85 RMB/kWh feed-in tariff for offshore wind projects offered from 2014-2021 played a central role in China's rapid growth in offshore wind deployment in those years.[49] Interviewees generally cited to this as the most important driver of Chinese offshore wind development.

- **VAT Rebate.** Offshore wind companies specifically benefit from value-added tax (VAT) rebates and corporate income tax reductions. Since 2015, companies selling self-produced

energy[v] from wind power within China have been eligible for a 50% VAT rebate.[50] That rebate was narrowed to apply only to sales of offshore wind power in 2025, and is set to end altogether at the end of 2027.[51]

- **Tax Exemption.** Further, some projects classified as national key infrastructure that satisfy specific government criteria enjoy a three-year tax exemption, followed by a 50% reduction for the following three years.[52]

- **Provincial Incentives.** Also, while central government feed-in tariffs for new offshore wind projects ended at the close of 2021, subnational governments continued to provide financial support. For example, Zhejiang offers direct electricity production subsidies, while Guangdong and Shandong provide installed capacity-based investment subsidies. These policies aim not only to reduce costs, but to structure competitive behavior, incentivize localized production, and align industrial deployment with national strategic priorities.

In addition to these direct fiscal measures, China has introduced market-based mechanisms—including tradeable green certificates and China Certified Emission Reductions (CCERs)—that create supplementary revenue streams for offshore wind.

- **Green Certificates.** In the electricity market, the NEA issues green certificates for renewable energy projects, allowing offshore wind projects to earn extra income by trading them with utilities and suppliers that are required to acquire a minimum amount.[53] Green Certificates provide evidence that the energy consumed came from a green source, and are measured in MWh of energy.[54] Green certificates do not imply a specific amount of avoided GHG emissions, unlike CCERs (discussed below). The typical purchasers for green certificates are either (i) Chinese firms in specified industries/sectors faced with state-mandated green energy consumption targets – electrolytic aluminum, steel, cement, polysilicon, and data centers, or (ii) voluntary buyers responding to supply chain pressure or requirements from purchasing companies (such as Apple or Microsoft).[55] Green certificates traded at around 6–8 RMB/certificate (1 MWh) in 2025–26.[56]

- **CCERs.** Additionally, an MEE policy includes offshore wind projects in its list of voluntary carbon reduction programs. As a result, projects located more than 30 km from shore or in waters deeper than 30 meters do not need the "additionality"[vi] certification from the MEE before generating China Certified Emission Reductions (CCERs) that can be sold to corporations seeking to offset their emissions, opening up an additional revenue stream for offshore wind projects.[57] CCERs quantify the reduction in tonnes of CO2-equivalent that the construction of a given project leads to. A CCER is measured against a counterfactual baseline, estimating emissions in a world in which the project was not developed. CCERs can be traded in China's voluntary GHG reduction market, and thus entail an additional stream of revenue for project developers. Omitting the MEE "additionality" certification requirement gives developers increased certainty ex ante that they will be eligible for this additional revenue stream, and thereby reduces upfront financial risk—though note that projects will

v The rebate is granted to the firm selling wind power and is calculated as 50% of the VAT collected and paid by the firm on the sale of wind energy. The requirement that power be "self-produced" excludes power trades and financial/holding companies from eligibility for the VAT rebate.

vi Additionality ordinarily addresses whether the emissions reductions would have occurred without the CCER incentive. The MEE concluded that offshore wind projects generally face significant financial and technical barriers, and therefore require the CCER incentive to be implemented.

still need to comply with all other applicable CCER requirements.[58] CCERs are purchased for (i) China carbon ETS compliance (up to 5%); (ii) meeting voluntary carbon neutrality pledges or requirements imposed by supply chain purchasers; and (iii) EU Carbon Border Adjustment Mechanism compliance purposes. Each CCER represents 1 tonne of CO2-equivalent emission reduction. CCERs traded at nearly 93 RMB at the end of July 2026.

Note that a firm cannot engage in "double counting" —that is, generating revenue through both green certificates and CCERs.[59] They must choose one or the other.

2.2.3. Administrative streamlining and spatial coordination

China has repeatedly reformed its offshore wind permitting system as bottlenecks emerged, using central planning to set overall capacity and spatial limits while decentralizing most project-level approval decisions to provincial authorities.[60]

The first major reform focused on **delegating project approval authority**. In 2013, the State Council shifted the approval of wind projects from the NDRC to provincial-level development and reform commissions and other authorized local investment authorities.[61] The goal was to shorten approval timelines, cut layers of central review, and give local governments a more direct stake in meeting renewable energy deployment targets, even though aggregate capacity control and national planning still remain in Beijing's hands.

A second major reform targeted the **number and timing of prerequisites for formal approval**. In 2017, regulators removed several pre-approval items that had slowed early-stage development—such as mandatory submission of detailed feasibility study review opinions, bank loan commitment letters, and grid-connection commitment letters—before an application could even enter the approval queue.[62] Only two prerequisites were retained at the pre-approval stage: a site-selection opinion (confirming basic spatial compatibility) and land or sea-use pre-examination.[63] Developers are still expected to secure feasibility studies, financing, and grid-connection agreements, but these are now handled later and through separate supervision mechanisms, rather than as gatekeeping documents that block an application from being formally accepted. This sequencing change lowers upfront transaction costs and lets developers move into the approval process earlier.

The third reform sought to improve **coordination among parallel approval procedures** that had previously been siloed. Offshore wind projects require distinct permits related to sea-use, environmental impact assessment, maritime safety, navigation, and submarine cable routing, each historically handled by different agencies with limited information sharing. In 2024, the Ministry of Natural Resources (MNR) instructed provincial natural resources departments to coordinate closely with energy, transportation, maritime, and environmental authorities and to integrate offshore wind zoning into a unified territorial spatial planning "one-map" system.[64] Under this approach, MNR at the central level sets national marine spatial planning rules, while provincial natural resources authorities administer day-to-day sea-use permits and ensure that energy project approvals issued by provincial DRCs are consistent with the "one-map" plan. This spatial coordination is especially important in major offshore wind provinces such as Guangdong,

Jiangsu, Shandong, Zhejiang, and Fujian, where overlapping marine uses and rapid build-out make conflicts over sea-use particularly salient.

2.2.4. Technology innovation policy and supply chain/industrial cluster support

China's rapid offshore wind expansion has been supported by strong national-level technological innovation policies and the promotion of advanced industrial manufacturing and servicing capabilities in its coastal regions. The lead agencies on such policies are the National Energy Administration (NEA), NDRC, and the Ministry of Science and Technology (MOST), with the Ministry of Industry and Information Technology (MIIT) providing complementary industrial policy support. At the policy level, China has deliberately promoted next-generation offshore wind technology through targeted national plans. The NEA's 14th Five-Year Plan for Technological Innovation in the Energy Sector explicitly prioritizes the development of 15 MW–plus turbines, deep-sea floating platforms, and integrated offshore energy systems, aiming to improve turbine efficiency and adaptability to complex marine environments.[65] Complementing these R&D efforts, the State Council's 2021 Carbon Peaking Action Plan explicitly calls for the construction of large-scale offshore wind demonstration bases, while NEA pilot programs support innovations such as hybrid offshore energy islands and the co-development of wind with offshore oil and gas infrastructure.[66]

At the same time, China's offshore wind innovation is reinforced by the country's robust coastal industrial base and the development of offshore wind industrial clusters. Provinces such as Guangdong, Jiangsu, and Shandong were already major centers of heavy manufacturing, port logistics, and marine engineering. As such, they provide an integrated supply chain that supports turbine production, foundation manufacturing, installation vessels, and operation and maintenance services. The rapid shift toward larger turbines illustrates how this industrial foundation can enhance technological upgrading. For projects with equivalent installed capacity, larger turbines significantly reduce the number of units required, thereby lowering foundation, installation, cable-laying, and long-term maintenance costs. China has led the way in developing and deploying larger turbines, largely due to Chinese manufacturers' ability to quickly iterate on new designs and move from design to development to deployment in rapid succession.[67] Today, China's wind turbines are estimated to be 20–30% cheaper than their European counterparts in export markets while achieving comparable performance levels, bolstering China's competitiveness in the global market.[68]

Policies to support the development of *domestic* Chinese champions (manufacturers, supply chain providers, and project developers) have been a core aspect of this innovation policy. Starting in 2005, China's NDRC legally mandated that all newly installed wind turbines (either on- or offshore) source at least 70% of their components from domestic suppliers.[69] This requirement remained in place through 2009, which helped domestic suppliers capture market share early on.[70] In addition, China set up the Special Fund for Wind Power Equipment Manufacturing in 2008, which provided grants to turbine manufacturers that agreed to use parts and components made in China.[71] Together, these programs allowed for the creation of a comprehensive domestic supply chain. At the same time, foreign manufacturers operated at a disadvantage in the Chinese market

unless they agreed to form a joint venture. China imposed a joint venture requirement on many industries, which promoted technology transfer from foreign manufacturers to domestic firms.[72] Restrictions on foreign investment into manufacturing industries remained in place until the 2015 revision of the Foreign Investment Catalogue. These restrictions protected China's infant turbine manufacturing industry, as well as other ancillary industries, from global competition.

Domestic manufacturers and the state-owned enterprises primarily involved in offshore wind development also benefited from low-interest debt facilities often purchased by state-backed financial institutions (so-called "green bonds"), which helped insulate them from macroeconomic headwinds.[73] Green bonds receive fiscal subsidies and tax incentives, which artificially lower the cost of capital for firms engaged in "green" sectors.[74] Since these bonds are available only to domestic firms, their issuance grants a competitive advantage to domestic firms over foreign ones.

At the provincial level, the offshore site tender process also tends to favor domestic firms. For example, in Guangdong, proposed projects gained bonus points in the bidding process if they could show that components would be sourced from factories located within Guangdong's industrial parks, and if they committed to upgrading local infrastructure such as ports.[75] This preference for local sourcing again renders domestic firms more competitive versus international manufacturers.

2.2.5. Grid integration and guaranteed consumption

The Chinese government has taken several steps to help offshore wind power connect to the grid more efficiently. These include expanding grid infrastructure, issuing guidance on integrating large offshore wind bases into the onshore system, and strengthening guaranteed purchase policies to reduce curtailment risk.[76]

In 2024, for example, the NDRC introduced a measure that divided qualifying renewable electricity generation into "guaranteed-purchase electricity"[77] and "market-traded electricity." The former is guaranteed to be purchased by the grid operator, providing ex ante certainty for generation assets. The portion of renewable energy designated as guaranteed-purchase depends on the renewable-electricity consumption responsibility assigned to each province by the national government. The province, in turn, translates that national target into a specific plan by allocating guaranteed-purchase shares among generation assets.[78] For offshore wind developers who receive a guaranteed-purchase agreement, the system mitigates concerns about grid connection and guarantees a set level of revenue to offshore firms.

This supports stable growth of the offshore wind industry and reduces investment risk, which should in turn reduce developers' cost of capital.[79] Together, these grid integration and guaranteed-consumption measures complement the fiscal and market-based incentives described above, helping to ensure that offshore wind projects can both connect to the system and reliably sell their output.

2.3 - "DEEP- AND FAR-SEA" AND FLOATING OFFSHORE WIND DEVELOPMENT

Chinese policymakers have increasingly promoted offshore wind development in deeper waters and farther from shore as high-quality nearshore sites have been utilized or begun to conflict with other maritime uses.

