IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

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To cite this article: Meng Li and Peng Wang 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **300** 042069

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Research on carbon emission quota allocation in power industry

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Abstract. China's power supply structure is dominated by coal-fired power and has high carbon emission characteristics. The carbon emissions in the power industry account for more than 40% of national total carbon emission. Therefore, the implementation of carbon emission quota trading in the power industry is of great significance to achieve China's national carbon emission reduction targets. In this paper, a carbon emission quota allocation scheme is determined based on the "historical law" or "baseline method" or a combination of the two, according to carbon market pilot experiences. Then combined with the actual situation of carbon emissions in the power industry and the effect of the allocation plan on carbon emission reduction, we determined the specific carbon quota indicators of the thermal power unit. Finally, the final carbon emission quota allocation solution reflects both the equity and efficiency principles in China's power industry.

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1. Introduction

The construction of the carbon market is a major institutional innovation and a complex system engineering. Since 2011, the National Development and Reform Commission has carried out carbon trading pilot projects in seven provinces and cities such as Beijing, Tianjin, Shanghai, Chongqing, Guangdong, Hubei, and Shenzhen, and accumulated experience in building a nationwide unified carbon trading market [1]. The transaction started in 2013 and by November 2017, the cumulative quota of the seven pilots exceeded 200 million tons of carbon dioxide equivalent, and the turnover exceeded 4.6 billion yuan. Moreover, from the scope of the pilot, the total amount and intensity of carbon emissions have shown a double decline, which plays a role in controlling the greenhouse gas emissions in the carbon market. On December 19, 2017, the National Development and Reform Commission (NDRC) announced that it will launch the long-awaited national carbon emission trading market.

The main problem in China is that the development of carbon trading theory and practice and the supporting legal system in China has been slow, so that there is no mature trading system. The carbon trading rules and prices in the international market are mainly formulated by carbon demanders such as foreign large carbon markets, financial institutions, and emission reduction entities. Domestic carbon emission sellers do not have good channels to obtain relatively fair carbon trading information, which

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directly leads to pricing power and Insufficient bargaining power[2,3]; China's carbon emissions trading market is still in its infancy, the market is fragmented, the market transaction volume is extremely unstable, and the volatility is large; many companies will increase their emission reduction technology by purchasing emission rights or buying new equipment. The financial burden is discouraged by the carbon trading market. During the trial operation, the administrative intervention was large, and the market lost its dominant position, which led to the price not fully reflecting the value of resources and the inability to internalize environmental issues through price transmission mechanisms. To solve this problem, this paper elaborates on the power industry's participation in the carbon market trading rules and its specific carbon quota allocation plan, and provides corresponding reference and policy recommendations for improving the carbon trading market of China's power industry.

2. National carbon market construction plan

Taking the power generation industry as the breakthrough to take the lead in launching the national carbon emissions trading system, we need to steadily advance the carbon market construction work in three phases.

2.1. Infrastructure construction period

With a year or so, the nationwide unified data reporting system, registration system and trading system will be completed. In-depth capacity building will be carried out to enhance the participation and management level of various subjects. Conduct carbon market management system construction.

2.2. Simulate the running period

It takes about one year to carry out the quota simulation transaction of the power generation industry, comprehensively examine the effectiveness and reliability of various factors in the market, strengthen the market risk warning and prevention mechanism, and improve the carbon market management system and support system.

2.3. Deepen the period of perfection

The quota spot transaction is carried out among the trading entities in the power generation industry. The transaction is only for the purpose of performance, the quota for the performance part is cancelled, and the remaining quota can be transferred and traded across the performance period. Under the premise of stable operation of the carbon market in the power generation industry, the market coverage will be gradually expanded to enrich the trading varieties and trading methods. Create conditions to incorporate national certified voluntary emission reductions into the national carbon market as soon as possible.

