

Offshore wind development in China

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- Wind power development in China
- Current status of offshore wind in China
- Challenges of offshore wind in China
- Outlook of offshore wind in China



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Energy transition in China: why?



Drivers for energy transition

Climate change
Environment pollution
Fossil energy resources

Energy revolution in China: clean, low-carbon, safe and efficient





 $Photo \ Sources: \ http://image.baidu.com/search/index?tn=baiduimage&ps=1&ct=201326592&lm=-1&cl=2&nc=1&ie=utf-8&word=\%E6\%B0\%94\%E5\%80\%99\%E5\%8F\%98\%E5\%8C\%96$

Energy transition in China: how?



- January 1st, 2006, Renewable Energy Law of the People's Republic of China
- China is top 1 on wind power, solar, and biomass in the world.
- 2018: The cumulative grid-connected capacity of wind power in China was 184.26 GW, accounting for 9.7% of the total installed capacity, 5.2% of total electric energy generated.



Photo Sources: http://www.pkulaw.cn/fulltext_form.aspx?Gid=57066

Wind power development in China



Installed Capacity

The total installed capacity and new install capacity of China wind electric from 2003 to 2018 (GW)



Data source: CWEA

Wind power development in China

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• 2018: Manufacturers, Newly installed capacity





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Why does China need offshore wind?



- In 2030, the maximum electricity demand of eastern China will reach nearly 1000 GW, which cannot be fully supplied by local energy supply and West-east electricity transmission project.
- Offshore wind resources in China is abundant and close to the demand centers. Offshore wind will help China transform from the coal-based to renewable-based energy structure.

2018	2030	Incremental rate	
1.8	5.4	3	the second second
1.7	4.2	2.5	and the second sec
3.5	5.3	1.5	Offshore wind
0.45	1.6	3.5	transmission project
11.4	12	1.05	and we share the
0.15	0.2	1.3	the set in the
19	28.7	1.5	m Zantyrich
ed capa	city (U	nit: 100GW)	
	2018 1.8 1.7 3.5 0.45 11.4 0.15 19 ed capa	2018 2030 1.8 5.4 1.7 4.2 3.5 5.3 0.45 1.6 11.4 12 0.15 0.2 19 28.7	20182030Incremental rate1.85.431.74.22.53.55.31.50.451.63.511.4121.050.150.21.31928.71.5

Data Sources: National Bureau of Statistics of China

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Promote planning and increase the target

 Planning: 74.72 GW Target in 2020: 6.6 GW 		Planning	Approval time	Grid connected target 2020	Grid connected capacity by Sep 2019
	Jiangsu	14.75	2017	3.5	3.87
	Fujian	13.30	2017	2.0	0.27
less 1	Shandong	12.75	2012	-	0
	Guangdong	9.85	2018	0.3	0.10
	Zhejiang	6.47	2016	0.3	0.25
1.2.1	Shanghai	6.15	2011	0.3	0.31
	Hebei	5.60	2012	-	0
	Hainan	3.95	2014	0.1	0
	Liaoning	1.90	2013	-	0.15
	Tianjin	-	-	0.1	0.09
	Guangxi	-	-	-	-
Data source: China Renewable	Total	74.72	/	6.6	5.04



• Manufacturing of large-scale offshore wind turbines

- In 2018: 52.8% of wind turbines have the capacity of 4MW for offshore in China
- In 2019: 5MW and above units have become mainstream for offshore in China





Advancement of design and construction capacity

- **Breakthrough 1:** 110kV and 220kV offshore booster stations were successfully installed. At present, there are 18 offshore booster stations in China, and another 6 are under construction, and 2 offshore converter stations are under design.
- **Breakthrough 2:** The basic design capability of wind turbines have been continuously improved, and the anti-icing design and integrated design capabilities have been improved. More than 900 foundations of various types have been completed, of which more than 500 are non-transition single pile foundations. Negative pressure, gravity, and jacket foundations have been applied.



