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Preliminary Discussion about CCUS in China's Oil and Petrochemical Enterprises under the Goal of Carbon Neutralization

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Abstract: Achieving the goal of carbon neutrality in 2060,which points out the direction for the sustainable development of China's energy enterprises.CCUS can give consideration to increasing production and environmental protection, which is the key factor to achieve the goal of carbon neutralization.At the same time, it will help China establish a new green energy system.This paper discusses the new situation and needs faced by CCUS in order to achieve the goal mentioned above.It discusses the the possibility of petrochemical industry into green and low-carbon energy mode.This paper investigates the key points of China's CO_2-EOR technology and predict the challenges we may face when implementing the new green model in view of the previous experience.Suggestions and prospects for the future development of China's Oil and Petrochemical Enterprises in CCUS technology are put forward from the technical level, economic level and enterprise level.

Keywords: CCUS; China's Oil and Petrochemical Enterprises; Carbon Neutralization; CO_2-EOR

1. Introduction

Global climate change has become one of the main factors threatening human survival and sustainable development.Therefore, reducing greenhouse gas emissions to mitigate climate change has become the focus of global attention.[1]The 2015 Paris agreement set the goal of achieving net zero emissions in the second half of this century,and the goal needs to limit the increase of global average temperature to 1.5℃.Therefore, countries around the world must take effective measures to reduce the generation and emission of greenhouse gases.[2]Governments are translating this goal into national strategies and putting forward the vision of a carbon-free future.In the general debate on the 75th United Nations General Assembly held in September 2020, President Xi Jinping made clear for the first time that China will enhance its independent contribution to climate change.China will adopt more effective policies striving to peak CO_2 emissions by 2030 and achieving carbon neutrality by 2060.Although improving energy efficiency and promoting renewable energy play a vital role in reducing carbon emissions, most countries will still use fossil fuels as the main energy in 50 years,especially for China.[3]In 2020, China's coal consumption accounted for 57.5%, oil for 18.9%, natural gas for 8.1%, and the total consumption of fossil energy up to 84.5%. The energy system needs to improve utilization efficiency and reform high carbon emission projects.

A new technology called CCUS(Carbon Capture ,Utilization and Storage) is expected to achieve a considerable degree of low-carbon utilization of fossil energy.It can achieve the following three points: realizing CO_2 emission reduction, ensuring clean energy utilization and ensuring energy security.

2. Importance of "carbon neutralization"

The global low-carbon economy is booming, and green economy is the top priority of China's current economic policy.On March 11, 2020, the outline of China's 14th five-year-plan was officially released, which clearly requires accelerating the establishment of China's carbon emission trading market (hereinafter referred to as "carbon market").On March 5, 2021, Premier Li Keqiang elaborated the overall economic and social requirements for 2021 in his government

work report, with special emphasis on "developing a green and low-carbon economy and accelerating the construction of a national carbon trading market".Yi Gang,the governor of the People's Bank of China, said at the China Development Forum that China's total investment in carbon neutrality will exceed 100 trillion yuan in the future.[4]It can be said that 2021 is the first year of global green economy competition.

For 800,000 years before the Industrial Revolution, the level of CO_2 in the earth's atmosphere fluctuated around the 240ppm;after the Industrial Revolution, CO_2 concentration increased sharply from 240ppm to 417ppm ,and have never fallen back.

The climate issue has become a serious problem that major global economies must face and consider.Firstly,China's green transition economic policy is based on the responsibility of big countries. Moreover, carbon neutrality is not only an environmental issue, but also a trade issue.[5]Due to the first mover advantage, the US and EU have reached the carbon peak in 2010 .However, as a developing country, China has not yet reached the peak.

Under the wave of green revolution, developed countries will start to increase carbon tariffs, which means the products with high carbon emissions from developing countries less and less competitive.If China does not make preparations as soon as possible, it will be passive.Further, new forms such as carbon tax and carbon trading are still forming a new carbon financial market. In the long run, the new energy will even reconstruct the global monetary system.Therefore, carbon neutralization is of far-reaching significance to China's strategic position.It can also be seen from Figure 2 that China will experience a rapid decline in the slope of the curve after 2030, which is much larger than other countries during the same period.This means that if we do not make sufficient preparations from now on, China's path of carbon neutrality will be more difficult after 2030.So we have to invest more to catch up. This is why carbon neutrality will surely become the longest, most certain and largest industrial track in China in the future.

