

Low Carbon-Development Strategy for the Oil and Gas Industry

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ABSTRACT

As an important source of carbon emissions in China, promoting the low-carbon development of the oil and gas industry is the only way to achieve the "dual-carbon" goal, and is also an important goal in the implementation of the "four revolutions and one co-operation" energy strategy. Therefore, this paper will explore the optimal path for low-carbon development of the oil and gas industry from the perspective of the four revolutions, one cooperation and ethical environment, with a view to accelerating the transformation and upgrading of the oil and gas industry and achieving high-quality development.

KEYWORDS

Oil and gas industry; low carbon development; "four revolutions, one co-operation"; development strategy.

1. INTRODUCTION

With the deepening of international action to address climate change, the transition to a low-carbon economy has become a major trend in world economic development. Both developed and developing countries, without exception, have attached great importance to the development of their low-carbon economies, and have tried to reduce the consumption of high-carbon energy sources, such as coal and oil, by means of technological innovation, institutional innovation, industrial transformation and the development of new energy sources, in order to reduce greenhouse gas emissions as much as possible.

Under the "dual-carbon" goal, the use of oil in the downstream of the industry chain will be significantly weakened in the future, while natural gas will play an active role as a "bridge" in the transition from fossil energy to non-fossil energy. Therefore, as Dong Xiucheng, executive director of the China International Institute of Low Carbon Economy, said: low-carbon transition will be both a challenge and an opportunity for the entire oil and gas industry. Since the 18th Party Congress, the Party Central Committee has clearly put forward the need to promote the energy revolution in depth, and creatively put forward the new energy security strategy of "four revolutions and one co-operation" and the new goal of "strong energy country". So, this paper will provide a low-carbon development strategy for the oil and gas industry in China from the above five aspects and ethical environment.

2. LOW CARBON DEVELOPMENT PATH FOR THE OIL AND GAS INDUSTRY

2.1. Establishment of diversified supply, increase storage and production capacity

Since the 18th National Congress of the Communist Party of China (CPC), China has clearly put forward the energy development strategy of "establishing a diversified supply system based on the domestic market, restoring the attributes of energy commodities, strengthening international co-

operation on all fronts, and realising energy security under the conditions of opening up and grasping the right of initiative". In order to establish a diversified supply system to ensure the security of energy supply, vigorously develop non-coal energy, and synchronise the development of energy distribution network and energy storage construction, so as to ensure the security of national oil and gas supply in the medium and long term.

2.1.1. Diversified supply system

For China, according to the forecast of primary energy consumption peaking in 2030, the peak value is about $41.9 \times 10^8 \text{t}$ of oil equivalent, and oil and natural gas consumption will peak in 2030 and 2040, respectively. In 2030, it is predicted that oil and gas will account for 18% and 12% of the total primary energy consumption, accounting for a total of 30%, and in 2060, it is predicted that oil and gas will account for 6% and 9%, accounting for a total of 15% (Figure 1). 15 per cent in 2060 (as shown in Figure 1). This shows that oil and gas will remain the mainstay of China's primary energy consumption in the long term.

