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China’s development of ETS as a GHG mitigating policy tool: A case of policy diffusion or domestic drivers? [1]

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Abstract

China launched its national emissions trading scheme (ETS) in late 2017. This article examines the key drivers behind China’s 2011 decision to opt for ETS as a GHG mitigating policy tool and what lay behind the choice of the system’s design features. Given the existence of the frontrunner EU ETS and that market mechanisms have spread across the world in recent years, we analyse the role played by policy diffusion in the decision to launch an ETS and in the subsequent design process, seen in relation to domestic drivers. The article investigates policy developments culminating in the 2011 carbon market announcement, and the reasons these design elements were chosen for the pilot schemes and the national market in the period 2011–2017. The article contributes to our understanding of policy diffusion at different stages of policy development in China, by revealing which diffusion mechanism is more prevalent at different stages. We find first that overall domestic conditions and drivers had the most consistent impact on policy decisions to establish a carbon market and on the selected sectors. However, a second key finding is that the role of policy diffusion varied over time, with such diffusion, in the form of *ideational impact*, playing the most important role early on, providing a powerful inducement for China to go for a carbon market. Third, *sophisticated learning* from international projects took place in the pilots, allowing China to adapt policies and design features to match local conditions.

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Emissions trading has been adopted as a way controlling carbon emissions in many jurisdictions in recent years. The EU Emissions Trading Scheme (ETS) has a long history, but jurisdictions such as California, New Zealand and South-Korea have also adopted market mechanisms.[2] The 2015 COP21 Paris Agreement that entered into force on 4 November 2016 (World Bank, 2016; UNFCCC, 2016), provides an additional incentive for countries to pursue carbon markets by including provisions that can support market mechanisms, for instance through 'internationally transferred mitigation outcomes' (ITMOs) to meet Nationally determined contributions (NDCs) (UNFCCC, 2015, article 6; Stavins & Stowe 2017, p.1; Marcu 2016, p.5).[3]

China, whose energy-related emissions in 2014 constituted 30 per cent of the world's total (BP, 2015), has tended to favour command and control approaches; electricity prices, for example, are set by the state. China had mixed experiences with its SO_2 trading pilots in the 1990s and 2000s (Hart & Ma 2014; Tung 2015; Zhang et al., 2016). So it came as a surprise to some when China decided in 2011 to establish a carbon market as part of its 12th Five-Year Plan (FYP, 2011–2015), as a supplement to existing policies promoting emission mitigation such as energy efficiency and coal consumption reduction programmes, and renewable energy schemes/targets. Seven localized pilots began in 2013 and 2014 to gain experience for use in the envisaged the national ETS system which started in 2017 – as announced by President Xi Jinping during his 2015 state visit to the US (The White House 2015; NDRC 2017a).

Hence, this article addresses two key research questions: first, which factors and key drivers can best explain China's decision to choose ETS as a GHG mitigating tool? Second, as to the subsequent design of emissions trading in China both in the pilots and at the national level, which factors and key drivers can best explain the different design choices?. As noted by Knox-Hayes (2016, p. 190), 'All of the emissions markets have been influenced to one degree or another by the EU ETS'. Given the global spread of emissions trading in recent years, we home in on the extent and impact of policy diffusion in decision making and design processes in relation to various domestic drivers. Insofar as we already know that design choices, such as cap-setting and the establishment of price management mechanisms, are important for the effectiveness of such systems, what we now need to learn more about is how such design dimensions are shaped, not least in China. China stands apart from well-studied systems such as the EU ETS and its design choices and their performance have important implications for the global fight against climate change. Furthermore, we need to know more about learning efficiency and specific policy transfers, including how well the external advisory process has been coordinated. Lessons here can inform recommendations for other countries on their ETS development.

Having said that, there is already a certain amount of knowledge to build on. China and its carbon market, including the status of the pilots and the national market, have been examined by several authors (Cheng & Xu 2011; Duan et al., 2014; Hübler et al., 2014; Jiang et al., 2016; Liu et al., 2015; Zhang et al., 2014). Others have explored a specific pilot design (Jiang et al., 2014; Qi et al., 2014; Wu et al., 2014). While some researchers have investigated earlier experience of market mechanisms in China and their implications for the carbon market (Hart & Ma 2014; Tung 2015; Zhang et al., 2016), others have studied the companies participating in the pilot projects (Shen, 2015). Miao (2013, p. 2) discusses whether Chinese institutions are ready to incorporate policy of this nature, while Goron and Cassisa (2017) ask what China's regulatory institutions have done to implement the seven ETS pilots.

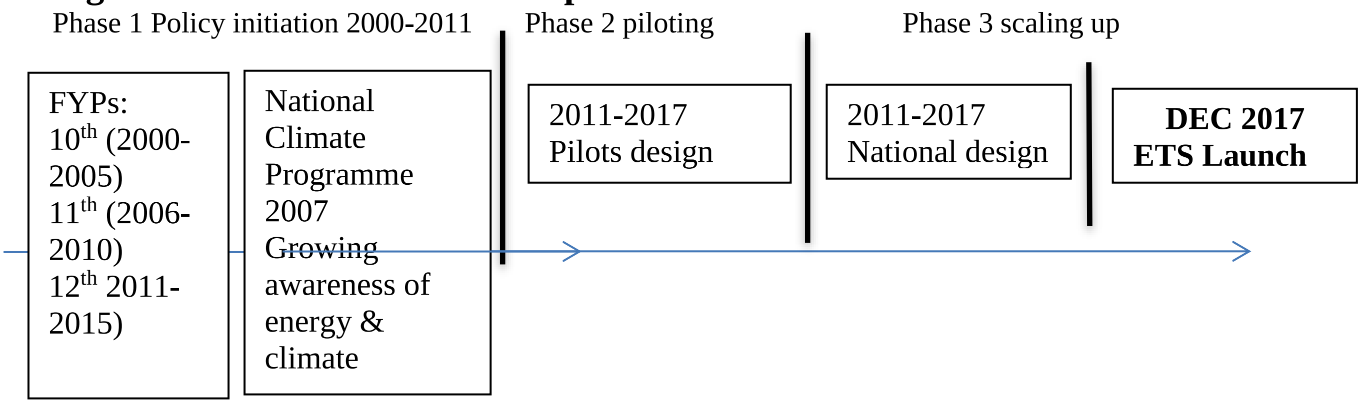
[2] See Wettestad & Gulbrandsen, 2015, for a discussion of different systems. See Bang et al., (2017) on California's cap and trade system.

[3] There are both market and non-market provisions in Article 6, see Marcu (2016) for more details.

There is less literature on the reasons for and drivers behind China's choice to establish a carbon market and, not least, its specific design elements Lo (2016) argues that as the largest emitter globally and having little say over global carbon governance, carbon sovereignty is a major reason for China to establish a carbon market (Lo 2016, p.106), though, does not discuss policy diffusion in relation to ETS establishment. In that respect, this article makes a novel contribution by considering the entire process of policy-making and identifying policy diffusion at various stages of policy development. According to some, current efforts to design carbon markets in China are informed by the country's experience of the Clean Development Mechanism (CDM) (Lo & Howes, 2014, p. 60), but they offer little evidence in support of their thesis. All the same, China's active engagement with CDM may have provided a more positive pull towards a carbon market, as discussed in section 3.1 below. How China acts on the emissions front has global implications. It is therefore not surprising that many international stakeholders offered to train officials and provide support as China's pilots and the national market system got under way. The question, however, is how influential this input has been.

