

# The Process of Foreign Oil Companies Developing New Energy and Its Enlightenment for China

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**Abstract:** *Due to the fundamental, complex and special nature of the petroleum and petrochemical industry, it plays an important role in the macro-evolution of global carbon peaking and carbon neutrality. Many petroleum companies around the world have been involved in the development of new energy in the energy transition to a greater or lesser extent, and their attitudes and strengths towards the development of new energy have varied at different stages. By sorting out the history of the development of new energy by famous petroleum companies, we can form a reference for the development of new energy by petroleum enterprises in China at present. By sorting out the changes of oil and petrochemical companies' planning and investment in new energy development, they are divided into three categories, one is the active and aggressive companies represented by BP and Shell, which saw the trend of new energy development earlier and actively invested in it; the second is the passive and conservative companies represented by ExxonMobil and Chevron, which chose a more conservative attitude towards new energy development by virtue of their dominant position in oil and gas resources; The third is the dual-track and prudent type of companies represented by Total and Eni, which have developed petroleum business and new energy business in a more balanced way. In recent years, domestic petroleum enterprises, represented by the three major oil companies, have gradually increased their investment in new energy, and the experience of foreign counterparts in developing new energy has become a referenced "stone" in the process of developing new energy for Chinese enterprises, which is of reference to the choice of carbon peak and carbon neutral development path for China's petroleum industry.*

**Keywords:** *petroleum companies, new energy, carbon neutrality, insights*

## 1. Introduction

Under the global trend of carbon emission reduction, low-carbon new energy and traditional petrochemical energy naturally have a substitution relationship, which leads to the conflict and of coordinated development of the two industry. This inconsistency between traditional petroleum and petrochemical and new energy business makes there are different views on the coordinated of the petroleum industry and new energy <sup>[1]</sup>. The substitution of new energy for oil began in the late 1970s oil crisis, oil companies in order to get rid of excessive dependence on petroleum products, to the future energy commanding heights, began to increase the investment in new energy development technology. In the mid-1990s, the world's development of the petroleum industry brought about by the increasing attention to the environmental problems, in the United Nations Framework for Climate Change, for the first time in the form of regulations signed the International Convention for the Limitation of Greenhouse Gas Emissions (ICLG), which was adopted by the United Nations. Under the UN climate change framework, the international community signed the Kyoto Protocol to limit greenhouse gas emissions for the first time in the form of regulations, further promoting the strategic transformation of oil companies to new energy development. Since then, major oil companies have formulated different development strategies based on their own resources and technological advantages <sup>[2]</sup>. Although the new energy represented by solar, wind and geothermal energy has made rapid development in the past 20 years, and the total installed capacity has exceeded 1Tw in 2018, and it is accelerating (Figure 1), the achievement of this development trend is not smooth sailing, and the choice of direction for the development of new energy in the performance of the oil companies is not static <sup>[3]</sup>. today's world, which is still dominated by the oil and gas industry, the large fluctuations in oil and gas prices, the drive of global climate change, and the world's progress towards the goal of global climate governance have all affected the attitude and strength of oil companies towards the development of energy sources <sup>[4]</sup>. In 2020, China has pledged to have carbon dioxide emissions peak before 2030 and achieve carbon neutrality before 2060, China's time from carbon peak to carbon neutral is more urgent.

the oil industry, the experience and lessons learned from the development of new energy by foreign companies have become the "stones" that we can touch on the road of development. By reviewing the history of the development of new energy by the world's oil companies, it is of practical significance for China's oil companies to choose the path of new energy development, and to plan the path of carbon peak and carbon neutrality in the industry.