In December 2024, the Ministry of Natural Resources adopted the so-called "Single 30" (单30) policy, requiring new offshore wind projects to be located either at least 30 kilometers (18.6 miles) from shore or in waters deeper than 30 meters (98.4 feet).[80] This marked a strategic shift toward deep-water and far-offshore wind development, replacing the earlier "double-ten" standard, promulgated in 2011, which only required projects to be built more than 10 kilometers (6.2 miles) from shore and in water depths greater than 10 meters (32.8 feet).[81]

This move toward "deep and far seas" has also prompted Chinese firms to develop floating offshore wind technologies. Since 2021, China has commissioned seven floating demonstration projects with a combined capacity of roughly 72 MW, and a large 1 GW commercial-scale floating project is under development off Hainan, led by PowerChina.[82] Chinese developers face distinctive engineering constraints: floating turbines must be typhoon-resilient and capable of being transported across relatively shallow coastal shelves, where limited water depths impose strict draft limits on floating foundations during transport and, to a lesser extent, during operation.[83]

The turn to deep-water and floating offshore wind has been enabled by rapid scaling to larger turbines, which deliver economies of scale and lower levelized costs of energy.[84] Larger machines help offset the higher costs of deep-water foundations and transmission infrastructure because fewer foundations and transmission cables are needed per unit of electricity generated. The phaseout of national feed-in tariffs has likely accelerated this trend toward larger turbine sizes, as developers seek to improve project economics in the absence of guaranteed price premiums.[85]

China's marine engineering equipment sector has also benefited from sustained state support over the past two decades, including industrial policies such as Made in China 2025 and subsequent five-year plans focused on intelligent manufacturing.[86] This sector is critical to scaling deep-sea offshore wind, since specialized installation vessels, fabrication yards, and related infrastructure all fall under the marine engineering equipment umbrella. Targeted subsidies, industrial upgrading programs, and other policy interventions have enhanced the competitiveness of Chinese marine engineering equipment firms and helped reduce the costs of deep-water offshore wind construction.

Oil and gas state-owned enterprises have begun to leverage their offshore engineering capabilities in this space. Two of China's floating offshore wind pilot projects were developed by CNOOC, the state-owned oil and gas company, to supply power directly to an offshore drilling platform, illustrating how existing deep-sea engineering expertise can be redeployed for offshore wind. In addition, developed sub-sea pipeline networks create a foundation for offshore hydrogen production, allowing green hydrogen produced via electrolysis powered by offshore wind to be transported onshore, at least in principle, through repurposed or newly built pipelines.[87]

Fig. 6 / A Summary of Floating Offshore Wind Projects in China							
Project Name	**Developer/ OEM**	**Status / Year**	**Location**	**Distance from Shore**	**Water Depth**	**Capacity**	**Key Features**
Sanxia Yinlinghao (引领号)	CTG + Mingyang Smart Energy	Commissioned (2021)	Yangjiang, Guangdong; Yangxi Shapa III wind farm	~30 km (nearshore–transitional)	~30–50 m	5.5 MW	China's first floating offshore wind demonstration project; typhoon-resistant design
Fuyouhao (扶摇号)	CSSC Haizhuang Wind Power	Demonstration (2022)	Zhanjiang, Guangdong	Not disclosed	~50–70 m	6.2 MW × 1	Deepwater floating demonstration platform; key test of mooring and stability systems
Haiyou Guanlanhao (海油观澜号)	CNOOC + Mingyang Smart Energy	Oilfield connected / Commissioned (2023)	Wenchang, Hainan; Wenchang oilfield	136 km	~120 m	7.25 MW	First "truly" deep-sea floating offshore wind project in China; powers offshore oil platforms
OceanX	Mingyang Smart Energy	Demonstration / Grid-connected (2024)	Yangjiang, Guangdong; Qingzhou IV wind farm	~70 km	~35 m	2 × 8.3 MW (twin-rotor)	World's first twin-rotor floating wind turbine
Guoneng Gongxiang-hao (国能共享号)	China Energy Investment Corporation	Demonstration / Commissioned (2024)	Guangdong / Fujian (multi-site)	~30 km	~35 m	4 MW	Multi-entity pilot platform exploring pathways toward scale-up; initial turbine linked w/ aquaculture
Sanxia Linghang-hao (三峡领航号)	CTG + Goldwind	Demonstration/ Installed (2026)	Off Yangjiang, Guangdong	~70 km	~50-60 m	16 MW x 1	World's largest single-unit floating wind turbine
Haiyou Anlan (海油安澜)	CNOOC subsidiary	Oilfield connected / Commissioned (2026)	Lufeng oilfield, Zhuhai	136 km	~136 m	16 MW x 1	China's deepest floating project; powers offshore oil platforms
Hainan Wanning	PowerChina	Phase I (unknown); Phase II (2027)	Hainan	n/a	n/a	200 MW (I); 800 MW (II)	China's first commercial scale floating wind project; under construction

Fig. 7 / Floating Offshore Wind Projects in China



2.4 - LIMITATIONS OF THE CHINESE APPROACH

Although China has been remarkably successful in rapidly deploying offshore wind capacity, its streamlined approach is not without downsides. In this section, we identify some potential drawbacks of China's current planning and permitting system for offshore wind.

2.4.1. Inadequate evaluation of ecological risks

China's offshore wind projects comply with the legal procedures required under the country's Environmental Impact Assessment (EIA) framework, but limitations[vii] in baseline ecological data, quantitative assessment standards, and long-term monitoring may cause project-level assessments to underestimate certain ecological impacts.[88] For example, in one case, ecological monitoring covered only a few days rather than an entire annual cycle, which means that the movements of migratory seabirds and other seasonal species are not fully captured.[89] Furthermore, scientific data on floating offshore ecosystems is limited, making it difficult for EIAs to evaluate potential impacts on marine mammals, fish migration patterns, and underwater noise with sufficient accuracy.[90] Environmental reviews fall short in other ways, too. Noise impact assessments are

vii Research has identified several limitations in the ecological assessment of offshore wind development, including the absence of unified quantitative standards for evaluating long-term underwater-noise effects, electromagnetic effects on marine organisms, and changes in seabed ecology, as well as insufficient long-term ecological assessment and post-construction monitoring.

confined to above-water impacts, without regard for the impact of underwater noise on marine animals.[91] There is also little attention paid to long-term impacts on marine ecosystems as a result of construction and disruption in the benthic zone.[92]

Finally, the project-by-project approach to conducting EIAs does not account for the cumulative ecological pressure created by the rapid build-out of multiple wind farms within the same sea area.[93] As a result, noise, habitat disturbance, and ecosystem fragmentation may intensify over time without being reflected in individual assessments. These factors suggest that formal compliance with EIA procedures may not be enough to ensure substantive ecological protection. However, due to the absence of a clear legal violation, environmental advocacy groups have limited grounds to initiate public interest litigation or administrative supervision, which further reduces external checks on development.

2.4.2. Military considerations

Military considerations represent a major source of sea-use conflict for offshore wind development, particularly during the approval and construction stages in strategically sensitive coastal regions near the Taiwan Strait. Under the Law on the Protection of Military Facilities, non-military construction is prohibited within designated military restricted and administrative zones,[94] and offshore wind projects must avoid areas that could interfere with the normal operation of military facilities.[95] While some conflicts can be anticipated and addressed at the planning stage through spatial avoidance, an increasing number arise from the growing frequency of military exercises, temporary navigation bans, and maritime patrols, which can disrupt installation and maintenance activities even in previously approved project areas.

In one case, interference with a submarine training route forced a project to relocate its site 12 kilometers offshore, increasing construction costs by 15% and delaying completion by eight months.[96] Similar disruptions occurred during the construction of the Yangjiang offshore wind cluster in Guangdong, where conflicts with naval training schedules resulted in 17 work stoppages and losses exceeding RMB 300 million (~$43 million). In extreme cases, inadequate early-stage assessment of military constraints has created severe legal and financial risks, as illustrated by a project in Pingtan, Fujian. There, an already completed offshore wind project faces the possibility of full dismantlement due to unresolved military-use conflicts, placing approximately RMB 1.8 billion (~$260 million) in sunk costs at risk.[97]

2.4.3. Grid integration constraints

Offshore wind development in China faces growing constraints on power system integration. In several coastal regions, grid capacity has not kept pace with the rapid expansion of offshore wind generation, limiting the effective integration of offshore wind power during periods of high output. Although offshore wind projects are connected to the onshore grid through submarine cables, transmission networks at major landing points are often operating close to capacity, leading to congestion and unstable power delivery. At the same time, a persistent mismatch exists between local electricity demand and offshore wind generation. Offshore wind power is predominantly

integrated into nearby grids, where its intermittent and volatile output poses challenges for real-time balancing. In some coastal provinces, peak-to-valley differences in electricity demand exceed 30-40%, making it difficult to absorb high levels of wind generation and resulting in curtailment that reduces utilization hours and weakens investment returns.[98]

These integration challenges are further compounded by rising long-distance transmission costs. For projects located tens of kilometers offshore, the construction and maintenance of high-voltage submarine cables significantly increase costs, and transmission losses can be significant as well.[99] As a result, deep-sea offshore wind power can often be generated but not fully integrated or efficiently utilized, with integration constraints emerging as a structural bottleneck. Such challenges have been observed in Jiangsu and Guangdong, where grid structure and intra-provincial transmission limits have restricted offshore wind integration.[100] In response, China is promoting local integration pathways, including offshore wind-based hydrogen production, direct green power supply to industrial parks, flexible energy storage, and more integrated planning approaches aimed at easing transmission constraints.

2.4.4. Undefined decommissioning framework

China's offshore wind industry is in a period of rapid expansion, and due to the relatively nascent nature of the industry, decommissioning has not been necessary yet. Since the expected lifespan of offshore wind turbines is around 25-30 years, China has another decade before its first offshore turbines will need to be decommissioned. As of now, no clear policies or legal provisions related to the dismantling of entire farms have been promulgated.[101]

3. GUANGDONG CASE STUDY: PROVINCIAL PLANNING AND GATEKEEPING IN PRACTICE

This section uses the example of Guangdong Province to illustrate how China's national offshore wind policy and law framework operates in conjunction with subnational and project level policy, law, and practice. Guangdong was not a first mover in offshore wind, but it has since fully committed to the sector. The province has installed more than 11 GW of offshore wind capacity as of 2025, accounting for over 10% of total global offshore capacity.[102] Guangdong is China's provincial leader in offshore wind when considering existing and planned capacity. The province is home to the headquarters of one of China's leading wind turbine OEMs (Mingyang) and has developed key offshore wind industrial clusters around the port cities of Yangjiang, Shanwei, Shantou, and Jieyang. Guangdong is also now piloting floating offshore wind turbines, and aggressively expanding into deeper-water development. Among provinces engaged in offshore wind, Guangdong is also notable for offering provincial-level subsidies after the elimination of the national feed-in tariff in 2021 and devolving project approval work to the city level to reduce administrative bottlenecks and enable faster build-out.

In short, Guangdong Province is a valuable case for study because of its speed and scale of build-out; experience in developing offshore wind supply chains and industrial clusters; focus on floating and deeper-water offshore projects; engineering to manage aggressive, typhoon weather and sea conditions; and innovations in subnational fiscal support and governance.

A complete analysis of practices in other provinces is beyond the scope of this report, but we note a few areas of similarity or difference worthy of further research.

