



# INTEGRATING WIND INTO THE CHINESE POWER MARKET

The Chinese energy targets imply a significant expansion in renewable energy in the years to come. Consequently, China has to meet the challenging task of optimizing their energy system, adapting it to handle fluctuating amounts of energy from renewable energy sources. Analysing how to improve the integration of wind power into the city of Baicheng's electricity and power supply, Denmark and China has entered into cooperation and initiated a pilot project in Baicheng.

### LOST ELECTRICITY FROM WIND TURBINES IN CHINA

China aims to be able to cover 15 pct. of its energy supply with non-fossil energy by 2020. Non-fossil energy denotes renewable energy and nuclear power. China is therefore currently focusing on increasing their use and generation of renewable energy.

Renewable energy comprised roughly 20 pct. of the total electricity production in 2012. Hydro power is still the most dominant renewable energy source, but wind power is the type of renewable energy that has risen the most in recent years. Today China has the world's largest market for wind turbines.

In recent years, wind turbines corresponding to 31,000 MW have been installed and connected to the power grid, in addition there are a number of wind turbines that have been erected, but are not yet grid-connected. The unconnected wind turbines are estimated to amount to 6,000 MW.

The increasing share of wind power adds to the challenges of integrating wind into the electricity system. One of the major Chinese challenges emerges as wind turbines are curtailed, as a consequence of the power grid's inability to collect the entire wind power production. In 2012, 20 TWh were lost from Chinese wind turbines being brought to a halt in periods with much wind and

small demand for electricity. This corresponds to 57 pct. of the annual Danish generation of electricity.

The Chinese wind generation is concentrated in the northern and north-eastern part of the country, where there are examples of up to 40 pct. of the potential wind power production not being utilized. Problems with stoppages of wind turbines will increase exponentially with a continued expansion, if no changes are made to the regulatory framework for the coal based production, which is still prioritized in China. Coal-based production is not adjusted accordingly, when there is available wind power, as is the case in Denmark.

### WHAT DOES DENMARK DO?

In Denmark more than 41 pct. of the energy for electricity supply is generated from renewable energy, of which 28 pct. is generated from wind power. It has been possible to integrate this high proportion of wind power in the Danish energy system without compromising the security of supply as Danish (and in general European) grid companies and system operators are legally obliged to take the delivery of wind power. To meet this obligation, Denmark is a part of a shared Nordic transmission grid, which allows Denmark to share energy with the neighbouring countries.

## THE PILOT PROJECT IN BAICHENG



In cases where an excess of wind in Denmark creates a surplus of energy, while there is a deficit in demand, Denmark sells energy to its neighbouring countries through the shared Nordic grid. Accordingly Denmark imports energy from the same neighbouring countries, when the demand exceeds the production. As a result, the wind turbines in Denmark can produce the full potential amount of energy at all times, without being disconnected and without compromising the security of supply.

Concurrently, the Danish electricity market is organised in order to provide incentives to produce electricity in the light of fluctuating market prices. In periods with high production of electricity, prices will be low and producers with high costs will adjust production downwards. In periods with low production, producers will try to produce and sell as much as possible.

Denmark also has an extended district heating system, capable of functioning as heat storage, thereby providing flexibility in the demand for electricity. Over the last 25 years, the Danish combined heat and power system has been adapted to wind power and today wind constitutes an important resource for electricity production, rather than presenting a problem for the electricity system.

### AN AREA WITH POTENTIALS

Baicheng is a metropolis in the Jilin province in north-eastern China. The area has excellent wind resources and the city has the potential to become the hub of electricity production in the province. The installed wind capacity in Baicheng amounts to a total of 3,800 MV. Thereof 2,000 MV are already grid connected and further 900 MV wind power is waiting to be connected. The remaining capacity is spread on three coal-fired plants.

As the city's own consumption of electricity only makes up 400 MV, or about 10 pct. of the produced amount, there is already a large export of electricity from the area. If wind power is better integrated into Baicheng's energy system, there is a basis for a large export of green power from wind turbines to the rest of the region.

### THE PILOT PROJECT IN BAICHENG

Consequently, a pilot project has been initiated in Baicheng, in order to study how to improve the integration of wind into the city's electricity and heat supply. The acquired knowledge from the project is intended

to be applicable to other provinces in China experiencing similar challenges.

The project is a cooperation between China National Renewable Energy Centre (CNREC), which is China's national renewable energy centre co-financed with Denmark, and 'Beijing Huajian Power Design and Research Institute' (BHJ). The pilot project is primarily conducted by experts from BHJ, with assistance from CNREC and experts from the Danish Energy Agency. The study will describe the city's production and consumption of energy.

The Danish experts will contribute with Danish experiences on the integration of wind power. As a part of the project, Chinese experts will visit Danish companies to gain an insight into how wind power is used in practice in Denmark. The project will assess the possibilities for optimal use of exchange relations, with the neighbouring areas and flexible production at the coal-fired plants, easing the integration of more wind power into the production of electricity.

In addition to the pilot project in Baicheng, there are several other Sino-Danish activities in north-eastern China related to the integration of wind power. In the nearby Harbin, in the Heilongjiang province, another Danish-supported project is currently underway. The project in Harbin focusses on analysing Harbin's energy system and identifying possible ways of integrating more wind power into the local electricity and heating system.

### FROM PILOT PROJECT TO A GENERAL FRAMEWORK

The purpose of the pilot project is to apply the experiences and knowledge gained to improve the integration of wind in the electricity system. It is furthermore the aim to permit wind power to take over the largest possible amount of the electricity production. Over time, it is the objective that the Jilin and Heilongjiang projects will function as inspiration for other Chinese provinces that wish to expand and increase the integration of wind into their electricity systems.

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