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STUDY

China's Role in Climate Change Negotiations

Perspectives for COP21

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- Along with the gradual change over the past decade in China's stance on climate change mitigation, its government has become much more active domestically to significantly reduce carbon emissions. Against the backdrop of the upcoming negotiations on climate change mitigation in Paris in December 2015 (COP21), these developments are of particular interest. In this study, Professor Zhongxiang Zhang describes these policies and goals as well as China's position in international climate change negotiations to illustrate China's position and scope for action at COP21.

- After an overview of China's changing stance in international climate change negotiations, there follows a description of various goals, policies and recent developments in China, which have successfully started to curb the growth of carbon emissions over the past decade. As air pollution and other environmental topics have become increasingly important for China's society and government, these efforts by the Chinese government are likely to further grow in scale and ambition.

- Based on this overview, China's scope for action at COP21 is explored as well as the likelihood of reaching an ambitious international agreement. Determining a date for China's carbon emissions to peak will be an important part of any such agreement, but a date for this carbon peak is still subject to intense debate and will likely prove to be among the most contentious issues at the COP21 summit.

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1. Introduction

China's 13th five-year plan (FYP) period (2016–2020) is crucial for the country. On the domestic level, the dense smog and haze that frequently shroud Beijing and other areas and steeply rising oil imports have raised significant concerns about a range of environmental problems, health risks, and energy security.

In the international arena, China faces intense pressure at and outside of international climate negotiations to be more ambitious in combating global climate change given that it is the world's largest energy consumer and carbon emitter and that its energy use and carbon dioxide (CO_2) emissions continue to rise rapidly as it swiftly moves toward becoming the largest economy in one or two decades. Thus, China, for its own sake as well as the international community's, cannot afford to continue along its conventional path of encouraging economic growth at the expense of the environment.

Chinese leaders have been well aware of the related challenges the country faces. In response, in November 2012 the 18th National Congress of the Central Committee of the Communist Party of China adopted a general policy of establishing a so-called ecological civilization — placing ecological goals at the same priority level as existing policies on economic, political, cultural, and social development — and emphasized that this ecological civilization would be fully implemented in all aspects of economic development.[1]

With the grand vision of an ecological civilization, the issue now becomes how China will balance its energy needs to fuel economic growth with the resulting potential impacts of climate change. This presents a tremendous climate policy dilemma, not only for China but for the entire world given China's emissions status and its dynamic economy. This remains so despite the current slowdown of the Chinese economy, which is entering the era of the so-called new normal.[2]

1. The government uses the term *ecological civilization* as shorthand to describe various ecological goals.

2. As elaborated by President Xi Jinping at the CEO Summit of the Asia-Pacific Economic Cooperation in November 2014 (Xinhua 2014), the Chinese economy in the new era is characterized by shifts from high-speed growth to mid- to high-speed growth, from quantity and speed to quality and efficiency, and from a production investment-driven model to an innovation-driven growth model.

This report examines China's role in international climate change negotiations and provides perspectives for the UN climate conference to be held in December in Paris. It discusses the evolution of China's stance in international climate negotiations, provides an overview and evaluation of mitigation goals and measures, analyzes the impact of a recent policy shift on prospects for the Paris conference, and discusses China's incentives and scope for action.

2. Evolution of China's Stance in International Climate Negotiations

The three major milestones in international climate negotiations are the United Nations-sponsored climate change conferences in Kyoto in December 1997, in Copenhagen in December 2009, and possibly the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015. Kyoto sought the first legally binding international climate change agreement, Copenhagen aimed to succeed the Kyoto agreement, and the Paris conference hopes to reach an agreement for the post-2020 era establishing absolute, quantitative commitments for all the major economies.

The 1997 Kyoto Protocol to the UNFCCC imposed limits on greenhouse gas (GHG) emissions for Annex 1 countries (i.e., the Organisation for Economic Co-operation and Development countries and countries with economies in transition) as listed in Annex B. These countries were to collectively reduce their emissions of six greenhouse gases 5.2 per cent below 1990 levels during the commitment period of 2008–12. Developing countries, including China and India, were not required to take on legally binding GHG emissions targets under the principle of common but differentiated responsibilities. The protocol also incorporated emissions trading, joint implementation, and the Clean Development Mechanism (CDM) to help Annex 1 countries meet their Kyoto targets at a lower overall cost, but it left the details of these flexibility mechanisms open for further negotiation.

The Kyoto Protocol drew a clear line between developed and developing countries. Developed countries had specific obligations to control their GHGs, but developing countries did not. This is a distinction that China, India, and the majority of the developing countries have fought hard to sustain since Kyoto, but it has led to significant tensions between emerging economies like China and India on the one hand and the developed economies like the European Union and the United States on the other because of the rapid increase in emissions from the emerging economies offsetting emissions reductions by the developed countries. This tension was particularly evident at the Copenhagen climate change conference, where for the first time China was blamed for dragging out international climate negotiations, while such blame previously had always been leveled at the United States.

French president Nicolas Sarkozy publicly asserted that progress in the talks was being held back by China (Watts 2009). British energy and climate change secretary Ed Miliband (2009) wrote in the *Guardian* that China had led the group of countries that had »hijacked« the climate negotiations, which had at times presented »a farcical picture to the public (…) We did not get an agreement on 50 per cent reductions in global emissions by 2050 or on 80 per cent reductions by developed countries. Both were vetoed by China, despite the support of a coalition of developed and the vast majority of developing countries.«[3] When asked on 19 December 2009 why the rich nations' emissions pledge had been removed from the final document, the spokesperson for Sweden, at that time holding the EU presidency, replied, »China didn't like numbers« (Economist 2009).

