Designing China’s national carbon emissions trading system in a transitional period

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Introduction

China is now in the process of transitioning its economy from ‘a phase of rapid growth to a stage of high-quality development’ and ‘building an ecological civilization’ (Xi, 2017). Carbon mitigation has become an inherent concern of domestic development in addition to an international responsibility. To achieve its climate mitigation targets – including peaking of its CO₂ emissions by 2030 – in a more cost-effective manner, China has shifted gradually from its decades-long tradition of mainly relying on command-and-control policy to market-based approaches, with carbon emissions trading as the main instrument. ‘Crossing the river by feeling the stones’ is a policy tradition of China established in its opening-up and reform process for the purpose of testing a new policy usually in limited geographical regions before its application in the whole country. The same tradition has been followed in the development of China’s national ETS with pilot systems being initiated in two provinces (Guangdong and Hubei) and five municipalities (Beijing, Tianjin, Shanghai, Chongqing and Shenzhen) in 2011. The seven pilot systems differ in many basic elements, from a legal basis to coverage, cap setting, allocation, monitoring, reporting and verification (MRV) systems, and compliance rules. Such a piloting practice has helped China gain rich first-hand experience on the design and operation of emission trading schemes (ETSSs) and laid a solid foundation for developing the national system (Deng, Li, Pang, & Duan, 2018).

Although experiences and lessons from many existing ETSSs, especially from the pilot systems, have provided useful references, the design of China’s national system has been in no sense an easy task, with China-specific challenges on top of the common problems faced by all systems. These challenges vary from significant disparities that exist between the different regions of the country to the renewable and energy efficiency policies interacting with ETS and the continuously evolving policy environment due to ongoing reform in all areas (Duan & Zhou, 2017; Duan, Tian, Zhao, & Li, 2017; Lin, Gu, Wang, & Liu, 2016; Zeng, Weishaar, & Vedder, 2018). The constraints brought by these issues have to be considered very carefully in the national system design as they directly affect the political acceptance, effectiveness and efficiency of the system, and sometimes contradict each other.

The development of China’s national ETS reached a crucial stage with the publication of the Development Plan of the National Carbon Emissions Trading System (Power Generation Sector) on 19 December 2017 (NDRC, 2017). According to the emissions thresholds announced, the power generation sector alone to be covered by the national system will include more than 1700 power generation companies with annual emissions of more than 3 billion tonnes of carbon dioxide, over 50% larger in terms of covered emissions than the current largest ETS, the EU ETS. The development plan, although only for the power generation sector, has clarified the principles and phased targets in the near future for the development of the whole national system, including a simulation phase of about one year to test the effectiveness and reliability and to further improve the system.
design. With the technical details still under deliberation, 2018 and the simulation phase scheduled in 2019 form a crucial period for ‘putting flesh on the bones’ of the system.

Against this background, a series of key issues shaping the design of China’s national system have been analysed with corresponding policy suggestions provided in seven articles presented in this special supplement of Climate Policy. In terms of geographical coverage, all of the more than 30 provincial-level regions will be included in China’s national system, but decisions are still to be made on which additional sectors besides power generation will be covered, possibly with a gradual expansion approach. The article by Qian, Zhou and Wu (2018) focuses on possible choices of sectoral coverage of the national system and analyses possible impacts of different choices on emission reduction, economic and social welfare change, and carbon leakage to uncovered sectors. Divergent allocation approaches have been utilized in China’s ETS pilot systems because of different considerations, including enhancing short-term political acceptance and coordinating with relevant industrial policies, but in the national system, the selection of allocation approaches will also need to assist the system’s transition to a fixed emissions cap in the foreseeable future, possibly well before 2030. The article by Pang, Zhou, Deng and Duan (2018) analyses the influence of nine allocation methods on China’s macro-economy, the covered industries, price of allowances and effectiveness of the system. Similar to the practice in the pilot systems (Pang & Duan, 2016), the emissions cap of China’s national system will not be a predetermined fixed one and will to a large extent be determined by the allocation approaches, given China’s carbon intensity mitigation targets up to 2030 which the national system is designed to achieve. The article by Qi and Cheng (2018) presents possible approaches to integrating the national system’s coverage, emissions cap and allocation approaches in the context of addressing special economic, technical and bargaining cost issues.

Maintaining a sufficiently high carbon price is necessary for incentivizing mitigation efforts by covered companies, but whether or not to establish a floor price, and if so the appropriate level of the floor price, has been extensively debated in both China’s pilot ETSs and the national system. The article by Weng, Zhang, Lu, and Zhang (2018) argues that a carbon floor price is needed to support the achievement of China’s mitigation targets given uncertainties in economic growth, technology improvement and renewable energy development, and suggests carbon floor prices at different stages needed to enable the achievement of China’s mitigation pledges with a 90% chance. Technology plays a central role in enabling mitigation and the impacts of China’s national system on the development and dissemination of clean technology should be one of the indicators to assess its performance. The article by Lin, Wang, Wu and Qi (2017) estimates the potential influence of China’s national system on possible redirection and crowding-out effects on technology innovation and finds that the former will overwhelm the latter.