- **Early Movers.** Jiangsu and Shanghai were among China's earliest movers in offshore wind, and their longer experience may offer lessons about cycles of cost and logistics learning and grid integration. These provinces benefited from shallow coastal waters, wherein turbines could more easily be constructed.

- **Deep Sea, Floating Focus.** In addition to Guangdong, Shandong and Fujian are both investing heavily in deep-water and floating wind, driven by a lack of usable shallow coastal water. Jiangsu, Shandong, Zhejiang, Shanghai, and Hainan are also actively pursuing deep-sea/nationally-managed-waters development to varying degrees.[103]

- **Industrial Clusters/Supply Chain Development.** Guangdong is notable for its offshore wind industrial clusters in Yangjiang, Shanwei, Shantou, and Jieyang. Jiangsu (Yancheng-Dafeng & Nantong-Rudong),[104] Fujian (Fuqing-Jiangyin Port),[105] and Shandong (Dongying-Guangli Port)[106] are other sites of industrial cluster and supply chain development in other parts of China.

- **Subnational Subsidies & Governance.** We note some variation in subnational subsidy policies with Shandong adopting a one-time capital subsidy[107] akin to Guangdong's and Zhejiang adopting a 10-year recurring per-kWh subsidy.[108]

3.1 - DEVELOPMENT TRAJECTORY

Guangdong's offshore wind build-out is fairly recent and can be understood as a four-phase trajectory over a decade in time: (I) an early demonstration phase (2016-18), (II) a period of rapid scaling-up tied to the phase-out of national feed-in tariffs (FiTs) (2019-21), (III) a post-central FiT phase (2022-present), and (IV) a post-Document 136 marketization phase (see Fig. 10). These phases align with the pricing and allocation regimes discussed in Section 3.3.

Phase I. During the first phase (2016–2018), offshore wind deployment in Guangdong remained modest in both scale and spatial scope. Projects were predominantly near-shore, fixed-bottom installations in shallow waters, typically 3–10 meters deep.[109] In 2016, the Guangdong Development and Reform Commission (DRC) approved the province's first offshore wind project, the 120 MW Zhuhai Guishan demonstration project, which subsequently entered operation in 2019.[110]

Phase II. The second phase (2019–2021) was characterized by a sharp acceleration in capacity additions. New offshore wind installations surged in 2021 in Guangdong and nationally, and Guangdong's share of national additions increased markedly (see Fig. 8). This build-out was driven by the FiT phase-out deadline (see Section 3.3), which triggered a "rush to connect," with a large volume of projects completed and commissioned within a compressed period.[111]

In this scale-up phase, growth concentrated in two main industrial clusters: western Guangdong around Yangjiang and eastern Guangdong around Shanwei and Lufeng.[112] Multiple large, multi-hundred-megawatt offshore wind farms were commissioned in both hubs, supported by expanding local manufacturing, port, and installation capacity.[113] Offshore wind was elevated to a provincial strategic priority,[114] tightly linked to Guangdong's broader industrial policy, including strategic emerging industry clusters, and to initiatives to develop the marine economy.[115]

Phase III. From 2022 onward, Guangdong entered a post-central FiT phase governed by the grid-parity pricing regime detailed in Section 3.3. During this third phase, both typical project size and average turbine capacity have continued to rise, and developers have built out dedicated offshore transmission infrastructure.[116]

Notable examples include the multi-phase, gigawatt-scale Qingzhou projects off the coast of Shaba Town within the Yangjiang cluster.[117] Guangdong has also become a testbed for next-generation offshore wind technologies: the Mingyang OceanX floating wind platform in Yangjiang, for instance, is configured as a 16.6 MW unit composed of two 8.3 MW turbines mounted on a single floating foundation, making it one of the largest capacity single floating platforms deployed to date.[118]

Phase IV. China's Document 136, issued in 2025, moved renewable output toward market prices instead of fixed tariffs. This phase overlays rather than replaces Phase III. Document 136 marketizes pricing but retains the coal-benchmark anchor of the grid-parity era (see Section 3.3).

Fig. 8 / Annual offshore wind capacity additions and Guangdong share of China's annual additions[119]			
Year	**Guangdong annual capacity addition (GW)**	**National annual capacity addition (GW)**	**Guangdong share of China's annual additions (%)**
2018	0.18	1.73	10.40%
2019	0.056	2.49	2.25%
2020	0.774	3.85	20.10%
2021	5.5	14.48	37.98%
2022	1.41	5.16	27.33%
2023	2.09	7.18	29.11%
2024	1.98	5.62	35.23%

3.2 - GOVERNANCE AND GRID

Guangdong's rapid offshore wind build-out reflects a provincial-led model in which a small set of public actors jointly decide where projects go, who builds them, and when they connect to the grid. Rather than relying on fragmented, project-by-project approvals, the province uses integrated planning that links site identification, early technical work, competitive allocation of development rights, and transmission build-out. This coordinated approach reduces uncertainty for developers and helps align timelines across agencies and the grid company, allowing large offshore projects with high upfront costs to move from plan to operation in only a few years.

At the core of this system is the **Guangdong DRC**, acting with and through its **Energy Bureau**. The provincial DRC/Energy Bureau prepares and revises Guangdong's offshore wind development plans, aligns provincial targets with national energy and climate goals, and works with natural resources and related marine authorities to ensure that planned sites and export routes are consistent with national and provincial land and sea spatial planning, ecological red lines,[viii] and sea-use requirements.[120] Before sites are offered to developers, the province commissions baseline work—such as wind resource measurements, geotechnical surveys, and maritime-use assessments—to confirm feasibility and narrow uncertainty about costs and environmental and navigational constraints.[121] The DRC then organizes competitive allocation rounds in which municipal governments (for example, Shanwei and Yangjiang) run local bidding processes within provincial rules, subject to provincial review and approval.[122]

At the same time, **marine and natural resources authorities** can act as gatekeepers for offshore wind sea-use rights, because projects must conform to marine spatial plans, conservation zones, and protected areas, and obtain formal sea-use approval from natural resources (marine)

[viii] "Ecological Red Line" refers to China's mandatory spatial conservation boundaries for ecologically critical land and marine areas, within which development activities are strictly restricted to safeguard ecological functions and ecological security.

departments. Their decisions on whether specific locations and layouts are compatible with shipping routes, fisheries, and conservation areas can reshape project design and influence how quickly projects clear sea-use approvals.[123] Reports from the early years of Chinese offshore development note poor coordination and conflicting priorities between the NEA bureaucracy and the State Oceanic Administration.[124] These conflicts have subsequently been mitigated through a variety of reforms, including devolution of authority to provincial governments, and the 2018 bureaucratic reform that dissolved SOA and folded its maritime spatial planning functions into a Ministry of Natural Resources "super-ministry."

Once a site is awarded, the **project company** leads the detailed feasibility studies, engineering design, and environmental and sea-use permitting, working with specialized design institutes and the relevant environmental, maritime, and natural resources agencies.[125]

In parallel, the provincial grid company—**China Southern Power Grid and its Guangdong Power Grid subsidiary**—assesses grid access, plans export routes, and decides how and when offshore wind power will be integrated into the onshore network. These grid-side decisions are critical: transmission lines, substations, and landing points must be built on time and at sufficient scale for offshore wind projects to export their output once turbines are installed. The grid company is thus a practical gatekeeper, even though it is not the formal permitting authority. It invests in and operates key offshore and onshore transmission assets, such as major high-voltage substations in western Guangdong that bundle power from multiple large offshore wind farms into the broader grid.[126] Delays or constraints on the grid side can slow the commissioning and full deliverability of projects, as illustrated by public reports of export bottlenecks affecting large projects in the Yangjiang cluster.[127] In some cases, the grid company also holds equity stakes in offshore wind projects, further blurring the line between "connector" and co-investor and reinforcing its influence over which projects advance and on what timeline.[128]

Guangdong's best offshore wind resources lie off its western and eastern coasts—around Yangjiang, Shanwei, Jieyang, and Chaozhou—while its largest electricity demand is concentrated in the Pearl River Delta and Greater Bay Area. Most offshore wind power therefore has to travel substantial distances to reach core load centers, making transmission planning and grid-integration central to the province's offshore wind strategy.[129] The 2021 provincial implementation plan requires coordinated planning of offshore wind transmission infrastructure, including early designation of submarine cable landing points, the configuration of offshore and onshore substations, the choice of export corridors, and—where relevant—the selection between high-voltage AC and DC technologies.[130] These decisions are to be aligned with land use and marine spatial plans and coordinated across energy, natural resources, marine, environmental, and maritime agencies.

At the planning level, the Guangdong Energy Bureau under the provincial DRC works with China Southern Power Grid and its Guangdong Power Grid subsidiary to incorporate offshore wind bases into provincial grid planning and investment decisions.[131] This has encouraged "bundled" export solutions in which multiple projects share common offshore substations, export corridors, and landing points, often combined with existing large thermal plants, to make more efficient use

of limited transmission routes and substation capacity.[132] In practice, however, transmission does not always keep pace with wind farm construction. A 2021 NDRC notice introduced a "build first, buy back later" mechanism for supporting grid connection assets: where grid companies are not ready to invest on schedule, developers may build certain grid connection facilities themselves —such as offshore substations or high voltage submarine cables—subject to later transfer to the grid company at an agreed valuation.[133]

In Guangdong, this approach has been applied to large projects such as parts of the Yangjiang Sanshan Island offshore wind complex, where the developer was allowed to construct offshore substations and high voltage export cables with combined export capacity on the order of 1 GW.[134] While this mechanism can accelerate grid connection and reduce the risk that completed projects sit idle waiting for transmission, it also creates new coordination and regulatory challenges. Publicly available information does not always clarify the timing or valuation of buybacks, or the safeguards around cost allocation and asset quality. National regulators have flagged delayed or incomplete buybacks and related grid access issues in enforcement cases in other regions and renewable sectors, suggesting that implementation of these mechanisms is uneven and that grid-integration risks remain material even where policy frameworks look robust on paper.[135]

In summary, Guangdong's experience shows that offshore wind outcomes are shaped not only by formal permitting rules but by how planning, site preparation, competitive allocation, and grid investment decisions are coordinated across a small group of provincial actors. In this model, the provincial DRC decides when and where to open sites, municipal governments help choose developers, and the grid company's infrastructure and commissioning choices effectively determine when projects can operate at scale.