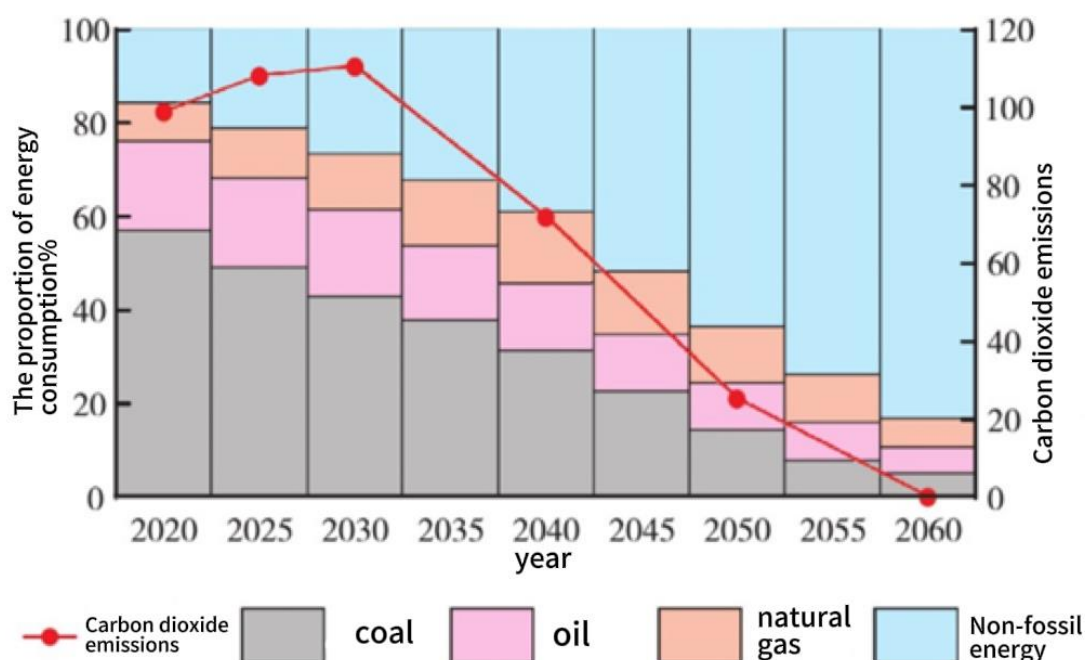


Figure 1 Projected changes in China's energy consumption structure and carbon emissions under a carbon-neutral target

Therefore, it is all the more important for us to establish a diversified energy supply system under the opportunity of "carbon peaking and carbon neutrality". At present, China's two deep and one non-conventional (marine and onshore deep, unconventional oil and gas) resources are abundant and the detection rate is low, the future has a greater potential to increase reserves and production, is an important support for China to achieve the goal of "stabilising oil and increasing gas". According to the data, in 2021, China's shale gas reserves will be 365.97 billion cubic metres (Figure 2), and the recoverable shale gas resources in China will be about 22 trillion cubic metres at a depth of 4,500 metres, which is one of the main areas of the world for the development of shale gas on a large scale and is on a par with conventional natural gas resources. Among them, Sichuan Basin, Yudong and Exi regions, Qianxiang region, Ordos Basin and Tarim Basin will be the key areas for future exploration and development and production growth. In addition, we will actively research and explore new technologies for the development of unconventional tight gas, shale gas, deep coalbed methane, and the development of shale oil on a large scale.

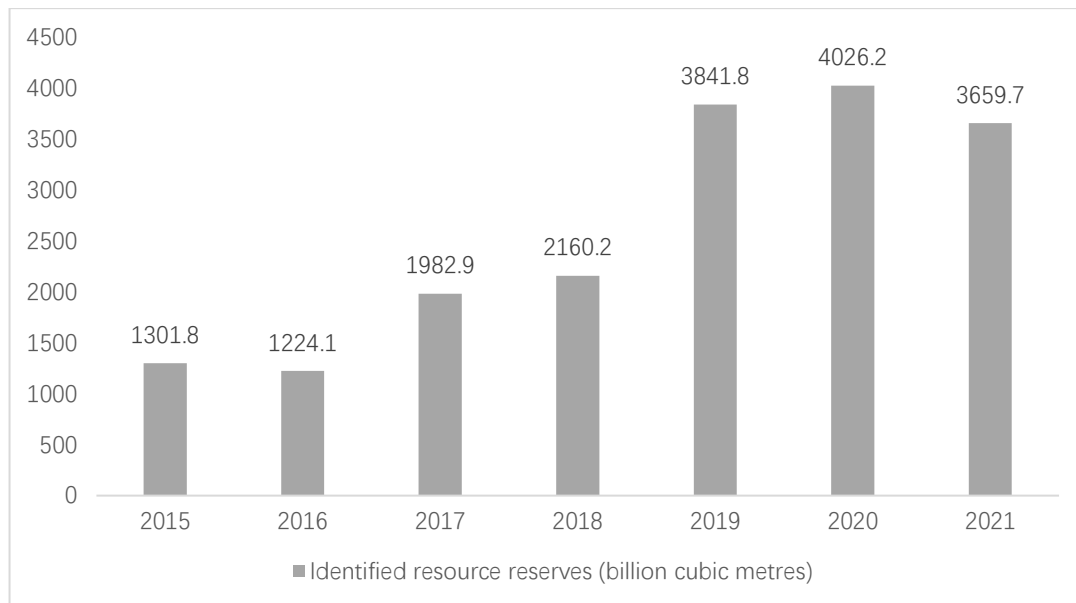


Figure 2 China's identified resource reserves of shale gas, 2015-2021

Oil and gas as the key to ensure China's energy security, should increase exploration and development efforts, adhere to the "regular and non-conventional, land and sea, deep and shallow", to achieve the orderly succession of resources from conventional oil and gas to unconventional oil and gas, from land to sea, in the shallow layer to the deep, and to promote increased reserves and stable oil and gas supply in the country, and reduce foreign dependence. Promote the increase of reserves, stable oil and gas, improve the domestic oil and gas supply, reduce the degree of foreign dependence, and strive to achieve an annual oil production of 2×10^8 t and natural gas production of $3,000 \times 10^8$ m³, and long-term stable production[1].