The establishment of a carbon market is also a process of capacity building, including improving relevant capacity such as data monitoring and reporting (Qi, Wang, & Zhang, 2014). The design, operation, assessment and improvement of an ETS relies heavily on data, and ensuring data availability and quality is always one of the major focus of efforts by the authorities during the system preparation and operation phases. Data needs of a specific ETS are determined by the system design including mainly the cap setting and allowance allocation approaches, while the data basis will also to some extent restrain design choices of the system. The article by Zeng et al. (2018) analyses the major data requirements for China’s national system, the current availability and quality of the required data and corresponding challenges, and presents both short- and long-term solutions. Along a similar theme, the article by Tang et al. (2018) introduces existing monitoring, reporting and verification (MRV) frameworks in China, identifies key challenges for establishing an effective MRV system for the national system and puts forward countermeasures.

**Determination of sectoral coverage**

The sectoral coverage of China’s national system will expand gradually from the power generation sector to other major emitting sectors. The article by Qian et al. (2018) highlights the possibility of inter-sectoral or inter-regional carbon leakage to be caused by limited coverage of the national system, which would weaken the mitigation effects of the system. A China national computable general equilibrium (CGE) model has been used to assess the impacts of six different choices of sectoral coverage from such aspects as emission scale, trade intensity, emission intensity, economic and welfare changes, and carbon leakage to uncovered sectors.
sectors. Results show that emission intensity and policy equivalence scenarios can achieve, respectively, the best emission reduction effect and the best economic and welfare effect. Partial coverage will not lead to significant inter-sectoral carbon leakage which therefore should not be a serious concern for the national system design. Covering sectors with high emissions and emission intensities will lead to highest emission reduction effects and moderate economic and welfare losses. Although double regulation of emissions from power generation can lead to the lowest inter-sectoral carbon leakage rate among all six scenarios, its emission reduction, economic and welfare effects are worse compared to other scenarios because it will result in higher electricity prices and lower carbon prices and thus less incentive for entities to switch to low-carbon technologies.

**Impacts of allowance allocation**

Allowance allocation methods strongly impact on the interests of companies/sectors covered by the ETS and therefore the political acceptance of the system. Developing allocation methods under the national system requires consideration not only of general issues such as economic efficiency and competitiveness concerns, but also of China’s special situation, such as the significant uncertainties surrounding its economic and industrial development, and heavy regulation of the electricity and heat generation sector (Wang, Teng, Zhou, & Cai, 2017). The article by Pang et al. (2018) builds a recursive dynamic general equilibrium model in an open economic environment to assess quantitatively the effects of nine allocation methods which have been adopted in existing systems. The results show that the ETS policy will have very limited impact on China’s GDP, auctioning and allocation approaches without ex-post adjustment having the same impacts on GDP, and the use of dynamic allocation methods, although preferred by many, should be limited due to their subsidy effects on output or on both output and emissions, and thus their negative impacts on the effectiveness of the system. In the ‘synthetic allocation method’ scenario, industries operating with overcapacity no longer enjoy the subsidy effect from dynamic allocation methods. It is recommended to limit the use and scope of ex-post adjustment allocation in order to maintain the scheme’s incentive to cut emissions, and this is particularly important for industries with excess capacity such as cement and iron and steel. With the gradually decreasing uncertainties related to economic and industrial development and improving data quality, the application of those one-off methods should be expanded to give full play to the role of ETS.

**Integration of emissions cap, coverage and allowance allocation**

Among key design elements of an ETS, coverage, allocation and cap setting are closely related to each other, and how to coordinate these three factors is a common challenge, especially for China’s national system due to the flexible nature of its emissions cap. The article by Qi and Cheng (2018) proposes a three-step approach to integrate the national system’s coverage, cap and allocation by combining top-down and bottom-up methods. The first step is a top-down process. The general principles for determining the coverage and allocation methods are established according to the system’s emissions reduction target and the data basis at the micro-level. The second step is a bottom-up process to determine the initial cap by aggregating the allowances allocated to the covered entities. The third step is another top-down approach. The aggregated cap and allocation methods are reviewed and revised to ensure the realization of the overall emissions reduction target. The special economic, technical and bargaining cost issues facing China’s national system, however, present many challenges to the implementation of this 3-step approach, including the harmonization of regional differences and unified rules of the system, the balance of flexibility on selection of covered sectors by local authorities and the rationale underpinning the unified allocation methods, and how to deal with the allowances of the pilot systems and the sectors covered by those pilot systems that are not yet covered by the national system.

