Local Climate Governance and Policy Innovation in China:

A Case Study of Piloting Emission Trading Scheme in Guangdong Province

Abstract:

This paper investigates how piloting programmes in China can promote local policy innovations. By using one of the piloting emission trading scheme (ETS) in Guangdong province as a case study, we argue that the main features of the piloting experiments, particularly in the climate change domain, are largely different from previous local marketisation experiments that dominate the reform period of China. Whereas previous experiments are often characterised as bottom-up or indigenous initiatives with strong patronage relations to the pro-reform politicians at central level, the current piloting programmes are often crafted in a top-down fashion that is often misaligned with local market or corporate interests. Hence, local policy innovations are designed, developed and brokered by the local state officers in order to bridge this central-local interest gap. As a result, successful implementation of these policy innovations largely depends on local political traditions, bureaucratic culture, and perceptions of distinctive development needs.

Key words: Policy Experiments, Policy Innovation, Emission Trading, Carbon Markets, Climate Governance, Climate Policy, China

1. Introduction:

As the largest greenhouse gases (GHG) emitter in the world, China announced an ambitious plan to curb its soaring emissions at the Paris climate change conference (COP 21) in 2015, pledging to peak its emissions by 2030. One of the key instruments it intends to apply to achieve this target is a nation-wide carbon trading system to be in place by the end of 2017. Prior to this announcement, seven piloting emission trading schemes (ETS) had already been launched since 2013, including 5 major cities and 2 provinces across the country. In this regard, the lessons learnt from these local piloting programs can inform the successful implementation of national climate change strategy (Han et al, 2012). Since their launch, the seven piloting ETS programs have been accumulating practical knowledge and experience on establishing legal and institutional frameworks for governing arguably the largest carbon market in the world. Such efforts would also contribute to setting up a comprehensive database for the measurement, registering, reporting, and validating of GHG emissions across various industries, as most of their carbon emissions have been poorly managed to date. The expectation is that carbon markets will also help to enhance corporations' awareness of climate change and their skills in managing carbon assets (Liu et al, 2015; Lo, 2016; Shen, 2015). In general, these local policy experiments in relation to ETS and a wide range of newly emerged institutional or policy innovations are expected to resolve many technical and institutional challenges of applying a market-based governance instrument in a rather centralised political economy (Lo, 2013), and consequently to provide a solid foundation for the future establishment of a national-wide cap-and-trade system (Zhang, 2015). Therefore, it is fair to argue that although the creation of carbon market and piloting trading programmes is a result of top-down political ambition, the implementation is a typical bottom-up approach where local innovations play a crucial role to its success.

However, little is known regarding why and how the local policy innovations emerged within the local ETS experiment and what implications this has for climate governance. Empirical studies reveal that in many respects these piloting ETS programs developed highly contrasting institutional arrangements and regulatory frameworks (Qi et al, 2014; Wu, 2015; Zhang, 2015), ranging from the scope of industries to be included within the ETS, the allocation of the emission allowances, the emissions measurement and validation process, to the penalty system for non-compliance corporations. The diversity in the policy innovations in the piloting phases represents tremendous differences of economic context, public-private relations, and interest configurations among key governance actors in these piloting areas, which impose significant challenges for the central government in 'handpicking' successful experiments in the construction of a national ETS. In this paper, we seek to understand the key factors that lead to the policy innovations via a case study of one of the piloting ETS programs in Guangdong province. Based on a series of in-depth interviews with the stakeholders involved in regulating or participating in the current carbon trading activities in this area, plus intensive analysis of existing policy documents and regulations, the paper intends to answer the question of what actors and interests are driving local policy and institutional innovations during the piloting phase of ETS, and what are the implications for China's climate governance in order to meet its ambitious emission reduction target by 2030.

The paper is constructed as follows. In section two, two rather separate groups of literature are reviewed regarding studies of China's tradition of local policy experiments and studies on multilevel climate governance experiments. The literature review aims to situate the case study in relation to the broader academic debate about climate governance and market instruments. Section three provides a historical and contextual account of Guangdong province's ETS experiment, focusing on the distinctive features of the locality as a long standing pioneer of economic and marketised reforms in the past three

decades. Section four presents the key innovative policies and policy changes adopted by Guangdong's provincial government to promote and regulate ETS. The analysis is carried out to understand the dynamics behind the emergence of these policies and changes. Section five provides a discussion of the empirical and theoretical implications of Guangdong's innovative efforts to regulate its ETS pilots. Section 6 concludes with a summary of the key findings.

