

# *Study on the Environmental Costs of Petrochemical Enterprises Based on Double Carbon Targets*

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**Abstract:** In September 2020, China clearly proposed to reach the goal of "carbon peak" in 2030 and "carbon neutral" in 2060 (hereinafter referred to as the "double carbon goal"). This is China's responsibility for environmental protection as an international power and an inevitable choice to achieve sustainable development in China. Based on the analysis of the impact of the "double carbon" target on China's petrochemical enterprises, this paper analyzes the three dimensions of environmental costs of petrochemical enterprises, i.e., the ex ante costs, the ex post costs and the ex post costs, and evaluates them respectively, and finally proposes a solution path, with a view to providing ideas and references for petrochemical enterprises to reduce their environmental costs. In order to provide ideas and references for petrochemical enterprises to reduce environmental costs.

## 1. Introduction

With the introduction and promotion of the "double carbon" target, China has accelerated the pace of reducing carbon emissions and promoting the adjustment of industrial and energy structures, and many cities have opened pilot projects on carbon emissions trading, in an effort to achieve the "double carbon" target as soon as possible. The "double carbon" target is undoubtedly a huge impact on petrochemical companies with high carbon emissions, which are facing the challenge of rising environmental costs. It is very important for high carbon emission enterprises to manage their environmental costs well, and effectively reduce their carbon emissions, which can bring considerable economic benefits and improve their environmental pollution problems.

At present, the research on the high environmental cost of petrochemical enterprises based on the "double carbon" objective is still in the exploration stage, and there is a lack of research on how to realize the path of reducing environmental cost. Xincheng Zhang (2022) [1] mainly focuses on the management and causes of environmental costs in petrochemical enterprises, and explores the countermeasures to improve cost management. Xueqi Gao (2021) [2] believes that the "carbon neutral" target is important for the cost of enterprises and proposes corresponding initiatives. Lu Xia (2019) [3] points out that the cost accounting of low carbon emissions is inextricably linked to the information disclosure of enterprises. It can be seen that the research on the environmental cost of enterprises by Chinese scholars has certain effect and depth, but the system is not complete and the depth of excavation is not rich enough, and it is difficult to obtain a universal theory to apply to

enterprises with high carbon emissions. In this paper, based on the previous research, we will study the environmental cost components of petrochemical enterprises and come up with generalized countermeasures, which can be extended to other polluting enterprises to find effective ways to reduce environmental costs for high carbon emission enterprises in the context of "double carbon" target.

## **2. The Impact of "Double Carbon" Target on Petrochemical Enterprises**

### **2.1. Current Situation of Petrochemical Enterprise Development**

The operation of petrochemical enterprises is mainly characterized by the use of oil or natural gas as the basic raw material, consuming a large amount of fuel and power for production, and easily generating "three waste" pollutants in the production process, i.e. waste gas, waste water and waste residue. The business scope of petrochemical enterprises mainly includes refining of petroleum products, exploration, extraction, production, sales and storage of chemical products and petroleum products, import and export trade of crude oil, and sales of petrochemical raw and auxiliary materials and equipment and parts thereof.

### **2.2. Challenges Faced by Petrochemical Companies**

With the implementation of the "double carbon" target, China's carbon emission standards for relevant enterprises will continue to improve, and the requirements for petrochemical enterprises to reduce emissions will also continue to improve, if the current development of petrochemical enterprises do not make corresponding changes to the initiative. Then its development space will be hindered.