We need to consider, Inderberg et al. (2017) argue, the temporal dimension in order to gain a deeper understanding of how diffusion and learning interact across the strategic and technical phases of climate policy development (p. 47). In line with this argument, we have divided the carbon market development process in China into three separate phases, though phases 2 and 3 happen in parallel (see figure 1). We have also attempted to identify which of the diffusion mechanisms is the more prevalent at the different phases (see table 3). Phase 1 is the policy initiation period. It started in 2000, the year the 10th FYP was initiated, leading up to 2011 when China decided to adopt an emissions trading scheme, and run the seven pilot schemes. Phase 2, pilot testing, lasted from 2011 to 2017and covers the formulation, design and operation of the pilot schemes. Phase 3, 2011 to 2017, covers the scaling up of ETS policy, including the development and specification of the national system

Fig 1. Case time-model for ETS pilots and national ETS



In the following sections, we examine policy diffusion before giving a chronological overview of each of the phases presented above. These empirical synopses are followed by a presentation of the relevant drivers and diffusion mechanisms we found to have an effect. In the last section we conclude and provide insights of more general application from the case to diffusion theory.

Research Design

The article makes use of qualitative methods and an inductive research approach to examine policy diffusion mechanisms in different phases of China's ETS policy development.

Evidence is culled from official statements and policy documents, supplemented by several rounds of interviews and communication in 2015, 2016 and 2017 with key stakeholders in China, including government officials, academics, consultants, experts, multilateral and bilateral institutions.[4] The article centres on the official policy decisions.[5] The data collected are key government policies, such as five-year plans, regulations and documents issued by the State Council and the National Development Reform Commission (NDRC) – the government agency in charge of the development of ETS in China, and local DRCs.

Diffusion and ETS development in China

Policy diffusion refers to policy innovation and spread of new approaches (Jordan and Huitema 2014a, p. 389). It is a process in which the decision-making party makes an 'interdependent, but uncoordinated, decision' (Elkins & Simmons, 2005, p. 35) regarding a policy others have pursued previously. The interdependency factor lies in that while the decision is autonomous and made without cooperation or coercion, it is nevertheless made in light of other governments' choices (Elkins & Simmons, 2005, p. 35).

Policy diffusion is also described as a process in which inventions enter into use through processes such as learning, transfer and adoption, indicating that an adopting actor adopts something new. (Jordan and Huitema 2014b, p.720). Policy diffusion studies have been said to be 'vitally important' because they reveal what is required to ensure that novel policies are taken up (Jordan and Huitema, p.729). Paterson et al. (2014, p.442) conclude that in order to understand the process through which the policies are adopted, it is necessary to understand 'the causal mechanisms for how ideas get transferred'. Policy-makers also need to review policies in response to environmental developments (Biesenbender & Tosun 2014, p. 425), and countries are likely to look to the international community for effective tools to mitigate, for instance, climate change (Stadelman and Castro, p 414). Stadelmann & Castro (2014, p.414), in their study, look into international diffusion of policies and the national adoption of renewable energy in developing countries, where they find domestic factors to be somewhat more dominant in the adoption of new policies (p. 419). Agenda setting processes are also relevant to policy diffusion, as analysed in Auld et al. (2014, p. 451). Maintaining a focus on events and international processes, they say, 'may be important in bringing an issue onto the agenda'. Moreover, coercion, competition, learning and emulation are key mechanisms in the movement of ideas, norms and policies across jurisdictions (Auld et al, p.414; Gilardi 2013). In order to zoom in on the development of the carbon market in China we need to take a closer look at what may trigger policy diffusion.

Diffusion can be seen as instigated by two types of trigger or pre-conditions. One type is *material consequences* (Underdal et al., 2015, p. 7). In this scenario, the decisions of one country's government will change the conditions for the government of another country (Elkins & Simmons, 2005, p. 39). This type of trigger produces an externality the Chinese government would need to take into account when making decisions. It also instigates two mechanisms of diffusion whereby the government adapts to the new situation. This can take the form of a *competitive* response with China perceiving the expansion of ETS around the world as a threat to its industries' international competitive edge, and therefore seeks to

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[4] The authors of this article speak and read Chinese and conducted interviews with Chinese stakeholders in their own language.

[5] Non-state stakeholders and think tanks are traditionally important sources of advice in the policy-making process in China (Wübbeke 2013; Li 2017, p.vii & p.11), advice that is fed into government-led research projects, policy discussions and reports that reach policy-makers. This is also the case for the carbon market where experts have played a central role in bringing information and knowledge to policy-makers. The article does not examine this specific aspect of the policy-making process.

design and operate a 'lenient' ETS system of its own.[6] But changes in *material consequences* can lead to a mandatory or *coercive* form of diffusion. Due to changes effected by other countries, such as prohibiting the import of goods produced without certified emissions and offsets, China would have no choice but to implement some form of ETS in order to continue exporting goods.

The other type of diffusion trigger can be seen as *ideational impact* or *learning*, a normative or cognitive influence on ideas (Elkins & Simmons, 2005, p. 42; Underdal et al., 2015, p. 7). If this type of trigger was in operation, then China will have adopted the ETS or certain design elements of which it had seen implemented by other countries, and seen as a good – or bad - option for controlling carbon emissions. Diffusion here occurs either as *simple emulation*, that is, 'clearly positive and somewhat uncritical assessments of the model chosen' (Underdal et al., 2015, p. 9) or as *sophisticated learning*, whereby the policy is evaluated, possibly with recommendations to rectify shortcomings of the model and improve aspects of it before adopting it at home (ibid.). Simmons et al. (2006, p. 787) provide a broader definition of diffusion that 'includes adjustments to national or local circumstances' that allows for *divergence* (Gulbrandsen et al., 2018, p. 17), a feature that is highly relevant to the present China case.

In determining the strength of diffusion, we look for possible references to the successes or failures of other models/design choices in official statements, as well as complementary information obtained from interviewees. We look at eight specific design features in the pilots (table 1) and the national scheme, insofar as these designs were made public at the time of writing.1) type of system chosen; 2) ambition level of national mitigation policies; 3) gases and sectors included in the market; 4) allocation mechanisms; 5) regulations for offsetting; 6) MRV (monitoring, reporting and verification) and enforcement; 7) price or quantity-focused management mechanisms; and 8) possible rules for revenue earmarking.[7]

Similarities between Chinese designs and existing carbon markets in other jurisdictions *may* indicate learning, but they could also be due to China taking a similar response to corresponding policy challenges (i.e. 'parallel play', see Bang et al. 2015). If, for instance, California and the US Environmental Protection Agency (EPA) had worked specifically on the Shenzhen pilot project, and the design similarities had more in common with California's design, it would suggest diffusion by *simple emulation*. If a policy is adopted, but certain design elements are rejected rather than improved and altered, it could be evidence of *sophisticated learning*. Here, interviews can help us decide whether the choices made can be seen as the result of diffusion or not.

It can also be noted that the pilots were set up to precisely with the purpose of learning lessons and gaining experience which the National Development and Reform Commission (NDRC) could feed into its design for the national market. We call this *internal learning*, but do not see it as policy diffusion as such.

Since it is unlikely in our view that policy diffusion is the only causal driver in the establishment and design of emissions trading in China, it will be necessary to scrutinize more closely domestic and other international factors in addition to policy diffusion since both could have had an important impact on design choices.