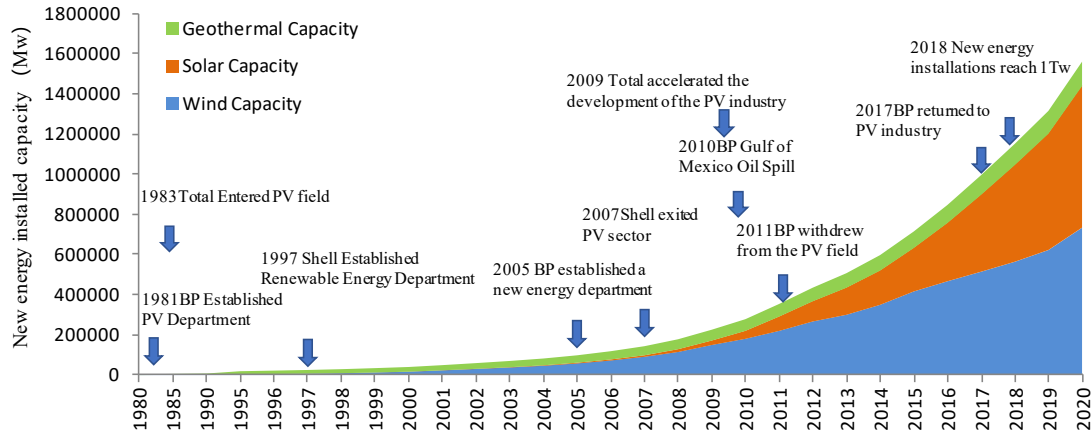


Fig.1 Global New Energy Installed Capacity Map(data from<sup>[5]</sup>)

## 2. New energy development history and current situation of foreign oil companies

### 2.1 Active Aggressive represented by bp and Shell

Bp is an international oil company that has earlier recognized the potential of solar energy and entered the field of solar photovoltaic, and in the later development of new energy has experienced a shift from solar energy to biomass-based energy. 1981, bp first set up a solar energy department, and through the acquisition of Lucas Energy Systems began to enter the research and development of photovoltaic power generation systems. In 2000, then president John Brown put forward the "Beyond Petroleum" strategic concept, redefining the meaning of bp. Bp Solar became the world's second-largest solar photovoltaic company in 2002, and jumped to the world's first place in 2005. Bp in 2005 expanded its solar energy business unit into the new energy department. And the market share of its solar business once accounted for about 10% of the global. However, as the global photovoltaic industry entered a period of rapid development, bp's profitability in the field declined rapidly, so in 2008 after the world financial crisis closed its solar plants one after another, and furthermore, due to the 2010 Gulf of Mexico offshore oil spill impact of the company's operations are facing greater financial pressures, announced the withdrawal of the long-term operation of solar energy field in 2011. 2013 further announced the Sale of part of the U.S. wind power business, during the same period of new energy development focus shifted to the field of biofuels with refining technology advantages<sup>[6]</sup>.

At the end of 2017, 6 years after withdrawing from the new energy field bp chose to return to the solar energy field, through the acquisition of a stake in Europe's largest solar energy developer Lightsource, realized the rapid expansion of the solar energy business again, with the installed capacity of the photovoltaic development project exceeding 12GW. Bp put forward the net-zero development goal in 2020, and continued to push forward to the transformation of the integrated energy company. 2021 put forward plans to develop 25GW of solar energy projects globally by 2025. Bp's basic view of the solar energy sector is that photovoltaics is an important part of the global future clean energy structure, the development of core technology fields have matured, and it is expected that the photovoltaic sector will maintain high growth rates over the next 20 years, with installed capacity accounting for about 10% of global power demand<sup>[5]</sup>.

Shell's scientists clearly proposed in 1988 that the use of fossil fuels is the main reason for the continuous increase in carbon dioxide content in the atmosphere. After analyzing the challenges and adverse effects it may bring to the entire energy industry and Shell, it further promoted Shell's transformation from fossil fuels to new energy. Shell established its Renewable Energy Division in 1997. In 2001, through a joint venture with Siemens, Shell Solar Energy Co., Ltd. became the fourth largest solar company in the world and after its first entry into the wind power sector in 1999, it ranked

fifth on the 2008 Global Wind Power Generation Enterprise Rankings<sup>[3]</sup>. At the same period, with the sharp rise in international oil prices, Shell continued to reduce investment in the field of renewable energy, sold most of the solar energy business in 2007, to 2009, has withdrawn from the renewable energy business of photovoltaic, wind power, hydroelectricity and other renewable energy. It has only focused on biofuels as its renewable energy concern and has focused on its traditional oil and gas business. In recent years, Shell has established cooperative relationships with multiple universities such as Massachusetts Institute of Technology, University of Houston, and Louisiana State University on energy transformation, striving to once again establish a dominant position in new energy technology.