China's petrochemical enterprises currently have a relatively low exploitation and research technology, regional supply and demand contradictions, industrial layout is not clear enough, etc., in the implementation of the "double carbon" goal will inevitably clean up and eliminate backward technology production capacity enterprises, which put forward higher requirements for the development of the petrochemical enterprise production capacity, forcing it to urgently transform and upgrade. Improve production capacity and reduce emissions. In the development process of improving production capacity, enterprises will be subject to technical barriers, most enterprises can not upgrade their own research, need to rely on outsourcing equipment, technology, etc. to improve production capacity, which also greatly increases the production costs of enterprises, their market price competitiveness will be weakened, the profit space will also be compressed. [4] The increase in costs will affect consumers' desire to consume, leading them to seek other inexpensive energy alternatives, which fundamentally affects the profits of enterprises and largely limits the development space of petrochemical enterprises. It can be seen that the implementation of the "double carbon" target will bring great challenges to petrochemical enterprises, and in the face of the severe development situation, it is particularly important to reduce carbon emissions and control environmental costs for the development of enterprises.

## **3. Analysis of the Composition of Environmental Costs of Petrochemical Enterprises**

Environmental cost is the cost that an enterprise has to pay because of environmental pollution brought by economic activities. In this paper, specific cost analysis will be conducted based on different stages of production process of petrochemical enterprises, which are ex ante environmental cost, ex post environmental cost and ex post environmental cost.

### 3.1. Ex Ante Environmental Costs

Ex ante environmental costs are costs associated with the formal production that petrochemical companies must pay before they can reduce their carbon emissions. The prior environmental costs that enterprises have to pay before production include the training cost of skilled workers, the change cost of smelting and other technologies, the purchase of higher machinery or R&D costs and the prevention cost of product design. At present, the exploration and extraction technology of petrochemical enterprises in China is still immature, and a large amount of carbon is generated in the process of extraction and smelting, which is one of the largest carbon emission links in the production chain of petrochemical enterprises. In order to improve production capacity and reduce carbon emissions, the exploration and mining department needs to make technical changes before production, and solve the problem of high carbon emissions at source by developing or purchasing high-tech smelting equipment and providing pre-employment technical training for staff. [5] The product design department needs to control the pollution level of raw materials and packaging needed for product production and carry out environmental and ecological design, which requires companies to pay greater design costs.

### 3.2. Environmental Costs in the Event

Ex-ante environmental costs are the environment-related costs that petrochemical companies have to pay during the production process such as extraction and smelting. The ex-post environmental costs include carbon emissions from transportation, process optimization, etc. The production process of petrochemical enterprises will emit the "three pollutants", so clean production is particularly important to the production of enterprises, and is also a breakthrough production technology challenges. To achieve cleaner production, the production sector needs to combine the production characteristics of petrochemical enterprises, optimize the production process, and update the production line and production equipment to reduce unnecessary waste of resources in the production process. [6] The layout of petrochemical enterprises in China is relatively uneven, and in the face of the problem of unreasonable industrial distribution, the logistics and transportation sector needs to cross long distances in the transportation process, and petrochemical enterprises will emit a large amount of carbon during the transportation and storage process from the extraction site to the point of sale and the storage area through pipelines or other means of transportation, so the purification emissions in the transportation process is also an important part of the enterprise to reduce carbon emissions.

### 3.3. Ex Post Environmental Costs

Post-event environmental costs are the environmental remediation costs that petrochemical companies have to pay after production. The post-event environmental costs to be paid by enterprises include the cost of environmental restoration, reuse and purification of recyclable resources, etc. At present, various localities in China have already imposed fines on relevant illegal enterprises in accordance with Article 40 of the National Measures for the Administration of Carbon Emission Trading (Trial Implementation). With the implementation of the "double carbon" policy, China's carbon emission standards will become higher and higher, which will also raise the production threshold for petrochemical enterprises. If a petrochemical company emits too much carbon during the production process, which seriously reduces the air quality and causes bad damage to the environment, it may face high fines. In order to compensate for the damage caused to the environment after production, enterprises have to carry out environmental remediation and need to reuse and purify the recyclable resources used in the production process in order to promote a positive interaction

between the environment and the economy, all of which constitute post-event environmental costs for enterprises and put greater cost pressure on them.