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[6] There's the possibility that border taxes levied on imports from countries without carbon control could also shed light on China's decision to establish its own carbon market. For more information on this discussion see Acuña et al. (2010)

7 For an elaboration of the design elements, see Underdal et al., 2015, pp. 5–6.

Turning then to domestic politics (either as factors mediating diffusion impulses or acting as independent causal forces) there are of course many ways to frame such an analysis. Here we take four broad sets of factors as points of departure for the analysis:

- The first set of factors comprises the fundamental economic, material characteristics of the jurisdiction (e.g. Harrison and Sundstrom 2010; Bang et al. 2015). Economic characteristics include factors such as natural resource endowments, the share of different fossil fuels in the energy mix, material infrastructure, industry structure and wealth.
- The second set of factors refers to the fit/misfit with existing policies, path dependencies and lock-in effects from existing policies (e.g. Pierson 2000). For instance, the well-known attempts of the EU to establish a carbon tax in the 1990s that failed due to unanimity requirements must be expected to have influenced the subsequent turn to emissions trading and the design of ETS. Here, also the possibility of what may be called 'internal learning' should be taken into consideration, i.e. how the effects of established policies may lead to revised policies and improved policies over time.
- The third set is directly related to government objectives and political processes. We consider the influence/impact of government (climate policy) objectives, party politics, political compromises and political events in policy accommodation processes (e.g. Knill et al. 2012; Biesenbender and Tosun 2014). This also includes growing awareness of the negative impacts climate change on China.
- The fourth set of factors refers to the domestic distribution of costs and benefits and the mobilization of affected actors (e.g. Olson 1965; Wilson 1973). We examine how domestic actors (utilities, energy-intensive industries and others) are materially affected by differing ETS models and alternative instruments (such as CO2 tax) and their lobbying and influence in the policy accommodation process.

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The development of ETS in China

Phase 1.ETS Policy initiation 2000–2011

Access to energy, largely coal, has been critical for the country's economic development and poverty alleviation in recent decades. With the rapid rise in total energy consumption, policy focused on optimising energy use. The 10th FYP (2000–2005) targeted energy saving and energy consumption in high intensity energy consuming industries, but the targets were not reached because of a surge in those industries' coal consumption (Andrews-Speed, 2012, p. 16; Li et al., 2011, p. 294). China's policy-makers became increasingly aware of the energy-related emissions and associated pollution and the 11th FYP (2006–2010) therefore continued to prioritise energy efficiency. It was thanks to extraordinary measures and an ability to overcome difficulties that some jurisdictions in China reached their mandatory energy intensity targets, and the national reduction in energy intensity reached 19.1 per cent (Heggelund et al., 2010, p. 235; Li et al., 2011, p. 294).

But the Chinese government also became aware in this period of shortcomings in the command-and-control policies and started to market mechanisms as a solution (interview 2; Lo 2016, p.55). Policy underwent radical re-alignment at the start of the 12th FYP period.[8] .

[8] This was further strengthened by the 18th Communist Party Congress in November 2012 (CCPCC, 2013, Deng, 2012; Zhang et al, 2016; Goulder et al, 2017). Here, social and economic reforms were given greater emphasis as more reliance was placed on market mechanisms as a governing device. The market was thus given a "decisive" role in allocating resources. In the wider policy context, this was very different from the previous control-and-command approach (CCPCC, 2013; Interview 2 & 16; Goulder et al.,2017)

The carbon market was not China's first encounter with emission trading mechanisms. China had made a start in the 1980s with the first sulphur dioxide (SO_2) trading pilots (Zhang et al., 2016, p. 876) which came about in response to a joint 1999 study between the State Environmental Protection Administration (SEPA, now Ministry of Environmental Protection), and the US EPA on SO_2 emissions trading. The US had introduced an SO_2 cap and trade system in 1995, and was familiar with SO_2 emissions trading through its Acid Rain Program (Ellerman et al. 2003, p.11). In China, there were pilots in four provinces, three cities and in one company.[9] It is a common feature of Chinese politics to try new policies first in small-scale pilots, before national adoption (Duan et al 2017). The SO_2 emission trading scheme lacked efficiency largely because a) local governments failed to enforce the scheme, b) the distribution of allocations was uneven and non-transparent and c) there were few penalties for non-compliance (Hart and Ma 2014). We conclude that the impact of these SO_2 emission trading schemes on China's adoption of carbon emissions trading was limited due to the less than positive results and possibly lack of legal backing, not to mention institutional differences.[10]

Furthermore, China has been part of the UNFCCC efforts and negotiations since the 1992 Convention came into being, and submitted its INDC before COP21.[11] The flexible mechanisms introduced by the Kyoto Protocol, ratified by China in 2002, also contributed to raising market awareness. While China was initially sceptical to the CDM, interest grew since it provided opportunities for international project support, as well as coinciding with China's domestic climate policy priorities, namely economic development and energy (Heggelund et al., 2010, p. 246). China soon became *the* CDM destination with about 60 per cent of projects worldwide. China's renewable energy development, for example, benefited greatly from CDM projects (Lewis 2010 p.2878). However, the situation changed in 2009 when the EU decided that when the first period of the Kyoto Protocol ended in 2012, the EU ETS would begin to accept offsets from China under specific conditions. It did not go unnoticed within the Chinese government that a change would come to the CDM system in China, and the rejection by the UNFCCC CDM Executive Board of China's application to register and have reviewed ten wind projects in 2009 due to additionality issues came as a surprise to the carbon market, and portended difficult times ahead for CDM in China. (Tung, 2015, p.87; Interview 10; He & Morse 2013, p. 1052).

Growing awareness of energy-related emissions, climate change and its impact made climate change a national policy priority, resulting in the 2007 publication of the *National Climate Change Programme* and the creation of the Chinese premier-led group on climate

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[9] After a collaborative study started in 1999 between the State Environmental Protection Administration (SEPA) and the US EPA on SO_2 emission trading, SEPA initiated in 2002 a pilot programme on SO_2 trading involving the four provinces of Henan, Jiangsu, Shandong and Shanxi, three cities Luizhou (Guangxi Province), Shanghai and Tianjin, as well as one company, the China Huaneng Group (Zhang et al., 2016 p. 876). The 11th FYP included a binding resolution to reduce SO_2 emissions and chemical oxygen demand (COD). Following this, the former SEPA, now Ministry of Environmental Protection, working with the Ministry of Finance, has initiated 11 emission trading pilot schemes since 2007 on SO_2 and COD (Zhang et al., 2016 p. 877).

[10] SEPA, now Ministry of Ecology and Environment , was the responsible authority for SO_2 emissions trading while NDRC is in charge of carbon emissions trading. NDRC as a commission has traditionally more authority to push policy in the bureaucratic hierarchy.

[11] As indicated in China's Intended National Determined Contribution (INDC), China is aiming to peak CO_2 emissions around 2030 (or earlier). The objectives of the INDC include reducing CO_2 emissions per unit of GDP (carbon intensity) by 60 to 65 per cent of 2005 levels, and increase the forest stock volume by around 4.5 billion cubic metres relative to the 2005 level. The INDC also aims to increase the share of non-fossil fuels in primary energy consumption to around 20 per cent (NDRC, 2015).

change (Heggelund & Nadin, 2017; NDRC, 2007). From that year on, energy policies were explicitly connected to the reduction of GHG emissions and climate change mitigation (Stensdal, 2014, p. 122). In the same period, China surpassed the US as the world's largest emitter in absolute terms (PBL, 2007), putting even more pressure on China to tackle its emissions. In 2009, before COP15 in Copenhagen, China announced for the first time its intention to reduce carbon intensity (= CO^2 emission intensity per unit of GDP) by 40–45 per cent by 2020 from 2005 levels (NDRC, 2010; Conrad, 2012, p. 436).

