Offshore Wind Power Policy in The U.S. And China: Comparison And Analysis

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Abstract. This paper compares and analyzes different offshore wind power policies between two countries, follows the timeline for the development phase, and explores deep reasons for framework differences in three aspects (Policy Environment, Financial Incentives, and Permit Processes). The key findings are that policy is the primary driver to boost offshore wind energy. A stable policy environment with long-term goals could revise developments from experience, support SOEs to raise capital and develop experiments for provincial and local governments and increase international collaborations. Differentiating FITs payments contribute to renewable electricity generation, promote technology price decreases, and ensure market certainty. Streamlined permitting accelerates speed construction and creates an energy innovation system with multiple brands and technologies. In the end, suggestions are given separately to help China and US further develop the offshore wind power industry.

Keywords: Renewable energy; offshore wind power; policy framework.

1. Introduction

Wind power is one of the most favorable sustainable energy sources in many countries, especially offshore wind power. It has witnessed rapid development since the 20s. According to the Global Wind Energy Council (GWEC) prediction, more than 235GW of offshore wind capacity will be installed globally from 2021 to 2030, and cumulative installed capacity will be over 270GW, with around a 23.6% compound growth rate [1].

As the two typical economies worldwide, the US and China are at different offshore wind power development levels. Although the unit cost of offshore wind power projects of the two countries has gradually entered the era of parity, at most USD 2,099/kW since 2020, the US is far behind China on new production scale and cumulative installation [2]. China's cumulative offshore wind production reaches 312.05MW in 2022, accounting for 49% of global offshore wind installation, while America's total capacity keeps 41 MW, only 0.65% of the global market [3]. China ranked first for two consistent years (2021 and 2022) in the world with the highest cumulative installed capacity, and Jiangsu province took the largest Chinese offshore wind installation capacity (62.7%) since 2021 [1]. For the long-term goals, China’s 14th Five Year Plan (FYP) process set the national capacity aim at 63.7 GW. Contrary to ambitious China, the national target of the US is to deploy 30GW installation capacity of offshore wind by 2030, and state-by-state goals for offshore wind are estimated to yield 17.4GW by 2030 and 25GW by 2035 [4].

Moreover, the U.S. experienced a period of wind turbine plant closures and consolidation from mid-2012 to 2020, leading to more reliance on imports in some years. Therefore, there is little available capacity to supply export markets, and U.S. exports have sharply dropped from their 2014 peak [5]. Compared with the U.S., the Chinese turbine market has expanded globally since Sinovel, Goldwind, United Power, and Dongfang Electric became the global four of ten wind turbine manufacturers in 2011 [1]. These manufacturers exported 3.3GW of products overseas, which took around 7% of the foreign market in 2021 [6]. Despite increasing turbine prices under recent supply-chain pressures in 2021, wind turbine prices declined by 50% between 2008 and 2020 [1].

From the report from The National Renewable Energy Laboratory (NREL), the North Atlantic region has become the main concentration of offshore wind development during the past ten years, like New York, Rhode Island, New Jersey, and Massachusetts, with deployment aboard to other coastal areas in the future, extending into the Gulf of Mexico, Pacific, and Great Lakes [7,4]. However, only Vineyard Wind Farm is under construction, and no commercial projects have achieved grid-connected operation. While China's main offshore wind power resources are focused on the southeast coasts, considering the better economic foundation and more electricity demand. Closer to the load center, the lesser the loss of electricity in long-distance transmission, without occupying more land resources. Therefore, Shanghai, Jiangsu, and Guangdong have become the leading developing and centralized places, and many pilot projects have already been applied, like Donghai Bridge Wind Farm.

Based on offshore wind power investment cost, capacity, supply chain, and deployment into consideration, China is apparently in a leading position, and the US is still at the start level to develop offshore wind, not to mention that its offshore wind energy potential was ignored. This paper aims to analyze the difference in offshore wind development from the policy comparison, explore the reasons behind these various policies, and then give proper suggestions to foster the offshore wind power industry.

2. Policy Comparision

2.1. The Policy Process

2.1.1 China

Compared with the US, China has more stable policy frameworks with long-term goals to develop the offshore wind industry. These continued policies provide long-term revenue certainty, handle permitting problems, and plan for grid expansion in time, constituting China's main characteristics of the energy innovation system. Only a few countries, like China, Germany, and Spain, have succeeded in these three parts [8].