Fig. 9 / Offshore Wind Development Stages[ix]			
Stage	**Description**	**Key stakeholders (typical roles)**	**Indicative timing**
Planning[136]	Province identifies suitable offshore wind areas and incorporates them into provincial development plans, aligned with national targets and guidance.	Provincial DRC/energy bureau (planning and coordination); NEA (alignment of provincial and national planning).	Ongoing; plans updated periodically.
Developer selection	Provincial authorities designate offshore wind development areas and select developers through competitive or, where permitted, non-competitive procedures.	Provincial DRC/energy bureau (sets rules and confirms results); municipal governments (for example, Shanwei, Yangjiang) manage local bidding;[137] grid company (provides preliminary grid-connection assessment).	Roughly 1–3 months from tender announcement to award.[138]
Site investigation and surveys	Provincial authorities commission site-specific field investigations, including wind measurements, geotechnical and hydrological surveys, and navigation and sea-use assessments.	Provincial DRC (commissions and coordinates studies); marine and natural resources authorities (technical input and review).	Several months (varies by site).
Approvals and permitting	Developers prepare the feasibility study and required technical studies covering areas such as environmental impacts, sea-area use, navigation safety, grid connection, geological conditions, and other project-specific requirements. These studies provide the technical basis for project approval and subsequent permitting.	Project company (SPV) and design institutes (prepare studies and designs); environmental, maritime, and natural resources agencies (issue permits); grid company (interconnection review).	Historically 2–3 years or longer for some projects; following reforms to streamline offshore wind development procedures starting in May 2022, approximately 1–2 years may be achievable, depending on project complexity and local requirements.[139]
Pre-construction permits and authorizations	Before construction begins, the developer obtains the permits and authorizations required for offshore and onshore construction, including approvals for sea-area use, land use, construction activities, marine works, and submarine cable installation.	Natural resources authorities (sea-area-use approvals); local natural resources and planning authorities (land-use approvals); local construction authorities (construction permits); maritime safety administrations (permits for construction activities on or under navigable waters); regional offices of the Ministry of Natural Resources (relevant authorizations for submarine cable routes and installation)	Timing varies by project and jurisdiction; generally completed before formal commencement of construction, with some procedures conducted in parallel.
Construction and grid connection	Offshore foundations, turbines, and inter-array cables are installed; onshore substations and transmission lines are built; project undergoes testing and grid connection.	EPC contractors and equipment suppliers (build the project); grid company (constructs and commissions grid connection).	Typically about 3 years from start of construction to full commissioning.
Operations and maintenance	Wind farm enters long-term operation, with routine maintenance, inspections, and environmental monitoring.	Project company (operates the wind farm); O&M providers (maintain equipment); relevant regulators (monitor safety and environmental compliance).	25–30 year operating life.

ix For illustrative purposes; assembled by authors from written materials and interviews. Actual practice may vary by place.

3.3 - PRICING AND ALLOCATION

In Guangdong, pricing rules and competitive allocation are tightly linked: they determine both whether projects are financeable and which developers win access to scarce sites. Offshore wind requires large upfront capital, multiyear construction, and exposure to policy and grid risks, so expected revenues under the prevailing tariff regime heavily shape investor interest and bid strategies.

Guangdong has moved through four main pricing–allocation regimes in accordance with national policy shifts.

Pre-Competitive Allocation (~2016-2018). Under the early FiT system, most projects approved before the end of 2018 qualified for fixed premium prices of 0.85 RMB/kWh for offshore projects and 0.75 RMB/kWh for intertidal projects, provided they were fully commissioned and grid connected by the end of 2021. During this phase, developer selection relied mainly on planning and administrative approvals; price competition played only a limited role, because tariffs were set centrally and uniformly for eligible projects.

Competitive Allocation (2019-2021). From 2019 to 2021, national policy began phasing out the FiT and introduced guidance prices[x] (指导电价) or price ceilings for newly approved projects[140] - that is, maximum allowed on-grid tariffs for 2019 approvals were set at 0.80 RMB/kWh and for 2020 approvals set at 0.75 RMB/kWh. At the same time, Guangdong rolled out a formal competitive allocation system for provincially administered sites. Developers bid for sites listed in the provincial offshore wind plan, submitting proposals scored on multiple criteria, including technical capability, financial strength, and bid electricity price.

Price became a prominent scoring factor, accounting for a large share of total evaluation points. The scoring system implemented an innovative tiered, decaying marginal-points formula – large price cuts near the ceiling earned points quickly, but the marginal reward for further cuts dropped off sharply beyond a threshold, specifically to discourage runaway price competition while still pushing costs down. Overall, this period used competitive bidding to push tariffs toward parity while still awarding projects to developers viewed as financially and technically capable.

Grid Parity (2022 onward). Since 2022, Guangdong has shifted to a grid parity model in response to NDRC's mid-2021 notice ending central subsidies for newly approved offshore wind and devolving tariff-setting to provincial price regulators effective August 2021. Under this model, offshore wind projects receive an administratively set tariff benchmarked to the provincial coal-fired power price (0.453 RMB/kWh). With an administratively set tariff equal to the coal benchmark, offshore wind projects are being incentivized to reach cost "parity" with coal. To ease this transition, the provincial government introduced temporary investment subsidies for provincial waters projects that missed the end of 2021 national grandfathering deadline but connected between 2022 and 2024, with support declining from 1,500 RMB/kW in 2022 to 1,000 in 2023, 500 in 2024, and zero from 2025 onward.

x "Guidance prices" refer to the maximum government-set tariffs for newly approved offshore wind projects (i.e., price ceilings), with actual tariffs determined through competitive bidding and not permitted to exceed the ceiling.

Competitive allocation continues, but price has been removed from the scoring framework; for example, during the 2023 bidding round Guangdong's government evaluated bids on developer capacity, construction and grid connection plans, and local industrial contributions, rather than on electricity price. In this parity phase, all developers face broadly similar tariff expectations with tighter margins, so allocation focuses on selecting firms that can reliably finance, build, and connect projects under fixed, low-price conditions.

Document 136 (2025). In September 2025, Guangdong implemented Document 136 – the national NDRC/NEA reform marketizing renewable energy pricing – through its own provincial rules, which apply different pricing tracks depending on when a project secured its development rights. Offshore wind projects that had already been awarded through competitive allocation before June 1, 2025 are treated as "stock" projects: they receive an effective flat price via a two-sided contract-for-differences settlement (差价结算机制) pegged to a mechanism price (机制电价) set at Guangdong's coal-fired power benchmark price (0.453 RMB/kWh) for a defined contracted volume of their output for up to 20 years.

Projects awarded on or after that date are "incremental" projects: these projects bid at periodic auctions to determine a competitively set mechanism price, not to exceed the coal-benchmark rate. The projects eligible at each auction round lock in this mechanism price for the full execution period (14 years for offshore wind) with payments handled via a monthly two-sided contract-for-difference settlement pegged to that auction-determined mechanism price.

In both cases, only a capped share of a project's output qualifies for the mechanism price; any generation beyond that contracted volume is sold at whatever price the power market yields.[141] The result is that Guangdong has moved incremental (new) projects from an effective administratively fixed price set at the coal benchmark to an effective competitively bid fixed price capped at the coal benchmark.

Fig. 10 / Evolution of offshore wind pricing and developer selection in Guangdong			
Stage	**Pricing mechanism**	**Developer selection process**	**Regions & illustrative projects**
Precompetitive allocation (~2016–2018)	Fixed national FiT (0.85 RMB/kWh offshore; 0.75 intertidal) for eligible projects	Sequenced via planning/ administrative approval; no unified scoring system	Zhuhai and scattered coastal sites – Zhuhai Guishan (120 MW approved 2016; first phase commissioned 2019)
Competitive allocation (2019–2021)	Bid prices capped by national guidance-price ceilings (0.80 RMB/kWh 2019; 0.75 RMB/kWh 2020)	Multi-criteria scoring (technical, financial, price) with tiered decaying-marginal-points formula, with price a major scoring component in practice.	Yangjiang (west), Shanwei (east) — Shanwei Houhu (~500 MW)
Grid parity (2022 onward)	Fixed benchmark on-grid price aligned with Guangdong's coal-fired power benchmark (0.453 RMB/kWh), with no national FiT premium; transitional provincial subsidies 2022–2024.	Competitive allocation continues; recent rounds (e.g., 2023) focused on developer capacity, construction and grid connection plans, and local industrial and ecological co-benefits. Price removed as a scoring factor	Yangjiang (core), Shanwei–Jieyang corridor — Qingzhou VI (~1 GW), Mingyang OceanX
Doc. 136 (2025 ; layered onto grid-parity stage)	Stock projects (< mid-2025): CfD pegged to coal benchmark mechanism price; incremental projects (> mid-2025): competitively bid mechanism price, capped at coal benchmark	Competitive allocation continues; auction-based for incremental projects	n/a

Central Role of SOEs in Offshore Wind Development

Guangdong's allocation rules shape who can participate. Provincial guidelines for competitive allocation impose high entry thresholds, including minimum net assets on the order of 50 billion RMB, limits on leverage, minimum equity shares in project capital structures, and requirements for prior offshore wind experience (for example, at least 0.5 GW of approved capacity nationwide within the preceding year). These criteria have tended to favor large, well-capitalized state-owned energy groups, and operating capacity in Guangdong is now concentrated among a small number of major SOE developers such as CGN, CTG, SPIC, and Guangdong Energy Group. These SOEs have centered offshore wind construction in Yangjiang, Shanwei, Jieyang, Zhanjiang, Huizhou, and Zhuhai.

Fig. 11 / Investors in operating offshore wind capacity in Guangdong[142]		
Investor group	**Operating capacity involved (GW)**	**Primary project locations (clusters)**
China General Nuclear (CGN)	~2.4–2.6	• Shanwei (Houhu; Jiazi I & II); • Huizhou (Gangkou I & II); • Yangjiang (Nanpengdao); • Zhuhai (Guishan)
China Three Gorges (CTG)	~2.2–2.4	• Yangjiang (Shaba Phases 1–5; Qingzhou IV) • Zhuhai (Guishan)
State Power Investment Corporation (SPIC)	~1.5–1.6	• Jieyang (Shenquan I & II) • Zhanjiang (Xuwen Phases 1–2)
Guangdong Energy Group (Yuedian)	~1.7–1.9	• Yangjiang (Qingzhou I; Shaba JV); • Zhanjiang (Wailuo; Xinliao); • Zhuhai (Jinwan)
Huadian Group	~0.5	• Yangjiang (Qingzhou III)
China Huaneng Group	~0.4	• Shantou / Nan'ao (Lemen II)
Datang Group	~0.25	• Shantou / Nan'ao (Lemen I) • Zhuhai (Guishan)
China Energy Conservation Group (CEC)	~0.3	• Yangjiang (Nanpengdao – CEC tranche)
China Southern Power Grid–affiliated entities	~0.2–0.3	• Zhuhai (Guishan demonstration)
Financial / mixed investors (e.g., Ping An)	<0.3	• Huizhou (Gangkou I)

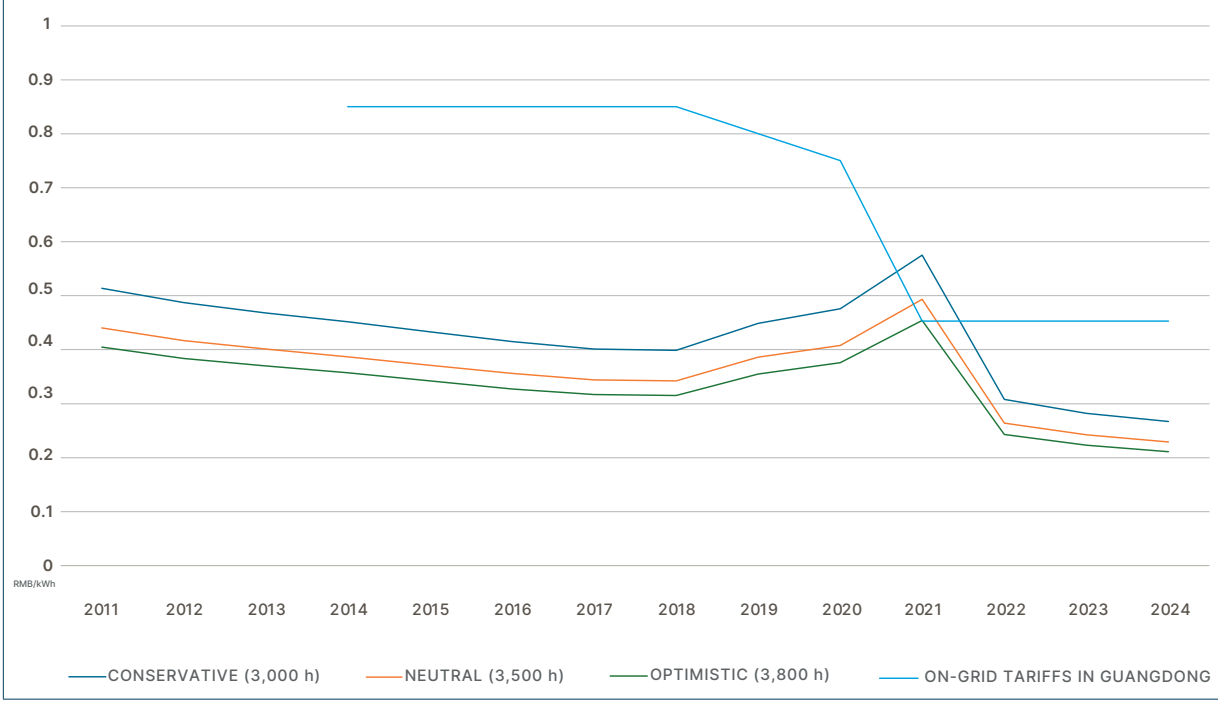
Levelized Cost Trends and the Push to Diversify Demand

Chinese pricing and allocation policies have been deliberately designed to squeeze costs down and push offshore wind toward competitiveness with conventional generation, rather than to guarantee revenues indefinitely. As national and provincial subsidies have been phased out in favor of market-based, coal-benchmarked pricing, developers have pursued two complementary strategies to

remain profitable: reducing per-unit costs through economies of scale—larger turbines and larger projects, discussed in Section 3.1—and diversifying revenue streams, discussed below.