2. Local climate governance and policy experiment: a review of literature

Two bodies of literature are highly relevant to this study. On the one hand, there are a large number of case studies regarding local policy experiments in China's post-Mao reform era. Most of these studies choose a specific policy area or piloting programme during China's economic reform era as the cases for analysis, and aim to explain how local institutional innovations are developed and then adopted in later national policy processes. It is noted that the recent pilot ETS programmes have also attracted many scholars to add to this literature. On the other hand, there are a handful of studies focussed on experimental climate governance instruments across various geographies. Researchers have considered how market instruments and other instruments or initiatives led by non-state actors can be conceptualised as a replacement or complement to the state-led climate governance approach (Okereke et al 2009; Bulkeley et al 2014; Hoffman 2011) including as part of a broader climate 'regime complex' (Keohane and Victor 2011). This paper argues that it is important to situate the analysis of China's ETS experiment in relation to these literatures because the experiment with market instruments through a cap-and-trade system is simultaneously a continuation of China's tradition of local policy experimentation, and a significant part of decentralised and fragmented experiments in governing climate change around the globe.

2.1. China's distinctive policy process of local policy experiment

There is a considerable amount of literature focusing on the role of local experiments and institutional innovations during China's economic reform era (Chien, 2007; Heilmann, 2007 and 2008; Naughton, 1994; Zhang et al, 2004; Zhu, 2012). These studies discuss the role of 'indigenous but centrally controlled' local experiments on a wide range of policy issues in pushing forward China's economic transition from a centrally planned economy to a more market oriented one during the past three decades. They reveal that policy experiments at local level, usually in the name of piloting programs and experimenting (shidian 试点), form an integral part of China's economic policy and therefore have a long history in China (Heilmann, 2008a). Their main purposes usually include creating political spaces for marketisation reforms albeit within a tightly controlled socialist ideology and political structure, and finding generalizable experience that can be applied by national policy making processes (Heilmann, 2007; Zhu, 2012). According to Heilmann (2008b), the general pattern of this policy process can be generalised as in *Figure 1*:

From the above figure, two distinctive features of China's local policy pilots should be noted. Firstly, most of initial ideas for local experiments were based on indigenous novel economic activities at the local level that aim to enhance local living standards and welfare (Chien, 2007; Zhu, 2012). Secondly, such activities are pushing the boundary of economic transition towards a more market oriented economy, and hence may often face political resistance from conservative officers at the central level. Therefore, pro-reform political leaders often explicitly or implicitly endorse piloting programmes as a test to break through institutional and ideological inertia and legitimise these innovative practices based on the outcome of the experiment. Patronage relationships are therefore important to advance such experiments (Heilmann, 2008b; Naughton, 1994). Most of the local experiments were concentrated on economic policy domains, and there are a large number of case studies of local reforms and

innovations in the policy areas of land ownership (Ding, 2003; Zhu, 1999), marketising housing schemes (Zhu, 2012), developing private enterprises (Young, 1995), reforming state-owned enterprises (Oi, 2011; Warner, 1996), and developing China's stock market, since these are the frontline areas for economic reforms. However, there is an increasing number of studies showing that this distinctive policy process of local policy experiments is spreading to other non-economic sectors (Florini et al, 2012), including the newly emergent environment and climate change domain. Research on some of the early experiments in these domains, such as the piloting initiatives for SO_2 emission trading schemes and low-carbon provinces and cities (Lu, 2011; NDRC, 2010; Tao and Mah, 2009; Wang et al, 2015), reveals rather limited achievements and tremendous challenges around transferring this local piloting process into the environmental and climate governance areas (Khanna et al, 2014; Lo, 2013; Xu, 2014).

2.2. *Market instruments as a form of experiment of non-state climate governance*

Beyond the unique history and experience of market mechanisms in China, there is a broader and growing literature on how best to understand the emergence, form and diffusion of carbon markets within a broader historical context of neo-liberalism and what has been referred to as a finance-led regime of accumulation (Paterson, 2012; Newell and Paterson, 2010; Parr, 2012), whereby solutions to the climate crisis inevitably bear the hallmarks and seek to serve financial actors that are increasingly powerful and important to securing growth in contemporary capitalism. Other work looks at the detailed practices of market-making: the methodologies, practices and assemblages required to bring markets into being from the construction of elaborate accounting methods to enable commensurability to allocating property rights and governing markets (Lane, 2012; Lovell and MacKenzie, 2011).

Considerable attention has been paid to explaining the rise of non-state climate governance or what has been labelled 'transnational climate change governance' (Bulkeley et al, 2014) providing typologies of the origins, form, financing and types of collaborations, networks and partnerships that have been emerging alongside, but often supplementing, the global climate regime (Hoffman, 2011). Focussed on the uneven diffusion and adoption of market instruments around the world, there is also a literature on 'varieties of carbon governance' (Fuhr and Lederer, 2009; Newell, 2009). This includes case study analysis of different countries experience of carbon markets to date, including China (Schroeder, 2012). This is in addition to a broader literature on the politics of carbon markets (Stephan and Paterson, 2011; Lane and Newell 2016), covering both their pre-history and the politics of their emergence as a preferred way of responding to the challenge of climate change, as well as efforts to move beyond this framing of viable alternatives (Stephan and Lane, 2015).