These domestic policy developments coincided with lobbying by external stakeholders. The EU had since 2005 been busy selling the idea of ETS from the first EU Summit through bilateral meetings and workshops (Interviews 2 & 6). In that period, the EU also initiated rounds of dialogues and exchanges involving both officials and experts at which they promoted the idea of emissions trading, and showed China how the EU ETS worked (interview 3; European Commission, 2015). China started to seriously consider a carbon market in 2009/10 (interview 7) when the Chinese Certified Emissions Reductions (CCERs) provisions and regulations were being introduced (interview 3).[12]

On October 29, 2011, NDRC issued *Notice on Carrying out Carbon Emissions Trading Pilots*, (NDRC, 2011) approving pilot carbon emissions trading in seven regions, and announcing that two provinces – Guangdong and Hubei – and five cities – Beijing, Chongqing, Shanghai, Shenzhen and Tianjin – had been approved by NDRC to pilot the ETS. The State Council released on 1 December 2011 the *Work Plan for Greenhouse Gas Emission Control during the 12th Five-Year Plan Period*, (Government of China, 2012), calling for the development of a general plan to establish a national carbon emissions trading market in China.

Factors shaping the 2011 decision to establish a carbon market

As might be expected, The factors shaping the 2011 decision were a combination of domestic needs and international influence. Domestically, China's energy objectives and achievements at the time are central to understanding its decision to go in for an ETS. There is a palpable correspondence between this decision to pursue an ETS and the larger developmental path, China's growing GHG emissions and its other mitigation policies. Market mechanisms were expected to accelerate the transformation of economic development patterns while lowering the cost of industrial upgrades. The 12th FYP (2011–2015) included, for example, the prescription to 'let the market play a fundamental role in resources allocation' (12 FYP, 2011, chapter 1.1).

As climate change became a key government priority as of 2007, it prompted a debate within the ministries on how to curb emissions in practice. The financial, environmental protection and tax authorities were in favour of implementing a carbon tax, which was proposed under the environmental protection tax law. NDRC was in favour of emissions trading. The different opinions aligned with areas of responsibility: carbon tax would be managed by the Ministry of Finance as it is responsible for budget and tax management, while NDRC, which is the responsible commission for leading China's international negotiations as well as coordinating domestic climate efforts, would be responsible for the carbon market.[13]

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[12] The national China Certified Emissions Reductions (CCER) system has been up and running for three years. It builds on lessons learned from operating the CDM. China's Interim Management Rules on Emissions Trading (NDRC 2014) support the pilot schemes' offset markets. Wind power, solar PV, hydropower and household biogas are the most popular project types (Roldao, 2016, p. 27; Duan, 2015, pp.1 & 9).

[13] See Hart et al., 2017 for a description and analysis of the stakeholders involved in mapping China's climate policies. The National People's Congress (NPC) 5-20 March 2018 has introduced structural changes to the

Referring to why a carbon tax was discarded, interviewees stated that adding another tax to the numerous taxes already in force would be very difficult. Trading became a feasible option (interview 12). The role of senior leaders was also of significance, such as former NDRC Vice Chairman Xie Zhenhua, who successfully promoted ETS in China. When he was head of the State Environmental Protection Administration, he was also responsible for the SO_2 trading pilot (interview 12).

In addition to domestic conditions and drivers there were external factors at play. Government officials and experts gained knowledge about market mechanisms from the UNFCCC negotiations. Experience of the many CDM projects in the period 2005–2012 greatly enhanced awareness of carbon trading, and showed that the market could be a cost-effective way to mitigate emissions (interview 5). CDM built up capacity within government departments and enterprises (interview 5) in key areas such as carbon counting and data collection, and methodologies were translated into Chinese. The CDM projects helped create the technical expertise that would eventually be useful for the carbon market; thousands of company employees were trained in CDM project development (Lewis 2010, p.2882). Senior negotiators on the Chinese UNFCCC delegation also acquired CDM experience (interview 5). Moreover, state-owned enterprises (SOEs) in the power, petrochemical, and cement sectors, had learned and benefited from Certified Emission Reduction (CER) trading through the CDM (Swartz, 2016). The SOEs would be important players in the future ETS.

As for diffusion, in the policy initiation phase, the above-mentioned CDM experiences combined with lobbying efforts on behalf of ETS by the EU and others had an *ideational impact* on the decision to implement a carbon market. That emissions trading was a feasible mechanism to control emissions was soon accepted and supported within the central government. Work on the CCER regulations and provisions began in 2009 (interview 5. The scheme builds on lessons gained from operating the CDM. The majority of CCER methodologies were based on CDM methodologies approved by NDRC (interview 3), and included in the Interim Management Rules on Emissions Trading (NDRC 2014). Chinese experts had been central in developing these methodologies and this can be viewed as an instance of *simple emulation* of these methodologies. Although they were not directly related to the decision to go for an ETS, having the capacity and domestic expertise would mean that China potentially would have a head start in establishing its own carbon market.

Phase 2. Pilot testing 2011-2017: Designing and setting up the pilots

In the pilot testing phase, the pilot governments started setting up their markets in 2011. The purpose of establishing ETS pilots was to learn a variety of lessons from different approaches and designs so as to inform the design of the national ETS. The seven pilots (see table 1) cover an area populated by 260 million people; they have widely varying economies (Jotzo & Loschel, 2014, p. 3) and represented 26.7 per cent of China's GDP in 2014 (Swartz, 2016, p. 12)..,The pilots differ greatly with regard to economic development levels. Beijing, Tianjin and Shanghai are all relatively well off, with per capita incomes (in 2015) above US$ 14,000; Guangdong is at US$10–12,000, while Chongqing and Hubei are in the range of US$8–10,000 (*The Economist*, 2016; see table 1 in Duan et al., 2014, p. 528). Shenzhen, the first pilot to launch a carbon market, was originally not included, but asked to take part and was added at the very end (interview 10).

ministries under the State Council. (MEP 2018; Renminwang 2018). Climate change responsibility, including the carbon market, is to be incorporated into a newly created Ministry of Ecology and Environment (Reklev & Chen 2018). The changes will likely take effect from June 2018, and it is premature to understand possible impacts on the carbon market.

NDRC has been supervising the development of the pilot systems in the sense of providing guidance whenever required by the project managers, while the piloting regions were granted full flexibility thus ensuring pilot system diversity (Duan et al., 2014, p. 529; Duan, 2015, p. 3). NDRC also provided limited training for people involved in the pilot projects. Additionally, a number of countries (EU, UK, Australia, Norway, Germany) and organisations (World Bank, ADB, IETA) [14] provided support at different stages by enabling joint research, training and capacity-building programmes, study tours and regular communication with major ETS stakeholders. In the beginning the focus was on getting the involved governments to understand and grasp the basics of the carbon market by studying existing markets, such as the EU and California. The MRV capacity-building projects funded by Norway, Australia, Germany, World Bank and ADB are one example of these efforts (Biedenkopf & Van Eynde, 2016; China Carbon Forum, 2016, p. 3; World Bank, 2013; ADB, 2016; GIZ, 2016).

