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China Inroads supports innovative European high-tech companies with the realization of a sustainable cooperation in China with relevant, reliable partners and distributors. We support machinery manufacturers that provide technological custom-made solutions in fields such as food processing, energy- and environmental technology and waste processing.



→ HOW CHINA IS FIGHTING RENEWABLE ENERGY WASTE

China has been the major force of global economic growth in the last few decades. Since 2010, China has become the world's second largest economy. China overtook the US as world's largest emitter of carbon dioxide in 2006, and in 2011 China became the world's biggest energy consumer. Consequently, China's energy consumption increased from 1.180 million tons of oil equivalent (MTOE) in 2000 to 3.100 MTOE in 2015. Although the Chinese government lowered the expected annual growth of domestic energy consumption in the last couple of years due to less impressive economic growth numbers, China's energy demand remains high. In fact, in 2015, China accounted for more than **20% of the global energy consumption**. To feed the high-energy demand, China's energy consumption structure has always relied heavily on the consumption of primary energy sources such as coal. Compared to renewables, coal is much cheaper to generate energy. In addition, China has the third largest coal reserves, after the US and Russia. However, China is on its way to become the biggest consumer of renewable energy. In November 2016, China's National Energy Administration (NEA) released its 13th Five Year Plan regarding the energy sector developments. This plan includes the goal to **reduce China's dependence on coal** and to **increase the share of non-fossil based energy** to at least 15% of the overall energy consumption by 2020. In fact, China already leads the world in terms of total production capacity of renewable energy. Due to the Chinese government's efforts to diversify the means of energy supply, the country has witnessed a significant increase in renewable energy capacity in recent years.

China's renewable energy capacities that continued to grow in 2016:

- Wind power capacity increased to 150 GW, an increase of 13% in comparison to 2015.
- Solar power production capacity increased to 77 gigawatts (GW) in 2016.
- Total production capacity of all national hydropower installations combined accounted for more than 300 GW.

Most renewable energy still unattainable for consumers

Despite 2016 being another year of growth in the renewable energy industry, China is struggling with supplying renewable energy to its consumers. A large amount of the energy generated in renewable-rich areas cannot be transmitted and stored in an efficient way to reach consumers in areas with low renewable sources. This results in **energy waste**.

Energy transmission leads to close-down of new wind turbines

According to NEA's 2016 statistics, China's northern, northwestern and northeastern regions witnessed wind power waste up to respectively 43%, 38% and 30% of the total generated wind power. The total waste of hydropower is equal to the amount of power that could supply Germany and the United Kingdom combined for one entire year. Renewable energy waste in China is such a problem to the extent that the Chinese government decided to shut down the construction of new wind turbines in the northern parts of China. Furthermore, the development of small- and medium-scale

hydropower plants in southwestern provinces such as Sichuan and Yunnan are also restricted.

One of the major causes is that the current way of energy transmission is not efficient enough. **There is no unified national power grid in China**, the country's power grid system is rather fragmented into multiple regional power grid clusters. There is a lack of connectivity between the different regional grid clusters. The two state grid companies, the State Grid Corporation of China (SGCC) and China Southern Power Grid Company (CSG) control respectively 80% and 20% of the energy transmission sector. Even within a regional grid cluster, there is insufficient connectivity between the renewables and the grid. China's largest renewable energy source are hydropower installations. Around 80% of the hydropower comes from southwestern parts of China, where several of the upper streams of Asia's major rivers are located. However, the energy demand in these hydropower-rich areas is often lower than the supply, while the energy demand in the coastal areas is much higher than the supply. The same occurs in areas with high-deployment of solar and wind power. Large amounts of renewable energy can be produced, however, **transmitting this energy to the highly-populated coastal areas is still difficult.**



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To increase efficient transmission, Chinese state owned grid companies have built High Voltage Direct Current (HVDC) transmission lines. With this system, renewable energy can be transmitted from one area to another in a rapid pace. Mr. Xue, former Union Director of State Grid Anhui Electric Power Company (part of SGCC), mentions that the construction of more HVDC transmission lines play an essential role in connecting the renewable energy sources in the inner regions with the existing regional grid clusters in the coastal areas. Until 2016, China counted almost twenty HVDC projects in operation or under construction. The most recent development involves the start of the construction of a HVDC line in January 2016, which would have a total length of more than 3.300 kilometers, running from Zhundong in Xinjiang region to Huainan in Anhui province.

