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China emission trading scheme: an overview

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1- Introduction

The urge for climate action has taken a growing space in every aspect of our lives since the 1980s after the first World Climate Conference in 1979 and the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 to raise awareness about climate change (IUC, 2000). Global warming could cause up to 250,000 death a year (Christensen, 2019) and the number of displaced people due to climate reasons could reach 1.2 billion by 2050 (Yeung, 2020). Climate change also endangers the global economy since it could reduce global GDP by 18% by 2050 if the temperature rises by 3.2°C (World Economic Forum, 2022) and 37% by 2100 (UCL, 2022). Climate change has a high chance of causing scarcity of resources such as petrol and gas according to scholars (PwC, 2016). China uses these resources for its national production to generate added value and maintain a high gross domestic product growth. The impact on growing economies would be devastating if stocks of petrol, gas or coal were depleted because China could not maintain its current growth level and would be severely impacted. Since 2006, the country has been the world's largest greenhouse gas emitter and represents 33% of global emissions (IEA, 2021). World leaders thus often pressure China to reduce its carbon emissions and limit global warming. American climate negotiators for instance mentioned the urge for Chinese climate action during the 27th Conference of Parties (COP) (PBS, 2022). The country itself has an interest in reducing Green House Gas (GHG) emissions since it is one of the principal human causes of global warming which lead to non-renewable resource scarcity. In order to continue to produce, meet demand and stay economically competitive, China had to take a step forward to limit climate change. A regional emission trading scheme (ETS) was then implemented in 2013 in the most polluting areas of China and in 2021, a national ETS was launched to attempt to reduce emissions related to global warming, following the European Union, Australia, California, and other pioneers in emission trading schemes. An ETS is a market-based mechanism to reduce GHG emissions, in this case, carbon Dioxide. The goal of the trading scheme is to set a certain emission boundary to companies' part of the ETS and allow them to emit a given level of emissions. If a company wants to produce more and go beyond its allowance, it can buy the allowances of companies which emitted less than their boundaries. Supply and demand then determine the price for carbon allowances.

Setting such boundaries on GHG emissions takes time and can harm the financial performance of concerned companies. This report aims to assess the environmental and financial effects of

the implementation of the national ETS by studying the effects of the regional trade scheme implemented in 2013. Finally, the Chinese ETS is compared to the European Union carbon allowance market to look at the effects of an ETS on the Chinese energy sector stock market.

2- Implementation of the ETS

In 2006, China surpassed the USA and became the biggest carbon emitter in the world reaching 11.1 billion tons of carbon emitted, accounting for 33% of the worldwide emissions (Yeung, 2020). The main contributor to China's emissions is the energy sector which represents 40% of all the emissions of the country (National Energy Administration 2021). Chinese energy production significantly relies on coal which is used to produce 56.8% of the whole country´s energy (Cheng, 2021).

2.1- China Certified Emission Reduction scheme

Due to its position as the most polluting country, China was pressured by other countries to reduce its emissions of carbon dioxide. First, after the Kyoto protocol in 2005, the Chinese government launched the first carbon reduction plan with the China Certified Emission Reduction scheme (CCERs) which awarded investors in greenhouse gas reduction projects with carbon credits that could be traded on the market. From 2006 to 2014, 60 billion yuan worth of CCER were exchanged between green investors who received them from the government and polluting companies who had to buy these credits from green investors (Xeero.io, 2022). This scheme was supposed to take place on a voluntary basis to promote the development of clean energy. China continued its emission reduction plan in its next 5 years policy by implementing the emission trading scheme in 2013 focusing on the 7 key regions of Beijing, Shanghai, Tianjin, Shenzhen, Chongqing, Guangdong, and Hubei. Fujian was later also added to the emission trade pilot cities (Huang & al., 2022). These 8 regions represent 42% of China’s carbon emissions and 9% of worldwide emissions in 2008 (Kong & Freeman, 2013). The ETS is focused on the energy industry which is responsible for 40% of national emissions (National Energy Administration 2021). In July 2021, China launched its national ETS which applies to the whole country’s energy sector and covers more power plants than the pilot.