#### 4. Evaluation of the Environmental Cost of Petrochemical Enterprises in China

Through the above analysis, it is easy to find that under the background of "double carbon", China's petrochemical enterprises will face higher environmental costs, and the cost pressure of enterprises has suddenly increased. Next, this paper will evaluate the environmental cost of China's petrochemical enterprises based on the comparative analysis method, and compare the cost profit margin of foreign petrochemical enterprises.

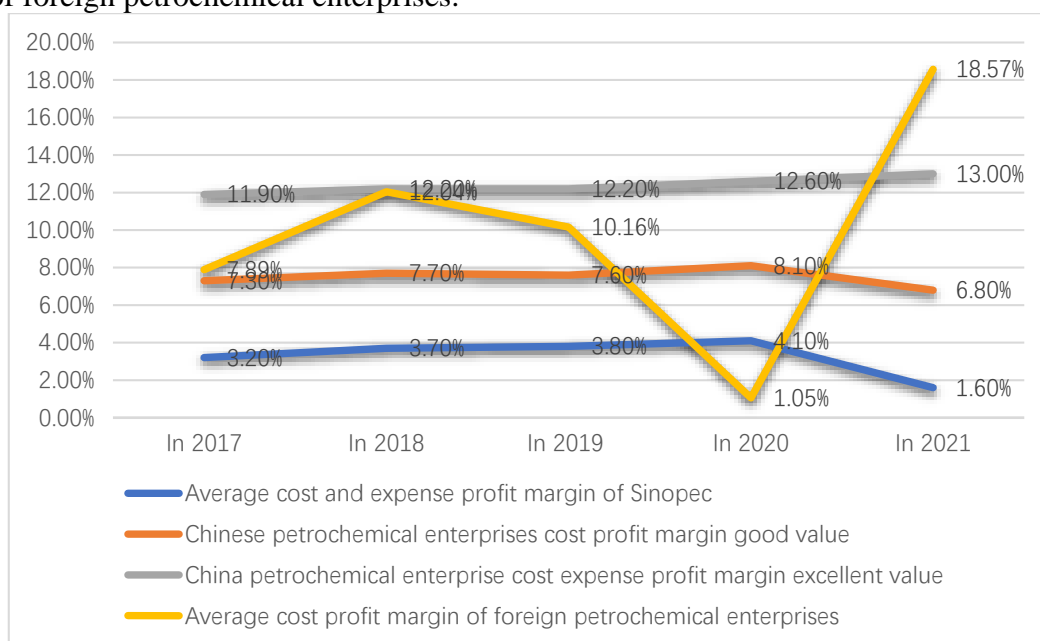


Figure 1: Comparison of cost and expense margins between Chinese and foreign petrochemical companies, 2017-2021

The higher the profit margin of cost, the less the enterprise has to pay for revenue, the better the enterprise controls its costs, and the stronger the profitability of the enterprise.

According to the data of the Petroleum and Petrochemical Enterprise Performance Evaluation Standard Value 2017-2021(As shown in Figure 1), it can be obtain that the average profit margin of recent cost and expense of Sinopec enterprises is below 5%, indicating that for every 100 yuan of cost spent by Sinopec enterprises, the profit is less than 5 yuan, and its profitability is relatively severe. Except for the year 2020, which was affected by the COVID-19 epidemic, the other years were far below the industry average of foreign petrochemical enterprises in the same period. In addition to 2020, the average cost profit margin of foreign petrochemical enterprises exceeds the good value of China, and in 2021, it exceeds the average level of China by 12 percentage points, which is much higher than the excellent value of our industry, indicating that foreign petrochemical enterprises have higher profitability efficiency, and the gap between domestic and foreign cost profitability is still large.

