

## LIGHTING UP BEIJING WITH ZHANGBEI WIND POWER



Located within the Hebei Province of China, the city of Zhangjiakou is gearing up for the 2022 Winter Olympics, for which it will host several games. At the time of writing, the construction of a sports stadium is progressing steadily and gaining momentum.

Zhangjiakou's location between the North China Plain and the Inner Mongolia Plateau, means the city is exposed to constant strong winds all year round. Residents describe the relentless winter wind as a 'wind that goes on and on from winter to spring'.

Yet, this bitter wind is not without its value. An estimation by the National Energy Bureau places the wind energy resource reserves in the region at around 40 million kilowatts (kW) a year, accounting for more than 70% of the onshore wind resources in Hebei Province. This is accompanied by abundant solar energy in Zhangjiakou, with estimated usable solar power exceeding 30 million kW a year.

### DEVELOPMENT AND CHALLENGES FOR RENEWABLE ENERGY IN ZHANGJIAKOU

China released its policy on renewable energy in 2005, followed by directives on promoting the development of wind power. With its outstanding natural resources, Zhangjiakou has witnessed rapid development of wind power in recent years. By the end of 2019, renewable energy capacity in Zhangjiakou had reached 13.6 million kW, making it one of the leading cities for this in China.

However, Zhangjiakou's achievements in generating renewable energy were limited by its lower consumption rate and the lack of viable external transmission channels. According to 2014 data, the maximum load of the energy grid in Zhangjiakou was only 1.85 million kW and the external transmission capacity of renewable energy was less than 4 million kW. Without the right infrastructure and tools to harness wind power for energy, much of Zhangjiakou's wind was untapped.

In China, the development of renewable energy such as wind and solar power faces two major challenges. First, the large-scale integration of renewable energy in existing energy grid infrastructure is difficult due to the volatile and fluctuating nature of renewable energy. For instance, windmills can only generate electricity when there is wind blowing and usually, most wind comes during the night. At this time, the electricity demand is at its lowest, making it difficult to coordinate with other means of power generation. The second challenge, is the geographic spread of energy harnessed. Unlike Denmark's windmills, which generate power to fulfil local demand, renewable energy facilities in China are usually based in suburbs, far away from dense power consumption areas. Thus, building long-distance power transmission was critical to the effective use of such precious resources.

### NEW TECHNOLOGY DRIVES REVOLUTION IN POWER TRANSMITTING

With the continued sophistication of the renewable energy space, new technologies such as the flexible High-voltage Direct Current (HVDC) transmission surfaced as new solutions to transmit high voltage electricity across long-distance

networks. With time, the voltage and capacity of these flexible HVDC transmission projects in China continue to grow. Thanks to its flexible control, highly compact design and strong adaptability to the environment, flexible HVDC transmission technology can support large-scale renewable energy being integrated into the power grid. In addition, this technology can also provide a more adaptable acceptance and transmission mode to improve the large-scale long-distance power transmission capacity of the grid.

The Zhangbei HVDC power transmission project kickstarted in February 2018, having been given the green light from the National Development and Reform Commission three months prior. It is the world's first HVDC power transmission system and one with the highest rated voltage and transmission capacities. The project is designed to transmit power at a rated voltage of  $\pm 500\text{kV}$ , with the transmission wires reaching 666 kilometres. It is an advanced system with four interconnected converter stations in a ring network including Zhangbei, Kangbao, Fengning and Beijing. It is designed to transmit up to 9 million kW of clean energy.

As the link between direct current and alternating current, the converter valves inside the converter stations are highly critical to the success of transmission. This is one of the most technologically demanding and challenging equipment elements of the flexible HVDC transmission system.

Wang Ke, Experiment Engineer from the water-cooling unit of the NR Electronic Power Electronics, explains "if you think of the converter valve as the engine of a car, the water-cooling system for the valve becomes the vehicle's cooling system. If there are any issues with the cooling system, the entire automobile will not be able to run". Grundfos' end-suction pumps play that pertinent role by supplying coolant efficiently and effectively. This ensures the smooth operation of the key converter valves in the Zhangbei Converter Station and the success of the Zhangbei HVDC Power Transmission Project.

Using pumps with a maximum capacity of 315 kW is a first in the ultra-high voltage industry in China. With four NKG pumps from Grundfos working at the same time, the water-cooling system is able to transmit a total of 3,000 tons of water every hour, approximately the size of 1.5 standard swimming pools. Aside from the 12 end-suction pumps serving as the main pumps, Grundfos also supplied the Zhangbei project with other pumps. These support the auxiliary equipment to the water-cooling system in the converter station and the cooling system for the circuit breakers.



## **CLEAN ENERGY FUELS GREEN DEVELOPMENT**

On December 27th 2019, the Zhangbei HVDC power transmission project started the commissioning and trial process. To date, the trial has been running smoothly, delivering significant energy saving results.

The Zhangbei project is the first of its kind. It has been lauded for its ability to coordinate the generation and storage of wind and solar energy. Not only instrumental to the important power transmission channel to Zhangjiakou's planned 20 million kW renewables by 2020, it is also able to support the 2022 Winter Olympic Games venues with 100% clean energy, delivering China's promise of a low-carbon and green Olympics.

The water-cooling system supported by Grundfos technology ensures that 22.5 billion kW/h of clean energy is supplied annually, almost 1/10th of the annual power usage in Beijing. Total clean energy transmitted will help save the use of 7.8 million tons of standard coals, reducing 20.4 million tons of CO2 emission and 58 million tons of NOx emissions. The power from the Zhangbei project will help raise the clean energy consumption level in Beijing, maximising the commercial and ecological benefits in both cities.

Wang Ke added, "The Zhangbei project has created twelve world firsts. We are very honored to provide a cooling system with Grundfos technology for this project. This project brings together our latest and most advanced technologies in the field of flexible HVDC transmission, benefiting our company and the entire industry. We look forward to continuing to innovate and improve our technologies to better support grid development for the future."