2.1.2. Increase storage and production capacity

According to the 2023 National Energy Work Conference: in 2022, China made every effort to promote oil and gas storage and production, crude oil production returned to 200 million tonnes, and natural gas production exceeded 217 billion cubic metres. Among them, Daqing Oilfield has achieved a steady production of 30 million tonnes for eight consecutive years, and Shengli Oilfield has achieved a steady production of more than 23.4 million tonnes for six consecutive years, playing the role of "ballast" for China's steady crude oil production. New breakthroughs have been achieved in new basins, with the Bayan Oilfield in the Hetao Basin being rapidly discovered and rapidly built up to a production rate of 260 million tonnes of proven geological reserves in three years, and a million-tonne-a-year oilfield has been built with high efficiency. Sulig gas field highlights technological innovation, strengthens the benefits of building production, promotes high-quality secondary accelerated development, production exceeded 30 billion cubic metres; Anyue gas field continues to promote rolling exploration and development, large carbonate gas field continues to maintain a stable production of 15 billion cubic metres; Puguang and Yuanba gas fields continue to strengthen the remaining gas fine description, fine tapping, encrypted adjustments and rolling construction of production, and increase the gas wells to control and treat water, classification and optimization of treatment. Therefore, we need to take advantage of the momentum and make every effort to promote China's oil and gas reserves and production.

First of all, need for China's oil and gas resource endowment characteristics and the development stage, increase scientific and technological research efforts, fully support the increase in reserves and production, to ensure long-term stability in crude oil production at the level of 200 million tonnes of natural gas production continues to grow steadily. Secondly, we should actively research and apply the technology of improving recovery rate, and continue to research and study the old oilfield three

times oil recovery technology, water drive fine development technology, thick oil and ultra-thick oil development technology. Finally, accelerate the research and development of deep and deep water oil and gas exploration and development technology, focusing on deep and ultra-deep on land, deep and ultra-deep water at sea and high temperature and high pressure, complex structures, complex reservoirs, oil and gas field exploration and development technology and key supporting engineering equipment[2].

2.2. Optimize the consumption structure and vigorously develop the natural gas industry

At present, China's energy production and consumption are ranked first in the world, is the world's largest oil importer and natural gas importer, the degree of external dependence reached 72%, 42%, respectively, to promote the low-carbon development of oil and natural gas is imminent. Therefore, China must start from the actual situation, do a good job in a steady and orderly manner to control the total amount of fossil energy consumption and reduce the amount of substitution, promote the transition from the black energy revolution to the green energy revolution, the formation of energy-saving society; accelerate the adjustment of the energy consumption structure, and increase the proportion of clean energy consumption. At the same time, government departments to introduce relevant energy saving and emission reduction policies, increase the control of oil consumption, reduce its share in total energy consumption. In addition, it is necessary to vigorously develop the natural gas industry, use natural gas as a bridge to achieve green transformation, promote the large-scale substitution of natural gas for highly polluting fuels, and synergise the development of renewable energy to orderly promote carbon reduction and emission reduction.

As the mainstay of the natural gas industry chain, natural gas power generation has become an important foundation for the efficient and stable operation of the new power system in the context of "dual carbon" due to its flexible start-up and shutdown advantages. As of the first half of 2022, Huaneng International maintained the leading position in terms of installed capacity of natural gas, reaching 12,243 kW, followed by Huadian International, with an installed capacity of 8,589.05 kW. Meanwhile, the "Medium and Long-term Plan for the Development of China's Hydrogen Energy Industry (2021-2035)" proposes that "hydrogen energy is an important carrier for the green and low-carbon transformation of energy-using end-uses", so it is inevitable to integrate hydrogen energy with natural gas to achieve low-carbon development. Hydrogen doping of natural gas for power generation, i.e., adding hydrogen fuel to natural gas generator sets for terminal applications, can save natural gas consumption while reducing carbon emissions, and is of positive significance to the construction of a large energy market with efficient circulation of various resource elements.