The BP Mexico oil spill in 2010 hindered the return of its new energy development.. Until 2017, with the development of new energy sources around the world, Shell expanded into offshore wind power through projects in the Netherlands, the United Kingdom and the United States, and again rapidly expanded the scope of its photovoltaic business. As of 2021, Shell has 1.2GW of wind power, photovoltaic capacity and 5.6GW of capacity under construction<sup>[7]</sup>, Shell's internal goals and attitudes towards the development of new energy are not consistent, in 2021, Shell was forced by the Dutch court to increase carbon emission reduction targets, proposing that Shell should reduce carbon emissions by 45% in 2030 compared with 2019, far higher than the company's 20% reduction target. Shell CEO Van Beurden believes in 2021 that clean energy is expected to account for 50% of the company's energy mix in the next 10 years. But Shell's new energy division believes that the pace of the company's energy strategy transformation is too slow.

Although BP and Shell recognized the impact of oil and gas energy on the environment and the development trend of new energy replacing fossil energy earlier, the industry developed slowly in the early stage due to immature photovoltaic and wind power technology and high cost. The economic risks of developing the new energy industry are also greater, and different oil companies have different understandings of the process of replacing oil and gas energy with new energy, which brings great fluctuations to the company's development.

## ***2.2 Passive conservative companies represented by ExxonMobil and Chevron***

ExxonMobil and Chevron have chosen to stick to the traditional oil and gas business by advantage of their strong control over oil and gas resources, and have adopted a more conservative attitude towards the development of new energy. ExxonMobil will continue to regard the oil and gas business as its main business for a period of time in the future, and invest less in the development of new energy, with the traditional oil and gas business "decarbonization" as the main objective, focusing on the development of its own advantages of CCS (carbon capture and storage) technology, as well as the long-term development of biofuels and hydrogen and other low-carbon business, in order to cope with the challenges faced by the fossil fuel business challenges. In 2020, the company released its "Energy and Carbon Summary" report, in which it set carbon reduction targets for 2025: a 15% to 20% reduction in upstream emissions intensity, a 40% to 50% reduction in methane emissions intensity, and a 35% to 45% reduction in combustion emissions intensity; and to achieve industry-leading GHG(greenhouse gas) emissions levels by 2035<sup>[8]</sup>. In 2021, it was announced that it would achieve net-zero carbon emissions by 2050 to achieve net-zero carbon emissions, from the current emission reduction plan, it remains dominated by advantaged natural gas and CCS (Carbon Capture and Storage).<sup>[9]</sup>

Chevron has been involved in the geothermal power industry since the 1960s. In 1971, the Service Contract for the exploration and development of the Tiwi geothermal resource was executed between Chevron and the National Power Corporation of the Philippines (NPC). With geothermal power projects in the Philippines and Indonesia, Chevron has become a global technology leader in the field of geothermal power generation. In 2005, Chevron changed its slogan to "Finding and supplying new energy for the world", and in 2010, it said in its publicity program that "it is time for oil companies to support the development of new energy". In 2021, Chevron announced a package of plans to increase investment in the low-carbon energy industry. By 2028, it is expected to invest over \$10 billion to promote its low-carbon strategy, with \$2 billion to reduce carbon intensity in its existing oil and gas business and other technologies used for biofuels, hydrogen, and carbon capture. The low-carbon development goal for 2030 is to capture 25 million tons of carbon dioxide annually and produce 150000 tons of hydrogen annually<sup>[10]</sup>.

Taking resources as the foundation is the guarantee for the company's development. ExxonMobil and Chevron Corporation still adhere to the oil and gas business as the main focus by controlling oil and gas resources. Chevron has developed a world-leading geothermal power generation industry

through the development of high-temperature geothermal resources in areas around the world.

### **2.3 Dual track stable model represented by Total and Eni**

In the face of energy transformation, Total and Eni have chosen to develop their traditional oil and gas business in coordination with energy transformation, gradually increasing investment in renewable energy fields such as offshore wind power and photovoltaic while retaining their fossil energy business.

In 1983, Total started to invest in the photovoltaic business, and after more than twenty years of technological accumulation in this field, it began to accelerate the development of the photovoltaic industry in 2009, and in 2020, it further decided to enter the offshore wind power market, and in 2021, Total changed its name to TotalEnergies. At present, the total capacity of Total's renewable energy power generation has reached nearly 10GW, which is a leading position in the international oil and petroleum petrochemical companies. At present, Total's total renewable energy generation capacity has reached nearly 10GW, a leading position among international oil and petrochemical companies. It plans to increase the total renewable energy generation capacity to 35GW by 2025, 100GW by 2030, and 40% of its sales from renewable energy sources by 2050, with milestones reflecting the company's ambition to transform its energy sources and become carbon-neutral by 2050<sup>[11]</sup>.