2.2- The choice of an ETS over other options

An ETS presents advantages and disadvantages. It is advantageous since an emission trade is a market-based solution that incentivizes companies to invest in GHG reduction projects and reduce their overall GHG emissions to facilitate and accelerate the transition to the green of the country. An ETS is also more easily accepted by industries and is known to affect less economic growth than other alternatives, such as a carbon tax for instance (Qian, 2022). An ETS, contrary to a carbon tax, also enhances the development of new modern technologies and leads to innovation since companies can generate profits from carbon excess by selling it on the carbon market (Qian, 2022). An ETS is, however, complicated to implement. Since the national ETS is still at an early stage of development, there is a lack of information on the results so far, but the firms initially part of the pilot ETS saw its implementation as a threat to their financial performance instead of an opportunity for ecological transition (Jin & al., 2021). Indeed, many of them were big polluters who feared the additional costs involved to buy allowances and continued to produce without investing in renewable energy power plants. An emission trading system also requires adapted regulation and full carbon disclosure. China however faced criticism regarding its ability to accurately measure carbon emission level of each industry and the strictness of the regulations for carbon trading (Cong & Lo, 2017).

2.3- Chinese pilot ETS

For these reasons, China chose to implement in 2013 a mandatory ETS for companies within the boundaries of the initial 8 concerned regions. This scheme is applied exclusively to energy production This means that iron and steel, petrochemical, building materials, chemical industry, paper-making aviation, and non-ferrous metals industries which are also polluting are not covered by the trading scheme (Peng & al., 2021). Over 2100 entities were concerned by this carbon market. The goals of the Chinese ETS were both economic and sustainable. China aimed to reduce its emissions to reduce external pressure from developed countries during summits and the Conference of Parties (COP). Secondly, China is the biggest GHG emitter, thus creating a national ETS would allow the country to create the largest carbon market in the world and become the world leader in terms of emission exchange and be a major influence worldwide in terms of sustainable finance (Buckley, 2021). China also aims to reach a carbon peak by 2030, then gradually reduce its GHG emissions until becoming carbon neutral by 2060 thanks to the development of renewable energy and emission-free project development (Peng & al., 2021).

The development of such an ETS could also increase the influence of China on a global level. Indeed, since the country is the biggest polluter on earth, its carbon market also has the potential to be the biggest in the world's biggest carbon market. However, The ETS is currently reserved for the domestic market and allowances cannot be traded with foreign countries.

3- Environmental effects of the ETS

3.1- Goals and potential of the ETS

As mentioned before, the goal of Beijing is to reach a carbon peak by 2030, which means despite the ETS, the country is still planning to pollute more until this date to gradually reduce them afterwards. Setting caps is not an appropriate option for this strategy since it would mean allowing companies to pollute more than they currently are and lead to extremely low carbon prices which would not incentivize companies to develop more energy-efficient power plants. China adopted a “flexible cap” to take into account the output of the production in addition to its carbon emission (ICAP, 2021). This system allows China to still increase its energy production level without increasing its emissions by the same amount since companies should be more and more energy efficient. After 2030, the energy firms should have developed enough renewable energy plants to increase their production while decreasing their emissions. The second goal is to be carbon neutral by 2060, the country wants to achieve this goal by relying completely on renewable energies and completing carbon reduction projects.

3.2- What China has achieved so far

Between 2006 and 2011, China decreased its carbon emissions by 19%, which is a sign China is involved in GHG reduction (Kaiman, 2021). The Green Total Factor Productivity (GTFP) is an index that measures the economic growth of a country or province by taking into account environmental factors. It can measure green how green is the growth of a country. In the first year, the Chinese national ETS was launched, the GTPF went up by 11.4% (Li & al., 2022). Furthermore, the carbon emissions intensity decline rate increased by 7.3% in provinces part of the pilot ETS and by 4.9% in non-pilot provinces between 2013 and 2018 (Huang & al., 2022). The carbon intensity depicts the number of grams of carbon dioxide emitted to produce a kilowatt hour (Kwh) of electricity. The carbon intensity decline rate depicts the pace at which

carbon intensity is reducing, so the pace at which power plants are improved. The difference between pilot and non-pilot provinces indicates the positive impact of the ETS on carbon intensity and carbon emissions. One can thus expect a high carbon emissions intensity decline rate in the whole country in the upcoming years due to the implementation of the national ETS.