Hydrogen-doped power generation has initially entered the stage of large-scale application in foreign countries, in which the United States, Europe and Japan are relatively leading. The United States in 2005 launched the "Advanced Hydrogen Combustion Turbine Development" project, in March 2022 General Electric Company and the Long Range Energy Terminal Company has achieved the Ohio Hannibal 485 MW combined-cycle power plant hydrogen-doped combustion transformation project has been completed hydrogen-doped test; Europe is actively committed to 2030 to provide a gas turbine that can handle 100% hydrogen fuel. 100% hydrogen-fuelled gas turbines by 2030; Japan's Kawasaki Heavy Industries and Japanese utility companies are also developing hydrogen-fuelled gas turbine technology [3]. Although there is still a gap between China and the world's advanced level in natural gas hydrogen doped power generation technology, China has accelerated the scientific research and application of related technologies in the past two years. For example, in September 2022, the transport combustion engine of Jingmen Green Power Plant of State Power Investment Group Limited achieved 30% hydrogen-doped combustion transformation and operation, and reached the international leading level in terms of precise control of hydrogen doping and NO_x emission control.

2.3. Green technology innovation and synergistic development with new energy sources

Since Rachel Carson's publication of *Silent Spring* in the 1960s, mankind has been reflecting on what it has done to nature, and this has led to the study of green technology innovation and sustainable development. Governments around the world have also provided incentives and effective co-operation for green technology innovation, leading to the rise of this green wave and a good start for the sustainable development of low carbon technologies. Therefore, the green treatment and utilisation of traditional fossil energy sources, and the promotion of technological innovation, commercial innovation and industrial innovation in the traditional energy industry with the development of green and low-carbon technologies as the core, have become the primary tasks of low-carbon energy development in the world today.

Firstly, based on the goal of "double carbon", China's future demand for refined oil products will drop sharply, and it is the development trend to promote the transformation of refining enterprises from "fuel-based" to "chemical-based". The petroleum industry mostly adopts the technology of catalytic cracking of petroleum to produce olefins, the technology of direct catalytic cracking of crude oil to produce more chemicals and other technologies for the direct preparation of chemicals from petroleum, as well as the technology of methanol-catalytic cracking of crude oil to produce olefins and other technologies of olefin-aromatics production from coupled petroleum-based and coal-based feedstocks, to build a new technology system for the production of olefins/aromatics and other chemicals from petroleum and to realise the use of such technologies in a low-carbon, clean and high-value manner, so as to increase the self-sufficiency rate of China's basic chemical raw materials and effectively promote the implementation of the "dual-carbon" strategy. As for natural gas, we should give full play to the clean and low-carbon advantages of natural gas's energy attributes and the raw material characteristics of its material attributes. On the one hand, we should accelerate the research and development and demonstration application of technologies such as high-efficiency and low-emission combustion of natural gas and gas turbine combined-cycle power generation, so as to give full play to the advantages of natural gas in terms of flexible regulation and rapid response, and to synergise the development of natural gas with renewable energy resources to form a benign complementarity. On the other hand, we will carry out technologies for the preparation of chemicals from natural gas, such as the anaerobic conversion of methane from a single active centre to olefins, aromatics, and the reforming of methane/carbon dioxide dry gas to syngas, so as to achieve the high-efficiency, clean, and high-value use of natural gas, and to effectively support the construction of a modern energy system that is clean, low-carbon, safe, and efficient.

Secondly, increase R&D investment in high-efficiency energy technologies. Government departments should introduce relevant policies to encourage the government and private research institutions and Europe, America, Japan and other developed countries in the use of energy technology to actively carry out exchanges and cooperation, the introduction and absorption of international advanced energy technology, to promote the domestic research and development and promotion of high-efficiency energy technology[4]. At the same time to strengthen the research and development of CO₂ capture, storage and utilisation (i.e. CCUS) technology, targeted development of low-carbon energy technologies, and increase the subsidies for the research and development of high-efficiency energy technologies. According to some experts, CCUS is a guaranteed bottom-up technology for fossil energy to achieve carbon peak and carbon neutrality, and it has the potential to achieve a cumulative emission reduction effect of hundreds of billions of tonnes. Based on different scenario analyses, CCUS technologies are expected to reduce emissions globally by 490 million tonnes of CO₂/year on average by 2030. By 2050, CCUS technologies are projected to reduce emissions by between 2.79 and 7.6 billion tonnes of CO₂/year, with an average of 4.66 billion tonnes of CO₂/year. The IEA Sustainability Scenario, which aims for net-zero emissions globally by 2070, has CCUS as the fourth most important technology, accounting for 15 per cent of cumulative emissions reductions. 15%, and it is predicted that CCUS will contribute about 6 billion tonnes/year