Our case study here speaks to a number of these debates by illustrating the actors, networks, institutions and processes that brought an ETS scheme into being in China. We explore what this reveals about the process of 'making' a market in one of the world's most powerful economies and a key contributor to greenhouse gas emissions. As well as offering an empirical analysis of initiatives aiming to address climate change, therefore, it also provides an interesting case study of how China's unique political economy creates carbon markets.

3. Implementing ETS experiment in a vanguard province for economic reforms

Guangdong (formerly Canton) is a coastal province of southeast China, borders Hong Kong and Macau, and is home to over 107 million in 2014. Guangdong province is best known for its vanguard status and as the heartland of marketization experiments in China since the beginning of Deng Xiaoping's 'reform and opening-up policy' (改革开放政策) in the early 1980s, even though piloting

programs and policy experiments have a long history throughout the history of CCP's rule (Heilmann, 2008a). Many pioneering reformist policies were first introduced in Guangdong before being adopted at national level. For example, one of the most significant marketised policy experiments is the establishment of the so-called four 'special economic zones' (SEZs) in 1979, among which three of them are located in Guangdong province (namely Shenzhen, Zhuhai and Shantou). Later in 1985, the SEZ experiment was further expanded to the provincial level in Guangdong under the banner of 'the Pearl River Delta Open Economic Zone'. Within these SEZs various flexible measures were designed for promoting the market economy, ranging from the market based pricing system to tax havens for foreign investments. The results of these experiments are remarkable. Prior to these reforms Guangdong's per capita GDP was lower than the national average, but since then Guangdong has become one of the most highly developed provinces in China with much higher per capita GDP compared to the national average throughout the reform era (Figure 1). In 2015, its GDP reached 1170 billion USD, accounting for over 10% of the country's total annual GDP. Consequently, Guangdong is generally seen as a showcase for the success of the economic reforms, with the highest level of marketization among other provinces in China. Its leaders are also well known for their enthusiasm and dedication to pursue innovative ideas to deepen the market reforms.

Despite Guangdong's vanguard position in bottom-up policy innovations for economic reforms, its environmental governance for pollution control and cleaner production is largely in line with a traditional command-and control system. The central government decides the major targets for the reduction of the overall energy intensity of industrial outputs and the appropriate limits for specific pollutants, and local officers' task is to make sure these targets are met. For example, during the period of 12th five year plan (2010-2015), the energy intensity for GDP and industrial output in Guangdong was required to be reduced by 18% and 21% respectively, which major pollutants like SO_2 and NOx to be reduced by 15% and 17%. All these top-down targets were met by quite a margin by 2015 (Guangdong Government, 2017). Although the command and control mode of governance appears to be effective, it has serious flaws in terms of its rather weak enforceability and capture by vested local interests (Kostka, 2015). Some of these targets are met only due to the shut-down of factories in the face of pressure from central government, but also because of technological upgrading in heavy polluting and inefficient industries. In addition, the fragmentation of the local regulatory system is another source of the chaotic implementation of environmental regulations, as cleaner production is largely regulated by the Ministry of Industry and Information Technology (MIIT), while the pollution targets are supervised by the Ministry of Environmental Protection (MEP). As a new governance area, climate change and GHG emissions are under the regulatory purview of the National Development and Reform Commissions (NDRC). As a result, the institutional design of governing climate change is developed in a rather parallel track with existing governance structures for cleaner production and pollution control.

As a result, the piloting ETS program represents a departure from previous policy experiments that focussed mainly on promoting economic growth within the region, or traditional environmental governance. In addition, policies targeting controls on emissions are often believed to have constraining effects on economic development amid claims that the output and welfare losses under cap-and-trade scenarios are significantly lower than in other mandatory emission control instruments (Hübler et al, 2014; Wang et al, 2015). Therefore, it is interesting to explore whether experiments like this ETS are supported by local public and private actors just as other pro-growth policy experiments were previously. The field study indicates a positive reaction towards ETS from most of the stakeholders interviewed, particularly among public actors and government officers. This is mainly because, like many other highly industrialised provinces, Guangdong faces tremendous challenges to rein in its

soaring energy consumption, air pollution and GHG emissions. In 2010, the provincial government announced its target to decrease its energy intensity (units of energy consumption to produce one unit of GDP) by 45% from 2005 level in 2020 (Guangdong Development and Reform Commission [GDRC], 2010). The introduction of ETS has then become an integral part of the policy mix to achieve that target due to the co-benefits it may produce to alleviate air pollution and produce energy saving (Cheng et al, 2015), even though most corporations were not very familiar with the concept of carbon trading when it was launched in December 2013.

