Comparison of additional empowerment of carbon capture applications in petrochemical, construction, power industry

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Abstract. Carbon capture is a technology that can reduce emissions of greenhouse gases such as carbon dioxide. For carbon dioxide produced in the atmosphere or in other industries, captures and stores carbon dioxide through chemical or physical methods, or processes and utilizes the captured carbon dioxide in other ways, so as to reduce the content of carbon dioxide in the atmosphere. Utilizing the captured carbon dioxide to achieve economic benefits is an efficient and economical method for carbon capture. This article focuses on the analysis of the three fields of petrochemical, construction, and power industry. By using the captured carbon dioxide to generate specific additional energy, and then comparing the benefits of the additional energy, it can be concluded which aspects are developable. Through analysis and comparison, the limitations and prospects for development in the three fields of petrochemical industry, construction industry and power industry can be given. Especially in power industry, the use of carbon capture technology to capture carbon dioxide from exhaust gases and store it underground can reduce emissions by at least 90%. In conclusion, after comparing the three sectors of the petrochemical industry, the building industry and the power industry. It can be concluded that the objectives to be achieved by applying carbon capture technologies and utilising, the additional empowerment generated, are similar. All are aimed at reducing emissions, improving energy efficiency and achieving sustainable development.

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1. Introduction

With the growth of global population and economic development, carbon emission has become a global problem [1]. Carbon emissions refer to greenhouse gases such as carbon dioxide released due to human activities. When these gases are emitted into the atmosphere, they will cause the temperature of the earth to rise. The main sources of these gases are energy consumption, industrial manufacturing, transportation and land use change. in terms of energy consumption, both petrochemical and power industry need to use various energy sources, and for power industry, the current main power industry method in the world is traditional thermal power industry, which means that the contribution of the power industry sector to the annual CO_2 emissions is huge [2, 3]. With the increasing severity of global warming and climate change, governments and companies around the world have gradually begun to take actions to reduce carbon emissions. Among them, the most common is the improvement of energy efficiency and the development and utilization of renewable energy. Energy efficiency improvement includes measures such as building energy saving, transportation energy saving and industrial energy saving. In addition, carbon capture technology, as one of the important measures to reduce carbon dioxide emissions, has been widely researched and applied. For the petrochemical industry, it can contribute to the reduction of greenhouse gas emissions, improve resource utilization, and ultimately help reduce production costs. For the construction industry, reducing carbon emissions is one aspect. The most important thing is to achieve sustainable development. The captured carbon dioxide can be used to produce new building materials, thereby reducing costs. For the field of power industry, it can not only improve energy utilization efficiency, but also help enhance its corporate image. Carbon utilization has become a good solution before achieving the goal of carbon neutrality, and can be regarded as an effective transition method. This paper will focus on the additional empowerment generated by the application of carbon capture technology in petrochemicals, construction industry, and power industry.

2. Comparison of the three fields of petrochemical industry, construction industry and power industry

The development of carbon capture technology is gradually reflected in various industries [4]. For example, In the petrochemical field, there are the following specific scope of implementation, namely carbon capture in petroleum refining, carbon capture in natural gas processing, and carbon capture in fertilizer manufacturing. In the field of construction, there are the following specific scope of implementation, namely carbon capture in ecological buildings, carbon neutral buildings, and carbon capture of building materials. The power industry has the following specific scope of implementation, namely carbon capture in coal-fired power plants, carbon capture in natural gas power plants, carbon capture in nuclear power plants, and carbon capture in the renewable energy power industry.There are many aspects of carbon capture technology that can be implemented in these three fields. However, the energy efficiency brought about by the carbon capture technology used in different aspects is different, and the additional energy generated is also different.

2.1 Petrochemical industry

The application of carbon capture technology in the petrochemical industry focuses on oil refineries and chemical plants, and the main sources of carbon dioxide in the petrochemical field are also in these two areas. For those companies in the petrochemical field, the application of carbon capture technology can effectively help them reduce carbon dioxide emissions, and can also improve energy efficiency, helping companies create more business opportunities and benefits.