Offshore wind construction costs in China, including Guangdong, rose during the peak build-out around 2019–2021 as many projects raced to meet the end-2021 FiT deadline, which introduced competition for limited vessels, ports, and engineering capacity. At the same time, policy support was being scaled back: tariffs for new approvals were reduced and then replaced by lower guidance prices, before giving way to benchmark, coal-linked on-grid prices with no national FiT premium and then post-Document 136 market pricing reforms. This combination—rising short-term costs and declining unit revenues—created a profitability squeeze that reinforced incentives to accelerate construction before tariff conditions worsened, while also making projects more vulnerable to delays, grid connection bottlenecks, and cost overruns.

Fig. 12 / Offshore wind LCOE under alternative annual utilization-hour scenarios versus Guangdong on-grid tariff benchmarks (2011-2024)[xi] [143]



As China's offshore wind projects face greater exposure to lower and more market-oriented electricity prices, developers and policymakers are exploring alternative pathways to boost the demand for offshore wind generation beyond conventional sales into the power market. A first emerging model is direct sales, where offshore wind farms supply a specific large electricity consumer through a dedicated line.[144] A second option is drawing on large electricity users as new sources of demand for offshore wind: data centers and computing facilities are one candidate,[145] particularly in coastal regions where offshore wind generation and rapidly growing computing

xi This is a simplified estimate of the levelized cost of offshore wind construction in China for the near-sea projects, based on statistics from the 2024 China Renewable Energy Project Cost Management Report (中国可再生能源工程造价管理报告2024年度) published by the Hydropower and Water Resources Planning and Design Institute (水电水利规划设计总院). The estimate excludes O&M, insurance, taxes and fees, sea-area leasing or sea-use charges, financing costs, decommissioning costs, and other expenses. Accordingly, the true all-in LCOE would be higher, and the implied "margin" relative to tariffs would be smaller. It assumes a 5% discount rate, a 20-year lifetime for offshore wind projects, and annual full-load hours of 3,000 (conservative), 3,500 (base/neutral), and 3,800 (optimistic). According to IEA, utilization hours in the UK are around 3,504 hours, U.S. around 3,767 hours, while in Guangdong sea regions with 3,800 hours would be considered good resources.

demand can be coordinated through power-computing integration policy.[146] A third pathway is the use of offshore wind electricity to produce green hydrogen and hydrogen-derived fuels such as ammonia and methanol; national policy has consequently encouraged coastal regions to explore offshore wind-based hydrogen, ammonia, and methanol production and the development of green marine fuels.[147] Rather than relying solely on electricity sales, such integrated models may create additional demand and revenue streams for offshore wind while facilitating local utilization and more intensive use of marine space.

3.4 - INDUSTRIAL CLUSTER & SUPPLY-CHAIN DEVELOPMENT

Guangdong's offshore wind strategy is built around **port-centered industrial clusters** that can support construction, installation, and long-term operation of large offshore wind bases. The province sets the overall direction through energy and industrial planning, while municipalities deploy fiscal tools—land, tax, and finance incentives—to attract turbine makers, foundation fabricators, marine-engineering firms, and project developers.

This approach was formalized in the provincial action plan on "strategic emerging industry clusters," which identifies offshore wind as a core pillar of a broader new energy cluster.[148] The plan designated two major offshore wind bases, one in western Guangdong (Yangjiang) and one in eastern Guangdong (Shanwei), each targeting roughly 10 GW of capacity supported by adjacent industrial and port infrastructure.[149] These bases are explicitly conceived as integrated systems, combining offshore resource areas with onshore manufacturing, assembly, logistics, and O&M hubs rather than treating wind farms as standalone projects.

Offshore wind is also woven into Guangdong's manufacturing and marine economy strategies. The Yangjiang offshore wind industrial base appears in the province's 14th Five-Year Plan for manufacturing, signaling priority status for concentrating wind-related manufacturing and services there.[150] Provincial marine economy plans emphasize offshore wind equipment and marine engineering as part of a larger effort to build port-based ocean industries, including shipbuilding, offshore engineering, and related services.[151] In policy language, offshore wind is framed as a lever for building high-end equipment manufacturing and a "blue economy" – referring to overall maritime economic development – rather than just as a source of low-carbon power.[152]

These provincial "umbrella" plans give coastal cities both a mandate and a playbook.[153] Municipalities are encouraged to reserve industrial land, upgrade ports, streamline approvals, and design investment promotion packages tailored to offshore wind. Yangjiang has used an "International Wind Power City" narrative to guide port upgrades and industrial park development, with a focus on full chain clustering from blades and nacelles to O&M centers and export logistics.[154] Shanwei has pursued a complementary path centered on the Shanwei (Lufeng) Marine Engineering Base, which combines port expansion with targeted incentives for wind equipment and offshore engineering firms to build a locally anchored "homeport" base for manufacturing and services.[155]

Both Yangjiang and Shanwei deploy similar fiscal and financial instruments to overcome the high upfront costs of offshore wind manufacturing and to ensure that announced projects actually get built. On the tax side, municipalities offer partial rebates of the local share of major taxes for newly established firms, especially in designated marine engineering or wind industry parks.[156] Yangjiang supplements this with completion-based rewards, linking subsidies to a share of fixed-asset investment once projects are completed and in operation, in order to discourage speculative landholding and unfinished plants.[157] Land and fee policies further lower fixed costs by making industrial land available at regulated (rather than purely market) prices and reducing or waiving selected local administrative fees during the early years of operation.[158]

Given the capital-intensive nature of offshore wind equipment and services, both cities add financing support. Shanwei offers loan interest subsidies and related financial incentives for firms in the Shanwei Marine Engineering Base and encourages key enterprises to strengthen their balance sheets through capital-market access, including support for qualifying firms to pursue stock exchange listings.[159] Yangjiang leans more heavily on city-level “finance+” government-guided funds, using public capital to catalyze private investment along the offshore wind industrial chain and to derisk priority projects.[160] Across these instruments, the shared objective is to translate provincial offshore wind plans into durable, port-centered industrial ecosystems and long-term local economic activity in Guangdong’s coastal cities.[161]

4. LESSONS FROM OTHER JURISDICTIONS

The previous sections have described the policy and law determinants of China's offshore wind development. We have emphasized the role of (1) integrated planning; (2) an evolving system of subsidies that has offered fiscal support and risk mitigation to drive deployment and continual cost reductions; (3) administrative streamlining; (4) technology and supply chain support; and (5) grid coordination.

Yet China is not the only country that has been successful in deploying offshore wind. This section turns to a discussion of offshore wind development in various European countries, Japan, and South Korea as a comparison to the Chinese example. While these nations employ distinct and varied policy levers to support their offshore wind industry, they also show core commonalities with the Chinese approach worth highlighting. We find that the European countries we survey each employ some form of the five policy and governance drivers we identified as operating in China. We introduce these examples to argue that the structural drivers of China's offshore wind industry are not limited in applicability to the Chinese context alone. At a policy level, these policy and governance drivers are ones that jurisdictions operating under rather varied political and legal systems have all sought to implement. Naturally, the exact law and policy mechanisms used to implement these approaches may differ across jurisdictions given different legal and institutional contexts, but the benefits of these law and policy mechanisms are clear.

4.1 - EUROPE - UK, GERMANY, DENMARK AND NETHERLANDS

4.1.1. State of the industry

As of May 2026, Europe had 39 GW of installed offshore capacity across thirteen countries, representing over 40% of total global capacity.[162] The world's first offshore wind farm was installed in Denmark in 1991, at Vindeby.[163] As such, Europe has extensive experience in the development and operation of offshore wind. And it is doubling down on offshore as a key component of its energy mix. Offshore capacity is expected to roughly double by 2030, though industry observers now project a meaningful shortfall against the 120 GW target the sector had once set for itself—current estimates put 2030 capacity closer to 70-73 GW, reflecting weak auction design, rising capital costs, and pipeline uncertainty across several markets.[164]

Europe's commitment to offshore wind can broadly be ascribed to three drivers: climate commitments; industrial policy; and energy independence. Europe has binding climate commitments to reduce greenhouse gas emissions by 55% relative to 1990 levels by 2030, and to reach climate neutrality by 2050.[165] To meet that goal, the continent is investing in an all-of-the-above approach to renewable energy resources. Numerous European countries are densely developed and therefore land-constrained, making solar or onshore wind relatively less feasible. Offshore wind is thus an attractive alternative.

Further, Europe views offshore wind development as a way of rebuilding its industrial base and growing employment. Offshore wind is uniquely suited to this—photovoltaic solar is less labor-intensive and relies heavily on imports from abroad (specifically, China),[166] and onshore wind does not require the development of port infrastructure in the same way offshore does. Offshore wind investment has a large multiplier effect, spurring necessary investment and employment in supporting sectors – including the port infrastructure and manufacturing capacity discussed in Section 4.1.3.[167] As a result, the wind industry (onshore and offshore) supported an estimated 440,000 jobs across Europe, projected to grow above 560,000 by 2030.[168]

Offshore wind is attractive because it can competitively be produced within Europe rather than depending heavily on foreign supply chains.[169] That advantage dovetails with Europe's desire to become more energy independent. The war in Ukraine and subsequent instability in natural gas markets have created a geopolitical impetus for domestic energy production. Energy- and cybersecurity concerns make Chinese products less appealing to the EU, which has created a competitive advantage for local manufacturers.[170] Onshoring of manufacturing insulates a critical sector of the economy from trade policy and exchange rate risks.