The pilot governments took local circumstances into consideration in designing their schemes, and some also consulted local stakeholders. The Beijing government spent a month soliciting questions and comments from stakeholders (interview 13). In Shanghai, the main regulation document was made accessible for public comments a few months before being passed in November 2013 (Shanghai DRC, 2015, p. 21). Enterprises expected to participate in the various pilots expressed mixed feelings about the ETS. Some were eager to take part, many others were more interested in the burden it would put on their sector and how it would affect their business rather than trying to understand how it worked (interview 13).

All the pilot schemes established caps based on the carbon intensity targets (CO_2 emissions per unit GDP) they were allocated in the 12^{th} FYP, among other factors (Duan et al., 2014, p. 529). All of the pilot schemes cover both direct and indirect emissions of CO_2. Chongqing is the only pilot community covering six GHGs (see table 1).

The different economic and energy structures of the seven jurisdictions have determined which sectors to include and the entry thresholds. Beijing, Shanghai and Shenzhen included large commercial and public buildings since they make a significant contribution to emissions (Duan et al., 2014, p. 530). The entry threshold varied from 3,000 tons CO_2 per year in Shenzhen to about 150,000 tons annually in Hubei; the most common threshold limit was 20,000 in Chongqing, Tianjin and in Shanghai's industrial sector.

All pilot projects chose free allocation as the main allowance approach, ranging from annual allocations in Beijing and Tianjin, to a three-year allocation in Shanghai. Free allocation approaches vary from grandfathering to benchmarking. Guangdong also chose to implement auctioning the first year and has since been joined by other schemes (see table 1). In the first year of the Guangdong pilot, the involved companies received 97 per cent of their allowances free, and only needed to buy the remaining 3 per cent, the criterion for receiving free allowances. Auctioning was chosen as a way to make the complying companies serious about the system (interview 10). Historical emission verifications were initially paid for by the pilot governments because they wanted reliable data and allowance allocation was dependent on historical emissions.

Before the implementation of ETS, there were already various information reporting systems developed by different authorities which are relevant to the ETS, e.g. energy consumption information reporting developed by the national energy efficiency authority, direct online reporting system for enterprises above designated scale developed by the national statistical authority, power sector statistical information reporting system developed

[14] Many organisations are involved in ETS capacity building projects in China such as Environmental Defense Fund (EDF) China, World Resources Institute (WRI), Energy Foundation China, IETA etc.

by China Electricity Council, and an information reporting system developed by State-owned Asset Supervision and Administration Commission of the State Council.

Major challenges in the use of data from the existing reporting systems include: 1) the verification component has been very weak if not missing altogether; and 2) the statistical method and calibre of these systems could be very different.. Also, there was concern that if companies paid themselves, the data could be less reliable. Beijing required enterprises to pay themselves from 2014, however (interview 2). 2015 was the first year all annual compliance cycles completed in the pilots (Qian & Chen, 2016). Some of the pilot schemes were modified, with Guangdong adding aviation for 2016, for example, and Shanghai adding a few more sectors, including shipping (Guangdong DRC, 2016; Shanghai DRC, 2016). At the end of 2016, the accumulated trading volume of the spot market in the seven pilot areas accounted for 68.6 MtCO2, with a total value of CNY 1.1 billion (EUR 151 million) (Qian & Huang, 2017). Prices in the pilot projects vary greatly. This is possibly due to several factors, such as over-allocation of allowances and policy uncertainties related to banking and borrowing of allowances from the ETS pilots to the national ETS (Swartz, 2016; Chen, 2017). Beijing reached the highest allowance price, peaking at CNY 69 / tCO2 (US$10) to RMB15 in Tianjin (Qian and Huang, 2017; *Carbon Pulse*, 2017) .[15]

[15] Updated information on prices can be found at China Pilot Market Prices http://carbon-pulse.com/category/china-national-ets/ and ICAP ETS Map https://icapcarbonaction.com/en/ets-map.

Table 1 – Pilots design

	Beijing	Shenzhen	Shanghai	Tianjin	Chongqing	Hubei	Guangdong
Type of system & start date	Cap and trade 28 November 2013	Cap and trade 18 June 2013	Cap and trade 26 November 2013	Cap and trade 26 December 2013	Cap and trade 19 June 2014	Cap and trade 2 April 2014	Cap and trade 19 December 2013
Economy-wide ambition level[16]	Carbon intensity target 2011–2015: 18% 2016–2020: 20,5%	Carbon intensity target 2011–2015: 21% By 2020: 50% from 2005[17]	Carbon intensity target 2011–2015: 19% 2016–2020: 20,5%	Carbon intensity target 2011–2015: 19% 2016–2020: 20,5%	Carbon intensity target 2011–2015: 17% 2016–2020: 19,5%	Carbon intensity target 2011–2015: 17% 2016–2020: 19,5%	Carbon intensity target 2011–2015: 19,5% 2016–2020: 20,5%
Coverage 2013-2016[18]	CO_2 Electric power, heat, cement, petro-chemical and service sector, transportation, urban rail transit operating units and public electric passenger transportation units	CO_2 Power, water supply, manufacturing sectors, buildings, public transportation	CO_2 Iron and steel, petrochemicals, chemicals, nonferrous metals, electric power, building materials, textiles, paper manufacturing, rubber; non-industrial sectors including chemical fibre, civil aviation, ports, airports, railways, business, hotels finance and shipping	CO_2 Heat and electricity production, iron and steel, petrochemicals, chemicals, exploration of oil and gas	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 Power, electrolytic aluminium, ferroalloys, calcium carbide, cement, caustic soda, iron and steel	CO_2 Electric power and heat, co-generation; automobiles, nonferrous metals, iron and steel, glass, building materials; cement, chemicals, petrochemicals, food and beverage, chemical fibre, paper manufacturing, ceramic manufacturing and medicine	CO_2 Energy, iron and steel, cement, and petrochemicals paper, pulp and civil aviation
Allocation mechanism	Free allocation and auctions	Free allocation and auctions	Free allocation and auctions	Free allocation	Free allocation	Free allocation and auctions	Free allocation and auctions

16 The 13th FYP aims at reducing national GDP CO_2 intensity by 18% of 2015 levels by 2020. The work plan of the FYP allocates specific carbon intensity targets to the pilot schemes as indicated in the table.

17 Shenzhen intends to peak its carbon emissions by 2020, and rather than a carbon-intensity target between 2016 and 2020, it has set its target from the year 2005 (Shenzhen DRC 2016b, ch.2.2).

18 The coverage of the different sectors and the emissions threshold in the period 2013-2016 vary between the pilots; the sector coverage has been listed together for simplicity.