4. *Overview of the design and construction of GD-ETS*

Among seven piloting ETS programmes, Guangdong and Shenzhen ETS are both located within Guangdong province. This is mainly due to the bureaucratic struggle as the political leaders of Shenzhen city insisted on having an independent ETS due to Shenzhen's rather distinctive economic and industrial structure compared to the rest of the Guangdong province. The launch of the GD-ETS was based on a rather short period of preparation work started in September 2012, when the provincial government released the guidelines and the implementation plan of the GD-ETS. Meanwhile, a dedicated carbon trading exchange, China Emissions Exchanges (CEEX), was established. After a year of intensive capacity building and training programs between 2012 and 2013, the first detailed plan regarding the distribution of emission allowances were released by the direct regulatory institution, GDRC in November 2013. In December 2013, these allowances were allocated via CEEX. In January 2014, the Guangdong government released the measures to regulate the operation of GD-ETS. The initial policy institutions and frameworks were established by then (see Appendix 1 for a summary of key policies and their main contents for the governance of GD-ETS). By 2017, GD-ETS had traded 158 million tons of CO_2 equivalent with total value of 3.72 billion RMB yuan (or 548 million USD), which takes over 35% of the total trade volume and market value of seven piloting programmes (Figure 2). GD-ETS hence is the largest carbon market among all the piloting localities.

The design of any cap-and-trade system from scratch is a highly complicated undertaking as the literature highlighted above on market-making illustrates clearly. The building blocks of an ETS normally include the scope of industries to be covered, cap measurement methodologies, the allowance allocation mechanism, the MRV (monitoring, reporting and verification) system, compliance and penalty measures, and in some cases offset mechanisms. On top of these operational elements, a dedicated regulatory framework needs to be established. It should be mentioned that the basic infrastructure of Chinese ETS piloting programmes appears to be largely identical, since the design is mainly borrowed from the EU-ETS models. Our fieldwork also illustrates that experts from EU countries played a significant role during the preparation and initial stages of constructing the GD-ETS. However, in order to make sure the borrowed blueprint fitted with the actual local context, Guangdong province has implemented a series of innovative adjustments to almost every aspect of the ETS construction.

4.1. *Coverage and scope of capped industries and enterprises*

What type of activities and enterprises should be included in the cap-and-trade is the first challenge that designers of an ETS system needed to address. Each industry would need different methodologies to measure and report its emissions and some of these methodologies can be highly complicated and costly to design. Although the general policy goal is often to include as many emitting entities, choices need to be made based about the feasibility of doing this. Guangdong therefore chose four heavy industries (cement, electricity, steel, and petrol chemistry) to be included in the ETS experiment. All the enterprises with annual emissions over 20,000 tons of CO_2 equivalent in these four industries (currently 186 enterprises) are included, covering around 55% of total emissions in the province. GD-ETS has a

conservative approach to cover only the core emission industries with easier methodologies to measure and report emissions and the number of enterprises included in GD-ETS is considerably fewer compared to other piloting ETS. But this conservative approach ensures that appropriate methodologies are applied for measuring and calculating the emission cap, which is believed to be crucial to the operational stability of ETS at the initial stage. Meanwhile, Guangdong has been carrying out research on the methodologies for measuring GHG emissions in industries like ceramics, textiles, nonferrous metals, pulp and paper, building, logistics and transportation, and plastic chemistry.

One distinctive element is that the majority of corporations within these core emission industries are state-owned enterprises, which represent Guangdong government's ambition to be a leader in the Chinese ETS experiment especially around the issue of how to encourage SOEs' emission reductions via market instruments, since SOEs are much less sensitive to the market signals and more keen to respond to political pressure (Shen, 2015). On the contrary, private companies are often smaller in size and more vulnerable to external policy changes. In addition, awareness among private companies of the potential for emissions reduction can be lower than for large SOEs. Therefore, the Guangdong government decided to encourage SOEs to enter the ETS experiments first, reflecting its rather distinctive protective tradition towards private and foreign enterprises.

4.2. *Cap on emissions: measurement and adjustment*

One of the common challenges for all the ETS designers in China is how to determine the caps, because China has not yet set any absolute targets for its emissions and neither have its local provinces. The most commonly seen targets are expressed in carbon intensity (the units of carbon emission to produce one unit of GDP) in national and local economic plans. The methodological challenge, therefore, is how to translate carbon intensity targets into the absolute emission caps for the industries to be included in the ETS. Basically, there are two alternatives given this background: set an absolute cap but allow it to increase based on the GDP rise, or make an intensity-based cap (Jiang et al, 2014). In the case of Guangdong, the 12th Five Year Plan (2010-2015) proscribed a 19% carbon intensity reduction by 2015 compared to 2010 level (People's Government of Guangdong Province [PGGP], 2012). Based on this overall target and other industrial development plans within the province (reflecting a more top-down approach), combined with the historical emissions and average technological level of a given industry (embodying a more bottom-up approach), the absolute emission cap was worked out.