3.3- The negative impacts of the ETS

Despite all the above-mentioned positive impacts of the pilot ETS in China which are auspicious for the national trading scheme, some of its effects are negative or not as good as expected. Firstly, according to the Difference-in-Difference model, the pilot ETS could have reduced carbon intensity by 22% while they only reduced it by 7.3% (Zhang & al., 2020). thus, the emission trading scheme was not fully efficient. Furthermore, in certain non-pilot regions, the carbon emissions intensity decline rate was negative over the five-year timeframe (Huang & al., 2022). A negative carbon intensity decline rate shows that power plants became less energy efficient and emitted more carbon to produce a kWh of electricity. This can be interpreted as a high carbon intensity transfer from pilot provinces to non-pilot provinces to limit the potential costs generated by the ETS. Not only can this be harmful to the environment, but also the Chinese economy. Indeed, these transfers are not possible anymore due to the implementation of the national ETS, hence these more polluting power plants are now part of the trading scheme and will need to be replaced or improved to limit their emissions and reduce the costs related to carbon allowance purchase. It can also be seen as an underinvestment in non-pilot regions that will unbalance the national ETS. Lastly, the latest IPPC report was very alarming on the emergency of the climatic situation and emphasized the need for action and a fast change in behaviours. The Chinese ETS is focused on carbon intensity and does not reduce carbon emissions. Thus, the first quarter of 2021 was the highest carbon emission growth level recorded in China for a decade (Myllyvirta, 2021). This trading scheme cannot be considered a viable solution to reduce emissions in the short run.

4- Financial effects of the ETS

4.1- Valuation of stocks of traditional energy suppliers

In order to estimate the potential financial effects of the implementation of the Chinese national emission trading scheme. One can analyze the financial performance of the main Chinese energy firms after the implementation of the pilot ETS in November 2013. Looking at the S&P 300 China A energy index which gives an overview of the stock market value in the energy industry which decreased by 10.7% between November 2013 and November 2014 (*S&P China a 300 Energy (Sector) Index | S&P Dow Jones Indices*, 2022). During the same year, the S&P energy global increased by 0.11% (*S&P 500 Energy | S&P Dow Jones Indices*, 2022). Compared with national indices and international competitors, the French firm Total energy stock grew by 0.8% during the same period and Kansai Electric Power Company, one of the major energy suppliers in Japan whose share value increased by 2.4%. The Shanghai stock exchange (SSE index) increased between November 2013 and November 2014 by 30.64%. However, some of the main state-owned energy companies, Huadian corp., Huaneng Power International Inc. and Datang Power International corp. saw their stock value go up by respectively 47.6%, 21.1% and 5.6%. The growth of these massive GHG emitters continued until the SSE crashed in 2015 due to slow of the Chinese economic growth. The difference in growth between the overall Chinese power sector and the state-owned company is thus very large. One can thus presume that State-owned firms did not suffer from the financial effects of the emission trade scheme as much as privately owned companies. This can be explained by the fact these companies could have been more prepared and aware of the carbon reduction policy and the Chinese government and their relationship with the government may also lead to facilitated access to subsidies (Liu & al., 2016). The market overall seems less concerned about the financial effects of ETS on State-owned firms. The theory that State-owned firms are less financially impacted by the ETS is that according to their respective annual reports, these three companies were affected differently by the ETS. For instance, Huaneng Power International Inc. declared that the ETS increased operating expenses and could impair the financial performance, while Datang international power co. declared some income from selling carbon emission rights. In Europe, most companies which failed to comply with their allowance level saw their valuation go down. In this case, both companies' valuations went up while the energy industry trend was the opposite. This enforces the theory that State-owned companies are financially less impacted by the trading scheme.

