Could Chinese Onshore Wind Power Achieve the Grid Parity in 2020? – Present LCOE Values and Future Evolution

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Overview

Onshore wind power capacity is increasing rapidly in China. In 2009, the newly-added capacity was 13.8 GW, which exceeded the total of China's capacity installation in the past twenty years and outpaced the scale of the US in the same year. By 2010, the cumulative installed capacity reached 43.5 GW. Since then, wind power entered into the large-scale deployment stage and at the end of 2015 a total of 143.8 GW was installated. This sharp increase of wind power capacity was mainly due to policies such as feed-in tariffs (FIT), carbon prices and decreasing costs for wind turbine technolgies. However, the subsidies to finance the FITs lead to a significant funding gap for the Chinese government and therefore reductions in FIT are ongoing. The Chinese government has adopted an ambitious goal which states that wind power will achieve grid parity with the on-grid price of coal-fired power in 2020. Whether this target can be achieved in 2020 is a great concern for policy makers as well as the potential investors. It is unclear if the nation-wide carbon pricing system, which was launched recently, will compensate for decreasing FITs. This paper investigates the political target and aims to answer the question if Chinese onshore wind power can achieve the Grid Parity in 2020? To do so we first calculate current levelized cost of electricity (LCOE) of wind power which are the basis to estimate the future LCOE up to 2025. Then we compare those estimates with the on-grid price of coal-fired power to determine whether grid parity can be achieved.

Methods

We construct a dataset of 2059 onshore wind power projects in China's thirty provinces over the period of 2006–2015. The project information is derived from the Clean Development Mechanism (CDM) database of UNEP and the Chinese certified emission reduction exchange (CCERE). The Table below shows the summary statistics.

Parameters	Unit	Mean	Std.Dev.	Min	Max	Number of observations
Capacity	MW	58.70	47.20	6.00	600.00	2059
Issuance success rate	%	87.79	9.60	66.78	170.31	558
Expected electricity generation	GWh	125.24	92.51	16.05	1567.24	2059

Avoided carbon emission intensity	t CO_2/MWh	0.92	0.09	0.60	1.65	2059
Unit capital cost	CNY/kW	8897.40	810.72	2947.80	11514.58	2059
Unit O&M cost	10000CNY/kW	25.54	4.99	8.67	71.67	2059
Own capital ratio	%	20.14	1.64	15	30	2059
IRR without CER	%	6.50	0.01	4.31	8.00	1959
Project lifetime	yr	20	0	20	20	2059
Loan interest rate	%	6.00	0.01	4.90	8.06	1902
Loan period	yr	15	0	15	15	2059

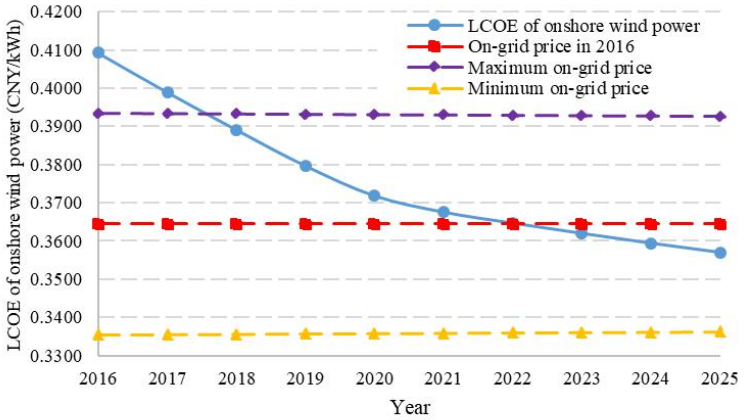
This dataset is used to estimate the learning rate of onshore wind power in China over the period of 2006–2015. Based on this learning rate, we calculate the future LCOE of Chinese onshore wind power from 2016 to 2025.

LCOEs are the levelized average lifetime costs or long-run average costs. LCOE represent the net discounted cost to install and operate a wind project divided by its power generation over its lifetime. In other words, LCOE are equivalent to the break-even tariff that wind project developers would require to build and operate a wind farm in a given location.

Results

Based on the data the learning coefficient is estimated to be 0.1106, which leads to a learning rate of 7.5% for onshore wind in China. Assuming similar learning rates for the future and including those in the estimates of future LCOE will lead to substantial reductions up to 2025. Figure 1 shows that the LCOEs would decrease from 0.41 to below 0.36 CNY/KWh, without a carbon price. Adding a carbon price, which wind power investors can get for the avoided carbon emissions compared to the generation mix, improves the financial situation. We differentiate four different carbon price scenarios: (i) no carbon price, (ii) a carbon price of 10 CNY/tCO2, as the lowest carbon price of Chinese carbon trading market, (iii) a carbon price of 35 CNY/tCO2, which is approximately equal to the average carbon price of Chinese carbon trading market, (iii) a price of 60 CNY/tCO2, as the highest carbon price of Chinese carbon trading market.

Fig. 1: Profitability of the wind power projects with different FIT decreases and carbon prices



Conclusions

Our results (see Figure 2 below) show that in order to achieve grid parity in 2020 wind power investments will need a carbon price slightly above 35 CNY/tCO2. With a carbon price below 35 CNY/tCO2 the political target cannot be met. Thus, additional revenues from carbon prices, as can be obtained by the Chinese offset system, in addition to the FIT play an important role to promote grid parity for wind power by 2020. How the nation-wide carbon pricing system, which is a cap and trade scheme and

was officially announced end of 2017, will impact the on-grid price for coal fired generation is yet to be seen.

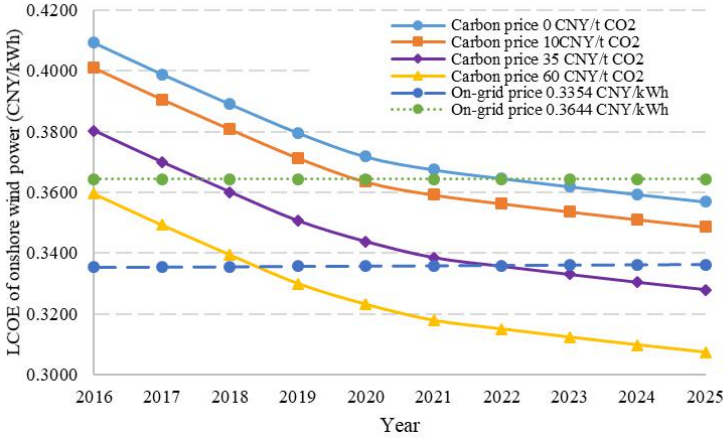


Fig 2: Wind LCOE evolution with a carbon price of 0, 10, 35 and 60CNY/tCO2 and grid parities calculations for different scenarios of power coal-fried on gird price