Theoretically, there are two major problems for this methodological approach to determine the emission caps. First, the projected industrial output based on the historical figures can be highly inaccurate due to the economic fluctuation or other external factors. Second, the new production capacities added to the ETS each year can be hard to measure given the boundary and unit of measurement is corporations and enterprises, not individual facilities. Therefore, in the policy design, additional allowances are created and retained by the regulators, both for the new industrial facilities and for the adjustment purposes if market fluctuations are higher than expected (Table 1).

One of the special features of GD-ETS is the flexible, transparent and cooperative approach adopted in determining its total emission cap. Capped enterprises are allowed to issue complaints regarding the methodology and provide suggestions for improvement. As a result, over 60% of capped enterprises raised complaints in 2013, and their opinions are largely incorporated into the final design of methodologies. During these interactions, surplus allowances were found (over 16 million tons of CO_2 equivalent) and collected from 61 enterprises, and insufficient allowances among 44 enterprises (around 4 million tons of CO_2 equivalent) were re-supplied by the government.

4.3. *Allowance distribution and allocation*

GD-ETS is the only piloting programme so far to insist on a combination of free allocation and an auction system for the allowance distribution. Theoretically, an allowance auction is the best way to identify the proper price for carbon emissions, which is the one of the basic objectives for the ETS experiment. But in reality, due to the resistance of the capped enterprises (as auctions will inevitably increase the cost to compliance), no other piloting ETS tried the auction option as systematically as GD-ETS. In 2013 and 2014, altogether 19 million tons of allowances of CO_2 equivalent were distributed via auctions. As expected, the auction system was initially resisted by the capped enterprises, arguing that it would generate a profound impact on their cash flow. The argument is particularly acute when they are requested to purchase 3% of total auctioned allowance before acquiring the 97% of free allowances. This 'compulsory' auction approach was abandoned in 2014 and replaced by a more flexible approach. The companies are allocated with the free allowances first (ranging from 95 to 97%) and then given the autonomy to purchase the rest of the allowances either from the primary or secondary market. Such policy adjustments are particularly welcomed by the cement and steel industries, which face tremendous economic difficulties and claim they cannot afford lump sum payment of auctioned allowances. As for the revenues generated from the auctions, Guangdong's NDRC established a dedicated low-carbon development fund for supporting low-carbon technology upgrade and innovation. The first trench of the funding amounting to 600 million RMB yuan is now available for low-carbon investment.

For the allocation of free allowances, GD-ETS also exhibited a progressive approach that gradually replaced the historical approach to the benchmark approach to determine the allowance cap. The historical approach, namely projecting future emissions on a capped enterprise based on its previous emissions during a certain period of time, can be notoriously inaccurate. The macro-economic or industrial performance can be highly unstable and fall out of the projected trajectory. In addition, an historical approach can be unfair to those companies who already embarked on mitigation activities prior to the introduction of ETS, and discourage enterprises who wish to do so. However, an historical approach is a convenient choice for the regulators for its simplicity in operation and hence becomes a most common approach for most of the piloting ETS programmes. Set against the historical approach is the benchmark approach, namely to use certain products, technology and process as a baseline emission scenario for the given industry and allocate allowance accordingly to each enterprise. Such methods are obviously more stringent for enterprises with out-dated technology or production processes. However, setting appropriate benchmarks is technologically challenging and needs more accurate emissions data, which is hard to acquire at the initial stages. GD-ETS' strategy is to apply both approaches at the beginning, but as more data are available more baselines of capped industries are developed and the benchmark approach has become more widely adopted. In some industries, such as cement and electricity generation, more than one set of baselines are developed.

4.4. *MRV and carbon accounting*

Accurate and authentic emission data is the prerequisite of any cap-and-trade system. GD-ETS established a comprehensive and stringent MRV system with relatively high technical and managerial standards. It appointed 29 independent, third party MRV entities from across the country to undertake MRV activities for the 190 or so capped enterprises. These activities are paid for by the provincial government to avoid fraud and deception that often arise when MRV activities are paid for by the capped enterprises themselves. In addition, constant trainings for the validators are organised to ensure their competence for various methodologies and industries. Since 2016, a dedicated

independent evaluation agency was established to review the MRV works randomly and to prevent fraud. The MRV results and emission reports are intensely monitored and constantly inspected under this institutional arrangement and the validators that are not meeting these standards are denied future MRV contracts. Recently, several validation companies were warned about the poor quality of their work and will be put on the black list if they fail to enhance their performance.