Construction costs are gradually reduced

- Through 10+ years, offshore wind investment per unit has gradually declined.
- The average cost of offshore wind power projects is around 15700 yuan / kW, mainly located in the seas of Jiangsu Province.



Industry & Acadamy

 100+ of universities in China dedicates to the research and teaching on wind power, thousands of qualified wind power engineers have been cultivated.





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China has 18000 km coastal line, average wind speed is around 7-8.5 m/s (90 m height), lower than in Europe.

	Province	Average wind speed (90m m/s)	IEC wind class
	Liaoning	6.5~7.3	111
The second second	Tianjin	6.9~7.5	111
	Hebei	6.9~7.8	III
	Shandong	6.7 ~ 7.5	111
and the second of the	Jiangsu	7.2 ~ 7.8	III ~ II
and the second s	Shanghai	7.0~7.6	~
a state a state of the state of	zhejiang	7.0~8.0	II ~ I+
1 0 162.8 226 000 073 1.300	Fujian	7.5~10	 ~ +
Offshore wind speed distribution for eastern China	Guangdong	6.5 ~ 8.5	l ~ l+

Data Sources: IEA report 2011

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Super typhoons are prevalent in east coast of China

Carlos Andres Andres	Name	Time	Level	Wind speed (m/s)
	Rammas un	Jul.	17	60
	Kalmaegi	Sep.	13	40
	Mujigae	Oct.	15	50
Trajectories of Typhoon	Sarika	Oct.	14	45
along east coast of China	Hato	Aug.	15	48
	Pakhar	Aug.	12	33
	Khanun	Oct.	14	42
Source: BNEF, 2018	Mangkhu t	Sep.	15	48

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Environmental constraints tightening, near sea is very crowded

Tightening ecological constraints

- 《Coastline protection and utilization management methods》: Strictly restrict construction projects from occupying natural shorelines;
- 《 Measures for the development and construction of offshore wind power 》

Large demand of new sea use

- Fishery use
- Industrial use,
- Transportation use,
- Land use
- Engineering use.

	国国	家家	能海	源洋	局局	文件
			围能新机	e(2016)	394 号	
	国家	家能调 上风电	〔局 国 开发到	家海? 世设管	羊局关 理办法	:于印发 去》的通知
天津、展改革	河北、辽 (能)	守、上演 原局)、消	,江苏、 #洋厅(回来#	新江、福 局),国:	建、山东 家电洞公 街、二排	、广东、广西、海南 2 司、南方电网公司 中核 中广线 水(
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😘 国家司再生越激信息管理中心发布

NOTICE CONTROL OF

Advanced operation and maintenance technologies are needed

- Lack of operation and maintenance experience
- O&M standards needed



The life cycle cost of a typical 1 GW offshore wind farm

Decreasing of the Feed-in Tariff

- Competitive pressure, such as UHV transmission channels, local distributed photovoltaics and onshore wind power.
- Reduction and the call off the offshore wind subsidies in China





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Outlook of offshore wind in China

•Industry:

- •Short-term: without subsidies, industrial restructuring;
- •Long-term: high demand, high speed development;

•Technologies:

- •Larger wind turbines
- Smart operation and maintenance
- •deep sea floating wind turbine
- Industrial policy

•Provincial level policies will be issued

Source : GE 2025 White Paper on China's Wind Power Generation Cost

North China Electric Power University



- Largest energy and electric power university in China: 36,396 students, most of them study energy and electric power related majors
- First undergraduate major of Wind Energy and Power Engineering (from 2006)
- First Renewable Energy school in China (from 2007)
- State key laboratory of alternate electric power system with renewable energy sources







Efficient wind turbine technologies

- Wind turbine blade design
- Integrated design of wind turbine
- Wind turbine Intelligent control
 - **Offshore wind turbines**

Intelligent wind farm technologies

- Wind Farm Design
- Intelligent control of wind farms
- Intelligent maintenance of wind farms
- Operation of new energy

power systems



Thank you!

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