of emission reductions in 2050 under the sustainability scenario. Taking oil companies as an example, in the field of oilfield extraction, CO₂ enhanced oil recovery (EOR) technology can be used to effectively squeeze out the underground oil and natural gas, thus increasing oil production and improving the recovery rate; advanced equipment can be developed and utilised to establish a technological sequence conducive to improving energy efficiency and lowering emissions, and through the reuse of resources, the consumption of traditional energy can be lowered; and the full use of existing geotechnology can be made in the oil and gas field areas with depleted resources, searching for favourable geological formations to permanently sequester CO₂, significantly reducing carbon emissions from the source[5].

At the same time, the development and progress of technology can provide constant power for the development of enterprises, oil and gas enterprises for the mastery and use of low-carbon technology degree, determines the enterprise in the future development of the road can develop the distance. From the current point of view, China's oil and gas enterprises R & D and promotion of low-carbon technology is relatively weak, the need to actively learn from domestic and foreign experience, and combined with their own actual low-carbon technology to further research and development to be able to grasp the initiative of low-carbon development and the right to speak. For oil and gas enterprises, they can strengthen their technological development and exploration through linkage and cooperation with research institutes and universities, develop new fuel development technologies, strengthen the efficiency of carbon dioxide utilisation, and enhance research on the conversion of value-added products. In addition, with the current emphasis on low-carbon development in countries around the world, more and more countries are putting forward higher requirements for low-carbon standards for their products. Therefore, oil and gas enterprises must take low carbon as an important part of the core competitiveness of enterprises, so that they can meet the low carbon standards of foreign countries when exporting their products; and continuously strengthen the research and development of low carbon technology and resource reserves. At present, the vast majority of oil and gas enterprises in the research and development of low-carbon technology is still in the initial stage of development, are in the same starting line, should seize this development opportunity, to obtain the first-mover advantage, accelerate the research and development of green technology, to lay the foundation of China's low-carbon development in the oil and gas industry discourse.

2.4. Building effective market systems and structures

In addition to the supply, consumption and technology levels, we need to develop strategies at the energy institutional level. For example, we need to build an effectively competitive market system and structure, and achieve market-based control of energy prices, so as to open the way for the low-carbon development of energy. Low-carbon development of the oil and gas industry can be achieved by building the following two systems:

2.4.1. Carbon emissions trading system

Nowadays, China has taken the initiative to comply with the international mainstream trend of "applying market mechanism to promote energy saving and emission reduction", actively carry out the construction of the carbon market, and continue to build the carbon emissions trading system. In August 2008, Shanghai set up the first batch of carbon emissions trading pilots in the country, and took the lead in exploring the construction of the environmental and energy trading market, which has helped China explore the establishment of a carbon trading system in line with the national conditions. The carbon trading system is in line with the national conditions. However, the main form of external carbon emissions trading in China is only CDM, and there are deficiencies in price negotiation, project auditing, etc. At the same time, there is also a lack of a unified market trading platform and a perfect trading mechanism, therefore, China still needs to further improve the carbon market and carbon pricing mechanism. From the dual dimensions of "quantity" and "price", expand the coverage and participation of the carbon emissions trading market, promote the reform of the

quota allocation method (with full consideration of the characteristics of various regions and industrial policies), promote the hybrid carbon pricing mechanism with the carbon market as the main body and carbon tax as the supplement, and gradually form a carbon pricing mechanism with the carbon market as the main body. hybrid carbon pricing mechanism, and gradually form a reasonable carbon pricing[6].