Another challenge of regulating MRV activities in China is that most of the MRV works are carried out on the basis of a company, rather than on a project or facility basis as often seen in other major ETS around the world. This is because the emission data on individual facilities such as power plants or industrial factories are rare and hard to acquire. But several pilot ETS, namely Shanghai, Beijing and Guangdong, managed to include newly built facilities into the scope of MRV, which significantly enhanced the accuracy of the validation reports. Lastly, it should be noted that most of the MRV expertise and professionals in China's carbon markets were developed to serve the CDM (Clean Development Mechanism) market in the form of DOEs (Designated Operational Entities) or project developers. Hence the large majority of these entities are based in Beijing and Shanghai. Guangdong province is relatively short of MRV expertise. Therefore, its regulators believe that stringent and specific MRV rules and guidelines would be helpful to cultivate its own carbon expertise. Such a policy goal is largely being achieved as the number of local MRV entities has increased in the past few years.

4.5. *Regulatory and market infrastructure*

GD-ETS is operated within a comprehensive regulatory framework (see Figure 4). Three distinctive features can be noted form this framework. First, top provincial leaders are involved and in charge of the top level institutions responsible for climate change and emission reductions. The provincial governor, the executive vice governor, and the head of Guangdong DRC, all have specific responsibility according to this institutional framework. Such arrangements exhibit the strong political commitment from the provincial leaders to tackle the problem of climate change, which urges lower level officers to treat the issue seriously. Second, a dedicated and permanent regulatory department, namely the Division of Responses to Climate Change, was established within Guangdong DRC to coordinate, supervise implementation, and regulate the emission reduction activities across the province, including the newly established ETS. Among all seven piloting localities only Hubei and Guangdong established such dedicated and permanent institutions for climate change issues. The field investigation revealed that such an arrangement is highly beneficial as dedicated climate officers often have a vision and ambition for the long-term growth of the carbon market, and are less likely subject to short term or instrumental interests, such as trading volume or market size.

It is also noted Guangdong's regulatory frameworks for its ETS is highly collaborative with non-state actors, particularly with the local academics and think tanks. During the preparation stage of GD-ETS, many academics were invited to join the policy design and evaluation works with the state officers. After the GD-ETS was launched, some of these academics were temporarily transferred as secondment employees of Guangdong DRC's newly established Division of Responses to Climate Change. They work with the newly appointed climate officers together under the same roof and on a daily basis. Such close working relationships have even been legitimised as part of the formal institutional framework in the name of the GD-ETS working team. In addition, an Allowance Evaluation Committee (AEC) was established between climate officers, experts, and corporate stakeholders to oversee the process of allowance setting and distribution.

As for the market institutions, the major innovation lies in the creation of dedicated finance institutions aiming to vitalising the secondary market and promoting market liquidity. One of the biggest challenges

for the piloting carbon market is the very low awareness and willingness among the enterprises to participate in the carbon trading (Shen, 2015). In Guangdong, dedicated carbon financing institutions and asset management companies has been introduced into the market to lower down the barrier for trading in the secondary market. Regulators encouraged innovative financial transactions such as buy-back or mortgage deals so that the capped enterprises are allowed to sell or mortgage their carbon assets for the finance needed for low carbon technological upgrades. Consequently, the enterprises became more active and motivated in engaging the carbon market instead of trading permits only on the primary market before the cut-off date for the obligatory purposes.

Another nascent institutional development is related to the on-going reforms of China's electricity sectors since 2015. Although China has gone through several rounds of electricity sectoral reform in the past two decades with mixed results (Andrew-Speed, 2012), the recent restructuring focus has been the marketisation and privatisation of the sales department of state electricity utilities. In Guangdong alone, there are over 280 newly established companies dedicated for electricity sales and trade after the reforms takes off, and some of them exhibited tremendous interests in integrating electricity and carbon trading activities. Electricity sector is the largest segment of GD-ETS, and the closer linkage between the two markets would attracts more electricity utilities into the secondary market. However, it impose new challenges regarding the previous regulations on indirect emissions and baseline scenarios as explained in previous sections, which needs to further regulatory adjustment.

4.6. *Major outcomes of the local policy innovations*

By 2016, Guangdong has become the largest and most active piloting ETS programme in China both in terms of its trading volume (23.34 million tons of CO_2 equivalent) and market value (around 42.5 million USD) (see Figure 5). The carbon price remains stable between 1.47 and 2.2 USD, without the abrupt price turbulence noted throughout the trading years (see Figure 6), indicating that most of the policy innovations mentioned in this section have generated lasting and positive impacts on market performance. For example, the auctions for allowance in 2016 are well accepted by market actors with more enthusiastic participation from both energy utilities and financial institutions. The shocks and impacts of these auctions on market performance are minimal. The successful institutionalisation of the auction system for allowance distribution is arguably one of the most important lessons learnt during the piloting stage.