	Beijing	Shenzhen	Shanghai	Tianjin	Chongqing	Hubei	Guangdong
Offsetting	Offsetting credits limited to 5% of the annual free allowances. CCERs issued, carbon emission reductions from energy saving projects and forest carbon sink projects. CCERs from projects outside Beijing can be used for up to 2.5% of annual allowances. Credits from hydropower, HFC, PFC, N2O and SF6 projects not eligible; reductions must be achieved after beginning of 2013.	CCERs limited to 10% of the annual compliance obligation Credits from hydro projects not eligible	CCERs limited to 5% of the annual free allowances. Credits for reductions achieved before January 2013 cannot be used to show compliance	CCERs limited to 10% of the annual compliance obligation. Credits must stem from CO2 reduction projects, excluding hydro, and have to be realized after 2013.	CCERs limited to 8% of the compliance obligation Credits from (hydro projects not allowed. Reductions have to be achieved after 2010; carbon sink projects excepted.	CCERs limited to 10% of the annual allowances allocated at beginning of compliance period; from Hubei Credits from large (and medium) hydro not allowed;	CCERs limited to 10% of the annual compliance obligation Half have to be from CO2 or CH4 reduction projects; 70% from Guangdong
MRV and enforcement	Annual reporting of CO2 Third-party verification required Check of verification outcome by fourth-party Penalties for non-compliance (can result in fines), and for failure to surrender sufficient allowances to match emissions	Annual reporting of CO2 emissions with a tier approach taking into account the size of the company. Third-party verification is required. Penalties for failure to submit emissions/verification reports on time/ providing fraudulent information / disturbing the market	Annual reporting of CO2 emissions. Third-party verification is required. Penalties for failure to submit emissions/verification reports on time and for submitting fraudulent information	Annual reporting of CO2 emissions. Third-party verification required. No financial penalties; non-compliant companies are disqualified for financial support for 3 years.	Annual reporting of GHG emissions. Third-party verification required. No financial penalties for non-compliance. The punishments may include media reporting and public exposure of the non-compliance,	Annual reporting of CO2 emissions. Third-party verification required. Penalties for failing to submit an emissions or verification report on time	Annual reporting of CO2 emissions. Third-party verification required. Penalties for failing to submit an emissions or verification report on time and for failure to surrender sufficient allowances to match emissions

	Beijing	Shenzhen	Shanghai	Tianjin	Chongqing	Hubei	Guangdong
Price/ quantity management	DRC can organize temporary auctions/buying steps in case of market fluctuations.	DRC: sell extra allowances from a reserve at fixed price in case of market fluctuations	Shanghai Environment and Energy Exchange: price stabilization measures/suspend trading in case of 10% variations in one day.	Tianjin DRC: organize temporary buy/sell operations	Chongqing Carbon Emissions Exchange: price stabilization measures. Compliance entities must not sell more than 50% of their free allocation.	DRC with advisory committee (can buy or sell allowances in order to stabilize the market)	Auction floor price.
Revenue earmarking	Open Market Operation Fund	NA	NA	NA	NA	Carbon Mitigation Fund	Guangdong Low Carbon Development Fund

Sources: The table is compiled by authors mainly with information obtained from relevant Development Reform Commissions in the pilots.

Factors influencing the pilot designs

Although there are seven different carbon markets, the factors influencing their design are mostly the same. Of domestic drivers, the pilots were approved by the NDRC, but the pilot governments were given full flexibility in the design phase, enabling them to consider fully the specific circumstances of the own jurisdictions in the system design. Central government provided technical assistance to the pilot areas on request. National targets set the ambition levels of the pilot schemes: they all used their allocated carbon intensities as the guide for cap-setting. The compliance units in the Chinese systems are the enterprises themselves, not the installations, as in the EU ETS. The reason for this is that enterprises are the units through which the governments usually regulate energy targets (interview 7).

Local conditions influenced many design choices, such as which sectors to include. Local stakeholders also influenced the design. One example is the Wuhan Iron and Steel (Group) Company which influenced the design of the Hubei pilot ETS. According to the original design, the enterprises bearing allowance surrender obligation in the system shall be the lowest-level legal person, not the group company composed of many legal persons. However, Wuhan Iron and Steel (Group) Company is one of the major tax payers of the province, has a huge influence on the policy design and wishes to act as a single entity in the system so as to balance the shortage and surplus of allowances of different enterprises of the group. They succeeded in their bid, and the whole group was treated as a single entity.

In Shanghai, rapidly growing companies asked for the growth factor to be reflected in their allowances, while others that had already implemented energy-saving measures wanted their efforts to be taken into consideration, and asked for benchmarking allocations, which, they thought, would be fairer. Their wishes were to some extent accommodated in the Shanghai pilot: the power sector, airlines, ports and airports were allocated by benchmarking. The Shanghai pilot regulations also included provisions for changing allocated allowances due to changes in activities or energy-saving projects conducted in 2006–2011. Listening to the complying companies and incorporating their wishes whenever possible were important for the Shanghai government, as they knew that in the end it was the companies that would have to live by the pilot regulations (Stensdal, 2016, pp.12–13). The pilot projects were generous in terms of allocation, the reason being that rather than making sure emissions were reduced at the outset, the pilot governments wanted the lifetime of pilot project to give stakeholders an opportunity to get used to the system of ETS (interviews 4&5). In line with this reasoning, there were no direct economic penalties in the Chongqing and Tianjin pilots (interview 4; Dong et al., 2016, p 8).

At the beginning of this phase, there was a strong involvement of foreign entities. Documents on carbon market elements in the major existing systems, mainly the EU ETS and Californian system, served as a useful basis and starting point for the design process in the piloting regions. To facilitate capacity improvement, some of the major documents were translated into Chinese for ease of use in the pilot regions and in China more widely (interview 10). The most studied existing market mechanism during the development of the pilot projects was the EU ETS (interviews 3, 4 16 & 18). The UK initially also played an important role, in particular in Guangdong, Hubei and Shenzhen (interview 2). Once the project implementers had gained the necessary understanding, however, the role of international support waned, leaving the pilot regions to formulate rules suited to their own circumstances.

In terms of diffusion in the pilot testing phase, , China has for the last decade been on the receiving end of carbon-market awareness-raising and agenda-setting. Given the frequent lobbying and collaboration on ETS capacity-building projects in the pilot areas, what we found were largely instances of *sophisticated learning* whereby policies and design features were tailored to fit local conditions guided by the experience of other countries. In choosing specific design features, the pilot governments undertook detailed reviews, balancing cost management with the feasibility of controlling emissions, before deciding which sectors to include. Nevertheless, one recurring figure that indicates a degree of *simple emulation* is 20,000, i.e., the 20,000 tons of carbon used as the entry-threshold in Chongqing, Shanghai and Tianjin. In the EU ETS's 2003 directive the entry-threshold for combustion installations was 20 MW, so the number 20,000 has likely been inspired by this (interview 3; EU, 2003, Annex 1).

Phase 3. Scaling up: Setting up the national ETS 2011–2017

At the same time as the pilots were being set up, NDRC was making preparations for the national emissions market (12^{th} FYP, 2011; NDRC, 2011). The pilots provided input to the policy of scaling up a national ETS. International projects also helped in this process. To name a few, the EU has carried out numerous capacity-building workshops and study tours to the EU for stakeholders on topics such as strengthening institutional capacity, cap-setting, allocation, monitoring and reporting, and Norway (through UNDP) has been working on a national registry with NDRC.

The national ETS was officially launched 19 December 2017 following a teleconference with central stakeholders such as ministries, national administrations and pilot provinces and cities (NDRC 2017c). NDRC issued a notice and a plan (2017a; 2017b) setting the course for the next few years. The carbon market, originally set to include six to eight sectors (table 2), begins with one sector, the important power sector (NDRC 2017a: NDRC 2017b). It covers 1,700 enterprises with an annual energy consumption of over 10,000 tons of coal equivalents or annual CO_2 emissions of over 26,000 tons, totalling near 3 billion tons per year (ibid, p 4; Reklev and Chen 2017).[19] According to the plan, a test period will most likely run until 2020 that includes one year to set up the system and another year to simulate the market before real trading begins (NDRC 2017b, p.3; Reklev and Chen 2017).