2.4.2. Green financial system

With the continuous advancement of China's industrialisation process, the use of a large amount of fossil energy has seriously exceeded the carrying capacity of China's ecological environment, and the development of green finance has become an objective requirement for the protection of the environment and the achievement of sustainable economic development. At present, China has basically formed a green financial development system including green financial regulation, green financial fund suppliers and demanders, green financial intermediaries, green financial market and intermediate service institutions and other main bodies (as shown in Figure 3), but there is still room for improvement in the aspects of regulation, fund suppliers and demanders, and market management. Therefore, we need to steadily develop carbon futures and green financial products, develop the carbon futures market in a prudent and orderly manner, and increase the innovation and supply of green financial products; improve the contact and coordination mechanism of the competent authorities in charge of the futures and spot market, trading institutions, registrars, clearing institutions and other relevant units, and promote the synergies of policies to better form the synergy between the futures and spot market. Innovative futures contract rule design in line with the spot market mechanism, taking carbon emission allowance (CEA) emission right futures in the national carbon market as an entry point, gradually expanding to other targets such as China Certified Voluntary Emission Reductions (CCER), and reasonably setting the sequence of futures contracts according to the market operation to ensure that the market maintains moderate liquidity, and further perfecting the carbon price discovery mechanism of marketisation. At the same time, introduce diversified investors such as commercial banks, investment banks, public funds, private equity funds, low-carbon funds, individual investors, etc., to cultivate more market players with risk management needs and strong risk management capabilities [6].