**Establishing a carbon floor price**

A low-carbon price is a common challenge for many ETSs, including China’s pilot systems, and this is also one of the core issues in the design of China’s national system. Price floors have been used in some systems such as the
Influence on clean technology innovation

Clean technology innovation is key for China to achieve its emissions reduction targets, and the national system is also expected to facilitate this process. The article by Lin et al. (2017) analyses the possible impacts of a carbon price imposed by the national system on clean technology innovation from two aspects, i.e. the redirection effect and the crowding-out effect. China’s clean patents data has been used to index clean innovation activities and to test the influence of the national system on these activities, and a three-step method combining econometric regressions and a counter-factual method has been utilized to address the data limitation challenge. The results show that the national system will induce increases in the patent quantity and proportion of clean inventions in all sectors to be covered by different rates, but the effect on overall R&D is negative, indicating that carbon costs might crowd out some R&D expenditures, although in a limited manner. In general, the national system is expected to help redirect technology innovation onto a cleaner path, although maintaining a reasonably high carbon price is critical to promote clean innovation.

Data challenges

Data are the foundation for the design and operation of an ETS. The article by Zeng et al. (2018) presents a comparative analysis of the data requirements of China’s national system and the existing ETS-related data for enterprises in China, and identifies the underlying data gaps in developing China’s national ETS in terms of both data availability and data quality. The analysis has been done from the aspects of six types of data, including production data, emissions data, technology data, management data, economic data and policy data, and three levels of data, that is, the region/sector level, the company level and the installation level data. It is found that the required data are generally available in China except for parts of data on emissions, and the main data challenges facing China’s national ETS include differences in company data availability in different sectors and imperfect data quality. Short-term strategies to address the challenges include establishing data-collection guidelines based on existing data and prioritizing major emissions or sectors with better data for inclusion under the ETS. The long-term solutions are to implement the concept of tiers, clarify data sources and introduce monitoring plan requirements, conduct MRV capacity building and establish a rigorous third-party verification system.

Establishing an effective MRV system

An effective MRV system is the cornerstone of the ETS. The article by Tang et al. (2018) reviews the work that has been accomplished with regard to the preparation of an MRV system for China’s national ETS and the implementation of relevant requirements, and identifies four key challenges in this respect: (1) ambiguity in the legal status of relevant policies and regulations in the MRV system; (2) unclear requirements for the content of the monitoring plan; (3) lack of consistency and harmonization in the accounting and reporting guidelines; and (4) insufficient usage of information technology in the MRV system. To address these challenges, it is proposed to create a framework legislation that is legally binding and of a sufficiently high legal status to facilitate legal enforcement of the MRV requirements and increase legal assurance, to establish clear rules on the content of the
monitoring plan and to develop templates to harmonize approaches across regions and reporting entities. The article also proposes to include specific requirements on monitoring and reporting in implementing regulations to ensure compliance with the main monitoring and reporting principles, and to establish an IT system for reporting which will be ultimately expanded to an integrated system that covers the whole compliance cycle including monitoring plans, emission reports, verification and verification management as well as multiple stakeholder access.

**Conclusion: the value of China’s experiences and lessons learned**

Implementing the urgently required transition from command-and-control policies to market-based approaches is not an easy task. By 2020, when its national ETS is planned to be in full operation, China will have spent nearly 10 years working towards this goal, starting from 2011 when the seven pilot ETSs were initiated. If the awareness-raising and capacity-building period under the Kyoto Protocol’s Clean Development Mechanism and voluntary domestic carbon market in China are taken into consideration, the process of developing China’s national ETS will be much longer. Regardless of the lengthy and sometimes painful process, the experiences and lessons learnt during this exercise are valuable, not only for the success of China’s national system but also for those developing countries interested in utilizing ETS to control their own carbon emissions, as they may face challenges very similar to those China has addressed. Such challenges may include no absolute emissions control target for the whole economy, significant uncertainties surrounding economic growth, a poor statistical system, limited data availability and poor data quality, limited awareness and capacity of major ETS participants, the need to coordinate with existing policies interacting with the ETS and the need to adapt the system design to a quickly evolving policy environment. In particular, a series of different approaches have been utilized in the design of China’s pilot ETSs, covering all major components of an ETS, and such diversified approaches may serve as a tool box of policy choices.

The development of an ETS is a long process, requiring periodic assessment of the system’s performance and improving the system design as needed. This is especially true for China’s national system, which operates in a rapidly evolving policy environment. This results, in particular, from the comprehensive reform process currently under way in China, which impacts directly on industrial policies, such as on energy efficiency and overcapacity phase-out, which aim at the same sectors covered by the ETS. China’s initial national ETS will not be without flaws, but some of its problems cannot be discovered in theoretical analysis and can only be revealed in the operational process. It is therefore beneficial to start the national system’s operation as soon as feasible and to improve the system gradually: perfect should not be made the enemy of good.