China's national ETS will be a two-level cap-and-trade system with unified rules for all provincial-level regions. The central authorities issue the regulations and overall allocation targets/quotas while the provinces are responsible for implementation, i.e., distributing to the enterprises (Duan, 2015, p. 1; *Energy News*, 2016). All provinces will be included in the system from the beginning. The NDRC issued the *Interim Management Rules on Emissions Trading* in December 2014. They provide the current basis for the national ETS (NDRC, 2014 see table 2).[20] After other sectors have been included, it is estimated that the carbon market will cover 3–5 billion tons of CO_2e with an expected trading volume of 1.2–8 billion CNY (ICAP, 2016a). As production rates vary from year to year, the cap will be different every year (Pang & Duan, 2016, p. 818).

[19] The number of sub-sectors as stated in NDRC 2016. The number of sub-sectors and products has been increasing and is not finally determined; as other sectors will gradually be included.

[20] The number of sub-sectors as stated in NDRC 2016. The number of sub-sectors and products has been increasing and is not finally determined; a gradual inclusion of other sectors will take place (NDRC 2017c).

Table 2 National ETS Sectors and subsectors

Sectors	Subsectors
Petrochemicals	Crude oil processing, ethylene
Chemicals	Calcium carbide, ammonia synthesis, methanol
Building materials	Clinker, plate glass
Iron and steel	Crude steel, crude steel processing
Non-ferrous metals	Electrolytic aluminium, copper smelting
Paper production	Pulp manufacturing, machine made paper, cardboard,
Power	**Power generation, heat-power cogeneration, power grid**
Civil Aviation	passenger transportation, air cargo transport, airport

Note: Bold font indicates only the power sector was included when the ETS was launched in late 2017; more sectors as shown in the table will gradually be incorporated as the system matures.

Source: NDRC 2016

The national system will cover only CO_2 at the beginning, but may gradually include other GHGs. The first period for the ETS is expected to be from 2017 to 2020 during which work will be done on producing a refined, improved and innovative ETS system (Roldao, 2016).

The national ETS will be initiated mainly with grandfathering before gradually moving to benchmarking and higher auctioned shares (Duan et al. 2017 p. 60; Roldao, 2016, p. 26; Reklev, 2016). There is agreement among government officials and experts of the need for a strong legal basis for the national ETS to ensure effective implementation and ability to impose sanctions for non-compliance.

According to the *Interim Rules* (NDRC, 2014), it will be allowed to use CCERs to partly offset emissions. The opportunity to offset emissions is important insofar as the national carbon market does not extend to important sectors such as agriculture and forest carbon sink projects. Although there are no specific regulations as yet, there will be some constraints in that not all CCERs issued will be eligible to offset emissions in China's national ETS (as is the case in the pilot projects, see table 1). Wind power, solar PV, hydropower and household biogas are the most popular project types in the pilot schemes' offset markets (Roldao, 2016, p. 27; Duan, 2015, pp.1 & 9). The NDRC halted approval of new offset projects in March 2017 (Chen & Reklev, 2017a), and have yet to finalise the offset eligibility criteria for the national ETS to be announced in regulations (NDRC, forthcoming). China also released its *13th Five-Year Plan on Greenhouse Gas (GHG) Emissions Contro*l which gives the carbon market an important role in addressing the country's emissions (State Council 2016).

Factors influencing the national-market design

What we know about the decision-making process and the details so far demonstrate that domestic drivers and conditions are most important for the national market design, but that there have also been some diffusion mechanisms in play.

The selected power sector, and the sectors to be gradually included, are based on national conditions and needs and illustrate the diversity of China's industries. The division of responsibilities between the NDRC, responsible for market regulations, and the regional governments, tasked with enforcement, is the normal approach. Because a national system would cover areas with significant differences in many respects, there was a need to address these regional disparities in the system's design. There have also been debates on how to design the national market to best fit Chinese conditions. The importance of having the central government consider issues of fairness between provinces at different economic levels was raised by the local Development and Reform Commissions and discussed on various occasions (interview 6).

The ultimate objective of the pilots was to test different approaches, gain experience and learn lessons to inform the use of the national system. As such, the piloting stage may be regarded as a form of *internal learning* where NDRC can learn by seeing the pilot schemes in action. Moreover, pilot projects have also become stakeholders in lobbying on behalf of their own interests and needs. For instance, the pilot schemes are lobbying to have their exchanges retained as part of the national market (interview 4 & 9).

From our interviews, it is clear that EU ETS was the most important model, in particular in the early stages of development. MRV and the Registry system are similar to EU ETS and EU regulations were also translated into Chinese, as mentioned above (interview 10). Although there are important differences between the EU and China, the differences between the economic situations of the Chinese provinces resemble the differences between the European countries (interview 9). Of the design elements and regulations, the guidelines for monitoring (interview 15) are very similar to the EU ETS's and can thus be seen as a *simple emulation* form of diffusion, although we mostly find *sophisticated learning* in the design aspects in general due to domestic and local conditions.

Another important similarity between EU ETS and China's national ETS is the structure of governance, especially the division of responsibilities between EU commission and EU member states and that between China's central government and the provincial governments. In the third phase of EU ETS, major rules of the system are developed at the EU level and implementation responsibilities are shouldered mainly by the member states. Similarly, in China's national system, unified rules for the whole system are developed by central government with input from various stakeholders. Responsibility to oversee compliance with rules is assigned to the provincial authorities. Speculatively, the lessons extracted from the EU ETS may have been helpful to China in setting up the national carbon market.

Following the decision to set up a national market, an argument promoted by NDRC to explain why ETS is good for China is that a national market will help enterprises comply with international standards and increase their competitiveness (interview 13). Thus, while the Chinese government did not decide in favour of an ETS for competitive reasons, the *competitive* aspect has become more relevant during the process of preparation (interview 3 & 7). In connection with the question of inter-province fairness, the issue of competition has also been raised (interview 6). Many stakeholders have expressed concern in case the ETS had a negative impact on the competitiveness of companies with less advanced technologies, most of which are located in the middle and western regions of China where economic and technological development levels are comparatively lower.

The assessment of whether to include aviation in the national ETS can also be viewed as a kind of attempted *coercion*. The EU threatened to include China in the EU ETS unless aviation was regulated.[21] China would rather decide for itself (interview 8) whether to include aviation in the national carbon market. The Civil Aviation Administration of China (CAAC) became interested in the national ETS, and it is expected that the International Civil Aviation Organization (ICAO) will regulate aviation in the future anyway. CAAC argued that including aviation in the ETS would give Chinese airlines a *competitive* advantage. For China,

[21] The background being the decision of the EU Commission that starting 1 January 2012, all airlines flying to Europe would be included in the EU ETS and thereby required to purchase carbon permits when exceeding a given cap.

it is not a matter of being against regulating aviation, but wanting to regulate it itself (interview15 & 8).