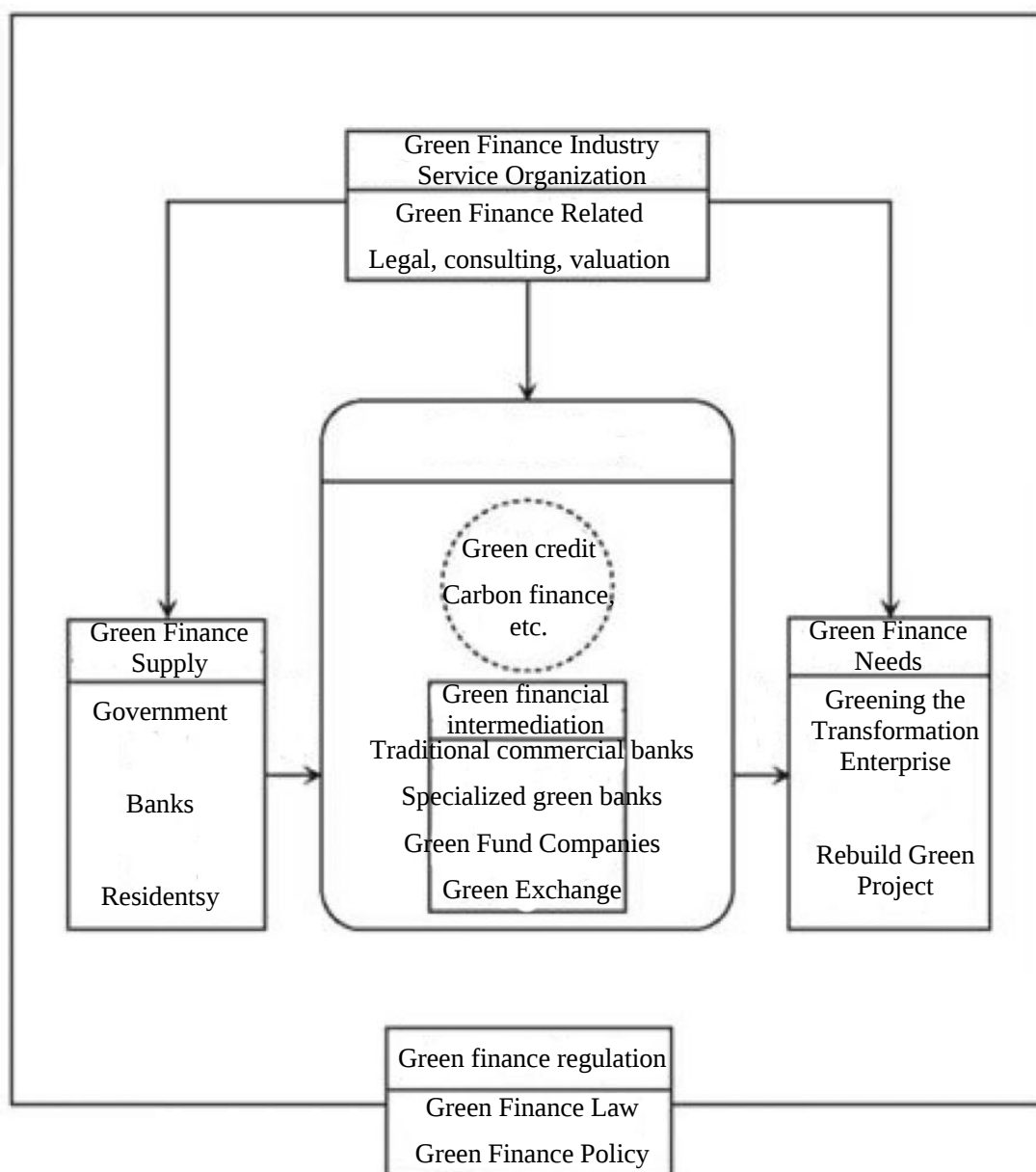


Figure 3 Green financial system

2.5. Carry out high-quality international co-operation

Relevant data show that for more than a decade, due to the continuous expansion of refining capacity and the decline in output of some onshore oilfields, crude oil processing volume pulls a substantial increase in the demand for crude oil, the scale of crude oil imports has expanded significantly, and China's oil and gas dependence on the outside world has climbed year after year. By the end of 2021, oil and natural gas external dependence climbed to 73% and 42% respectively. With short-term problems in the energy sector emerging and uncertainties accumulating, we must change the status quo of one-dimensional dependence and make clear the importance of energy cooperation; under the premise of safeguarding our own energy security, and based on current domestic conditions, we will strengthen international cooperation in all aspects of energy production and consumption to achieve the effective use of international resources. In the long run, the development of high-quality international energy cooperation is the main trend in the future. In the future, countries will pay more attention to promoting the facilitation of cross-border flows of capital, technology, production capacity, information and other factors in the energy sector, and relying on various multilateral

cooperation mechanisms and platforms, shaping a future-oriented global energy value chain, so as to promote energy development and cooperation among countries along the Belt and Road.

At present, among the regions and countries along the "Belt and Road", the Middle East and Russia are the heavyweights of the world's oil and gas market, and have complementary energy relations with China; the Asia-Pacific region has an active oil and gas trade, and has the basis and space for cooperation. We need to take "One Belt, One Road" as the focus point of oil and gas international cooperation, make every effort to carry out whole industry chain cooperation, accelerate the cooperation of oil and gas upstream projects in Russia's East Siberia and the Far East, and promote the completion of the D line of China-Central Asia natural gas pipeline as soon as possible. We will accelerate cooperation on oil and gas upstream projects in Russia's East Siberia and the Far East, promote the completion of the China-Central Asia natural gas pipeline Line D as soon as possible, and set up a mechanism for pipeline safety co-insurance with Central Asian countries within the framework of the Shanghai Cooperation Organisation. Taking "One Belt, One Road" as an innovative point for international oil and gas cooperation, we will actively explore the possibility of cooperating with Saudi Arabia in oil storage projects, and strengthen oil and gas trade with Iran and Iraq in the central and eastern regions, so as to promote cooperation in upstream oil and gas projects. Taking the "Belt and Road" as the enhancement point of oil and gas international cooperation, we will expand the cooperation with Indonesia in upstream oil and gas projects, and make full use of the technological breakthroughs in shale gas in recent years to explore the potential of cooperation in shale gas; at the same time, on the basis of the cooperation in Malaysia's natural gas pipeline project, we will actively push forward the construction of the trans-ASEAN natural gas pipeline system. In general, the "Belt and Road" along the route gathered the global energy consumption and production of big countries, although the economic development of each country is not balanced, but the energy advantage is significant, the prospect of international cooperation is very broad.

2.6. Create an effective ethical environment

If we want the oil and gas industry to realise low carbon development as soon as possible, we need to create an ethical environment conducive to low carbon development not only through the Four Revolutions and One Co-operation, but also from the perspective of the enterprise, the society and the individual, in order to accelerate the realisation of low carbon development in the oil and gas industry.

2.6.1. Enterprises need to take multiple measures

At present, China's oil and gas industry has achieved a series of effective results in low-carbon development, but the role of enterprises in low-carbon responsibility and low-carbon influence still needs to be continuously improved.

Firstly, more oil and gas companies should be encouraged to actively participate in the development of low-carbon transformation. At present, PetroChina, Sinopec and CNOOC have all formulated action paths for green and low-carbon development according to their own development strategies. For example, PetroChina has formulated the Green and Low Carbon Development Action Plan 3.0, which plans to implement three major actions such as "Green Enterprise Construction Leader Action", "Clean Energy Contributor Action", "Carbon Recycling Economy Pioneer Action" and "Energy Saving and Carbon Reduction Action". It plans to implement three major actions such as "Green Enterprise Construction Leader Action", "Clean Energy Contributor Action", "Carbon Recycling Economy Pioneer Action", and ten major projects such as energy saving and carbon reduction, and strive to become the backbone of realising China's "dual-carbon" goal and guaranteeing energy security[7]. 2021, China Oil & Gas Enterprise was established by PetroChina, Sinopec, CNOOC, and the National Pipeline Network Company, Beijing Gas, and other city gas enterprises. initiated the establishment of the China Oil and Gas Enterprises Methane Emission Control Alliance, which promises to strive to reduce the average methane emission intensity of the natural gas production

process of the member enterprises to below 0.25% by 2025, close to the world's advanced level, and endeavour to reach the world's first-class level by 2035[8]. In addition to the participation of these leading oil and gas companies, we need to unite more energy companies to join hands in low-carbon initiatives and formulate unique corporate low-carbon development strategies that take into account their own actual conditions.