2.1.1 Reduction of carbon dioxide emissions

Petrochemical companies are one of the main sources of CO_2 emissions due to the use of fossil fuels in their production processes and reactions with other chemicals to make chemical products. These chemical reactions will produce a large amount of carbon dioxide emissions, causing serious pollution and impact on the environment. To reduce this pollution and emissions, petrochemical companies can adopt carbon capture technology. This technology can capture and store or utilize carbon dioxide during the production process, thereby reducing carbon dioxide emissions. Specifically, carbon capture technologies can be used to separate carbon dioxide from the exhaust gas stream, and then store it or use it to produce other value-added products, such as fertilizers, feed, etc. [5, 6]. Nowadays, there are quite mature technologies, such as the biomitigation of carbon dioxide using microalgae systems, which can be used as carbon-neutral single-cell biofactories for the production of food, fertilizers and other products [7]. These products can be sold directly, thereby generating additional revenue for the business. Therefore, the application of carbon capture technology is the most direct way for petrochemical enterprises, which can not only achieve emission reduction, but also create economic benefits [8].

2.1.2 Improvement of energy efficiency

By capturing CO_2 and using it, the company's carbon footprint and energy waste can be reduced [2]. This technology can be achieved in a variety of ways, such as using captured carbon dioxide to produce other valuable chemicals or storing it in underground gas storage for future use. These methods can help companies reduce carbon emissions and lower energy costs. By applying carbon capture technology, petrochemical companies can use energy more efficiently in their production processes, thereby increasing production efficiency and reducing

operating costs [4].

2.1.3 Improvement of sustainability and environmental profile

Petrochemical companies are often considered as one of the main culprits of pollution, but applying carbon capture technology can help these companies reduce carbon emissions and improve their sustainability and environmental profile. These companies can use carbon capture technology as a marketing point to highlight that the products they produce are environmentally friendly products, so as to improve the image and reputation of the company and attract more environmentally conscious consumers and partners.

2.2 Construction industry

The building industry is an important carbon emission area, including buildings, lighting, heating, ventilation, air conditioning, etc. all emit large amounts of carbon dioxide. The application of carbon capture technology can help the construction industry reduce carbon emissions and improve the energy efficiency of buildings. In addition, it can not only help consumers improve the indoor environment, but also improve the sustainability and environmental image of the building. Compared to industry and transport, the benefits of achieving emission reductions are relatively higher, which indirectly indicates that the more likely it is to use CO_2 to generate additional empowerment [9].

2.2.1 Reduction of carbon emissions

Carbon emissions from the construction industry come mainly from the production of building materials, energy consumption during construction, and energy consumption during the use phase of buildings. The application of carbon capture and utilization technologies can reduce carbon emissions from the construction sector [10]. In the production and selection of building materials, carbon capture technologies, such as the use of biomass energy, the use of low-carbon cement, etc., can be used to reduce carbon emissions [11]. During the construction process, carbon capture technologies can be employed to capture carbon dioxide, such as air purification systems, bioreactors, etc. [12, 13]. In addition, in the building use phase, the use of energy management systems, intelligent building technologies, etc. can reduce energy consumption and further reduce carbon emissions [14].

2.2.2 Improvement of energy efficiency

Buildings account for the majority of global energy consumption and are a major source of greenhouse gas emissions. A building's heating, ventilation and air conditioning systems require a lot of energy to maintain a comfortable indoor environment. These systems use energy sources such as fossil fuels to generate heat or cool, emitting large amounts of greenhouse gases such as carbon dioxide. By applying carbon capture technology, a building's heating, ventilation and air conditioning systems can capture carbon dioxide from exhaust gases, reducing greenhouse gas emissions and improving energy efficiency [15]. Carbon capture technology can be implemented in a variety of ways, the most common of which is to introduce exhaust gases into special chemicals so that carbon dioxide is adsorbed and separated and then stored or reused.

2.2.3 Sustainability

CO_2 emissions can have a negative impact on indoor air quality, and the application of carbon capture technology can control indoor CO_2 content within an appropriate range, improve indoor environmental quality, and improve living and working comfort. In addition, sustainability and environmental protection have become important trends in the development of the construction industry, among which the development and application of sustainable materials continue to rise [16, 17]. Carbon capture technology can help the construction industry achieve its goals of reducing emissions and improving energy efficiency, improve the sustainability and environmental image of buildings, and attract more environmentally conscious consumers and partners.

2.3 Power industry

Power industry is one of the largest CO_2 emission source globally [18]. Power plants use fossil fuels, oil and gas to generate electricity [19]. The combustion process of these energy sources produces large amounts of carbon dioxide and other greenhouse gas emissions, and carbon capture technology is one way to solve the problem of carbon emissions in the power industry. The application of carbon capture technology can help the power industry reduce carbon emissions and reduce environmental impact, while also saving costs for businesses. By reducing CO_2 emissions, the power industry can contribute to the global climate change problem, while also contributing to sustainable development.