Through quantitative comparison, the cost ratio of China's petrochemical enterprises is relatively large, resulting in a relatively lower profitability than that of foreign countries. The above analysis shows that under the "double carbon" target, petrochemical enterprises have to pay more environmental costs, so it will increase the cost of enterprises. As a result, the environmental cost of petrochemical enterprises so it will increase the cost of enterprises, resulting in a significant decline in the average cost profit margin of Chinese petrochemical enterprises in 2021, which is far different

from that of foreign countries in the same period. which shows that the environmental cost control and management ability of petrochemical enterprises in China is still insufficient.

## **5. Measures to Reduce Environmental Costs of Petrochemical Enterprises under the "Double Carbon" Target**

### **5.1. Establish a Sound Legal System for Environmental Costs**

It is easy to find that most countries have made excellent progress in environmental cost accounting without the constraints of legal provisions and supervision by government departments. At present, China's legal provisions on environmental cost accounting are still in the exploration period. Although in the 1970s, China promulgated the Environmental Protection Law of the People's Republic of China, and more than 400 environmental standards have been promulgated one after another. However, most of the control aspects are in the environmental prevention and treatment of sewage costs, but it has not played a great role in promoting the development of environmental accounting.<sup>[7]</sup> Therefore, China's laws and regulations should follow the policy hotspots, under the background of the "double carbon" target, constantly improve, strengthen government supervision, and control the pollution emission of relevant enterprises in real time, so as to force the transformation and upgrading of petrochemical and other high carbon emission enterprises, and realize low carbon emission from the source, and also provide a legal basis for enterprises to control environmental costs. Legal basis. In addition, economic instruments can be used to indirectly control the high carbon emissions of enterprises, such as increasing taxes and low-carbon subsidies, so that more enterprises can deepen the concept of environmental protection into their corporate culture and make them voluntarily disclose the environmental accounting costs.

### **5.2. Improve the Accounting Method of Environmental Costs**

At present, there is no unified standard about the accounting scope of environmental cost in China, and there are mainly three accounting methods, namely manufacturing cost method, operation cost method and life cycle cost method, all of which have shortcomings in accounting and cannot reflect the environmental cost of enterprises comprehensively and accurately, and the procedure of calculation is too confusing. Therefore, to promote the development of environmental accounting cost in China, we must first clarify the scope of environmental cost calculation and accounting methods. Improving China's current cost accounting system is the first step to promote environmental accounting costs, and it is necessary to step out of the original accounting model, divest environmental costs from the original accounting accounts and create new accounting account names. The newly created accounting accounts should be in line with the attributes of environmental costs and their causes of occurrence, and should not be set arbitrarily, otherwise it will make the work of accountants more difficult, and it is also not conducive to the accounting of environmental costs. Secondly, the improved environmental cost accounting method should be proceduralized and standardized, so that it can become a standard system in the industry and a detailed operation guideline can be issued to become a guideline for cost checking and guiding whether the environmental cost accounting of enterprises is standardized, so that each enterprise with high carbon emission can take the initiative to disclose the environmental cost. [8]At the same time, this also poses a new challenge to the relevant enterprises, because the step-by-step procedures of accounting are more stringent, requiring a basically sound accounting system and better rules and regulations of the enterprises. In order to meet the industry standards, the relevant enterprises must rectify and improve the internal aspects of the enterprises, and pay more attention to and consciously control the environmental costs.