Another major achievement is from the wider adoption of the benchmark approach for counting the emissions of capped industries. By 2016, over 90% of the capped industries are using baselines rather than historical data for allowance setting. As described earlier, this benchmark approach seemed to be challenging at the initial stage amid fears it might deter some industries from being included in the ETS for their lack of appropriate methodology to set the baselines. Yet it appears to have enhanced the fairness and hence produce positive incentives among the capped enterprises to engage in carbon trading activities in the long run. Lastly, the intensive collaborations between state and non-state stakeholders helped to create a transparent policy environment. Guangdong ETS has an effective policy release and announcement system to prevent information leakage to the market. In general, these policy experiments show that while Guangdong had a slow start at the initial stage of market development, establishing sustainable rules for long-term market growth has paid off.

5. Implications for the local Innovations in GD-ETS experiment

In the previous section, the overview of the institutional and policy development of GD-ETS was presented. It was noted that from almost every aspect of the construction of a cap-and-trade

system, innovative measures were developed to facilitate the design and operation of the piloting ETS programme. In this section, the theoretical and empirical implications of these innovations are analysed.

5.1. Local experiments in non-economic policy domains

One of the major differences between piloting ETS programs compared to most previous local policy experiments is that it they constitute a non-economic experiment aiming to curbing carbon emissions in a cost-effective manner, whereas early experiments were usually developed to promote local economic growth. Therefore, most of the early local policy experiments were often economically driven and developed in a bottom-up fashion, and usually widely supported by the local stakeholders who wished to economically benefit from these marketisation experiments (Heilmann, 2008a). The political barriers for these early experiments are often not from the local level, therefore, but from the top and senior officers who are more sceptical or ambivalent about market oriented reforms for normative and ideological reasons. In such cases patronage within the higher level officialdom who support these local experiments is often crucial for the successful implementation of these experiments (Heilmann, 2008b).

However, when the piloting programs and local experiments moved into the non-economic policy domains, the power dynamics and interest configurations changed significantly. First, lacking obvious local economic benefits, it is difficult to win support for these experiments from local stakeholders. Taking emission trading as an example, China in the past decades has launched several piloting emission trading schemes for SO_2 in various localities but with little success (Gao et al, 2009). One of the reasons for these failures is the lack of enthusiasm among the capped enterprises to participate in the trading (Shin, 2013). As a result, the key to the success of piloting programs is no-longer determined by patron relations with top political officers, but by local willingness to embark on the experiments sincerely. Such a change of power dynamics is driving climate officers to design relatively benign policy or measures to attract enterprises into the ETS programmes, particularly at the initial stage of experiment. This is the main reason why most of the policy innovations around the crucial aspects of the ETS, such as allowance calculation and distribution, the penalty system and MRV, are not designed in the most stringent manner among most of the piloting localities across China. A balance needs to be maintained for local policy makers between meeting top-down political commands and accommodating and negotiating with local corporate interests.

5.2. Level of marketisation, local economic development and political culture

The attitude and preferences of local policy makers, caught between the divided interests of central officers and local business, have become crucial in shaping the outcome of innovative policy and institutional design. There are countless studies of China's environmental governance arguing that local government officials systematically prioritise local economic development and deter, often implicitly, the environmental regulations from the top (Eaton and Kostka, 2014), leading to the failures of this command-and-control model (Breslin 2007; Economy 2004; Ho, 2006; Mol and Carter, 2006). Such understandings, though accurately identified as the root causes of many environmental crises in China, have yet to capture the recent attitude changes among local policy makers under increasing pressure both from Beijing and local societies in dealing with daunting environmental challenges within their political domain in the past decade. In this regard, even the piloting of ETS as a market instrument may not fundamentally replace the previous 'command and control' mode of environmental governance in China, as other scholars

have pointed out (Lo, 2013). It may provide ambitious localities with the means to move towards more progressive and environmentally friendly institutional arrangements and policy frameworks out of the existing governance structure. The question is, therefore, what factors enable local policy makers to adopt a more pro-climate attitude rather than one more narrowly focussed only on growth?