Eni is one of the earliest European oil companies to low-carbon transition, but with bp and Shell to take a relatively radical path of transition, Eni in the combination of its traditional upstream strengths based on the choice of a "dual-track" transition, that is, not to reduce the exploration and production at the same time, and vigorously develop new energy business in order to achieve the goal of carbon neutrality by 2050<sup>[12]</sup>. Eni's renewable energy installed capacity reached 1.1GW in 2021, and it proposes to achieve renewable energy installed capacity of 4GW, 15GW and 60GW by 2024, 2030 and 2050 respectively, and Eni proposes to build a CCUS (Carbon Capture, Utilization and Storage) project with a storage capacity of 7 million tons/year by 2030, and the carbon storage capacity will reach 50 million tons/year in 2050. In 2050, the carbon storage capacity will reach 50 million tons/year. In terms of emission reduction targets, 15% reduction from 2018 levels by 2035, 55% reduction in carbon intensity from 2018 levels by 2050, and reduce GHG emissions by 80% by 2050 plan to achieve complete carbon neutrality<sup>[13]</sup>.

The dual track stable development of oil and gas energy and new energy companies has avoided major ups and downs in the development of new energy. Although the initial stage of development is slow, with the accumulation of technology, there may be significant development.

## **3. Status of low-carbon development in China's Petroleum and Petrochemical Industry**

With the rapid development of China's new energy industry, it further promotes the return of the energy properties of oil and gas resources to the properties of chemical raw materials, and also promotes the low-carbon development of China's petroleum and petrochemical industry. China's petrochemical industry has recently become more and more important in the world petrochemical industry, according to the statistics of the European Chemical Industry Council, in 2020, the global chemicals market is 3.47 trillion €, and China's chemicals market share accounts for 44.5% of the world, and Europe accounts for 18.1%. After the Russia-Ukraine conflict, Europe is facing an energy crisis, oil and gas prices have risen sharply, resulting in a significant increase in the production costs of related petrochemical products. It can be expected that the proportion of China's petrochemical products in the world will become more and more important. At the same time, China's petrochemical industry is under increasing pressure for low-carbon development as its scale expands.

### **3.1 Characteristics of Energy Consumption and Carbon Emission in Petroleum and Petrochemical Industry**

As a resource- and energy-intensive industry, oil and gas extraction accounts for 26% of carbon emissions from energy production, and the petrochemical industry is at the forefront of global industrial emissions, accounting for about 15% of industrial emissions. The oil and gas extraction process has a large footprint and has a large potential for integration with solar and wind power. Carbon dioxide emissions from the petrochemical industry come mainly from the use of fossil fuels in the life cycle of products, as well as process emissions generated during the production of these products. According to statistics, the global chemicals and petrochemicals industry accounts for 5.8% of total GHG emissions, of which 3.6% comes from energy use and 2.2% from industrial production

processes<sup>[14]</sup> (Figure 2). The low-carbon development of the petroleum and petrochemical industry has an important impact on the achievement of carbon neutrality goals.

