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Climate Mitigation Policy in China - A Special Supplement of *Climate Policy Journal*

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China is not only the world's largest energy consumer and emitter of CO_2, but is additionally expected to become the world's largest economy within the next two decades. China's air pollution crisis and the economic burden of rising oil imports have only compounded the urgency of formulating a viable and sufficiently ambitious plan to curtail fossil fuel dependence and CO_2 emissions. The catalysts for the country's intended low-carbon structural change are both domestic and international, as well as environmental and economic. The likelihood that China's low-carbon energy transition will be sufficiently bold and expeditious is a matter of profound importance, not only for China but for the world.

The goals of China's mitigation policy have been outlined by the Central Committee of the Chinese Communist Party in its 13th Five Year Plan (FYP) (2016 to 2020) for the approval of the National People's Congress (China's parliament) in March 2016. These goals had already been incorporated in its Intended Nationally-Determined Contribution (INDC) submitted to the UN Climate Change Secretariat in June 2015 [1]. Through these documents, China has committed itself domestically and internationally to a reduction in carbon intensity of 40-45% by 2020 and 60-65% by 2030 (from 2005 levels); and to the peaking of CO2 emission levels "around 2030", with "best efforts to peak early". At the same time, China seeks to increase the share of non-fossil fuels in primary energy consumption to "about 15%" by 2020 and "around 20%" by 2030, with additional goals to expand forest cover on its territory.

Essential to these emission and energy goals is the need to significantly limit nationwide coal consumption, especially in absolute terms and in the most severely polluted regions. As part of China's mitigation policy, unprecedented efforts are under way to consume energy more efficiently and to cut carbon emissions, particularly in the most energy-intensive industrial sectors, and especially in electricity generation.

At the same time, China has gradually moved to centre stage as a participant in the international climate change negotiations. By announcing hard commitments and ambitious policies, China has encouraged other major parties to follow suit, and thus markedly increased the prospects for strong, global action that will achieve the global target to limit temperature rise to two degrees Celsius by 2100.

These critical issues form the background for the five papers included in the *Climate Policy Journal* Special Supplement on Climate Mitigation Policy in China, guest edited by ZhongXiang Zhang of Tianjin University. Together with Professor Zhang's editorial, these papers provide an in-depth and wide-ranging analysis of the challenges that China faces in addressing climate change, the country's evolving approach to tackling the problem, the core policies it is developing in response and the prospects for their effective implementation. Generous financial support for the preparation and open access publication of the Special Supplement was provided by the Children's Investment Fund Foundation (CIFF).

[1] Enhanced Actions On Climate Change: China's Intended Nationally Determined Contributions. Unofficial translation. Available from www.unfccc.int.

The Supplement begins by reviewing the many projections that have been made of China's future emissions, before exploring the emergence of a "green growth" narrative in Chinese policy-making. The Supplement then focuses on China's emission mitigation efforts at the sectoral and city levels, and finally investigates its evolving carbon market, reviewing the pilot emission trading schemes launched from 2013 and prospects for the planned roll-out of a nationwide scheme in 2017. This briefing note summarizes the main themes of the five papers, highlighting their key findings and insights. In doing so, it draws and expands on the Supplement's Editorial by Professor Zhang.

Emissions projections

It is well-known that predictions of future levels of greenhouse gas emissions, energy demand and the technological composition of the energy supply, have often turned out to be wrong. The case of China is no exception. No mainstream analyst or model predicted the enormous growth of Chinese energy consumption and CO_2 emissions since 2000, due primarily to a more than doubling of emissions from domestic industry. Similarly, no mainstream model predicted that growth in China's CO_2 emissions from fossil fuel combustion would appear to halt suddenly in 2014, due to reduced demand for Chinese exports, and government efforts to balance the economy, curtail coal use and air pollution, increase efficiency and grow the share of non-fossil energy supply.

The future is similarly uncertain. In their review of 89 scenarios of Chinese emissions up to 2030, Michael Grubb, Fu Sha, Thomas Spencer, Nick Hughes, ZhongXiang Zhang and Paolo Agnolucci, find that predicted trajectories for China's CO_2 emissions vary considerably, by a factor of almost 2.5 (7-18 $GtCO_2$ depending on the scenario considered). The factors most responsible for China's CO_2 emissions over the next 15 years will be the level of total primary energy demand, the energy intensity of GDP, the carbon intensity of energy and, relatedly, the share of energy from non-fossil sources. Interestingly, GDP per capita and population size were found to be far weaker predictors of future CO_2 levels.