4.2- Effect on sustainable energy firms

Renewable energy producers in China have also seen a dramatic increase in their share price since July 2021 after the launch of the emission trade scheme. For instance, China Renewable Investment ltd, a large investor in wind turbines saw its share price go up by over 44% between July 2021 and February 2022. Datang renewable power stock went up by 25.5% over the same period while the SSE index only increased by 5%. Ming Yang Smart energy group limited is a state-owned enterprise, and still, its share price benefited from the ETS and increased by 19.2%. Analyzing data after February 2022 would be irrelevant considering the conflict in Ukraine and the energy crisis. Such growth in the renewable energy sector can be partly explained by the implementation of the national ETS. But other factors did contribute to this outcome.

4.3- China's investments in renewable energy

Since 2014, China is the largest investor in renewable energy development according to the World Economic Forum. Indeed, the country invested 132.6 billion dollars in the development of renewable energy. In 2021, renewable energy capacity represented 44.8% of the whole Chinese power generation capacity (Yin, 2022). Renewable energy consumption accounted for 29.8% of the total Chinese consumption while it only represented 2.1% of the energy generated in 2012 and 5.3% in 2017 (WEF, 2018). This development of renewable energies to achieve their goal of reaching a carbon peak in 2030 and carbon neutrality in 2060 can be explained by government action. Beijing uses a feed-in-tariff system to develop investments in renewable energy. Feed-in-investment consists of paying prices above market prices to the renewable energy producer (Lin & Wesseh, 2013). The more expensive the production of a kilowatt of green energy is, the higher the price for it will be. This allows renewable energy producers to limit the additional costs related to clean energy production and to offer similar tariffs to their consumers. This method increases investment in renewable energy and helps to attract new investors since it reduces uncertainty related to renewable energy production due to the cost of power plants since most renewable technologies are relatively new.

4.4- National ETS effects

After the implementation of a pilot ETS in 2013, the stocks of the Chinese energy companies went down according to the S&P China A 300 energy index. However, some empirical evidence shows that the biggest state-owned companies' stocks were less impacted by the trading scheme.

In 2021, after the implementation of a national ETS, the energy sector market stock decreased, but less dramatically than in 2013. This could be explained by several factors. First, companies prepared more for the new legislation since they were expecting financial effects of the carbon market similar to 2013. These companies thus had more time to manage the resources necessary to reduce their GHG emissions or replace their power plants. A second explanation would be that investors are not afraid of investing in the energy market since the development of renewable energies. Since more firms try to reduce their GHG gas emissions and develop renewable energy power plants, investors are less likely to think ETS could generate additional costs for energy sector companies.

4.5- Limitations

The latter section of the report tried to identify the effects of the Chinese ETS on the stock market valuations of energy companies. This analysis was mostly based on the share prices of specific companies and indices. Thus, the share price of companies is influenced by a multitude of factors, some of the variations reported might have been caused by other factors than the ETS and be irrelevant. The Covid-19 crisis and the Ukraine invasion also affected the global market and particularly the energy sectors, limiting the analysis of the stock market during these periods.

5- Differences between EU and China ETS

Since 2005 and the Kyoto protocol, the European Union launched an emission trading scheme in order to comply with the reduction of emission policy agreed upon among countries. This Emission trading scheme has similarities with China, but also differences.

5.1- Prices

Firstly, the price of a ton of carbon on the market is much lower in China than in the European carbon allowance market. On the first of November 2022 after peaks at over 90€, a ton of carbon was priced at 76.72€ (79.42$), the same ton of carbon on the Chinese market was worth an average of 7.14$. With a price over 10 times lower. One can question the efficiency of the ETS system in China. Indeed, an underpriced ton of carbon on the market will not incentivize energy companies to reduce their carbon emissions. Low carbon price reduces the effects of ETS on

carbon reduction and is less efficient since there is a negative correlation between an increase in carbon prices and carbon emissions (Lin & Wesseh, 2013). However, Gross Domestic Product and carbon emissions reduction at the same time. Thus, a higher carbon price causes a decrease in both emissions and GDP. However, the negative effects of high allowance prices on GDP decline over time (Lin & Wesseh, 2013). One can assume that having relatively low prices at the introduction of the ETS would limit the impact and spread impact on growth over several years. EU allowance price was first set at 8€ and was in a range between 20 and 25 euros after a year. Thus, if one assumes that China ETS will follow the same path as Eu ETS, the carbon prices should rise over time to become more efficient in terms of emission reduction while avoiding dramatic effects on growth in a short period.