Floating offshore wind is a major part of Europe's offshore strategy, especially for countries along the Mediterranean Sea and Atlantic Ocean. Floating wind turbines are not currently cost-competitive with fixed-turbine models in Europe, and industry participants do not believe that will change in the near term.[171] Nevertheless, many countries remain committed to developing floating wind in order to meet their climate commitments.[172]

4.1.2. Planning & coordination

The four European countries leading in offshore wind development (the United Kingdom, Germany, Denmark, and the Netherlands) have all adopted a similar approach to the planning and siting of offshore wind farms. To the maximum extent possible, these jurisdictions have engaged in long-term planning processes, and centralized all pre-construction steps, to varying degrees, in a single state entity responsible for everything from identifying sites to arranging transmission connections. The goal is to have sites be "shovel-ready" by the time they are offered for lease. Not only does this type of integrated planning speed up development, it also shifts risk from developers to the government. A lot of the early costs involved with scouting a site are highly risky, since it is difficult to say ex ante how valuable a site will end up being for offshore development. By having a state agency shoulder this burden, developers are in a more certain position at the time of bidding.

4.1.3. Technology & industrial policy

As in China, European countries have leveraged industrial policy to grow their domestic offshore wind industries. Offshore wind fits within the bloc's broader green industrial policy, promulgated in the European Green Deal Industrial Plan and the Net-Zero Industry Act. The latter aims to enhance European manufacturing capacity for net-zero technologies and their components, and seeks to make the clean energy sector in the EU globally competitive. A bloc-wide binding 2050 carbon neutrality target provides long-term certainty to developers that the industry will continue to receive state support.[173]

As a result of these legislative actions, and to support offshore wind construction, the industry association WindEurope estimates that 6.5 billion euros in port infrastructure investment will be needed by 2030.[174] Those funds would go to the expansion of thirty existing ports, construction of between 15-20 new ports, and six floating port projects.[175] Other links in the supply chain are developing rapidly as well. Over the past two years, more than 11 billion euros in investments have been announced across the continent.[176] Major OEMs such as Siemens Gamesa and Vestas operate domestic manufacturing centers in the United Kingdom and Germany, attracted by state subsidies and the promise of strong local demand.[177] Europe has thus used policy levers at the bloc- and country-level to foster its offshore wind industry, supporting both the construction of turbines as well as investing in the ancillary infrastructure needed to support the industry's growth.

4.1.4. Fiscal and market-based incentives

Over the past decade, European jurisdictions have experimented with various payment mechanisms for offshore wind operators. The most generous version is the one-sided CfD, which offers wind farms a guaranteed minimum price on their production and also allows operators to capture excess returns whenever energy prices rise above the strike price. The Netherlands operates a form of one-sided CfD scheme for some subsidized projects.[178] A two-sided CfD removes the downside risk for the developer, but also takes away the chance to capture upside profits when energy prices go above the fixed rate. It guarantees the developer a fixed price per unit of energy, but asks the developer to repay the government whenever the market price for energy exceeds the agreed-upon strike price. Thus, the developer knows exactly what return they are set to receive. Denmark and the United Kingdom both use two-sided CfDs for offshore wind.

Germany's experience in the last few years illustrates the risk of moving away from risk-shifting mechanisms. Under a mid-2022 amendment to its Offshore Wind Energy Act, the German Parliament dropped a proposed CfD scheme in favor of an auction design built around uncapped negative bidding – effectively requiring developers to bid for the right to build, while bearing full exposure to market prices with no government price support.[179] A subsequent 2025 auction for pre-examined sites received no bids at all, prompting the government to scale back planned 2026 auction volumes while it reconsiders the design.[180] As of mid-2026, Germany's Federal Council has called for a move to a two-sided CfD model, with a revised framework expected to apply to auctions from 2027 onward.[181] In September 2026, the German legislature approved a two-stage bidding process: First, sites are offered absent any subsidies. If no bids are received during this stage, the process moves to Stage 2. That stage uses a CfD-based support mechanism.[182]

Denmark experienced a similar episode the prior year. In 2024, Denmark ran a tender for three unsubsidized sites, using a structure that required winning bidders to make ongoing concession payments to the state and accept 20% state co-ownership of each project. The tender received zero bids across three sites on offer.[183] Denmark subsequently suspended the program, reworked the terms to reintroduce CfD-style state support, and re-tendered; the revised tender, structured around fixed-strike-price contracts, has since drawn multiple bidders.[184]

Together, the German and Danish experiences make the same point from two different jurisdictions within roughly the same eighteen-month period: when governments have attempted to shift price risk fully onto developers, offshore wind tenders failed to attract bids under then-prevailing market conditions, and both governments have since moved back toward risk-shifting CfD structures in response. Risk-shifting mechanisms, in the form of either one- or two-sided CfDs, remain the preferred and apparently necessary form of compensation for market participants as of this writing.

4.1.5. Grid integration

Countries in Europe have seen success with proactive transmission planning after early projects were delayed by insufficient coordination between transmission planning entities and offshore wind developers. In the Netherlands, for example, transmission planning for offshore wind was centralized within one entity, and transmission links were standardized. In Germany, transmission operators are legally required, under the Energy Act (Energiewirtschaftsgesetz, EnWG), to construct grid connections for offshore wind farms on a defined timeline and are liable for damages in the event of delay.[185] In the United Kingdom, early experiments with a point-to-point, project-based transmission development approach produced frequent delays.[186] In response, the UK called for a large-scale review of existing practices, which led to a new, centralized approach to network planning.[187] These reforms aim to ensure that offshore wind projects can connect to the grid once complete.

4.2 - ASIA - JAPAN AND SOUTH KOREA

While China is clearly the leader in offshore wind deployment in Asia, other jurisdictions are similarly investing in the technology. Japan and South Korea both operate multiple offshore projects and have announced plans to significantly expand capacity in the future.[188] This report will not cover other Asian jurisdictions in detail, but it is worth pointing out that Japan and South Korea are both adopting policy approaches seen in China and Western Europe.[189] In 2025, for example, South Korea moved towards a streamlined, centrally planned process that aims to speed up approvals and siting, and shift risk away from developers, akin to the European and Chinese models.[190] Japan, too, relies on long-term strategic planning and a centralized agency to conduct surveys and siting.[191] Japan also relies on feed-in premiums to ensure its nascent offshore wind industry remains financially viable, as China did during the earlier stages of its offshore build-out.[192]

These two jurisdictions thus provide additional evidence that the lessons we draw from China's example are applicable beyond the Chinese context.

4.3 - SUMMARY

Broadly speaking, two main lessons can be drawn from the European and non-China Asian experiences described above: the value of centralized planning, and the importance of de-risking

offshore wind development. First, all European leaders in offshore deployment have converged on a centralized, state-led planning and permitting process. South Korea is similarly moving towards a centralized model. Centralized planning and permitting should front-load as many of the pre-construction steps involved in offshore wind development as possible, so that sites are "shovel-ready" once offered for lease. This reduces uncertainty for developers and allows them to more accurately price projects. It also speeds up development, reduces the chance of delays or cost overruns, and minimizes the chance of duplicative work done by different government agencies.

Second, it seems clear that risk is a particular barrier to development in the offshore wind industry given high capital requirements and long project timelines. That lesson has now been learned the hard way more than once. To spur development, governments should shift risk away from private developers to the extent possible. One way of doing so is offering feed-in tariffs or CfDs, which shift pricing risk onto the state and facilitate revenue projections for developers. Germany and Denmark each tried the alternative – asking developers to absorb full market risk with no state-backed price support – and both saw their tenders fail to attract a single bid; both have since moved to restore risk-shifting mechanisms. Another way of de-risking is to guarantee interconnection links for offshore developers, so that the risk (and accompanying costs) of delay is minimized, as Germany's EnWG does for grid connection.

Risk shifting doesn't have to be limited to project developers; it can also apply to the supply chain that builds their equipment. In the EU, the European Investment Bank has formed a counter-guarantee facility of five billion euros meant to support wind industry manufacturing investments through risk-sharing instruments. That facility has already been tapped to de-risk supply chain investments. For example, in 2025 the European Investment Bank signed a counter-guarantee agreement with Spanish manufacturer Navantia Seanergies that would see the firm receive advance payments from the bank when taking on new wind construction projects.[193] These approaches reduce the risk for private companies and facilitate entry into the industry for them. At a time of regulatory uncertainty in the United States, California and other U.S. states would benefit from offering a greater degree of stability and certainty to developers and manufacturers.

5. POLICIES FOR CONSIDERATION

The preceding sections have traced how China has built out its offshore wind industry using a distinct mix of policy and legal instruments that support several key governance functions—de-risking capital, guaranteeing revenue certainty, streamlining permitting, building supply chains, and coordinating grid integration. We note that countries in Europe, Japan, and South Korea have also instituted policies to promote many of these governance functions as well (particularly in de-risking and administrative streamlining). This section translates those comparative findings into a set of specific items for California and the United States to consider.

We largely treat these as policies for consideration, but make a preliminary assessment of these policies using a four-part template, designed to let a reader assess not just what the foreign mechanism does, but whether and how it could actually work here. The list is not exhaustive, but a suggested sampling of practices we survey in the report.

- **Mechanism:** What the foreign jurisdiction actually does.
- **CA/U.S. vehicle:** A preliminary estimate of the institutional path by which California or the federal government could adopt a version of the mechanism.
- **Transferability:** An assessment of how much the mechanism's success abroad depends on institutional or political dynamics particular to China or other jurisdictions versus how much of it is a portable policy design choice that could function under U.S. legal and market institutions largely as-is. We rate this High, Moderate, or Low, or note where not yet determinable given open questions specific to that item.
- **Magnitude/cost:** A rough estimate of what adopting the mechanism would actually require in terms of political or economic effort/cost. We rate this High, Moderate, or Low, or note where not yet determinable given open questions specific to that item.

We organize the policies for consideration that follow into five categories: financial and legal instrument design (Part A), planning and permitting (Part B), demand diversification and market development (Part C), target durability (Part D), and guardrails (Part E).

A. FINANCIAL AND LEGAL INSTRUMENT DESIGN

1. Restore and stabilize the basic project subsidy stack: price support, procurement guarantee, tax relief, green certificates/certified emission reductions

- **Mechanism:** China's early offshore wind build-out rested on a four-part stack: a guaranteed feed-in tariff (price support), a state-guaranteed procurement obligation, two forms of tax relief (VAT relief and corporate income tax exemption), and tradeable green certificates/emission credits. China has phased out price support in stages – first, the FiT itself (2019–2021), then a move to coal-benchmark grid parity (after 2022), and a shift to greater marketization after

Document 136 (2025). Various provincial governments have offered some bridge support as central price support phased out. Announcement No. 10 of 2025 discontinued the VAT refund for onshore wind from November 2025 but extended it for offshore wind through December 2027. Green certificates and certified emission reduction credits are potential new sources of revenue, but are not yet significant contributors to the economics of offshore wind projects.

- **CA/U.S. vehicle:** Unlike China's system and CfD-based systems commonly seen in Europe which guarantee price directly, the U.S. has relied on tax credits to achieve a similar bankability effect indirectly – the investment tax credit (ITC)/production tax credit (PTC) choice under the Inflation Reduction Act, with no direct federal price-support analog. The 2025 reconciliation act has narrowed the window for wind projects to qualify for these credits, which is likely to affect California's offshore wind pipeline given current project timelines. This argues for restoring a durable federal tax credit, but California shouldn't wait on federal action alone. At the state level, the priority should be shoring up the procurement-guarantee leg, where California already has central-procurement authority that doesn't require federal action; price support has no real state-level equivalent short of a state FiT, which would be a heavier lift; and a sales/use tax exclusion for offshore wind manufacturing equipment may be the most achievable near-term state action, building on an existing state mechanism for advanced manufacturing.