"Carbon neutrality" is the central focus of all these regulations. Then, a series of FYPs, as a leading government regulation, integrate into national, provincial, and local energy policies and plans to guide investment decisions and the transformation to renewables. In 1993, the punishing time of the Chinese first policy related to wind electricity was around 20 years behind that of the US. However, China is still on the way to the offshore wind energy transition. The Wind Base Programme (2008) started its pilot process first, 7 locations with the best wind resources are selected from the 34 provinces (municipalities) and targets (138GW) are set to be reached by 2020 [9]. Then, other supplementary energy policies like A Feed-in Tariff Regulation (2009) and the 12th FYP process help go forward quickly on offshore wind development. They encourage accelerating the growth of wind and other renewable energy sources and set four different tariff categories applied for the entire 20-year operational period typically. Interim Measures for the Administration of Development and Construction of Offshore Wind Power (2010) also releases more opportunities for foreign investors to join tendering process and technical cooperation. It removals 70% of domestic requirements of the value of wind turbine materials and components, and targets for offshore wind development are set (5GW by 2015 and 30GW by 2020), although energy security was still prioritized. During the 13th FYP process, the construction of offshore wind farms in Jiangsu and Fujian has maintained a rapid development speed: Liaoning, Zhejiang, Hebei, and other provinces are also actively accelerating the pace of developing which together account for 15% of the whole installation capacity [10].

Despite the recall of the subsidies policy of offshore wind projects after 2021, the 14th FYP process is a turning point from installed capacity to shares of renewable energy generation. Since the 14th FYP process, more laws, regulations, and rules have been issued for the power sectors with more flexible timeframes, like the setting of an 18% wind and solar PV electricity generation, and the easing of offshore wind project permitting. The prospection is that solar and wind power will replace hydropower as the second leading power generation technology since 2025. Green Power Trading Rules (2022) follows the 14th FYP, utilises another incentive by two grids separately to improve financing amount, and encourages offshore wind operators to join power purchase agreements with benefits. All in all, China’s ambitions to develop offshore wind are emerged in its FYPs and supported by other provincial, and local strategies. These continuous policies, with the quick and firm cooperation of all stakeholders, contribute to the leading position of the Chinese offshore wind power industry.

2.1.2 The US

Compared to robust policy-making processes throughout China, US energy policies on offshore wind power are incoherent, especially before Biden. The first U.S.-Industry-Led Offshore Wind Energy Guidance Document (OCRP-1-2022) was approved in 2022. From the 1970s to the 2020s, there was an obscure gap in analyzing the offshore wind power industry because no specific regulations directly apply to the “offshore wind”. Offshore wind is always together with the rules of onshore wind to promote the wind energy development on total, from Renewable Energy and Energy Efficiency Technology Competitiveness Act (1989), some descriptions like “improve design methodologies, develop more wind turbines, and enhance output to increase the cost competitiveness” are listed.

Before The Jones Act (2021), only some limited environmental and marine mammal protection clauses existed. The Marine Mammal Protection Act (1994) set the requirements for minimizing the impacts of wind energy development on marine mammals and other marine resources. Furthermore, a few federal and state environmental licensing are needed to guarantee the project proceeds as planned. Clean Water Act (1977) prescribes that permits are essential to avoid the punishment of regular construction pollution. What is more, the construction of offshore wind farms must ensure no big conflicts with marine uses, including tribal fishing, commercial activities, recreational events. The Jones Act (2021), meant to protect its maritime industry, says that only U.S.-flagged, U.S.-built, and crewed American vessels can move goods between ports, and only one installation vessel is currently under construction [11]. Outer Continental Shelf Lands Act (2022), which manages related matters with US waters and the seabed beneath, further requires offshore wind construction and operations should be carefully adapted to the Jones Act’s requirements. Therefore, US offshore wind energy environmental permits are stricter than China, which is the main factor that constrains the quick development of offshore wind power. One more example is that it took almost eight years for Dominion to get all the necessary permits and approvals for its 12MW wind farm project located off the coast of Virginia [12].

Changes in American party authorities from different interest stands are another reason setting the speed back of the offshore wind power development. In 2018, the past present Tramp tried to dramatically cut funding for a Department of Energy Program, which supports research and development of clean energy technologies, to benefit the coal industry [13]. Thanks to the newly elected President Joe Biden, the Inflation Reduction Act (2022) issue is trying to resolve the stagnation of offshore wind energy. It provides more opening opportunities for workers in other industries to pursue a career in the green economy, and USD 30 billion in targeted grant and loan programs for clean electricity investments are provided [14]. Other detailed regulations include Offshore Compliance Recommended Practices (2022), the first of five recommended action plans for offshore wind energy, is the primary reference document for U.S. offshore wind standards requirements. It will help bring greater transparency, consistency, and certainty to the regulatory process of the U.S. offshore wind energy industry. Other four companion documents are also under work by the U.S. Offshore Wind Standards Initiative and will be approved later. With these new regulations issued step by step, the U.S. will witness a blooming development of the offshore wind industry.