“China’s HVDC’s transmission network is unique in the world because of its size and capacity.”



If the HVDC lines can transmit renewable energy this easy, shouldn't this solve the problem of renewable energy waste? Unfortunately, the situation is a little more complex. Mr. Kees-Jan van Oeveren, Director and Country Manager Singapore at DNV GL, explains that proven technology is available to transmit large amounts of renewable energy over long distances such as 1000 to 2000 km. China's HVDC's transmission network is unique in the world because of its size and capacity. However, the **system has limitations**, and the HVDC lines are currently not solving China's geographical mismatch between renewable sources and load centers. Currently, the highest curtailed provinces in the Northeast and Northwest are not all connected to the load centers in the East yet, and the long distance transmission HVDC highways are predominately committed to transmit thermal and hydro power to load centers.

Besides the system limitation to evacuate renewable energy, Mr. Van Oeveren mentions another important factor that contributes to waste of renewable energy: **overcapacity**. Between 2000 and 2010, China's annual electricity demand growth showed double digits. After 2012, the demand for electricity slowed down due to changes in the economy, reaching levels of ~1% in 2015 and ~5% in 2016. In contrast, generation capacity expansion continued to increase with a relatively stable

rate of 10% annually. Furthermore, Mr. Van Oeveren mentions that coal fired power stations with obligations for providing district heating and heat to industries complicate the intake of renewable energy even further. Inflexibility in changing the ratio between heat and electricity output forces the power system to take in the electricity which subsequently limits the intake of renewable energy, and contributes to curtailment of renewables.



Energy storage: Hydrogen as a solution?

Apart from improving the energy transmission situation, energy storage methods can also play a prominent role in solving the issue of energy waste from renewables. The development of China's energy storage industry started relatively late, but it has taken large steps forward in recent years. At the end of 2016, there were more than 110 energy storage projects in operation in China.

Electricity produced from renewable energy sources can be used efficiently if stored when the demand is low and discharged when demand is high. Mr. Gijs Kreeft, PhD researcher on Power-to-Gas (P2G) energy storage at the University of Groningen, explains that when energy surplus that is generated from renewables is converted into hydrogen using electrolysis, the hydrogen can be stored and used for multiple purposes. This is called Hydrogen Energy Storage (HES). Another application of hydrogen in the P2G system chain is methanation. Converted hydrogen is then combined with carbon dioxide and converted into synthetic natural gas, which can directly be added into the existing gas grid network. French based McPhy is specialized in hydrogen solutions for energy storage. After showing their solution to a Chinese delegation from Hebei province during a visit to Europe, a joint project in China was set up. Mr. Pascal Mauberger, CEO of McPhy, explains that their technology will be used on a new windfarm project in China. Mr. Mauberger sees big potential for hydrogen technology in China. **"Using hydrogen technology together with wind and solar energy eliminates pollution in the whole production chain."**

The new windfarm, including McPhy technology, is now being built in Hebei province and it is likely that the project size will increase next year. Mr. Mauberger not only sees potential for hydrogen technology in solar and wind farms across China, but also for a clean public transportation system, for example hydrogen

buses. Especially the large scale of projects in China is an advantage for companies. When it comes to hydrogen bus projects in Europe, cities in France should be grouped together to ensure 1000 buses joining an experiment. With Chinese mega-cities, it is no problem to use 2000 buses just for the initial trial. New initiatives can gain from these **economies of scale** as this can reduce costs.

Battery initiatives

Apart from HES and P2G, a variety of other energy storage technologies are also expected to contribute to the renewable energy integration. For instance, mechanical, electrochemical and thermal energy storage methods, such as pumped hydro storage and lithium-ion batteries. Chairman of China Energy Storage Alliance (CNESA), Mr. Johnson Yu, predicts that in the next ten to fifteen years, there will not be one single energy storage technology that is dominant, instead **many storage technologies will co-exist**.¹ The Energy Storage White Paper 2016, published by CNESA, mentions that China's energy storage projects are largely led by battery technology companies, six out of the ten largest domestic energy storage companies in 2015 (in terms of project installation scale) are focused on battery technology.