With the national ETS, it is envisaged that the costs of achieving China’s mitigation targets by 2030 will be reduced compared to the utilization of command-and-control policies, and this may in turn incentivize China to increase the ambition of its mitigation targets, for example, to peak its carbon emissions well before 2030 at a lower level. Such changing policy targets will in turn affect the design of the system, for example to change the system cap from a flexible one, determined to a large extent by the allocation approaches, to a predetermined absolute level. As guest editors, we are glad to see that some suggestions given in the articles of this special supplement have already been incorporated in the latest design of China’s national ETS and we are confident that the long-term proposals will help address new challenges that may arise in the future regarding China’s national ETS.

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References

Deng, Z., Li, D., Pang, T., & Duan, M. (2018). Effectiveness of pilot carbon emissions trading systems in China. *Climate Policy*. doi:10.1080/14693062.2018.1438245

Duan, M., Tian, Z., Zhao, Y., & Li, M. (2017). Interactions and coordination between carbon emissions trading and other direct carbon mitigation policies in China. *Energy Research & Social Science*, 33 (2017), 59–69.

Duan, M., & Zhou, L. (2017). Key issues in designing China’s national carbon emissions trading system. *Economics of Energy & Environmental Policy*, 6 (2), 55–72.

Lin, W., Gu, A., Wang, X., & Liu, B. (2016). Aligning emissions trading and feed-in tariffs in China. *Climate Policy*, 16(4), 434–455. doi:10.1080/14693062.2015.1011599

Lin, S., Wang, B., Wu, W., & Qi, S. (2017). The potential influence of the carbon market on clean technology innovation in China. *Climate Policy*. doi:10.1080/14693062.2017.1392279

NDRC. (2017). 全国碳排放权交易市场建设方案(发电行业)[The development plan of the national carbon emissions trading system (power generation sector)]. Retrieved from http://qhs.ndrc.gov.cn/qjfzjz/201712/W020171221535050998016.pdf. An unofficial English translation is http://www.ef.org/wp-content/uploads/2017/12/China_ETS_Policy_Document_English.pdf

Pang, T., & Duan, M. (2016). Cap setting and allowance allocation in China’s emissions trading pilot programmes: Special issues and innovative solutions. *Climate Policy*, 16(7), 815–835. doi:10.1080/14693062.2015.1052956

Pang, T., Zhou, S., Deng, Z., & Duan, M. (2018). The influence of different allowance allocation methods on China’s economic and sectoral development. *Climate Policy*. doi:10.1080/14693062.2018.1470962.

Qi, S., & Cheng, S. (2018). China’s national emissions trading scheme: Integrating cap, coverage and allocation. *Climate Policy*. doi:10.1080/14693062.2017.1415198

Qi, S., Wang, B., & Zhang, J. (2014). Policy design of the Hubei ETS pilot in China. *Energy Policy*, 75, 31–38.

Qian, H., Zhou, Y., & Wu, L. (2018). Evaluating various choices of sector coverage in China’s national Emissions Trading System (ETS). *Climate Policy*. doi:10.1080/14693062.2018.1464894.

Tang, R., Guo, W., Oudenes, M., Li, P., Wang, J., Tang, J., … Wang, H. (2018). Key challenges for the establishment of the monitoring, reporting and verification (MRV) system in China’s national carbon emissions trading market. *Climate Policy*. doi:10.1080/14693062.2018.1454882

Wang, X., Teng, T., Zhou, S., & Cai, B. (2017). Identifying the industrial sectors at risk of carbon leakage in China. *Climate Policy*, 17(4), 443–457. doi:10.1080/14693062.2015.1104497

Weng, Y., Zhang, D., Lu, L., & Zhang, X. (2018). A general equilibrium analysis of floor prices for China’s national carbon emissions trading system. *Climate Policy*. doi:10.1080/14693062.2018.1464895

Xi, J. (2017, October 18). Report to the 19th National Congress of the Communist Party of China. Retrieved from http://www.gov.cn/zhuanli/2017-10/27/content_5234876.htm. English translation: http://www.chinadaily.com.cn/china/19thpcncnationalcongress/2017-11/04/content_34115212.htm

Zeng, X., Yu, Z., Duan, M., Li, W., Li, M., & Liang, X. (2018). Data-related challenges and solutions in building China’s carbon emissions trading scheme. *Climate Policy*. doi:10.1080/14693062.2018.1473239.

Zeng, Y., Weishaar, S., & Vedder, H. (2018). Electricity regulation in the Chinese national emissions trading scheme (ETS): Lessons for carbon leakage and linkage with the EU ETS. *Climate Policy*. doi:10.1080/14693062.2018.1426553