In their review, Grubb et al highlight the importance of structural change in driving emission trends. They argue that the clear trend here is towards a lower-carbon future, through technological substitution especially in electricity production, as well as a reduction in overall energy demand, especially in industry. Crucially, they find that China's climate mitigation policy is reinforced by its broader macroeconomic agenda of shifting to a 'new normal', in which the exceptional export-led growth of the past decade is brought down to more sustainable levels and heavy industry is partially replaced by a growing service sector. In this regard, energy system models, which tend to assume continued economic growth of 6-7 percent annually and a relatively high value-added of industry to GDP, appear inconsistent with this 'new normal' macroeconomic policy. Hence, some of the scenarios modeled could be vulnerable to significant overestimation, as many models have erred similarly in the past.

Given the scale of uncertainty, China's caution hitherto in designating 2030 as a peak year for emissions is understandable. At the same time, Grubb et al contend that there are some grounds for greater optimism: China's CO_2 emissions could potentially peak well before 2030. Such a scenario would be a major boon for global efforts to keep climate warming to below two degrees Celsius.

The Strategy for Low-Carbon Green Growth

As the data assessed in Grubb et al reveals, rising GDP per capita is not necessarily an obstacle to low-carbon structural change. What matters most is reducing both the level of energy demand and the carbon intensity of energy, neither of which is inherently precluded by economic growth. In fact, in China (as elsewhere) the changing structure of economic growth is part and parcel of mitigation policy.

In his contribution to the Special Supplement, Yongsheng Zhang, from the Development and Research Center of the State Council, explains how China's low-carbon strategy has been framed in terms of grand aspirations for sustainable "green growth". This "low-carbon green growth" strategy is part of longer-term goals to operationalize the practice of "ecological civilization", as outlined in the 18th Chinese Communist Party Congress Communiqué, and other recent policy documents such as the outlined 13th FYP.

Zhang explores how a "low-carbon green growth" strategy is being put into practice. He shares Grubb et al's assessment that China's emissions may well peak before 2030, as structural change towards an internet and service-based economy dovetails with, and reinforces, efforts to cut

emissions. According to Zhang, such structural change, especially through the internet, could enable the poorer provinces of China to avoid high carbon (and highly polluting) industrialization, and instead "leapfrog" to a low-carbon digital economy. As such, carbon mitigation policy should be seen as "an opportunity, rather than just a burden, for economic growth".

In this regard, Zhang draws attention to a lesser known pillar of Chinese mitigation policy, namely, a strong state-led fostering of green industries. All industries with a low carbon footprint (including internet-based companies) are considered "green" under China's framework. Part and parcel of China's green industrial policy is a targeted annual growth rate for low-carbon industries of 20 percent over the period 2011-2015, to be achieved through tax incentives and financial support, R&D, and removing barriers through market consolidation. China is pursuing the most active green industrial policy in the world. The renewable energy industry, in particular, is becoming a new source of economic growth for China.

Despite these positive developments, Zhang strikes a cautionary note in recalling that limiting global temperature rise to 2 degrees cannot be achieved without stringent implementation and stronger targets, both in China and throughout the world. Zhang claims that "marginally improving the existing growth pathway" is not enough, arguing for nothing less than "a more fundamental paradigm shift", towards an alternative development model based less on material consumption and far more on sustainability, happiness and well-being, broadly conceived. Zhang is under no illusion as to the challenges involved in implementing such a vision. However, the fact that such thinking is emerging in China heralds a significant sea change in a country which, in common with other developing countries, has sought to emulate "the consumerism and materialism of the industrial countries", as Zhang puts it. Given its rising influence in the world, for China to redefine its understanding of development in this way could represent just as significant a contribution to the fight against climate change, as its more concrete policy initiatives.

Key energy-consuming sectors

Ultimately, meeting China's climate and energy targets will require major changes in its key energy-consuming sectors, a subject tackled by Can Wang, Yuan Yang and Junjie Zhang in their contribution to the Supplement. The electricity generation, industry, buildings, and transport sectors together account for about three-quarters of China's total energy use and resulting carbon emissions, while accounting for 70% of the increase in China's energy consumption between 2000 and 2012. Among these sectors, electricity generation and industry currently dominate: Electricity demand has soared, with electricity generation doubling between 2005 and 2012 to make China the world's largest electricity generator. Although the Chinese industrial sector is still huge (about half the world's cement and steel are produced in China), the growth in energy consumption by this sector has slowed since 2008, partly due to the global economic slow-down, but predominantly because of structural change in the Chinese economy, a trend also highlighted in other papers in this Supplement. The authors conclude that industrial energy consumption could thus peak before 2040, or even as early as 2030. By contrast, urbanization and rising incomes have meant an acceleration in energy consumption in the buildings and transport sectors. Wang et al demonstrate how, in 2013 alone, China acquired more floor space than Australia's total housing inventory, while per capita motor vehicle ownership increased nearly fourfold from 2005 to 2013. China has been the world's largest car market since 2009.