It can be predicted that the "dual carbon" goal will reshape the life of every ordinary person through basic necessities.Moreover, the huge carbon financial market formed by the central government will affect the operation of each energy enterprise.Two related key words are carbon trading and carbon tax.[6]Carbon trading is a scheme in which companies receive credits for reducing their carbon emissions, which can be bought and sold to other companies.The EU set up the carbon market back in 2005.[7] At present, the market is very active,and the price of the EU and US is 100 yuan/ton.China has also started trading pilot since 2013. At present, China's carbon trading price is 15-40 yuan/ton, and the trading is not as active as the EU and US markets.This means that China's carbon trading market has huge room for expanding.Carbon tax refers to the tax levied on CO_2 emissions, which is levied according to the proportion of its carbon content to reduce fossil fuel consumption and CO_2 emissions.In the future, driven by carbon trading and carbon tax, the petrochemical industry will usher in new changes, and the demand for green transformation is imminent.

The proposal of 2060 carbon neutrality target will lead China into the era of climate economy.It not only means that China will achieve zero CO_2 emission in 40 years,but also means that China needs to make comprehensive reforms and adjustments in the fields of economy, industry, energy consumption and infrastructure.Only in this way can we build a clean, green,high-quality development economy.

3. Domestic status quo of CCUS in Petroleum and Gas industry

In the past 5 years, China has built and operated 21 related projects, with an annual sealed stock of about 1.7 million tons.[8]The designed capture scale of all projects is less than 400000 tons/year, and most of them are less than 100000 tons/year.All projects are in the pilot stage and not commercialized.

Under the scenario of deep emission reduction, China needs to capture 27 billion tons of CO_2 in 2050.At present, the total annual catch of CCUS in China is about 1.7 million tons.[9] It is urgent to expand the deployment in the future.

4. Economic Research of CCUS

The large-scale deployment and application of CCUS has great challenges for the following reasons.This technology is

not only complex(multi-category, multi-classification,cross-industry,etc.), but also dynamic during the planning and development.Moreover, the economy of CCUS is significantly affected by international and domestic climate policies,international energy prices and other factors.Summarizing the global CCUS project, it is found that improving oil and gas recovery has played an important role in the financial balance of the technology.In terms of the cost of CCUS, the natural gas treatment process is the lowest, which is $20-27/ton; and the cement industry has the highest cost, which is $104-194/ton.[10]The application of CCUS can directly reduce greenhouse gas emissions in the oil industry and respond to the national requirements for climate change and carbon reduction.The greenhouse gas emissions of the petroleum and gas industry account for a large proportion of the total emissions of the country, so it is under great pressure to reduce emissions.With the establishment and operation of the national carbon market, petrochemical enterprises will be included in the national carbon trading market. Carbon emission quotas are allocated once a year, and the excess emissions must be purchased in the market.As a good means of emission reduction, CCUS can directly reduce the carbon emissions of the oil and gas industry. At the same time, the surplus of carbon trading can be sold in the market to obtain corresponding income.Existing CO_2-EOR projects in China have improved recovery by an average of 10%-20%.In addition,China has great potential for CO_2 sequestration.Large-scale development of CO_2-EOR technology in the future can realize permanent CO_2 sequestration while giving consideration to greater benefits.

5. New exploration of low carbon in Petroleum Enterprises

Oilfield companies such as Daqing, Changqing and Xinjiang are all carrying out CO_2 flooding and burial technology research and pilot test.If the annual oil scale is about 500,000 tons, the corresponding annual CO_2 injection is about 1 million tons.In 2013, China Petroleum and Chemical Industry Federation,CNPC and Shenhua Group cooperated to implement a pilot project of 100,000 tons/year and a large-scale demonstration project of 1 million tons/year.[11]In 2018, more than 120,000 tons of liquid CO_2 was injected and sequestration in CO_2 flooding yellow 3 pilot test area of ultra-low permeability reservoir of Changqing Oilfield, and oil production was increased by 13,000 tons. Compared with water flooding, the recovery factor is expected to be improved by 15.1%.

The green and low-carbon strategic of CNPC initiatives actively implement the Declaration on carbon peaking and carbon neutralization in China's petroleum and chemical industry,and aim to build a "clean, low-carbon, safe and efficient" modern energy system by developing low-carbon emission reduction businesses,contributing to low-carbon goals, and developing appropriate renewable energy projects.[12]

Under the "dual carbon" target, China's Oil and Petrochemical Enterprises shoulder the social responsibility of ensuring the national oil and gas supply. While implementing the process of"increase storage and production", they need to make contributions to the national carbon reduction target and find new focal points to maintain continuous market competitiveness.In the era of carbon neutrality, responsible international energy companies cannot stay out of the way. They should actively demonstrate the possibility of developing renewable energy projects and maintain a good corporate image of being responsible for future generations and the environment.

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