Operation Mechanism and Evaluation of Carbon Market in Electricity Industry: A Review of its Current Status and Future Perspectives

Shuanzhu Sun *, Chunlei Zhou
China Jiangsu Frontier Electric Technology Co. Ltd, Nanjing, China
*Corresponding author e-mail: 295273953@qq.com

Abstract. The current EU carbon trading market and the RGGI carbon market are relatively successful. Therefore, after studying the EU and RGGI thermal power units participating in carbon trading, it is of positive significance for formulating emission patterns in line with China's thermal power units. Through the international experience of the carbon trading market, we will build China's carbon trading market.

1. Introduction
In 2009, the Regional Greenhouse Gas Initiative (“RGGI”) became the first mandatory limit and trading plan to limit US carbon dioxide emissions. In countries participating in RGGI, electric generators are required to emit no more than the amount of carbon dioxide they receive. RGGI is characterized by the allocation of carbon dioxide credits to the market primarily through auctions. Of the circulated CO2 credits, 94% initially entered the market through auctions. By the end of 2016, RGGI had successfully held 34 auctions and sold a total of 860 million US dollars in carbon dioxide emissions, totaling 2.6 billion US dollars.

As an advocate of sustainable low-carbon economic development, the EU has been fully promoting the world's actions to jointly address climate change. As a member of the emission reduction commitment of “Kyoto Protocol”, the EU has made many powerful moves to effectively fulfill the emission reduction targets. However, since the EU is a multi-national alliance organization, the degree of development and emission reduction techniques among each member country are not the same. Some countries need to reduce emissions a little, while others are relatively few. In this case, one is needed. Can be carried out; the market for emissions trading. Therefore, the European Union Emissions Trading Scheme (EU ETS) has emerged. In January 2005, the EU ETS was officially in force, and there were approximately 11500 emission entities involved in the system, covering 27 members of the EU. Currently, the EU Emissions Trading System (EU-ETS) is the world's largest and most advanced carbon emissions trading system. The EU ETS can be a model for China to establish a carbon trading market system [1,2].

The power industry is the most important basic energy industry in the development of the national economy. It is also a major source of greenhouse gas emissions and an important area for carbon emission reduction. Therefore, in areas where market mechanisms are used for carbon emission management, the power industry is often carbon emissions. An important subject of the rights trading market.
2. A review of EU-ETU in electricity industry

The trading mechanism of the EU ETS is the total amount of control and trading. Since its official entry into force on January 1, 2005, two implementation phases have been completed, and the third implementation phase is now underway.

In the first two phases of the EU ETS (2005-2007 and 2008-2012, respectively), most of the limits were allocated free of charge for thermal power plants. The number of limits received by each thermal power unit is determined by the National Distribution Plan (NAP). In the first two stages, although the EU ETS is a whole construction, how the various member states of the EU allocate the total emissions of thermal power units, and how the emission entities in each member state allocate quotas, but each member country decides itself. Before implementing the thermal power plant emission reduction project, each country must submit a national distribution plan to the European Commission of the competent authority. In the plan, the thermal power unit emissions and measurement standards to be applied for should be stated. After the NAP is evaluated, it is distributed free of charge to the non-period of 95% of the historical emission levels of the thermal power units, but each emission entity in the thermal power unit will be punished for every ton of carbon dioxide emission. Each member has a 5% cap to sell the quota. In the second phase, the general understanding of the first phase, but the auction limit is increased to 5%-10%, with greater flexibility.

Most of the limits for the third phase of the EU ETS will be provided through auctions. In the third phase, the power sector, especially the thermal power unit, will need a full auction limit, and a total of about 50% of the total free amount will be auctioned from 2013, and this number is rising during the trading period [3].

In the third trading period (2013 to 2020), distribution is achieved by applying new EU-wide, fully coordinated distribution rules. Member States’ emissions, including thermal power units, still require a “distribution plan”, called the “National Implementation Measures” document, which contains all the details of the appropriations for each facility planned in the country. Member States are still responsible for data collection and final distribution. The committee is responsible for approving or rejecting non-self-governing institutions or parts thereof and making changes if necessary.

In the three phases, most of the limits for thermal power units in the first two phases were allocated free of charge. However, starting from the third issue of 2013, all unallocated limits of the thermal power unit will be auctioned. In the third phase, thermal power units use a baseline method to determine the allocation quota. The total amount of free distribution that should be obtained for each installation is determined by the thermal power plant related greenhouse gas emission baseline. These benchmarks are set within the average emissions level of the thermal power unit of the 10% highest efficiency unit. In this way, the thermal power plant's efficient facilities should receive all or almost all of the quotas that meet the obligations of the EU ETS. Inefficiently, the thermal power unit's installations must increase their efforts to compensate for emissions by reducing emissions or purchasing more quotas. This is a phase-out mechanism for thermal power plants.

3. A review of RGGI in electricity industry

RGGI complements the project by legal norms and specific rules to achieve coherence and flexibility and operability of regional cooperative emission reduction mechanisms. RGGI assigns discretion to each state on specific rules, and specifies policies and rules that are consistent with the specific time of each state. The core content is the cap-and-trade of carbon dioxide. The allocation of quotas to the states adopts a historical method, giving historical carbon dioxide emissions, and adjusting according to factors such as electricity consumption, population, and new sources of emissions in each state to determine the total quota. The allocation of power plant quotas is generally assigned by the states to the bank, and the rules are similar to the NOx emission trading scheme. The cap-and-trade market is designed to provide companies with effective incentives to reduce or offset emissions. In the short term, high-emission generators use less than low-emission generators. In the long run, the market will influence the company's decision on compensation projects to eliminate old inefficient power generation, retain existing zero-emission power generation, and maintain, improve fuel efficiency and reduce carbon
intensity. Predictable CO₂ limit prices reduce the risk of long-term investments reducing CO₂ emissions. The availability of futures and options contracts allows companies to circumvent the risks of such investments as carbon dioxide cap prices may fluctuate.