Wang et al explain how, since the start of the 11th FYP in 2006, China has launched a series of programmes designed to improve sectoral energy efficiency. Small, inefficient coal-fired power plants have been shut down, vehicle fuel efficiency standards have been raised, and building codes have been strengthened. There remains considerable room for improvement, however. The emissions intensity of new vehicles in China, for example, remains much higher than in the EU, while building regulations are still more lenient compared to European standards. In terms of energy sources, coal still dominates, accounting for 70% of Chinese total primary energy supply in 2012 (as shown in Grubb et al's paper). Severe pollution, however, has prompted China to start to control coal consumption, and even to reduce coal use in the worst-affected areas of Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta.

Meeting China's emission goals will clearly require a step-change in efficiency, as well as an accelerated switch to lower-carbon forms of energy. This will mean moving beyond traditional command and control measures, some which have been costly and inflexible, and will anyway be less effective in

consumption-side regulation, where a large number of economic agents are involved. The Chinese government has taken this on board, as evidenced by the introduction of emissions trading, initially through the seven pilot schemes described in detail in ZhongXiang Zhang's contribution to the Special Supplement (see below). Wang et al favour emissions trading, but guard against overlap with other climate and energy policies, leading to reduced cost-effectiveness. They also advocate more stringent caps and greater auctioning (rather than free allocation) of allowances in the future. However, they also point out that the carbon price is unlikely to reach a high enough level to stimulate a large-scale transition to low-carbon energy, due partly to tight regulation of electricity prices by the government (to keep inflation levels low, and raise living standards in what is still a developing country). Therefore, the authors suggest the introduction of a Renewable Quota System as a supplement to the carbon market, with the aim of fostering low-carbon technological development, while creating the preconditions for a more stringent cap. Such a system would set generation-based targets for generators, grid companies, and regional governments, while imposing strict penalties for non-compliance.

Finally, the authors suggest that China could sign up to international sector-based emission targets. They argue that the cement, steel, and aluminium sectors could be the first to be covered under such a sectoral approach, given that China has tremendous mitigation potential in these three sectors, and that their emissions are likely to peak within the next two decades. Such sector-based targets could then allow China to link its impending national carbon market (which would include these sectors) with an international trading system. There is a long way to go, but the building blocks for effective action are in place.

Low-Carbon City Pilots (LCCP) programme

In China, cities account for more than 60% of total energy consumption. Their contribution continues to increase given projections that about two-thirds of the Chinese population will live in urban areas by 2030. This unprecedented urbanisation means that cities will play an even greater role in shaping energy demand and CO_2 emissions, and delivering targets, in the 13th FYP and beyond. In this context, the Low-Carbon City Pilots (LCCPs) programme was launched by the National Development and Reform Commission (NDRC) throughout 2010-2012 in six provinces and 36 cities, in an effort to lead the transition to a low-carbon economy. In 2011, the total gross domestic product (GDP) in these 36 cities accounted for 33% of the entire country's GDP, and their combined population totalled 18.5% of China's population.

The Supplement paper by Yufei Wang, Qijiao Song, Jijiang He, and Ye Qi reviews the LCCP programme to date, its achievements, lessons learned and remaining challenges, focusing on Zhenjiang as a case study. They show that the majority of these pilots have set more stringent carbon intensity targets for 2020 than the national target level. In addition, all the pilot provinces and cities are working towards CO_2 emissions peaks in 2030 or earlier, even without any central government obligation; fifteen pilot provinces and cities are aiming for a CO_2 emissions peak in 2020 or earlier. The authors explain how energy efficiency initiatives, and command and control tools, tend to dominate the low-carbon strategies of the pilot cities (eg raising efficiency standards for buildings). However, pilots are also engaged in promoting renewable energy generation, promoting a shift to services in the local economy, enhancing carbon sequestration (eg through targets for expanding forest cover) and encouraging low-carbon lifestyles. An extensive list of policy tools and actions taken by the LCCP pilots is included in the paper.

The overall picture, however, is perhaps not as rosy as policy pronouncements and documents may suggest. For example, the rationale behind these commitments, as well as the feasibility and costs of achieving them, remain unclear. There is little evidence that rigorous analysis of the economic implications of the targets has taken place. In the Zhenjiang case, CO_2 emissions under the base scenario would only peak in 2039, compared with peaking in 2019 under the low-carbon scenario. This huge difference obviously raises questions. Is 2039 under the base scenario far too conservative? Or is 2019 in the low-carbon scenario very optimistic? At what cost, and how, could the 2019 peak be achieved? These kinds of question are crucial in order to have a better understanding of the situation in any pilot city, but none of the pilots have sufficiently addressed them.