One of China's largest energy storage projects is in Zhangbei, Hebei province, where SGCC constructed the National Wind and Solar Energy Storage and Transmission Demonstration Project. This was done in cooperation with BYD Co Ltd, a Chinese manufacturer of automobiles and rechargeable batteries. It is said to be one of the world's largest battery energy storage stations that has been in operation since 2011. A recent development is NEA's approval of the construction of another large demonstration project in Liaoning province where a massive 800 megawatt-hour vanadium flow battery is being built by Chinese battery manufacturer Rongke Power in cooperation with US-based UniEnergy Technologies. China hopes to address the issue of renewable energy waste by setting up energy storage demonstration projects. Chairman Yu of CNESA describes that China's energy storage sector is transforming from a period of demonstration to commercialization. Wider deployment and increased commercialization of energy storage can be seen in the application of distributed energy in the microgrid industry as can be seen in the figure below.

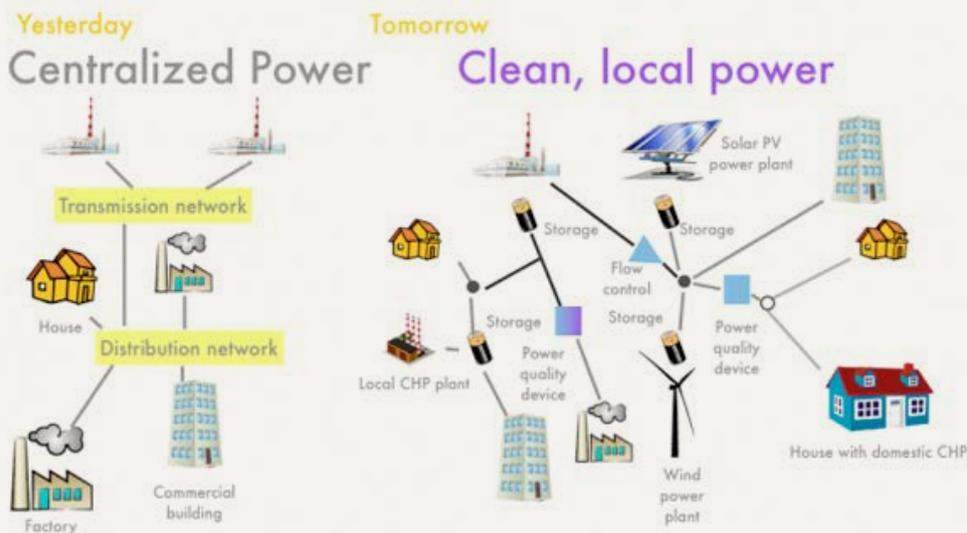


Figure 1: Transformation from one-source transmission network to a microgrid industry with energy transmitted from different resources. [source: <http://highwestenergy.com/Websites/hwenergy/images/DGEN.png>]

¹ It's Time for Storage: CNESA Chairman Johnson Yu (2017, April 10).

Retrieved from <http://en.cnesa.org/featured-stories/2017/4/6/time-for-storage-an-interview-with-cnesa-chairman-johnson-yu>

China's subsidy programs to energy storage projects are continuously vulnerable to changes, many projects receive a low-level or instable financial support. However, the Chinese government has increased focus on the application of energy storage technologies. More subsidy programs that will support energy storage projects are expected to be launched soon.

“China's economic development is closely linked to the country's energy strategy.”

Support of the Chinese government

There has been an upward trend in the installation of energy storage projects in the last few years. In fact, China's policy makers highly value the importance of developments and the applicability regarding energy storage technology. The Chinese government introduced new guidelines at a meeting of the National Energy Committee in 2016, Chinese Premier Li Keqiang indicated the need to **accelerate innovative developments in the energy storage industry** to effectively make use of the increasing renewable energy capacity. He pointed out that China's economic development is closely linked to the country's energy strategy. He also emphasized that China will continue to seek partnership with international technology companies who can contribute to China's national sustainable energy development. Mr. Mauberger believes it is important for governments to contribute to the transition to renewable energy. The technologies are available, there is a willingness from the industry. All that is needed now is the government to trigger the change by improving policies.

The ambitions of the Chinese government, combined with the advantages of the economies of scale of the Chinese market offer **tremendous opportunities** for European technology providers to create a greener China! Are you interested in providing innovative solutions that contribute to the further development of the renewable energy sector in China? Or are you facing challenges in your current cooperation?

**Please contact us through info@chinainroads.com or call +31 (0)30 7851373.
For more information see how we work [here](#) in 90 seconds.**