Analysis of the Functionality of the Chinese Wind Power Market
A Comparative Evaluation with Germany

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Abstract: This paper examines the functionality of the Chinese wind energy market. For this analysis, the indicators market structure, market behaviour, and market result are used. For each indicator, several criteria, which are based on literature research, are tested for both the Chinese and the German wind energy market and then are evaluated in a comparative manner. Finally, on the basis of the most serious challenges in the Chinese wind energy market, that are revealed by the comparative analysis, measures are deducted with support from expert's opinions. The measures are meant to provide potential solutions for the improvement of the functionality of the Chinese wind power market.

1 INTRODUCTION

China is well aware of the importance of the environment. China recently ratified the Paris Agreement(Volvovici et al. 2016) and emphasized the importance of the environment in its strategic orientation, namely its Five Year Plans (FYP)(AHK Greater China 2016). Furthermore, a change in the energy sector towards cleaner energy generation is planned. As a result, China is not only the country that has the worldwide highest annual investments in renewable energy technologies but also the worldwide highest installed capacity, namely 129.34 GW in 2015. However, even though the US has only half of China's capacity of wind power plants, it generates more electricity out of them(Davidson 2013; Zhang et al. 2016).

Thus, China does not utilize its available resources - wind power and wind power plants - as efficiently as it could. These are indices for a malfunction in the wind power sector in China that does not only have an effect on the Chinese air quality in cities but also on global warming. This study analyses the functionality of the Chinese wind power market that seems not to provide sufficient incentives. Germany's wind power market is used as a reference.

2 THEORETICAL BACKGROUND

After the first Chinese wind power pilot project in Rongcheng was installed in 1986, basically three phases were run through. First, wind power projects were dependent on foreign capital and credits and feed-in tariffs were way below the actual costs. Second, in the 90s there was still a significant, for generators disadvantageous, difference between costs and tariffs. However, the government already intended to promote renewable energies. Finally, after 2003 the plan for domestic manufacturing was published to reduce production costs and promote wind power(Yao, Herrerias 2014).

Nowadays China is the country that has the highest newly installed capacity in 2015 with 48.5% of the globally installed capacity and the largest amount of cumulative capacity with 33.6% worldwide. For 2016 30.83 GW newly installed capacity was planned which is slightly less than 2015. An approximately steadily increase is expected until 2017 when a decreasing growth is predicted due to the decreasing feed-in tariff.

On the other side, offshore wind power is still not very meaningful despite its increasing growth rate and 306.5 MW newly installed capacity in

2015.The total installed capacity was about 1 GW and therefore is not taken into further account(GEWC 2016).

3 METHOD

The analysis of the Chinese wind power market follows the pattern displayed in Figure 1.

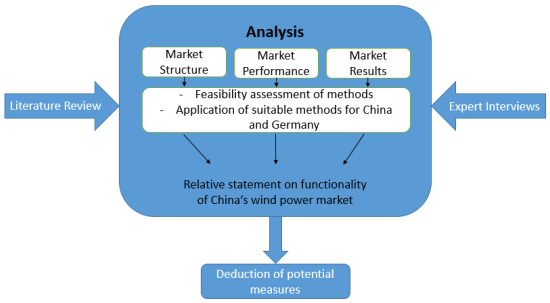

Figure 1: Methodological approach (own representation).

The first step is the consideration of the functionality in terms of excessive market power of single generators. Therefore, three different areas are taken into account, namely the market structure, the market performance and the market results which represent the standard classification of market functionality tests(Ellersdorfer 2009; Peters 2000).

Based on a literature review, possible criteria that serve as indicators for the functionality are taken into account for each area. They are described first before their usability for the purpose of this thesis is checked based on the feasibility, i.e. the complexity, the informative value, the applicability for the Chinese circumstances and most importantly on the availability of required data which is significantly the limiting factor when it comes to research topics that are that sensible. Data availability is checked using literature review as depicted in the previous parts plus using interviews with international and Chinese experts.

The selected criteria are provided with necessary data to conduct a statement about the single aspects. However, since there is no standardized classification of functionality and isolated statements are hard to interpret by themselves, the German wind power market is used as a reference, i.e. is evaluated regarding the same criteria as China, so that a comparative statement can be drawn. Since the outcomes of the different areas cannot be considered separately, the results of all criteria assessment are evaluated holistically to determine the result and statements about the market functionality in comparison to Germany.

4 RESULTS

The table below shows an overview of the results of the comparison between China and Germany regarding all covered criteria. The status can have the specifications “potential available”, “same” and “lead” and describes the contribution of the respective criteria to the functionality of the Chinese wind power market in comparison to the German one.

The column data quality specifies if the data available is “medium”, “good” or “insufficient”. Thereby the worse data quality out of the German one and Chinese one is considered. For each criterion, three specifications that are straightforward to distinguish are chosen to allow a result that is both easy to understand and clear.

The overview illustrates that the indicators for the functionality of the Chinese market are fulfilled in lower degree than in Germany in all aspects except the concentration of OEMs and wind power plant operators. Many aspects like the quality issues or the innovation progress can be justified by the fact that the wind power started to play an important role in China only ten years ago. The improvement of these factors may take some time. One reason might be that the whole understanding of the Chinese economy is undergoing a transformation from the factory of the world towards an innovative nation.

Other criteria show problems that are inherent in the system like the pricing policy respectively the not yet fully-developed market for electricity.

