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CARBON EMISSION REDUCTION ESTIMATE OUTLOOK OF CHINA'S POWER INDUSTRY

ОЦЕНКА СПОСОБОВ СНИЖЕНИЯ ВЫБРОСОВ УГЛЕКИСЛОГО ГАЗА КИТАЙСКОЙ ЭНЕРГЕТИЧЕСКОЙ ПРОМЫШЛЕННОСТИ

Jiu An Liu[1,2], S. Tynovec[3]

Цзюянь Лю[1,2], С. Тыновец[3]

[1]Belarusian State University, BSU, Minsk, Republic of Belarus
[2]International Sakharov Environmental Institute of Belarusian State University, ISEI BSU, Minsk, Republic of Belarus
Liujiuan78@163.com
[3]Polessky State University, Pinsk, Republic of Belarus

[1]Белорусский государственный университет, БГУ, г. Минск, Республика Беларусь
[2]Учреждение образования «Международный государственный экологический институт имени А. Д. Сахарова» Белорусского государственного университета, МГЭИ им. А. Д. Сахарова БГУ, г. Минск, Республика Беларусь
[3]Полесский государственный университет, Пинск, Беларусь

This paper focuses on the power industry with the largest carbon emission in China. This paper discusses the effect and prospect of carbon emission reduction by developing hydropower, wind power and solar power in the electric power industry. Discuss the problems existing in the development of new energy.

Это работа сфокусирована на энергетической промышленности с самым большим уровнем выбросов углекислого газа в Китае. А также рассматривает эффективность и перспективы снижения выбросов углекислого газа путем использования гидро, ветровой и солнечной энергии в электроэнергетической промышленности. В данной работе обсуждаются существующие проблемы развития новой энергии (имеется в виду пути получения энергии иными способами).

Keywords: China, carbon reduction, wind power, solar power, grid stability.

Ключевые слова: Китай, снижение уровня углекислого газа, ветровая энергия, солнечная энергия, стабильность энергосистем.

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China is the world's largest emitter of carbon dioxide, according to BP Statistical Review of World Energy, China's emissions of 9.894 billion tons in 2020, from 2019, an increase of 88 million tons. Emissions account for about 30.7 % of the global total. Therefore, China's implementation effect of energy conservation and emission reduction has a huge impact on the world.

According to data released by the China Carbon Emission Database, of all the industries involved in fossil energy in the country, the power sector has the largest emissions, accounting for 44 percent of the total. So, the transformation of the power industry has become a top priority. Clean energy replaces fossil energy. In the electric power industry, thermal power generation accounts for the largest proportion, the installed capacity of about 54 % of the country's total. Therefore, in order to reduce the carbon emission of the power industry, on the one hand, it is necessary to improve the carbon emission of thermal power generation energy, and more importantly, it is necessary to find some clean energy to replace thermal power, so that clean energy becomes the main force of power generation.

In 2020, coal will account for less than 50 percent of China's installed power and slightly more than 60 percent of its generating capacity, while non-fossil energy will account for more than 50 percent of installed power and more than one-third

of its generating capacity. The installed power generation capacity, generation structure and generation utilization time of various energy sources in China in 2020 are shown in Table 1 [1].

Table 1 – Power structure of China in 2020

Indicators	The power of the generator installed	Total generating capacity	Annual power generation utilization time
Unit	BkW	TkW·h	h
Total	2.2	7.62	3758
Proportion of coal power generation	49	61	4216
Proportion of natural gas power generation	5	3	/
Proportion of hydroelectric power generation	15	17	3827
Proportion of nuclear power generation	2	5	7453
Proportion of wind power generation	13	6	2073
Proportion of solar power generation	12	3	1281
Others	4	5	/

At present, the main clean energy is hydropower, wind power, solar power, and hydrogen power generation, which is highly anticipated by all parties.

Problems facing the development of clean energy. In clean energy, water power generation is more mature at present. But China has 540 million kw of exploitable hydropower, of which 400 million kw is economically beneficial. As of 2020, 330 million hydropower resources have been developed, so there are not many profitable hydropower resources waiting to be developed. Therefore, it mainly considers wind energy, light energy and nuclear energy.

Wind power, photovoltaics and biomass accounted for 26 % of the total installed capacity of all types of power plants in 2020. But these three types of power plants only account for 11 percent of the total power generation, compared with about 2.4 percent. That is to say, if we need 100 MW power generation, assuming that all wind, photovoltaic and biomass power plants to supply, at least 240 MW needs to be designed, otherwise there will be a serious shortage of power.

The reason for this is that wind, photovoltaic and biomass power generation fluctuate greatly. The State Grid has calculated the number of hours of use each year for different types of power plant equipment. That's how many hours a year those generators work. The year is 365 days, and the generating equipment should operate at full capacity for 8,760 hours a year. In fact, nuclear power plants can operate for an average of 7,400 hours, coal-fired power plants for 4,200 hours, hydropower plants for 3,800 hours, wind power plants for 2,100 hours, and light power plants for the least, only 1,300 hours.

In other words, the annual utilization hours of new energy power plants are only $^1/_3$ to $^1/_2$ of those of the largest thermal power plants in China, so the total installed capacity should be 2-3 times that of the thermal power plants to complete the replacement of power supply mode. Therefore, the implementation of new energy is very difficult.

Progress and prospects of wind and solar power generation. After a long time of technology accumulation, wind power and photoelectric are gradually reaching the practical stage.