The authors point to several other shortcomings of the LCCP. Local government officials still tend to regard economic growth, rather than sustainability, as their major priority, as this remains the main determinant of their personal careers. At the same time, there is still limited understanding among

local officials of concepts and strategies surrounding low-carbon growth, made worse by the absence of clear guidance from central government. Traditional command and control measures tend to dominate because officials are more familiar with these, with only limited recourse to more flexible and cost effective market mechanisms. Furthermore, central government does not provide any preferential policies and financial support to the pilots, even though this is probably one of their real motives for applying to join the programme. The pilots may be given priority if a low-carbon development special fund is established and provided in the future, but the absence of any such fund now may hinder them from achieving their full potential and meeting the expectations behind their establishment. Moreover, monitoring and evaluation mechanisms to assess the performance and effectiveness of the pilots are not well established.

The authors make several recommendations, including the better integration of policy between the national and local levels. The central government should establish an integrated institutional framework that cascades from national to urban levels, while pilots should use carbon management systems, including a consistent methodology for the preparation of GHG inventories. Pilots could also work towards harnessing innovative financing mechanisms, and attracting diversified investment from within China and internationally. Crucially, to enable the scaling up of effective low-carbon initiatives, improved communication channels must be established for cities and provinces to share both positive and negative experiences.

Carbon emissions trading

Putting a price on carbon is considered a crucial step in China's endeavour to reduce its energy consumption and carbon emissions, and thereby genuinely transform into a low-carbon economy. To this end, the Chinese government has approved seven pilot carbon trading schemes: in Beijing; Chongqing; Guangdong; Hubei; Shanghai; Shenzhen; and Tianjin.

These pilot regions were deliberately selected to be at varying stages of development and are given considerable leeway to design their own schemes. The schemes have features in common, but vary considerably in their approach to issues such as the coverage of sectors, allocation of allowances, price uncertainty and market stabilization, potential market power of dominant players, use of offsets, and enforcement and compliance. The article by ZhongXiang Zhang examines the key features of China's carbon trading pilots and lessons learned so far from their implementation, before considering the transition from the pilots to a national carbon trading scheme. The article finds that educating the covered entities, strictly enforcing compliance rules, ascribing allowances as financial assets and defining their valid duration, and including non-compliance in the credit record of non-complying entities, are crucial to enabling active and effective participation in carbon emissions trading.

China now aims to establish a nationwide emissions trading scheme (ETS) by late 2017. It initially plans to include power generation, iron and steel, nonferrous metals, building materials, chemicals, paper making, and possibly aviation in its national ETS, with the threshold for a covered emissions source to be set much higher than those in most of the existing pilots. However, to authorise emissions trading at the national level, Zhang suggests that existing interim measures released by the NDRC are not sufficient, and that national ETS legislation needs to be established. Moreover, retrospective examination of the experience of the carbon trading pilots, with their differing timing, coverage, and scope, suggests the need for a two-tier carbon trading management system. The central government should set emissions caps to level the playing field and avoid in-country carbon leakage. It should also be in charge of national rule-setting to ensure consistent regulation in terms of coverage, scope, standards for measuring, reporting, and verification, allowance allocation and compliance. In the meantime, provincial governments should be assigned responsibility for rule implementation, but be given the flexibility to go beyond national requirements.

The limited sectoral coverage and high threshold of the future nationwide scheme also suggests that there will be initial co-existence between regional and national carbon trading. Until a nationwide carbon market becomes fully functional, regional ETSs will continue to function in parallel, and those entities covered in the existing regional ETSs will be unconditionally integrated into a nationwide ETS if they meet the latter's threshold. In this context, a balance needs to be struck between the preferences of pilots to keep their own autonomy and characteristics, and the need to have a harmonised national carbon trading scheme in order to achieve the smooth interconnection of carbon pilots and a national ETS.

The forthcoming launch of nationwide emissions trading in China is a landmark development, both domestically and internationally. Together with the other policies and initiatives discussed in this Special Supplement – China's low-carbon green growth strategy, sectoral initiatives, and the Low-Carbon Cities Programme – the prospects for effective climate action in China are looking promising. China's leadership is clearly serious about wanting to cut its greenhouse gas emissions. Add to the mix long-term structural change towards a less energy-intensive economy, and efforts to control coal consumption motivated by crippling air pollution, and there is room for optimism that China will meet, and better, its existing emission targets. Within less than a decade, China has gone from a rather reluctant player in the climate change regime, to a world-leader in climate target-setting and policy making. China may still be a large part of the climate change problem, but it is an increasingly important part of the solution too. If China can make good on its pronouncements and rigorously implement its ambitious policies, then the world may yet still avoid the worst impacts of climate change.

The full Special Supplement is available for free from the Climate Policy website at http://www.tandfonline.com/toc/tcpo20/15/sup1

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