2.3.1 Reduction of carbon emissions

Coal-fired power industry and natural gas power industry are the two main ways of generating electricity. The common denominator is that they produce large amounts of carbon dioxide and other greenhouse gas emissions when burned. An effective solution is the application of carbon capture technology, which captures carbon dioxide through different methods such as physical absorption, chemical adsorption, and membrane separation, of which post-combustion carbon capture is the most common method [20, 21]. By applying these technologies, power plants can separate carbon dioxide from the emitted exhaust gases and store it, or convert it into other useful substances such as calcium carbonate. According to statistics, the application of carbon capture technology can reduce the carbon emissions of the power industry by about 80% [2, 22, 23]. Power plants use the gas-liquid absorption method to capture carbon dioxide before

combustion using chemical and physical solvents, thereby achieving emission reduction.

2.3.2 Improvement of energy efficiency

The power industry needs a lot of energy to meet the growing energy demand, but it also generates a lot of carbon emissions, which has a serious impact on the environment. With the increasing global concern for environmental protection, reducing carbon emissions has become an important goal for the sustainable development of the power industry. In this context, the application of carbon capture technology has become an effective means. Carbon capture technology improves energy efficiency by separating carbon dioxide from the exhaust stream and storing or reusing it, helping to reduce carbon emissions and energy loss [24]. This technology can be applied in various power industries methods such as coal and natural gas, and has significant effects on reducing carbon dioxide emissions, improving power industry efficiency and reducing energy costs. In addition, the adoption of carbon capture technology can also reduce dependence on fossil fuels, thereby further promoting the development of clean energy. Therefore, the power industry can reduce carbon emissions, reduce waste and improve energy efficiency by adopting carbon capture technology, while also achieving more environmentally friendly and sustainable development through this technology.

2.3.3 Development of sustainability

As the international community becomes more restrictive on carbon emissions, carbon capture technology will become an important business opportunity for the power industry. Applying carbon capture technology can help power generators meet carbon emission standard, thereby avoiding or mitigating economic risks such as carbon fines. In addition, the application of carbon capture technology can also provide carbon capture and storage services for power industries enterprises, thereby generating revenue. In the future, it will be applied in more industries and fields, and become a key technology to achieve sustainable development.

3. Discussion

The additional empowerment generated by the application of carbon capture technology in petrochemicals, construction and power industry may face some obstacles in practice. 1. Technology maturity and economic cost—Carbon capture technology is still at the early stage of development, and there are still some challenges in terms of technological maturity and economic cost. Especially for small and medium-sized businesses, equipment and operating costs can be prohibitive, which may limit the adoption of the technology. 2. Energy policy and market environment—Energy policy and market environment also have an important impact on the promotion and application of carbon capture technology. For example, without relevant policy support and market acceptance, companies may lack incentive to invest in and implement carbon capture technologies. 3. Social awareness and cooperation—The application of carbon capture technology involves multiple stakeholders, including enterprises, governments and the public. Therefore, social awareness and cooperation are also key factors in promoting application. For example, companies need to actively participate in public and government discussions and decision-making, while building a credible and sustainable brand image in society. In summary, the additional empowerment of carbon capture applications in petrochemicals, buildings, and power industry faces barriers to technological maturity and economic costs, energy policy and market environment, as well as societal awareness and cooperation.

4. Conclusion

The additional empowerment generated by the application of carbon capture technology in the fields of petrochemical, construction and power industry mainly includes the following aspects: 1. Reduce carbon dioxide emissions---carbon capture technology can capture and store greenhouse gases such as carbon dioxide produced in industrial production processes, thereby reducing carbon dioxide emissions and reducing carbon footprint. This is of great significance for reducing global greenhouse gas emissions and addressing climate change. 2. Improve the image of corporate social responsibility---By using carbon capture technology, enterprises can improve their environmental protection image and enhance their sense of social responsibility. This helps enterprises establish a good corporate image and get more opportunities and support in the market competition. 3. Promote technological innovation and progress---The application of carbon capture technology requires enterprises to carry out technological innovation and progress, which helps enterprises to enhance their own technical strength and competitiveness. At the same time, technological innovation and progress will also help promote the application and development of carbon capture technology, so as to make greater contributions to environmental protection and sustainable development. 4. Improve product added value and market competitiveness—By using carbon capture technology, enterprises can convert captured carbon dioxide into value-added products, such as carbonated beverages, fertilizers, etc., thereby enhancing product added value and market competitiveness. In general, the additional empowerment generated by the application of carbon capture technology in petrochemicals, construction and power industry is multifaceted, not only contributing to environmental protection and sustainable development, but also bringing business opportunities and market competitiveness.

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