5.2- Cap and trade system

The EU ETS is a cap-and-trade system, which means companies participating in the trading scheme have a set amount of carbon they can emit. If their emission level is greater than their emission cap, they have to buy carbon on the market to pollute more (Oberndorfer, 2009). The Chinese system works differently since it is a "flexible cap" (Liu & al., 2016). Companies do not have a set number of tons of carbon they can generate, but a certain efficiency when they produce power. This system is based on carbon intensity, which is the amount of carbon emitted to produce a kilowatt. Contrarily to Europe, China does not try to set a carbon limit but pushes power firms to be more efficient and produce the same amount of electricity with fewer emissions of GHG, so improve their power plants over time. It encourages investment in more energy-efficient plants rather than a reduction of outputs.

5.3- Double counting of carbon costs

Another main difference between the EU and Chinese ETS is the double counting of carbon costs. In Europe, the costs linked to the purchase of carbon allowance are split between the power supplier and the end consumer through augmentation of energy prices (Zeng et al., 2018). The end consumer thus suffers od the indirect costs of carbon. In China, the energy price is an on-grid Tariff. It means that the energy price is more restricted (Zeng et al., 2018). Thus, if an energy producer needs to buy a carbon allowance, he must bear the entirety of its cost. On the other hand, the end consumer will also bear a carbon price. Thus, in China, there is a double

count of energy carbon costs. Both these systems incentivize companies and consumers to reduce their consumption and GHG emissions. However, since the Chinese system impedes power firms to increase prices, they need to bear the total costs of allowance which can be harmful to their financial performances and reduce their profit. Considering this factor, a lower price in China than in Europe for a ton of carbon seems justified since the cost is only applied for one agent instead of being shared between the energy supplier and the end customer.

6- Conclusion

To conclude, China implemented a national ETS that has a potential emission reduction power of over 20% compared to the 2020 emissions (Zhang et al., 2020). The implementation of this trading scheme was a long process with mixed results. Even though the carbon intensity decreased under the pilot ETS, 2021 was the year China emitted the most greenhouse gases in the last decade. Thus, one can question the efficiency of the ETS. However, Beijing aims to reach a peak in 2030, thus despite its high carbon emissions, this goal is still achievable. Furthermore, demographics in China and growing demand require a consequent production to match demand, so intensive GHG emissions. The launch of the national ETS seemed to have impacted less the stock valuations of main public energy companies. Thus, private energy companies suffer more of the consequences of the ETS.

European ETS, which reached a mature stage and is one of the world's most developed seems to have a similar negative financial effect on companies that fail to stay within their allowed emission level. The respective markets of the two ETS reacted differently to the trading scheme since both systems are different and were implemented at different periods, however, thus, the financial effects of European ETS and Chinese ETS do not seem to generate similar reactions of the market. The European ETS seems to negatively affect companies which have an excess of allowance while Chinese ETS has a greater negative financial impact on private firms. The ETS and China policies in general seems to help the development of sustainable energy with subsidies and Feed-in investments in renewable energy firms.

Considering the factors mentioned in this report, different scenarios are possible. The first one would be the negative impact of the Emission trading scheme on companies' finances and the environment because of the carbon low prices, which would represent a harmful expense for profitability, but insufficient to incentivize the development of environment friendly power plants. Another scenario would be a positive effect if the price of carbon is sufficiently high to

incentivize companies to develop clean energy. No carbon taxes or any environmental incentive would be necessary and Chinese companies would increase their profit.

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