Another huge issue related to the market is the powerful position of the grid companies that not only act like monopolies but also have a huge influence on the wind power plant operators as well as on other aspects.

Another outcome of the overview is the fact that the majority of the data available is not good. This is not only the case for China but for Germany as well. Especially trustworthy quantitative data is hard to gather. Even several experts could not comment on all aspects since they lack relevant information.

There are four main measures that can help to improve the situation in China. Two of them are physical aspects, namely the development of the infrastructure and the elimination of overcapacities.

The development of an appropriate infrastructure enables the transmission of renewable electricity

from the western generation to the eastern load centers to increase the productivity. Therefore, an integration of the existing grid systems is necessary. Due to economic aspects, the development of the fundamental grid should be preferred over high voltage direct current lines and storage systems like batteries. These additional measures are not required until the share of renewable generated electricity reaches 50%.

Table 1: Results of the functionality analysis(own representation).

Criterion	Status of China compared to Germany	Data quality
Market structure		
Market concentration and propensity for concentration and fusions	same	medium
Degree of linkage	potential available	medium
Market entry barriers	potential available	medium
Analysis of Porter's Five Forces	potential available	medium
Threat of new entrants	potential available	medium
Power of suppliers	lead	medium
Power of customers	potential available	good
Threat of substitute products	potential available	good
Market transparency	potential available	medium
Product differentiation	potential available	good
Market Performance Testing		
Performance and result based indices	not applicable	insufficient
Optimization and Simulation Models	not applicable	insufficient
Sales and price policy	potential available	good
Demand-related behavior	potential available	medium
Product Improvement and Innovation actions	potential available	good
Risk orientation	potential available	medium
Advertising and information behavior	not applicable	insufficient
Propensity for restriction of competition	not applicable	insufficient
Market Result Testing		
Quality	potential available	medium
Innovation and technological progress	potential available	good
Productivity and capacity utilization	potential available	good
Adaptation ability	potential available	medium
Contribution to shortage and surplus correction	not applicable	insufficient

Even though coal fired power plants have full load hours below 4000 hours new coal power plants are planned. Thus, the threat of substitutes increases. As shown in the previous part the overall capacity is increasing faster than the economic growth respectively the demand. To defuse the situation, coal fired power plants have to be closed or at least not newly build.

The third measure, an economic electricity market that allows a more market oriented price development is already planned and tested in pilot areas but is not mature yet. It is important that wholesale market prices can emerge freely so that they help to find the most efficient allocations. Furthermore, the market must be highly flexible since renewable energies are volatile. One approach can be flexible intraday markets that trade products with a delivery period as short as 15 minutes and late gate closures. Moreover, regulations for all aspects of the market and especially the short term market have to be specified.

The fourth measure, the unbundling of the grid companies, might be the most difficult one due to conflicting interests and their huge influence. Not only the steps of the value chain transmission, distribution and sale should be segregated but also a variety of companies should be involved. Thus, customers can choose their electricity provider and competition is strengthened. As a further result, the power of the grid companies will decrease and put the wind power plant operators in a stronger negotiation position.

4 CONCLUSIONS

The conducted analysis shows challenges regarding the functionality of the Chinese wind power market, which are mainly caused by the still immature character of the developing electricity market and the high power of grid companies. This results in a relatively low grid connection of wind power plants and high curtailment rates. Possible solutions – unbundling, the introduction of more market mechanisms and restructuring of the infrastructure and power mix – are deducted based on the German market. The dealing with the problems has a high priority in China. The government introduces many new regulations to deal with environmental problems as mentioned in the current FYP and China's announced coal peak. China is currently undergoing a transformation of its energy sector and also continuing to open its markets to more market power. Thus, the conducted research has a high

timeliness. Moreover, Germany functions as a role model with regard to its energy transition. Especially China has shown in the past that it is willing to compare existing models of other energy markets and adapt its own policies to the best fitting ones. Germany with its EEG (renewable energy law) and ARegV (incentive ordinance for grid operators) is of high interest for Chinese officials like CNREC.

China's political system allows the government to implement reforms and changes in policies relatively fast and with relatively few resistances. The main requirement is the political willingness for the considered change. According to expert's and published regulations and statements, China is willing to change its energy system.

Another important factor is that the Chinese population is favouring renewable energies. A survey shows that over 90% of the interviewed Chinese people are willing to pay more for electricity generated by renewable energies. However, the current Chinese power market does not enable them to opt for such electricity.

Thus, the government and the population is willing to change its energy system and the population accepts that it could come at some additional costs. The only missing part is missing regulations to implement successful changes.

Therefore, deducted solutions could be of high importance for Chinese think tanks that consult the Chinese government regarding new policies.

However, due to the scope of this analysis several data sets that would be necessary for an in-depth analysis could not be gathered. Data concerning the energy market are hard to acquire in general. Since the market is highly regulated, market actors have no interest to publish all of their data that could be used for regulations limiting their profits. Therefore, another analysis that is based on a broader and deeper data fundament should be conducted. To achieve the highest success, cooperation with a Chinese research institute is proposed. Thus, data gathering could be easier because of the overcoming of language barriers. Future research should also focus on the reform of the Chinese energy market that had just begun when this research was conducted and when only limited information was available.

The planned reform of the energy market is a further indicator that China is willing to reform its energy system. An analysis like this one that depicts current challenges and provides points of reference for possible solutions might help China to overcome its role as the global largest CO2 emitter.

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