Table 3 Policy development and policy diffusion mechanisms

Phase 1 Policy Initiation 2000-2011	**Phase 2 Pilot Testing 2011-2017**	**Phase 3 Policy Scaling up 2011-2017**
Political situation and milestones	*Political situation and milestones*	*Political situation and milestones*
• Growing awareness of energy & climate • National Climate Programme & climate policies; • 10th FYP (2000-05) &11th FYP (2006-2010)	• Pilots design developed in 7 pilots • 12th FYP (2011–2015) & 13th FYP (2016-2020	• Design of national ETS prepared • 13th FYP (2016-2020) • Launch of national ETS in December 2017
ETS Policy drivers	*ETS Policy drivers*	*ETS Policy drivers*
China's domestic needs and energy & climate policy priorities foundation of decision to go for a national ETS	Local and domestic factors & national policy objectives had most influence on design and sector choices	China's domestic needs and policy priorities foundation of the national ETS design & sectors *Internal learning* within the country from experiences and lessons of running the pilot schemes
Diffusion mechanism(s) prevalent	*Diffusion mechanism(s) prevalent*	*Diffusion mechanism(s) prevalent*
Policy diffusion had *ideational impact* CDM/UNFCCC; -donor dialogues on carbon markets	*Sophisticated learning* from international projects: -adapting policies and design features to local conditions -free allocation *Possible simple emulation:* -entry-threshold in 3 pilots	*Sophisticated learning/simple emulation:* -MRV & Registry -ETS regulations *Coercive element:* -aviation *Competitive considerations:* -industry

Source: Authors' compilation

Concluding remarks

China officially established a national carbon market in December 2017 based on a two-year development period and trial of the system. Actual trading will most likely begin in 2020. For the time being, only the power sector is covered, but more sectors will gradually be incorporated as the system matures. The article has identified conditions under which different diffusion mechanisms appear to be active as the various stages of policy development (table 3). We find that China's domestic needs and policy priorities have continuously been at the foundation of the ETS, be they policy choices or design options. Yet a complex set of reasons and drivers such as the domestic energy situation and the country's wider development direction determined choices in the policy initiation phase 1, when China decided to establish a carbon market. This was when the *ideational impact* of donor countries was registered and the lobbying activities of multilateral organisations took place. Without these domestic conditions, we posit that China would not have turned to ETS. In phase 1, the possibility of policy diffusion hinged on whether to adopt the ETS or not. The phase ended in the decision to do so, and can be understood as the tipping point for further actions. In short, the impact of such external forces was at its strongest in these early years.

Following the decision to establish a carbon market, the policy diffusion conditions changed. In phases 2 and 3, when the specific pilot schemes and national market design elements were chosen, choice of design and sectors was mainly influenced by local and domestic factors. We conclude that in the pilot testing stage and when the pilot schemes were set up, diffusion occurred in the form of learning. It was at this time the officials running the pilot schemes learned in a very practical way about the basic mechanisms of a carbon market by examining systems run in the EU, California and other jurisdictions. By means of *sophisticated learning* they used their acquired knowledge to create markets with regulations customized to local circumstances and centrally delegated carbon-intensity targets. Our case study also supports Inderberg et al.'s (2017 p. 47) finding that the temporal aspect is of importance in gaining a comprehensive understanding of how diffusion mechanisms and domestic conditions and drivers interact in climate policy development.

As for *ideational impact* or *learning* we note two observations from this case. One, the national ETS and the pilots were and are two parallel processes. We saw in phase 3, during the scaling up operations – the national design stage – what we call an instance of *internal learning*, i.e., within the country by building on the experiences and lessons learnt from running the pilot schemes submitted to NDRC and its work on the national ETS. The common practice of running pilot schemes in China represents as such an institutionalized *internal learning* mechanism. Moreover, the modelling of CCER regulations on CDM methodologies in phase 1 shows that *simple emulation* does not necessarily occur only as a 'somewhat uncritical assessment' (Underdal et al., 2015, p. 9), but gave China an advantage in establishing its own carbon market.

In addition to *learning*, we heard arguments echoing *competitive considerations* in phase 3, i.e., during the formulation of the national market. The NDRC argued that the ETS would make China's industry better prepared to fulfil international standards and meet demands and would also improve its competitiveness. CAAC supported the inclusion of aviation in the national market for similar reasons, highlighting the competitive advantage, although the sector's inclusion might point to an element of *coercion*; if China did not regulate aviation itself, the EU would.

The UNFCCC connection has been important, in particular with regard to the CDM experience, and to creating the perception that China, which contributes significantly to global GHG emissions, needs to take responsibility to reduce emissions. This points to the relevance of events and international processes that may be important in propelling issues onto the agenda, (Auld et al., 2014, p. 451). China's preparations for and the objectives of the INDC, followed by submission to the UNFCCC, provide an additional incentive for China to cement its ETS even further. The national ETS, when operational, will contribute to Chinese efforts to reach its emissions reduction targets as set out in the 13^{th} FYP (2016–2020), and subsequent FYPs.

It will be important for China to succeed with its ETS. Much funding and prestige have gone into its establishment, and it also has the stated support of the highest political leadership. During the first period of the national ETS (2017–2020), it will be important to work on existing challenges such as strengthening data quality, scaling up MRV, bringing enforcement and compliance throughout the country under one national system, as well as building further capacity in provinces with different developmental levels. Experts have pointed to the need to ensure a strong legal basis for effective implementation and potential punishment for non-compliance. The State Council has yet to adopt legislation of this nature.

Finally, it is essential to identify synergies between the ETS and other climate and energy policies.

The degree to which international organizations and countries have shown their interest and willingness to collaborate with and support China in its ETS development is outstanding and highlights issues related to *persuasion* and *learning*. It also indicates that China was looking to the international community for tools to address climate change mitigation challenges (Stadelman and Castro, p. 414). While the decision to adopt ETS and then later to select the various designs was China's to make unilaterally, the opportunity to learn and take on ideas was made easier and encouraged by the many international partners who provided support at all stages of the process. A successful ETS in China will have an important symbolic impact on existing as well as future systems, including the EU ETS. Continued research into the development of China's carbon market and its impact both domestically and globally is essential.

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Appendix

Interviews for ETS article

'China's development of ETS as a GHG mitigating policy tool: A case of policy diffusion or domestic drivers?

Authors are/have been based in Beijing & Shanghai for a number of years – also during the write-up of the article - and have taken part in workshops, seminars and meetings with key stakeholders involved in developing China's ETS. The authors have closely followed the development of the ETS in China for a number of years, and in addition to the formal interviews had many opportunities to communicate and interact with key stakeholders involved in developing the ETS in China.

Interview No.	Date	Place	Activity
1	26 June 2014	Beijing	International org.
2	30 March, 2015	Beijing	Expert/ university (Chinese),
3	1 April, 2015	Beijing	2 Experts (think tank) (Chinese)
4	3 April 2015	Beijing	Expert (international)
5	2 April 2015	Beijing	Expert/consultancy (Chinese)
6	3 April	Beijing	Expert/consultancy (international)
7	2 April 2015	Beijing	Government
8	3 April 2015	Beijing	Expert/Consultancy (Chinese)
9	7 April 2015	Beijing	Expert/university (Chinese)
10	8 April 2015	Beijing	Consultant (Chinese)
11	2 April 2015	Beijing	Expert (think tank) (Chinese)
12	9 April 2015	Beijing	International (embassy)
13	29 October 2015	Beijing	Expert/university (Chinese)
14	29 October 2015	Beijing	Expert/university (Chinese)
15	30 October 2015	Beijing	Expert/consultancy (international)
16	30 October 2015	Beijing	Expert/ (Chinese) (think tank)
17	30 October 2015	Beijing	International org.
18	27 October 2015	Beijing	Expert/consultancy (Chinese)
19	28 October 2015	Beijing	Expert/ (Chinese) (think tank)
20	27 April 2015	Beijing	Expert (international) & embassy