### 5.3. Sound Disclosure Model Suitable for China's Environmental Costs

The current information disclosure procedure for environmental costs in China is not sound, and the form of disclosure is not uniform and very confusing, resulting in no comparability of information disclosed between different enterprises. At the same time, most enterprises do not highlight the content of disclosure, simply choose to disclose the information that is beneficial to the enterprise, while the information that is unfavorable to the enterprise is chosen to be expressed obscurely or simply not disclosed, so that the disclosed information does not have much reference value, and does not use other information users to make reasonable scientific judgments for investment, which will also reduce the enthusiasm of market investment. One of the reasons that lead to such a significant loophole in our environmental cost information disclosure is that our current environmental cost disclosure model is not yet sound and not suitable for the development of our market, therefore, a sound disclosure model suitable for our environmental cost becomes the key to the development of our environmental cost at present. From the above, we can see that to promote the development of environmental costs, we must first clarify the scope of accounting for environmental costs, and this will be accompanied by the generation of new accounting accounts that will have the effect of revealing environmental costs. The environmental cost statement can be added to the existing three forms and one note, so that the environmental cost statement can become an indispensable part of the financial information of enterprises, specifically analyzing the capitalized and expensed expenditures of enterprises on the environment, improving the quality of environmental cost information disclosure, making it an industry consensus, and raising the awareness of enterprises to actively disclose environmental costs. [9] At the same time, the government should set up an assessment group and establish a reward and punishment system to fine enterprises with irregular environmental cost disclosure and reward enterprises with standardized and complete disclosure, so as to restrain and regulate the environmental cost disclosure mode of enterprises.

### 5.4. Cultivate All-round Accounting Talents

At present, there are a large number of accountants in China, but the number of high-quality accountants is limited, and their knowledge of environmental cost accounting is still insufficient. With the implementation of "double carbon" policy, the requirements for accountants will become higher and higher, requiring accountants to accurately and completely budget, account and disclose environmental costs, and also requiring accountants to reasonably control the costs of enterprises, so as to minimize the costs before, during and afterwards of enterprises with high carbon emissions, such as petrochemicals, and increase the profits of enterprises and realize the wealth of shareholders. corporate profits and maximize shareholder wealth of enterprises [10]. Therefore, it is necessary to cultivate a full range of accounting talents and improve the professional level of accounting personnel in order to face the high level of requirements for accounting personnel under the "double carbon" policy, and to meet and respond to the changes and challenges of accounting in different environments. This requires enterprises to invest more costs in training accounting staff, so that traditional accounting staff can be transformed into new era accounting staff with high quality and fast, and enterprises can make use of big data and accounting information technology to complete environmental cost forecasting efficiently and scientifically. At the same time, accounting personnel should develop the concept of lifelong learning, constantly improve their professional skills to adapt to the development needs of the data era, improve their own use of intelligent technology, and constantly improve the ability to extract and analyze information in order to cope with internal and external financial risks, develop scientific and reasonable financial decision-making programs, and continuously realize the change of environmental costs in enterprises.



## 5.5. In-depth Implementation of the Concept of Environmental Protection

Environmental protection is the mainstream consciousness of contemporary society, and it is also the social responsibility that every enterprise should undertake. The concept of environmental protection should be implemented into the culture of every enterprise, making it a cultural symbol of an enterprise and strengthening the identity of environmental protection in order to fundamentally solve the problem of high carbon emissions and guarantee the realization of the "double carbon" target. Petrochemical enterprises should clarify the requirements of the "double carbon" policy, implement pollution reduction and carbon reduction in every aspect of their production, clarify the timing and realization path of each task, reduce carbon emissions, and help achieve the "double carbon" goal as soon as possible. This will not only improve the civilization level of the city, but also inadvertently impose constraints on the production of petrochemical enterprises, which will strive to transform and upgrade to achieve low-carbon emissions in order to meet the public's low-carbon pursuit. [11]

## 6. Conclusion

The concept of green, environmental protection and low-carbon production under the "double carbon" policy is a standard that all enterprises should pursue, which is also a challenge and opportunity for petrochemical and other high carbon emission enterprises in the background of the times. As a petrochemical company, which is most affected by the "double carbon" target, controlling environmental costs and reducing carbon emissions have become one of the most important tasks of the company. Only by managing environmental costs well can petrochemical enterprises create conditions for better development and break through the development bottleneck to seek high quality development under the low carbon policy. It is hoped that the study of environmental costs of petrochemical enterprises in this paper can bring inspiration to enterprises with high carbon emissions and help them reduce environmental costs, so that they can upgrade their economic development and green transformation simultaneously and help them achieve the goal of "double carbon".

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