- **Transferability:** High for the underlying design principle — layering price support, procurement guarantee, tax relief, and tradeable credits as distinct instruments, and withdrawing them in a deliberate sequence rather than all at once — though the VAT mechanism itself doesn't translate directly to the U.S. tax system.

- **Magnitude/cost:** High for restoring a federal offshore-wind ITC/PTC, which requires congressional action; Low-Moderate for strengthening the state procurement guarantee mechanism, which is achievable through existing state regulatory authority; Low for the state sales-tax exclusion, which is a comparatively low-cost, unilaterally achievable state action.

2. Invest in industrial clusters and supply chain development

- **Mechanism:** Guangdong's model, exemplified by Yangjiang, paired site-level port investment with deliberate cultivation of an in-region manufacturing base — component suppliers, assembly facilities, and specialized labor co-located near the port. Guangdong is promoting, and city governments (Yangjiang, Shanwei, Shantou, Jieyang) are pursuing varied industrial cluster strategies to build next generation economic development around manufacturing and the green energy provided by offshore wind.

- **CA vehicle:** California has several existing manufacturing-incentive tools (e.g., sales/use tax exclusions for alternative-energy and advanced-manufacturing equipment) that could plausibly be extended or prioritized to cover in-state manufacturers of offshore wind components (turbine towers, foundations, subsea cable, blades), with disbursement or compliance conditioned on verified production capacity or job-creation benchmarks rather than granted unconditionally.

- **Transferability:** High, as a design principle.

- **Magnitude/cost:** High (potentially) given California cost structures and the significant lead of European and Chinese offshore wind manufacturers. Depends on which existing program is used and how much of its capacity the state allocates to offshore wind manufacturers specifically.

3. State-capitalized counter-guarantee facility for supply-chain investment

- **Mechanism:** The EU has created a multi-billion-euro counter-guarantee facility, launched under its 2023 Wind Power Action Plan, in which the EIB counter-guarantees commercial banks that then extend guarantee portfolios to wind manufacturers – de-risking a manufacturer's ability to secure advance payments, offer performance guarantees, and pay suppliers early.

- **CA vehicle:** IBank already has loan-guarantee and low-cost financing authority; the Legislature could consider capitalizing or authorizing a dedicated offshore-wind-supply-chain guarantee facility within IBank to backstop advance payments to California-based manufacturers/fabricators.

- **Transferability:** High — closer to the EU/EIB model (a market economy using a public development bank, with commercial banks as an intermediating layer) than to China's SOE/state-bank model, so a cleaner import than most Chinese mechanisms.

- **Magnitude/cost:** Moderate. Likely a modest pilot relative to the EU's continent-wide facility, sized to California's much smaller near-term manufacturing base – exact figures would need further scoping.

4. Local-content scoring bonus in state procurement, tied to port-grant completion

- **Mechanism:** Guangdong's competitive allocation process awards bonus points to bidders who commit to sourcing components from local industrial parks and upgrading local port infrastructure – directly linking developer selection to industrial cluster formation.

- **CA vehicle:** California could incorporate in-state content scoring criteria into its existing centralized offshore wind procurement process, with bonus weighting for bidders committing capacity to state-funded port facilities – creating a similar feedback loop between site allocation and cluster development.

- **Transferability:** Moderate. Would need legal review of potential trade or dormant Commerce Clause issues.

- **Magnitude/cost:** Moderate. Likely no new appropriation required – primarily a scoring methodology change within an existing solicitation process, though it raises questions about increased complexity and legal durability.

5. Design future CPUC/DWR procurement rounds with an eye toward a stock/incremental split, modeled on Document 136

- **Mechanism:** China's 2025 Document 136 reform sorts projects by award date into "stock" (flat tariff pegged to the coal benchmark) and "incremental" (competitively bid, capped by that same benchmark) — giving legacy projects revenue certainty while pushing new entrants toward market discipline, all under one system rather than an all-or-nothing subsidy cliff. The policy is meant to help China's offshore wind industry to transition from more heavily subsidized projects to greater market discipline.
- **CA vehicle:** Not applicable to the current lease cohort. Worth revisiting once California has an installed "stock" of offshore wind – projects that cleared the current fragile first-mover phase – at which point a similar split could apply to later procurement rounds: honor terms for that stock while shifting new rounds toward greater market discipline. Premature to specify the exact procurement vehicle for this before that point is reached.
- **Transferability:** Low, for now. High, once applicable. Tiering certainty by cohort after a stock exists is a market-design choice that doesn't depend on SOE capital or state-directed banks.
- **Magnitude/cost:** To be determined – depends on the procurement structure in place by the time California has a stock cohort to protect.

B. PLANNING & PERMITTING

6. State-funded pre-leasing site characterization

- **Mechanism:** Guangdong's DRC commissions wind-resource, geotechnical, and maritime-use surveys before offering sites to developers, narrowing cost and environmental uncertainty ahead of competitive allocation.
- **CA vehicle:** California could establish a state-funded pre-leasing site-characterization program, building on the existing BOEM/California Intergovernmental Renewable Energy Task Force for coordination, though the task force currently has no mandate or funding to commission surveys itself and a funding source would need to be identified. Given BOEM's current leasing suspension, this should be framed as no-regrets preparatory work rather than tied to a specific lease-round date.
- **Transferability:** High in principle, though funding source and survey costs—especially at California's greater water depths—will be materially higher than Guangdong's shallow-water context.
- **Magnitude/cost:** Moderate-High. Possibly tens of millions of dollars per lease area for baseline surveys—currently unbudgeted as a state cost, and not yet tied to a specific existing funding source.

7. One-stop interagency permitting coordination

- **Mechanism:** South Korea's February 2025 Special Act replaced a fragmented "open-door" system spanning up to 29 regulations across 10 ministries and 8+ year timelines with a single government-led zoning and permitting process, implemented through a newly created one-stop authority.

- **CA vehicle:** Given the current suspension of federal offshore wind leasing, the more immediately actionable step may be state-side coordination alone—a mechanism (new or housed within an existing agency) to align CEQA lead agency review, Coastal Commission, CDFW, and State Lands Commission/CPUC-DWR approvals on defined joint-review timelines, without depending on federal buy-in. The existing BOEM/California task force would remain the right vehicle for federal-state handoffs once leasing resumes, but shouldn't be the sole vehicle given how much of it is currently outside California's control.

- **Transferability:** Moderate-High, as a design principle. South Korea's model concentrates authority in a way that would require California to accept faster, more centralized environmental review timelines. California has precedent for accepting faster, centralized review (e.g., AB 205's siting authority).

- **Magnitude/cost:** Moderate for state-side coordination—primarily an administrative/staffing cost, though aligning multiple state agencies with independent statutory mandates on binding joint timelines can face genuine administrative and political friction. Uncertain for federal-state coordination specifically, since its cost and feasibility depend heavily on federal executive posture toward offshore wind leasing, which has oscillated significantly between administrations.

C. DEMAND DIVERSIFICATION AND MARKET DEVELOPMENT

8. Demand diversification via direct sales and dedicated large-offtaker connections

- **Mechanism:** Guangdong and offshore wind developers are pushing to diversify demand through direct sales to large industrial consumers, data-center/computing-demand coordination, offshore wind-to-hydrogen production, marine aquaculture, and other "blue" economy co-location pairings.

- **CA vehicle:** CPUC could explore authorizing direct-line or sleeved PPA structures between offshore wind projects and large industrial/data-center offtakers. Increasingly relevant given California's data-center demand growth.

- **Transferability:** To be determined. Dedicated-line sales and sleeved PPAs already exist in U.S. electricity markets in other contexts, though legal barriers specific to this application are beyond the scope of this report.

- **Magnitude/cost:** Moderate. No direct state appropriation, but a CPUC rulemaking of this kind typically takes time, and who bears dedicated-line costs would need to be resolved in the rulemaking itself.

D. TARGET DURABILITY

9. Statutory (not just administrative) codification of offshore wind targets

- **Mechanism:** China's offshore wind targets are embedded in five-year plans; California's 2–5 GW/2030 and 25 GW/2045 goals, by contrast, were adopted by the CEC as administrative planning goals under AB 525's process mandate, not written into statute as binding numeric targets.

- **CA vehicle:** Elevate the planning goals into binding statutory targets analogous to California's renewable portfolio standard (RPS) structure, giving developers and financiers a harder floor of policy durability that survives changes in CEC leadership or federal posture.

- **Transferability:** High—doesn't require any Chinese institutional feature; simply a choice about how much legal weight to give a target, and California has already done this for RPS.

- **Magnitude/cost:** Moderate. No direct cost; primarily a legislative-drafting exercise, though possible political friction in passage.

E. GUARDRAILS

10. Front-loaded regional environmental review and tribal consultation

- **Mechanism:** China's speed is often attributed to less thorough environmental review with fewer veto points as compared to the U.S. or Europe; in the U.S. the China model is not generally seen as a model for emulation in this regard. Europe's "shovel-ready" siting model and South Korea's new consultation requirements offer a more transferable lesson: resolve ecological and community concerns before leasing rather than project-by-project after.

- **CA vehicle:** Use AB 525 implementation and other existing authorities to fund regional (not per-project) cumulative environmental baseline studies and formal tribal consultation ahead of later federal lease rounds, preserving CEQA review while reducing the odds that unresolved issues surface as late-stage disputes. California has several existing or recent permitting/CEQA streamlining tools that could plausibly support this and would need further review. The point is to use front-loaded information gathering to improve environmental and social integrity, so that project acceleration does not come at integrity's expense.

- **Transferability:** High for the front-loading sequencing logic from Europe and Korea. Low for China's environmental impact assessment methods, which are not suggested as a potential import absent further research to ascertain actual empirical practice.

- **Magnitude/cost:** Moderate-High—comparable order of magnitude to the site-characterization recommendation (potentially tens of millions), with the range depending on scope of review and participation.

6. CONCLUSION

We identify a consistent set of policies and structural conditions supporting successful offshore wind development in jurisdictions that otherwise differ in political system, legal framework, and market structure. The persistent presence of these characteristics across jurisdictions that were able to launch a successful offshore wind program leads us to recommend that California consider key lessons from these jurisdictions.

China's success in growing its offshore wind industry is the result of a deliberate national strategy that leveraged durable planning targets, centralized planning authorities, evolving but continued fiscal support, and deliberate cultivation of a soup-to-nuts domestic supply chain. This strategy has substantial top-down aspects, but also relies on the governance, market activity, and energy of subnational governments and state-owned and private companies. Targets and goals are set at the national level in coordination with subnational governments, but the practical implementation of policies is left to provincial governments. An examination of the Guangdong case study shows how these policies materialize in practice. Provincial authorities take charge of the surveying and preparation of potential development sites, local grid companies coordinate transmission planning with developers, and transitional subsidies are awarded to ensure that offshore projects remain financially viable.

At both the national and provincial level, policies act to reduce the upfront risk faced by offshore wind developers. Long-term planning and durable goals signal that state policy support of the industry will remain for the foreseeable future. Central planning and robust pre-auction site preparation make it easy for developers to estimate the value of the sites they are bidding on. At the same time, a focus on supply chain build-out both lowers infrastructure costs and increases economic benefits at the provincial level in the form of higher employment and greater tax revenue. That generates provincial buy-in, and aligns incentives between national policymakers, provincial authorities, and companies active in the industry. At the same time, China has substantially reduced fiscal subsidies in recent years and is forcing offshore wind projects to compete with other electricity resources to a greater degree on a market basis. Offshore projects are now experimenting with different "blue economy" avenues for boosting profitability, including linking with hydrogen or oil production, data centers, and aquaculture. How China manages this transition from heavy subsidy toward greater competition will hold valuable lessons for the rest of the world.