3. Electricity industry carbon emission quota allocation plan

Quota allocation is divided into free allocation and paid distribution. The free quota allocation includes three methods: the benchmark method, the historical method, and the baseline history. The benchmark method uses the benchmark indicator as the CO_2 emission per unit of output (carbon emission intensity) or the total annual average CO_2 emissions. The quota allocation is the product of the benchmark and the physical output or the benchmark indicator; history The law is based on the historical carbon emission intensity, and the quota allocation is the product of historical carbon emission intensity, physical output and emission reduction coefficient.

Paid distribution is divided into auction method and pricing method. The scientific rationality of quota allocation needs to learn from the experience of the international carbon market to facilitate the convergence of the pilot carbon market. According to the EU carbon trading system EUETS, North American RGGI and WCI quota allocation experience, the power industry quota allocation method changes have the following characteristics, the development trend is from free distribution to the auction allocation, the auction ratio is gradually expanded until no more free Distribution; free distribution from the historical law to the benchmark method; in order to avoid the risk of carbon leakage, the initial allocation method is relatively loose.

According to the experience of historical quota allocation in China's pilot carbon market, the carbon trading pilot areas and Fujian's quota allocation methods are different, but all are based on free quotas, and most of the pilots have adopted the baseline method. In 2017, the "National Carbon Trading Market Quota Allocation Plan (Discussion Draft)", the general idea of the allocation of power industry quotas is the baseline method + pre-allocation.

The quota calculation process is based on the production in 2015, and the initial allocation of 70% of the quota. The actual quota will be refunded after the actual production is calculated.

In the quota allocation method, 11 baselines are divided according to the pressure parameters, capacity level and fuel type of the unit, which are divided into power supply and heating quotas, namely: total quota allocation = total power supply quota + total heating quota. At the same time, the cooling method, heating mode and fuel heating value of IGCC unit are considered. The calculation formula is shown in Table 1. It can be seen from Table 1 that the unit's CO_2 emission reference value is different due to different unit pressure parameters and capacity levels, even if the fuel type is the same; however, the unit's CO_2 emission reference value is independent of the unit pressure parameter and capacity level. The units are all 0.1118tCO_2/GJ, and the gas units are unified to 0.0602tCO_2/GJ [4,5].

Table 1. The setting of carbon emission quota allocation reference value

The types of units	quota allocation reference value(tCO2/MWh)
Ultra-supercritical 1000 MW unit	0.8066
Ultra-supercritical 600MW unit	0.8267
Supercritical 600MW unit	0.8610
Supercritical 300MW unit	0.8748
Subcritical 600MW unit	0.8928
Subcritical 300MW unit	0.9266
High-pressure ultra-high pressure unit below 300MW	1.0177
Circulating fluidized bed IGCC 300MW and above	0.9565
Circulating fluidized bed IGCC 300MW and below	1.1597
Gas class F or above	0.3795
Gas unit below F	0.5192

4. Conclusion

At present, China has clearly defined the basic path planning of the national carbon market and the achievement of targets at various stages, and the research on carbon accounting has been relatively mature, especially the accounting of total carbon emissions, the scope of research has been continuously expanded, and the method system has been continuously improved. However, China's carbon quota allocation is still in the growth stage. With the continuous development of carbon markets in various countries, the carbon trading system has been continuously improved. The application of free distribution methods in various industries is more targeted, and the paid distribution method has been widely used. In the application of the free distribution method history method, the baseline method, the historical strength reduction method, etc., how to balance the fairness and efficiency issues; when the paid distribution method is fixed price sale, auction, commissioned auction, etc., how to exert the vitality of the market allocation resources, Hot and difficult issues in current research. In addition, the research on carbon pricing is still in the exploratory stage. At present, the carbon trading and carbon tax mechanism are more commonly used, and the project offset mechanism is gradually accepted on a global scale.

Therefore, China should actively promote the role of pilots in the national carbon market and complete the transition from pilot to national unified carbon market. By drawing on the advanced

experience of international carbon market construction, we will clarify the carbon quota allocation standards and promote the carbon market process.

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