2.2. Main Findings on Differences

2.2.1 Policy Environment

GWEC concludes that a long-term solid legislative background is one factor resulting in the success of China's offshore wind energy [9]. The policy environment was continuous and stable, and it also absorbed lessons learned from developing the price curve for advanced renewable technologies and conventional energy generation [9]. Supportive renewable resources start from onshore wind power, solar, and offshore wind [9]. In addition, state-owned energy enterprises (SOEs) mainly take charge of Chinese wind projects. No matter the limited market shares that private investors and foreign-owned companies have of the total wind capacity, around 80% of the total capacity was taken by the SOEs, and provincial governments increasingly own the remaining 20% [9]. This SOEs-centered rapid innovation system has the innate advantage of mobilizing funding for strategic national missions, empowering provincial and municipal governments to conduct commercial and technical trials, spreading risks, and sustaining competition, as a result, sharing the benefits of a vast domestic market [8]. Jinshan Offshore Wind Phase I is a good example; as the first grid-party offshore wind case in China, it was announced by the Shanghai government in 2022 and tendered by three SOEs with a fixed feed-in tariff rate of RMB 0.302KWh [15]. Although no subsidies will be given for offshore wind projects coming online after 2021, the local government is still willing to support the industry with its subsidies. This project has a total investment of RMB 3.1 billion and it is cooperating with the "North-South Transformation" strategy for Jinshan District, which provides municipal, commercial test beds for offshore wind energy [15]. Moreover, policy-driven international cooperation is essential for China to achieve global leadership goals in offshore wind technology. China has received the most extensive support and assistance from the Clean Development Mechanism (CDM) of the UN Framework Convention on Climate Change (UNFCCC), and its USD 4.1 billion low-carbon energy R&D spending in 2020 accounted for 15% of the world [9,8].

Compared to the robust policy framework of China, the U.S. policy about offshore wind energy is not clear. The USA Department of Wind Energy Program receives far less funds per year than other resources (USD 50 million) [16]. The Trump administration, a firm defender of coal fuels, has also created many regulatory barriers since 2017 [17]. Even now, the publication of IRA (2022) still cannot solve the problem of ineffective local policies. New York State Governor Andrew Cuomo’s new commitment to 2400MW of offshore wind power has unclear implementation [17]. It has not been elevated to the level of regulation, not to mention forming a clear path to the practice. All these administrative obstructions increase the construction period of offshore wind projects. The lack of consistent policy signals also leads to uncertainty in markets. It will affect the investment enthusiasm and the time perspective of investors. Like US offshore wind projects need to be built and maintained by four or five expensive specialized ships, it takes around three years to be constructed [18]. However, without a decisive policy about the future offshore wind build-out, no investors would bid for these massive vessels with capital outlay estimated at more than $100 million [19]. Not to mention more restrictions towards operation from the Jones Act (2021).

2.2.2 Financial incentives

Chinese policymakers use Feed-in Tariff (FIT) payments to encourage green electricity production through financial premiums on renewable energy, then related technologies are promoted to compete with traditional energy sources that receive other subsidies all the time, providing market certainty for developers. More importantly, FIT payments have a tariff degression approach, with the technology price decreasing as the market develops to increase investors' confidence and support stable market growth. China ‘s wind financial subsidies are divided into five stages: Pilot (1993-2003), Concession Tender (2003-2009), Benchmark Price (2009-2020), Competitive Allocation (2019-2020), and Parity (2020-Now) [1]. The tariff degression occurs on a fixed schedule, under the instructions of a series of FYPs and supplementary regulations. Despite no more national subsidies during the parity process, Guangdong and Zhejiang have established owned successful provincial financial subsidy systems for offshore wind power, which are more appropriate for the local market. Moreover, different project sizes have different wind FIT payments. It benefits distributed projects, helps track different generation costs, and avoids over-high payments for large wind projects [20].

The US implements tax credits (PTC/ITC) to promote offshore wind energy development from the federal level. A wind production tax credit (PTC) provides credit to businesses that make offshore wind electricity. In contrast, an investment tax credit (ITC) reduces the wind project operator’s tax expenses based on the capital investment of these projects. The Energy Policy Act 1992 first recommends the PTC with other renewable energies. This policy has been renewed and extended many times, with gaps between parties. Until the issue of the American Reinvestment and Recovery Act (2009) introduces ITC as a substitution for PTC. After that, PTC and ITC start their parallel operation. The Offshore Wind Manufacturing Act of 2021 firstly set formal subsidy rules to promote facilities' production of offshore wind turbines. Qualified facilities would receive a 30% ITC and the PTC would be from 2 cents to 5 cents per watt, multiplied by the total rated capacity of the turbine. The ITC would remain at 30% until 2028 and then phase down, while the PTC would be available through 2030 [23]. Although the PTC does not need expenditure of funds, it is typically short-term (3 years) and must be amended regularly [20]. Some PTCs have experienced challenges associated with political transitions and frequent policy changes. Moreover, the ITC is normally applied to the early stages of offshore wind project development based on total project cost. However, it has no actual effects to facilitate production. Even so, PTC and ITC are more suitable than FIT payments in the US for governmental financial pressures and negative pandemic influence in recent years. More importantly, formulating differential tariffs in each region requires a long period and a clear and effective policy framework; it does not apply to the American political system so well.