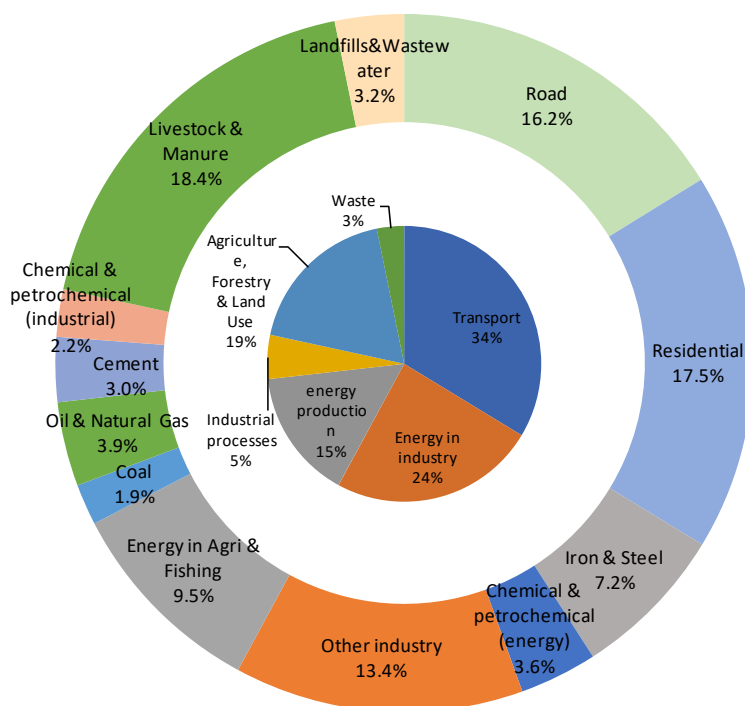


Fig. 2 Share of greenhouse gas emitting industries (%) (data from<sup>[14]</sup>)

The petrochemical industry includes oil refining and chemical industry, in recent years, on the one hand, with the popularization and use of new energy vehicles, new energy sources are increasingly replacing gasoline, on the other hand, the demand for chemical products for social development is still growing, the petrochemical industry to reduce the oil and increase the chemical development trend is becoming more and more significant. As a result, the industry generally expects the refining business to peak ahead of the chemicals business. In 2019, China's petrochemical industry consumes about 170 million tons of standard coal of energy, accounting for 4.9% of the total end-use energy consumption of society as a whole, which mainly includes coal, petroleum coke, fuel oil, natural gas, dry gas of refineries, electric power, and heat, etc. <sup>[15]</sup>. The energy consumption of the petrochemical industry can be divided into primary energy and secondary energy, where primary energy mainly includes oil, natural gas, coal, etc., which are directly consumed in the production process, and secondary energy mainly includes electricity and heat. Since China's petrochemical industry is still dominated by primary fossil energy with high carbon emissions, choosing clean and low-carbon new energy sources to replace fossil energy is an important way for the industry's low-carbon development <sup>[16-17]</sup>. With the increase of electrification in the petrochemical industry, the increased utilization of new energy sources will further promote the return of the energy properties of oil and gas resources to the properties of chemical raw materials.

### 3.2 The current situation of the development of new energy in China's petroleum and petrochemical enterprises

China's petroleum and petrochemical enterprises, represented by the three major central oil companies, have increased their investment in new energy in recent years. On the road of energy transformation, Sinopec first announced that it would take net-zero emissions as the ultimate goal, and strive to achieve carbon neutrality 10 years earlier than the national commitment, and at the same time put forward the "one base, two wings and three new" industrial pattern, vigorously develop new energy business Sinopec has formulated the core business of new energy as hydrogen energy, and adhered to the goal of new energy diversification, and strived to reach ten million tons of standard coal by 2025 by new energy supply capacity <sup>[18]</sup>. The Sinopec Xinjiang Kuche Green Hydrogen Demonstration Project is the largest green hydrogen production project currently under construction. After the project is put into operation, it can produce up to 20000 tons of green hydrogen annually. It utilizes abundant solar energy to produce hydrogen, solving the shortcomings of high volatility and poor continuity in new energy production. It provides a feasible solution for the petrochemical industry that requires high

stability in energy supply.

In recent years, PetroChina has accelerated the development of new energy industry, promoted the layout and planning of new energy business at a strategic level, accelerated the green industry layout centered on "six bases and five projects", perfected the five energy platforms of "oil, gas, heat, electricity and hydrogen", and made clear plans for the three-step goals of clean substitution, strategic succession and green transformation of new energy to traditional energy. The company has clearly planned the three-step goals of clean substitution, strategic succession and green transformation of new energy to traditional energy. By 2025, the utilization of new energy will reach 23 million tons of standard coal, accounting for about 7% of the total energy, which is the clean substitution of new energy to traditional energy; by 2035, new energy, oil and gas will each account for one-third of the total energy, basically realizing the strategic succession of heat, electricity and hydrogen to oil and gas business; by 2050, the share of heat, electricity and hydrogen will account for about 50% of the total energy, and realize the green and low-carbon transformation development.<sup>[19]</sup>