Our field work reveals that, although in general local policy makers would not want to scare away enterprises by making and enforcing stringent rules, to some extent local governments did press business to comply with the requirements. In addition, the local economic and political context clearly affects the form, direction and nature of policy and institutional innovation. In this case study, Guangdong, as the forerunner of Chinese economic reforms, exhibited a rather strong ambition to establish a long-lasting and well-functioning ETS programme. At the outset, the provincial leaders and their climate officers were truly convinced of the urgency and necessity for Guangdong, a relatively affluent, economically developed, high-emission province, to treat climate change issues as a real and long-term challenge. Therefore, although ETS experiments are handed down from higher level officials in a top-down manner, Guangdong officers did not treat it as a mere political task, and its policy making is not purely motivated by pleasing the higher level officers. Instead, it focuses on its own needs for low-carbon transformation, and the policy design and regulatory frameworks are reconciled with the demand for long-term stability and securing benefits for the ETS and its future development.

Consequently, some relatively stringent policy innovations can be noted in GD-ETS, such as insisting on allowance auctions, efforts to develop complicated carbon accounting methodologies for various industries, preferring baseline approaches over historical approaches for allowance distribution, and adopting a rather stringent MRV system. All these measures are particularly difficult to get accepted by the business communities and consequently largely abandoned by most other piloting programs. Yet Guangdong implemented all these seemingly challenging measures in the belief of their long-term value for a well-functioned carbon market. These measures inevitably encounter resistance from business communities. But instead of compromising the policy design, the Guangdong government sought to mitigate this resistance by enhancing the flexibility of the policy, the transparency of governance, and through intensive communications with the stakeholders. For example, the allowance auction, as one of the most sensitive policy issues, has been fiercely deterred by the capped enterprises due to its impact on some companies' cash flow (Liu et al, 2016). These complaints were soon assimilated by the policy makers, however, to optimise the auction system for the next year (2014-2015), including adjusting the floor price and differentiating industries for the proportion of auctioned allowances. Meanwhile, since many capped companies are questioning the usage of the fund collected from the allowance auctions, a dedicated measure regarding the management of this fund was passed in 2014 to enhance transparency. Some of these policy alterations inevitably led to market fluctuations that received further criticism from some academics and market participants, but the policy learning process based on intensive communications between regulators and market participants proved to be valuable for the enhancement of the overall performance of GD-ETS in the long run.

6. Conclusion:

In this article, we provide an overview of the innovative policies, measures and institutional arrangements that were developed to construct, negotiate and implement a local piloting cap-and-

trade schemes in Guangdong province. Through this case study we argued that China's piloting programmes in the climate governance domain are very different to previous local experiments aimed at promoting economic growth. Pilot ETSs are implemented in a top-down fashion and therefore often encounter opposition from local business communities. Local governments are caught between the political ambition to address climate change issues from the top, and local business interests that are keen to maintain the status quo. Most of the policy and institutional innovations aim to reconcile this conflict of objectives (Shen, 2015). In this regard, the introduction of market instruments for climate change governance has not yet bridged the gap between policy making at the central level and policy implementation at the local level, which has long haunted China's environmental governance.

However, from the case study of GD-ETS we can also observe how determination on the part of local government to tackle climate change can strongly shape the outcome of innovative measures. This is a function of the emission and pollution profile of the locality, its stage of development and degree of marketisation, and the political culture among local bureaucracies. The comparatively stringent but transparent rules and institutions found in GD-ETS reflect this locality's urgent need for emission reductions and pollution control as a highly industrialised province, its relatively liberalised tradition and political economy, and more open minded regulators. Therefore, it would be challenging to generalise all these innovations when considering the construction of a national carbon market, because the economic and political contexts in other parts of the country are very different to those which prevail in Guangdong province. One of the key implications of this study is that besides the other challenges of constructing a national cap-and-trade system, such as lack of comprehensive legal frameworks, weak enforcement and under-developed MRV systems, and low awareness and wiliness to engage among enterprises (Lo, 2016; Zhang, 2015), this study points out another concern regarding the highly unbalanced development stages and variant political cultures and traditions across the country that will shape the performance of a united carbon market. Previously, no other regional carbon markets, including the EU-ETS, have had to face such dramatic political and economic differences among its members within the scheme.

To conclude, some of GD-ETS' innovation can be highly applicable to other highly industrialised provinces or cities with a relatively open political culture. Yet establishing an equally stringent and transparent system at nationwide level can be difficult when other provinces may not face the same urgent needs for emission reductions as Guangdong province. For some areas in China, poverty alleviation, industrialisation and urbanisation, and economic development remain at the top of political agenda, and many local officers are keen to adhere to the traditional corporatist culture (Dickson, 2008) to govern private sectors. In this regard, an internal separation between 'developed provinces' and 'developing provinces' in the national ETS can be helpful, when the industrialised and marketised provinces are required to contribute more for the emission reduction, and industrialising provinces can contribute by providing carbon offsets. Such an arrangement could draw upon the experience of Kyoto Protocol, which separates Annex-1 and non-Annex 1 countries with different roles. However, demarcating lines of responsibility among various provinces brings with it other political challenges.

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