According to the Renewable Energy Market Report 2021 released by the International Energy Agency, China will account for more than 80 percent of the world's installed renewable energy capacity in 2019 and 2020. Among them, the cumulative installed capacity of photovoltaic has exceeded 25,000 megawatts, ranking first in the world for six consecutive years. Photovoltaic power generation currently accounts for 12 % of the country's total installed capacity. Eighty-five percent of the world's solar panels are made in China or by Chinese companies. The cost of photovoltaic power has been reduced to a level comparable to that of thermal power. Photovoltaic electricity prices have fallen to less than 0.4 yuan. The price of some photovoltaic power stations is reduced to 0.3 yuan/KWH, which is similar to that of thermal power.

China is focusing on offshore wind power. China has about 750 million kilowatts of exploitable wind energy offshore, nearly three times the amount on land. If this part of the resources can be fully utilized, wind power is likely to become the main force. Due to the lack of mountain barriers, offshore wind turbines can operate for more than 4,000 hours per year, which is 20 to 40 percent more efficient than onshore wind turbines.

The main problem facing wind power is still the generation of electricity, the price is too high, currently about 0.53 yuan/KWH. So, the opportunity point is how to help it improve the efficiency of power generation, reduce the cost of power generation.

However, with the continuous improvement of fan manufacturing technology, the cost is expected to be further reduced. Industry forecasts, by 2030, the world may appear in the power of 20 MW fan. The average capacity installed in Europe in 2020 was 8.2 MW, according to the European Wind Energy Association. The latest units from leading companies such as Siemens and Gamsa are around 14 MW, so there is plenty of room for growth. In terms of blade diameter, the industry predicts that by 2030, fan blade diameter can reach 275 meters [2]. The latest blades from leading companies such as Vestas are around 115 meters in diameter.

China is now a champion of renewable energy and a world leader in the field of renewable energy. The growth rate of renewable energy in China has been faster than in the rest of the world. Renewable energy accounted for 72.8 % of the country's new installed capacity, and China added 72 gigawatts of wind and 49 gigawatts of solar, three to five times as

much as the United States. The accumulative installed capacity is 934 GW, up 17.5 % year on year. In 2020, China will add 138 gigawatts of renewable energy capacity, more than the rest of the world combined.

The impact of wind power generation on the power grid. Although wind and solar energy are promising, one big problem remains. That is, these two kinds of power generation energy fluctuations are relatively large. Photovoltaic technology is the effect of the photoelectric effect on a semiconductor material, such as silicon, where light energy is converted into electricity. Well, you can generate electricity during the day, but not at night, and the electricity generated on sunny days is not the same as that generated on cloudy days. And electrical appliances need a steady source of power to work. At present, I am working in thermal power, which can balance the fluctuation of photoelectric power. But industry experts point out that China's grid currently suffers up to 15 percent of erratic generation. Any more will affect social production and people's lives.

By September 2021, photovoltaic installed machine scale is 278 million kilowatts, and according to the national plan, by 2030, wind installed capacity to reach more than 1.2 billion kilowatts. Therefore, the problem of power supply stability urgently needs to be solved. The solution is to add energy storage. It is used to store the electricity generated by photovoltaic power stations and then release it steadily.

The existing technology means, that is, electrochemical storage. It has inherent problems, such as a short storage time and a quick release of power in extreme cold. Raw material resources are limited. According to world Bank estimates in 2020, production of battery raw materials, such as lithium, will have to increase by 500 % by 2050 to meet demand. But given the world's proven reserves of recoverable lithium, that amount is simply not there.

Will be in sight in 2021. Such as electromagnetic energy storage, flywheel energy storage, compressed air energy storage, supercapacitor technology, and discussion of the hottest hydrogen storage and so on. Electromagnetic energy storage and ultracapacitors are at the very beginning of the laboratory stage; Flywheel energy storage, compressed air, and liquid flow batteries are progressing slightly faster, but only in the actual testing stage. Hydrogen storage is high on the list, but it's not at the commercial stage, somewhere between actual testing and commercialization.

From the discussion in 2021, the most likely to become the main energy storage is pumped storage. Pumped storage energy is a high conversion rate, with 1 degree of electricity pumped up the water, can release about 0.8 degrees of electricity; Second, if large-scale application, the construction cost can be diluted and eventually allocated to the energy storage cost per KWH, about only a little over 20 cents, which is $^1/_3$ or even $^1/_4$ of the cost of energy storage with lithium batteries.

According to the 2030 Carbon Peak Action Plan released by The State Council of China, the country aims to more than triple the installed capacity of pumped storage power stations to about 120 million kilowatts by 2030.

Summary. China is under a lot of pressure to cut carbon emissions. At the same time, through technological and industrial accumulation, China has a certain strength in hydropower, wind power and solar power generation. In the future, it will focus on wind power and solar power generation. But the construction of wind and solar power still faces big technical problems that need to be solved quickly.

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НАНОЧАСТИЦЫ С БОЛЬШИМ БУДУЩИМ
NANOPARTICLES WITH A GREAT FUTURE

С. И. Пекарская[1,2], Е. Е. Тарасова[1,2]

S. I. Pekarskaya[1,2], E. E. Tarasova[1,2]

[1]Белорусский государственный университет, БГУ
[2]Учреждение образования «Международный государственный экологический институт имени А. Д. Сахарова» Белорусского государственного университета, МГЭИ им. А. Д. Сахарова БГУ, г. Минск, Республика Беларусь
kbb@iseu.by

[1]Belarusian State University, BSU
[2]International Sakharov Environmental Institute of Belarusian State University, ISEI BSU, Minsk, Republic of Belarus

Представлены основные понятия и термины довольно актуальной на сегодняшний день сферы – нанотехнологии. Во всем мире нанотехнологии являются одной из основных тем для изучения и развития науки XXI века.