Secondly, we should continue to increase investment in low-carbon and new energy projects. While using natural gas as a transitional energy source, Chinese oil and gas companies should actively expand their new energy business, i.e., while subtracting investment in traditional business, they will continue to add investment in low-carbon and new energy projects. On the one hand, Chinese oil and gas companies may vigorously lay out renewable energy businesses such as solar power, wind power, biomass and natural gas power generation. On the other hand, Chinese oil and gas companies also need to carry out more in-depth forward-looking exploration; especially in the field of low-carbon energy, natural gas can be combined with hydrogen energy development.

Lastly, the company's technology and business model innovation should be strengthened. Under the background of low-carbon transition and domestic gas market reform, M&A activities in the natural gas industry chain will become increasingly active, especially in the city gas sector. Oil and gas enterprises need to seize the opportunity to innovate enterprise business models, vigorously carry out cross-border co-operation, and explore oil and gas medium and terminal. Carry out the idea of low-carbon development into the entire product development and design work, and at the same time, create a low-emission development concept for all employees, and then according to their own development path and development plan to explore the development and use of new energy. For example, some of China's oil and gas enterprises are located in the desert and the Gobi region with good sunshine, so the resources in the region can be transformed into new resources of solar energy and wind energy. Overall, oil and gas companies must explore and build unique solutions that meet China's development requirements under the requirements of the low-carbon development concept.

2.6.2. Comprehensive implementation of source control of pollutant emissions in the oil and gas industry

At present, the international oil and gas energy industry attaches great importance to the source control of sewage and process reduction, the end of the amount of sewage and pollution load is greatly reduced, the conventional treatment process can meet the demand for pollutant control, and its overall energy consumption and carbon emissions are low. China's petroleum and petrochemical industry in the "13th Five-Year Plan" period has generally achieved the pollutant discharge standards, but the solution taken with the international industry in the sewage reuse rate, water utilisation rate, carbon emission reduction rate and other aspects of the gap still exists. Moreover, the pollution control process often results in the phenomenon of "two highs and one low" of high chemical consumption, high greenhouse gas emissions and low energy efficiency. Therefore, the comprehensive implementation of source pollution control and process management, pollution reduction and carbon reduction synergistically [8].

The oil and gas industry needs to establish the integration and development mechanism of source greening, process cleaning and waste resourcing. With the source of green control and systematic integrated management as a means, relying on green production technology, vigorously implement cleaner production, promote the "three wastes" synergistic control and disposal, waste gas and greenhouse gases synergistic control and disposal, improve the efficiency of resource recycling, so as to reduce the intensity of pollutants and carbon emissions per unit of product.

2.6.3. Establishment of Low Carbon Awareness among the Population

In addition to the enforcement of relevant policy constraints by the national government, in order to fully form the social structure of low-carbon development, it is also necessary for the active participation of the general public. First of all, make up the relevant areas of laws and regulations to

strengthen the public's legal awareness; secondly, to encourage and support the rapid development of environmental protection associations, and the people of the oil and gas low-carbon development of vivid propaganda, and then deep into the lives of the public; finally, the people's own transformation, low-carbon as their own habits. After all, environmental problems and energy shortages have begun to affect the lives of the people, then the people also need to shoulder a sense of moral responsibility from their own starting point, and constantly through the community, the news and other ways to build up a low-carbon awareness, for the low-carbon development of the oil and gas industry to establish a favourable market environment. Finally, a green shift in consumer culture is needed, and the shift in consumer culture depends to a certain extent on a shift in the ethical environment. At present, in the face of environmental threats and energy threats, most of them are still mainly environmental remediation consumption, focusing on the end of consumer goods, i.e. whether the products are environmentally friendly and energy-saving. However, production consumption is much more than living consumption, so we should shift the focus of consumption culture from the consumption terminal to the whole process of production, so as to realise the overall greening of consumption culture.

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