2.2.3 Permit processes

The rules and standards to build offshore wind power farms are clear and straightforward in China. There are only four stages to follow (Planning, Design, Construction, Operation and Maintenance), and every stage contains at most six regulations [21]. For offshore wind's most critical construction stage, only two codes are included, which focus on technical, safety, and inspection requirements. No wonder the Donghai Bridge Offshore Wind Farm, with a total installed capacity of 102MW, takes only two years from approval to operation (2019-2010). However, domestic market demand, large population, and policy impetus should also be considered. In addition, the licensing process is further streamlined by China's New 14th FYP. The Institute for Energy Economics and Financial Analysis (IEEFA) research shows 38 offshore Chinese wind farms that employ multiple turbine models from either a single supplier or, more frequently, different models from more than one supplier [22]. These mixed model farms provide opportunities for data collection on comparative performance that accelerates the learning process of wind turbine technologies [22]. Thus, a unique energy innovation system is created for the offshore wind industry, bringing more brands to healthy compete and more technologies to market quickly.

The licensing process for offshore wind projects in the U.S. can be complex and involves several regulatory bodies at different levels of government. At the federal level, the Bureau of Ocean Energy Management (BOEM) is responsible for managing offshore energy resources [23]. It oversees the leasing process for offshore wind farms in federal waters, which typically begins with a competitive auction or a non-competitive process for designated wind energy areas. The selected developers must then submit plans for review and approval, which involves coordination with federal agencies including the U.S. Fish and Wildlife Service (USFWS) [23]. Moreover, the developers have regulatory frameworks at the state level to permit requirements and environmental assessments. Local planning authorities also have jurisdiction over certain aspects of the project, such as onshore infrastructure and transmission lines. Therefore, it always faces stagnation in working closely with these authorities to obtain necessary permits, and approvals, and address local concerns.

The need for more awareness at the social and community levels is another barrier to the stagnation of the permit processes. Much of the ocean area now planned for offshore wind power was initially used for transportation and fishing. The development of wind power would jeopardize the benefits of these activities. In the meantime, owing to the lack of effective demonstrations, involvements in education, and public information campaigns towards offshore wind energy, the public needs more acceptance of the positive aspects and goes against the construction. The Vineyard Wind Farm had nearly two decades of community relations work before completing its 800MW project, and a cooperative partner called Vineyard Power has around 1,400 members building relationships with fishermen and other stakeholders [24]. In this case, prioritizing stakeholders' engagement is the prime method to smooth the permitting process. Other alternative frameworks could also be used to overcome some of these constraints, such as simplifying social licenses to operate, creating positive responses by providing proper education, and launching public campaigns to improve the understanding of renewables [16].

3. Conclusion

The Policy is critical to the wind energy growth between China and the US. Even though China's starting point of offshore wind power policy is far behind the US, 30-year quick development to a lead proves its success in the offshore wind power industry. A favorable policy environment, powerful financial incentives, and simple permit processes, all of them are indispensable to increasing the global competitiveness of offshore wind energy: Stable and continuous policy environment could integrate the lessons learned from ongoing developments, direct SOEs to mobilize funding, and provide commercial test beds for renewables, as well as enhance international cooperation to achieve a global leadership; Differentiating FITs payments promote green electricity production, develop offshore wind technology, and convey market certainty for developers; Clear and decisive regulations of permits reduce the constructed period and contribute to the creation of energy innovation system. From China's advanced experience, the US needs to establish coherent and complementary policy packages to cater to changing market conditions and promote the sustainable growth of the offshore wind industry. Moreover, It is also necessary to insist on incentives for PTCs and ITCs to further develop offshore wind technologies. Finally, streamlining permit processes should be considered, including limiting the number of agencies engaged with review and approval, prioritizing stakeholders' engagement, and arousing social acceptance of offshore wind power. However, China's policies are not always perfect. The rapid development of wind power has strained the electricity grid infrastructure. It is urged to issue more regulations to relieve grid access and integration conflicts. Moreover, accelerating grid planning coordination at the national and provincial levels is a vital measure to promote offshore wind power production. Furthermore, it will be the tendency to release the proportion of private wind investment and enhance non-taxable entities' participation to build more global offshore wind projects cooperation.

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