China National Offshore Oil Corporation (CNOOC), as an early international cooperation company, started to develop new energy earlier, in 2004 that is, to start the construction of new energy sector, in 2007, CNOOC built China's first offshore wind turbine in Bohai Bay, and power supply for the nearby oilfields, but due to the fact that China's new energy development is still in its infancy at the time, the cost of construction is relatively high, coupled with the strong fluctuation of wind power, does not have the conditions for sustainable development. conditions. In recent years, CNOOC has once again initiated the development of new energy and formulated a new energy development plan. This includes utilizing the advantages of marine resources to actively develop offshore wind power and natural gas hydrates, accelerating the layout of offshore wind power business, building the whole wind power industry chain, and entering the overseas market in due course. During the "14th Five-Year Plan" period, CNOOC's investment in renewable energy will reach 5%-10%, in 2025, the proportion of new energy industry revenue will reach 10%, and at least 50% of the profit will come from new energy by 2050.<sup>[20]</sup>

With the leading role of China's large petroleum and petrochemical enterprises in developing the new energy industry, the opportunity for the integration of the petroleum and petrochemical industry with new energy is becoming increasingly mature, which will further promote the low-carbon development of energy consumption in China's petrochemical industry.

#### **4. Policy recommendations for low-carbon transformation and development in the petroleum and petrochemical industry**

Since the Russia-Ukraine conflict, some countries have restricted the import of Russian fossil fuels, leading to a severe energy and raw material crisis in the global petrochemical industry, which objectively accelerated the transformation of oil to raw material properties, and also promoted the transformation of energy supply in the industry from petrochemical energy to new energy. From the tortuous process of developing new energy in global petroleum and petrochemical companies, it can be expected that the evolution of replacing fossil fuels with new energy in the industry will further accelerate.

China's petrochemical industry is in a critical period of low-carbon development, and the effectiveness of traditional energy-saving and emission reduction paths has reached its limit. New technologies and methods require huge investment in research and development and equipment transformation construction. Therefore, the experience and lessons learned by foreign oil companies in the development of new energy have important reference value for the development of China's petrochemical industry.

(1) Although replacing high emission fossil fuels with low-carbon new energy is a major trend in historical development, it can be seen from the development history of foreign oil companies that the development process of new energy is very tortuous. In order to avoid severe fluctuations in the industry and maintain a smooth transition in energy supply, within the overall framework of the current national dual carbon goals, it is recommended that based on the historical carbon emissions of the industry, the country plan the development goals of carbon peak and carbon neutrality in the petroleum and petrochemical industry, orderly promote the development of new energy in the industry, and achieve a smooth replacement of fossil fuels to new energy, to ensure national energy security while preventing rash advance and Over Conservative.

(2) The relevant government departments should provide policy support for the development and utilization of new energy for petroleum and petrochemical enterprises, encourage enterprises to accelerate the layout of new energy businesses such as photovoltaic and wind power, participate in the construction of new power systems, encourage enterprises to engage in clean energy substitution development based on their own industry energy demand, and the relevant government departments should avoid severe fluctuations that may occur during the new energy transformation process of foreign oil companies through reasonable planning.

(3) Strengthening joint research between enterprises and universities, promoting multi energy coupling in the petroleum and petrochemical production process, and researching key technologies for energy cleaning, and seizing technological advantages are important guarantees for the future integration and development of the petroleum and petrochemical industry and new energy. This not only reduces the development risks of enterprises, but also promotes the transformation of social achievements.

## 5. Conclusions

In conclusion, this article introduces the process of developing new energy in the petrochemical industry under the macro background of global carbon peak and carbon neutrality, and provides insights for the low-carbon development of China's petrochemical industry. Firstly, by sorting out the development history of famous oil companies in the field of new energy, and based on the changes in their plans and investments in new energy development, they are divided into three categories. One type is the proactive and aggressive companies represented by BP and Shell, which are the first to see the trend of new energy development and actively invest in it; Secondly, passive conservative companies represented by ExxonMobil and Chevron have chosen a more conservative attitude towards the development of new energy due to their advantageous position in controlling oil and gas resources; The third is a dual track stable company represented by Total and Eni, which has developed its oil and gas business and new energy business in a relatively balanced manner. Secondly, it introduces the new energy goals formulated by China's petroleum and petrochemical enterprises, represented by the three major central petroleum enterprises, in recent years. Finally, from the national macro level and the development of the petrochemical industry, it is proposed that the state should make overall macro planning for the low-carbon development goals of the petrochemical industry, provide policy support for the development and utilization of new energy in petroleum and petrochemical enterprises, strengthen the joint research between enterprises and universities, promote the research on key technologies of multi-energy coupling and clean energy in the petroleum and petrochemical production process, and jointly ensure the low-carbon development of the petrochemical industry.

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