Since the establishment of the RGGI carbon trading market, member states have achieved a certain increase in the economy, the carbon dioxide emissions of the power generation industry have achieved more than 40% of the emission reductions, and the total carbon dioxide emissions of the power generation industry of RGGI member states was 163 million in 2005. The ton was reduced to 92 million tons in 2013, a drop of more than 40%. The RGGI-level market quota auction has accumulated revenues of US$2.517 billion and has invested more than US$1 billion in energy efficiency, clean and renewable energy use in the region, making RGGI member states' energy efficiency at the national advanced level. In addition, RGGI's investment has also boosted local economic growth and employment. Many types of carbon financial instruments make the RGGI carbon market more diversified, enhance the liquidity of the carbon market, and stimulate the vitality of the carbon market. In addition to the quotas that can be purchased in quarterly auctions, the control companies can also obtain quotas in futures trading and physical transactions in the secondary market. This allows the control companies to control the quotas they hold at any time in their own business conditions, helping companies to have multiple choices in the performance process. In addition, the participation of many investment institutions has also prospered the carbon market, which can stabilize the large fluctuations in the quota prices of the primary market to a certain extent, and also help the market to find the price [4-6].

In the RGGI area, only a few coal-fired power plants entered, and after 2009, few natural gas plants left. Coal-fired power plants with relatively low efficiency have withdrawn from the market, and some more efficient natural gas plants have also entered the market. Another important issue in regional regulation is the spillover effect. The interconnected grid enables power transmission between RGGI and its neighbors, which makes RGGI policies likely to affect neighboring countries. They believe that RGGI has led to a decline in the technical efficiency of coal-fired power plants in neighboring states.

4. Conclusion and suggestion
This paper takes the carbon trading market of RGGI and EU-ETS as an example, and thoroughly studies the rules of the international thermal power units participating in the carbon market trading, focusing on the international carbon trading model and participating in the carbon industry. The specific data of carbon trading volume since the formation of the trading market has analyzed the reduction of carbon emissions in the thermal power industry, that is, the impact of participating in the carbon trading market on the thermal power industry; and further combining China's actual national conditions, and put forward corresponding reference enlightenment And policy recommendations to improve the carbon trading market in China's power industry:

(1) The key to the quota setting
A reasonable set of quotas is the key to ensuring that the carbon market is active and carbon prices are reasonable. A reasonable quota setting helps to reflect the cost of carbon emission reduction through the carbon market, and can effectively promote the low carbon development of the industry and society. From the perspective of the distribution method, the auction method adopted by RGGI can reduce the government's management cost, avoid the game of various distribution methods, and increase the subjective initiative of the enterprise. For the purpose of performance, through auctions, companies can more actively manage their carbon emissions and carbon assets. For the purpose of extra profit, auctions enable companies to participate in secondary market transactions more actively. The problem with the auction is that the auction adds to the cost of the business at the initial stage relative to the free quota allocation. However, the auction proceeds and investment in clean development projects are also earmarked for special purposes, which can promote the transformation of the whole society to low carbon through the carbon market.

(2) Unified transaction subject
From the perspective of the trading entity, RGGI trades on a power plant basis. The advantage of this design is that the number of market participants is large and the market can be more active. However,
the disadvantage is that the technical emission reduction methods that the power plant can implement are limited, and it is not convenient to adjust between different power generation structures. If trading is carried out by company or group, it is possible to consider the adjustment of quotas among different power plants within the group and the planning of the development of different power generation structures, which is conducive to reducing the cost of compliance.

Although greenhouse gas emission reduction targets are set by the government, carbon emission trading can significantly reduce the cost of achieving emission reductions. According to a research report supported by the US Environmental Protection Association, only the power industry achieves the same emission target. Because the transactions in the carbon trading market are unified and many unnecessary expenses are reduced, enterprises can save a certain cost on average.

(3) Develop operational technical standards

One of RGGI's worthwhile references is the establishment of a uniform technical standard for operability to facilitate the management of CO₂ emission limits for thermal power plants in various states. For China, China has the characteristics of natural monopoly and administrative monopoly. Insufficient market competition environment will restrict the optimal allocation of abatement costs, and the state-owned enterprises' awareness of subject and cost control is weak, and the guidance and incentives of market mechanisms are also difficult to play. Therefore, it is necessary to establish an effective carbon trading system in China, taking into account the development and survival emissions of backward areas. In the future, the national emission reduction system should be based on compulsory emission reduction, and implement regional differential treatment, supplemented by a flexible market. Means of reducing emissions.

In addition, flexible market systems can be used to enhance corporate compliance and compliance capabilities. In the power industry, emission limits for the industry and companies can be defined and energy efficiency indicators for power generation can be established. The carbon trading system itself cannot effectively reduce emissions, which means that the establishment of China's carbon trading system should be in line with the improvement of energy efficiency, the development of renewable energy, and the introduction of carbon sequestration technology.

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