European jurisdictions have similarly landed on a centralized, state-led site preparation system that aims to reduce upfront uncertainty for developers. Collaborations between grid authorities and site developers are also promoted to ensure that offshore projects can join the grid as soon as they are finished. Pricing mechanisms common across Europe, such as contracts-for-difference pricing, further aim to shift risk away from private developers onto the government. Bloc-wide and national targeted industrial policies also seek to build out a domestic supply chain to support offshore development. The European offshore wind industry has encountered economic headwinds as the bloc attempted to reduce state subsidies, leading to a return to

greater levels of government-led project risk mitigation. The European context, too, will provide valuable lessons going forward in balancing state support and market discipline.

These convergent findings suggest directions for California to follow as it develops its offshore wind industry. California has much to learn from jurisdictions that by now have substantial experience in developing financially viable offshore wind resources, even as the specific mechanisms for doing so require further legal and institutional analysis.

APPENDIX—Key Milestones in Chinese Offshore Wind Development

The timeline below highlights the yearly development of offshore wind energy in China. The timeframe covered in this timeline is from 2005 to 2026.

YEAR	MILESTONES
2005	The Renewable Energy Law was adopted, laying a legal foundation for the development of renewable energy, including wind power. The Renewable Energy Industry Development Guidance Catalog, issued by NDRC, included offshore wind as a national technology priority for the first time.
2007	The first offshore wind pilot project in China, located in the Bohai Sea near Suizhong, Liaoning (a 1.5 MW turbine), was successfully connected to the grid.
2008	Following NDRC's 2007 call for the development of a 300 MW offshore wind demonstration project in Rudong, Jiangsu, Longyuan Power established a preparatory office in 2008 to advance the project's development. Construction began on the Donghai Bridge Offshore Wind Project in Shanghai. This marked China's first commercial-scale offshore wind farm, signaling a shift from policy aspiration to concrete implementation.
2009	The amended Renewable Energy Law (2009) established a national fund to subsidize renewable energy by covering the gap between its feed-in tariff and the average on-grid tariff for conventional power. The NEA issued the Outline for Offshore Wind Farm Project Planning, officially launching offshore wind planning along China's coastal regions. Specific projects classified as national key infrastructure and meeting additional criteria were granted a three-year corporate income tax exemption, followed by a 50% reduction for the next three years. Longyuan Power's Rudong intertidal pilot wind farm connected its first two 1.5 MW turbines to the grid, providing early technical demonstration.
2010	The NEA introduced the Interim Measures for the Administration of Offshore Wind Power Development and Construction, clarifying planning and approval procedures, introducing competitive concession mechanisms, and laying the foundation for a government-led regulatory model. The Donghai Bridge Offshore Wind Farm (Phase I), consisting of 34 × 3 MW turbines, was fully connected to the grid – the first offshore wind farm outside Europe. Longyuan Power completed its Rudong intertidal pilot wind farm in Jiangsu, an early demonstration of large-scale wind development in intertidal areas.

2012	Offshore wind was incorporated into the 12th Five-Year Plan for Strategic Emerging Industries and the Marine Economy, elevating its status as a national strategic industry. The State Council, NDRC, and SOA incorporated offshore wind into the National Marine Functional Zoning Plan (2011–2020), formally linking it to national marine spatial planning. The 12th Five-Year Plan for Wind Power Development set a target of 5 GW cumulative offshore wind capacity by 2015 (not achieved).
2014	The NEA released the National Offshore Wind Development and Construction Plan (2014–2016), covering 44 projects with a total capacity of 10.53 GW, calling for streamlined approval procedures, enhanced coordination with maritime and defense authorities, and grid companies to ensure timely grid connection and market integration. The NDRC issued a notice on offshore wind feed-in tariff policy, setting rates at 0.75 RMB/kWh for intertidal projects and 0.85 RMB/kWh for nearshore projects (both including tax).
2015	China adopted the Paris Agreement and the UN Sustainable Development Goals (SDGs) (though it did not ratify the Paris Agreement until 2016). China formally became an Association Country of the International Energy Agency (IEA). By 2015, China's cumulative offshore wind capacity stood around 1 GW, far short of the 5 GW target set in the 12th Five-Year Plan for Wind Power Development; global offshore wind capacity reached 12 GW at year-end. The State Council issued the Opinions on Accelerating the Construction of Ecological Civilization, embedding offshore wind within China's broader ecological civilization framework. The National Marine Main Functional Zone Plan explicitly supported offshore renewable energy, calling for scientific development of offshore wind in the northern Jiangsu sea area. The State Council's "Document No. 9" on power sector reform outlined "controlling the middle, liberalizing both ends," paving the way for mid- and long-term electricity markets and green power trading. Offshore wind companies benefited from VAT rebates and corporate income tax reductions; firms selling wind power became eligible for a 50% VAT rebate.
2016	The 13th Five-Year Plan for Wind Power Development set offshore wind targets of 5 GW grid-connected and 10 GW under construction by 2020. The NDRC/NEA Energy Technology Revolution Innovation Action Plan (2016–2030) identified offshore wind construction, operation, and maintenance as core areas of technological innovation. China Three Gorges Corporation (CTG) acquired an 80% stake in Germany's Meerwind offshore wind farm, deepening its European footprint.

2017	Marine spatial planning reforms under the 13th Five-Year Plan for National Marine Economy Development (2017) sought to balance ecological protection with industrial growth, enabling more sustainable offshore wind deployment in key coastal zones.
2018	China became the world's largest market for annual offshore additions, according to the report by the U.S. Department of Energy. Large-scale offshore wind turbines were increasingly localized, with manufacturers such as Goldwind, Shanghai Electric, Mingyang, Envision, HZ Windpower, and Sinovel testing and demonstrating turbines above 5 MW.
2019	The NDRC and NEA launched policies to accelerate subsidy-free "grid parity" projects, ensuring priority grid access, full consumption, and allowing additional revenue through green certificate trading. The NEA introduced competitive allocation rules for wind projects, with bidding price as the decisive factor, carrying no less than 40% weight in evaluations.
2020	China announced its "dual carbon" goals — peaking emissions by 2030 and reaching carbon neutrality by 2060. The Bank of China issued $942.5 million in blue bonds to fund offshore wind and marine sewage treatment projects in China, the UK, and France. Jiangsu became the first province in China to surpass 5 GW of offshore wind capacity. Goldwind partnered with a South African energy company to launch a demonstration wind project in North Africa, supporting local supply chains and job creation.
2021	China updated its Paris NDC in October 2021, formally embedding the "dual carbon" goals. Offshore wind was explicitly integrated into the 14th Five-Year Plan (2021–2025) as a key driver of the energy transition. China became the global leader in offshore wind capacity, adding 14.48 GW in 2021 alone — a 3.8-fold increase from the previous year. a. In 2021, 14.48 GW was added, and in 2020 3.85 GW was added. So 3.8 times more, roughly. The 2021 Green Bond Endorsed Project Catalogue established clean energy definitions, enabling offshore wind firms to issue blue bonds, while authorities explored inclusion of offshore wind in REITs（不动产投资信托基金) pilots. Mingyang Smart Energy entered the European offshore market with Italy's Taranto project and partnered in Vietnam's largest intertidal wind farm, supplying turbines and local maintenance support.

2022	Offshore wind was emphasized as central to China's energy transition and carbon neutrality strategy in high-level policies, including the 14th Five-Year Plan for Renewable Energy Development and the forthcoming Energy Law. Central government subsidies for new offshore wind projects ended after 2021, though regional governments continue to provide financial support — Zhejiang offers direct electricity subsidies, while Guangdong and Shandong provide installed capacity-based subsidies. The NEA's 14th Five-Year Plan for Technological Innovation in the Energy Sector prioritized 15 MW+ turbines, floating wind farms, and R&D for deepwater deployment, reinforced by the Science and Technology Support Action Plan for Carbon Peaking and Neutrality (2022–2030).
2023	By the end of 2023, China had installed 6,680 offshore turbines totaling 37.7 GW, representing about 50% of global market share. It has led the world in offshore wind deployment for six consecutive years, contributing over 60% of annual global additions. The NEA promoted integrated development of offshore wind with oil and gas infrastructure to improve efficiency. The MEE's Measures for Voluntary GHG Emission Reduction Trading included offshore wind projects, with those >30 km from shore or >30 m deep eligible to generate CCERs without extra certification. The NDRC expanded the green certificate scheme, enabling offshore wind projects to gain additional market-based revenue. Under the BRI framework, China and ASEAN launched an offshore wind technology exchange platform. State Grid Jiangsu led the approval of IEC TS 63487, an international technical specification for HVDC offshore wind grid connections.

2024	The State Council released the Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development, the country's first national plan for green transformation, emphasizing offshore wind and coastal nuclear bases. The NDRC issued the Measures for the Supervision of Full Guarantee Purchase of Renewable Energy Power, applying to offshore wind, and providing for renewable electricity to be accommodated through a combination of guaranteed purchases and market-based transactions. The Notice on Further Strengthening Sea-Use Management for Offshore Wind Power Projects《关于进一步加强海上风电项目用海管理的通知》requires new offshore wind projects, in principle, to be located more than 30 km from shore or in waters deeper than 30 meters, and sets requirements for spatial planning, ecological protection, sea-use standards, and approval procedures. Provinces actively promoted offshore wind as part of green development: Guangdong designated it a priority in its Beautiful Guangdong Plan (2024–2035); Zhejiang and Shandong introduced financial incentives; Fujian approved 11 offshore projects totaling 4.85 GW. In 2024 alone, 22 offshore wind turbines were exported, contributing to a cumulative total of 138 turbines exported globally. The China Quality Certification Center (CQC) co-authored IEC TS 61400-26-4:2024, a global reliability standard for wind energy systems.
2025	China's first comprehensive Energy Law entered into effect. Dongfang Electric installed a 26 MW offshore wind turbine prototype at the Dongying Wind Power Equipment Testing and Certification Innovation Base in Shandong. Total installed offshore wind capacity in China reached approximately 48 GW by the end of 2025. China announced its first absolute emissions-reduction target, pledging to cut economy-wide net greenhouse gas emissions 7–10% from peak levels by 2035, raise non-fossil fuels to over 30% of energy consumption, and expand wind and solar capacity to 3,600 GW by 2035. Announcement No. 10 of 2025《财政部 海关总署 税务总局关于调整风力发电等增值税政策的公告》revised VAT incentives for wind power, granting offshore wind electricity a 50% VAT refund from November 1, 2025 through December 31, 2027, while ending the previous VAT refund applicable to wind power generally.
2026	The world's first 20 MW offshore wind turbine was installed and connected to the grid in Fujian waters. The NDRC and NEA issued the Notice on the Orderly Development of Multi-User Green Power Direct Connections《关于有序推动多用户绿电直连发展有关事项的通知》, allowing wind and other renewable energy projects to supply multiple users through dedicated transmission and transformation facilities, subject to requirements on power traceability, allocation, and self-consumption. The NDRC and NEA issued the 15th Five-Year Plan for Renewable Energy Development《可再生能源发展"十五五"规划》, setting a target of more than 100 GW of cumulative offshore wind capacity by 2030 and approximately 100 GW of new offshore wind projects commencing construction during 2026–2030.

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