The Copenhagen Accord at the least blurred the once-clear distinction between developed and developing countries. For the first time, all the major economies pledged to take on specific individual responsibilities. While falling far short of a legally binding global agreement, the accord reflected a political consensus on the main elements of a future framework among the major emitters and representatives of the main negotiating groups. Two years later in Durban, the parties to the UNFCCC agreed to establish the Ad Hoc Working Group on the Durban Platform for Enhanced Action and to launch a process to develop a protocol, another legal instrument, or an agreed outcome with legal force under the UNFCCC applicable to all parties for their post-2020 climate commitments (UNFCCC 2011).

The 2013 UN climate conference in Lima was a crucial point along the road to COP21 in Paris. At the heart of the Lima Call for Climate Action (UNFCCC 2014) is that all parties agreed to submit their Intended Nationally Determined Contributions (INDCs). The INDCs are voluntary in nature and should point to advancement beyond the current undertakings of the individual parties. All nations were requested to submit their INDCs well in advance of the Paris conference, preferably before the end of March 2015 but no later than October 2015.[4] The Lima Call amounts to two significant shifts in international climate negotiations. One is a shift from the original UNFCCC emphasis on developed country leadership to a fully global process, and the other is from the Kyoto-style, quantity-based, legally binding »commitments« toward voluntary and broad »contributions« (as in the INDCs) to defuse major points of contention, such as sovereignty issues as well as the potentially historic dimension of COP21. This approach stands in contrast to the desire of the European Union and numerous climate activists for a legally binding treaty and is more in line with the vision of the soft global governance preferred by the United States and China.

To what extent the initial bottom-up contributions will be sufficient to hold the average rise in global temperature to below 2 °C above pre-industrial levels depends on each country's contributions and their review and possible strengthening over time. The UNFCCC Secretariat is required by 1 November 2015 to publish a synthesis aggregating the anticipated effect of the INDCs submitted by 1 October. The intention is that the timing of the report will allow sufficient leeway for pledges to be revised, where necessary, ahead of the COP21 negotiations. There is, however, no formal review process or a formal agreement to aggregate these commitments for comparison against the global goal.[5] Detailed

3. It is not so hard to understand why China rejected the two numbers cited, but rejecting a long-standing, widely reported proposal without putting forward an alternative created a bad image of China. The feeling was portrayed in Western media that the rich countries should forgo announcing their unilateral cuts. As suggested in Zhang (2009, 2011a, 2011b), China should have insisted on an at least 80 per cent emissions reduction by developed countries and that by 2050 per capita GHG emissions for all major countries be no higher than the world's average at that time.

4. By 18 August 2015, 29 submissions had been received from 56 countries. That of the 28 EU countries was combined into a single submission. For full details of these and subsequent submissions, see »INDCs as communicated by parties«; http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx.

5. In Lima, the parties had been unable to agree on a proposed formal peer-review process by which parties would be invited to review one another's pledges and subsequently revise their own. The Lima Call for Climate Action does provide the conditions for such a process to take place informally outside the UNFCCC.

specifications for contributions, review processes, and potential mechanisms to increase ambitions over time are of paramount importance to a post-2020 climate agreement. At COP21, as in Lima, these details will be difficult to agree on and represent the main challenge in the run-up to the conference.

China's stance toward international climate negotiations has been evolving concurrent with changes in domestic and international contexts. While China has been very active in participating in international climate negotiations and formulating and undertaking domestic climate mitigation and adaptation measures since the early days of climate talks, there is a discrepancy between its domestic actions and its simultaneous reticence to act at the international level. China is only now beginning to be widely seen as playing a long-awaited increasingly positive role in this complex process.

In the lead-up to and at Copenhagen, China took the initiative to ally with India and other major developing countries, took full advantage of being the world's largest carbon emitter, and attempted to secure a deal to its advantage. It is widely reported that Beijing walked away »happy,« but doing so came at a high price. Although China was officially backed by allies like India and Brazil, their representatives admitted in private that the negotiations had primarily been China's battle (Graham-Harrison 2009).[6]

China never publically admitted any wrongdoings in dragging on international climate negotiations at Copenhagen or having taken a different stance or strategy that might have contributed to a better outcome there. What has been observed since is that in line with changes in the domestic and international landscapes, China has been recalibrating its position by setting even more stringent mitigation goals than those it had agreed to, adopting new policies and measures while strengthening existing ones, leading South-South cooperation, providing support for technology, financing, and capacity building for climate mitigation and adaptation among other developing countries to the extent possible, and playing a larger role in international climate negotiations.

6. See Zhang (2010a) for reflections of China's stance and responses at Copenhagen.

3. Overview and Evaluation of Mitigation Goals and measures

3.1 Overview and Evaluation of Mitigation Goals[7]

China achieved a quadrupling of its gross domestic product (GDP) with only a doubling of energy consumption between 1980 and 2000 (Zhang 2003). Based on the trends of the 1980s and 1990s, the U.S. Energy Information Administration (2004) had estimated that China's CO_2 emissions would not be expected to catch up with the world's then-largest carbon emitter until 2030. China's energy use, however, surged since the turn of this century, almost doubling between 2000 and 2007. Despite similar rates of economic growth as in the previous two decades, the rate of growth in its energy use during this period more than doubled. As a result, China became the world's largest carbon emitter in 2007. To reverse this trend, China for the first time incorporated an input indicator as a constraint in its five-year economic planning. The government required that during the 11th five-year period (2006–10), energy use per unit of GDP be cut by 20 per cent (State Council 2006).

Zhang (2000a, 2000b) envisioned that China could make a voluntary commitment to total GHG emissions per unit of GDP at some point around 2020 and that a combination of a targeted carbon intensity level with an emissions cap at the sector level would be the most stringent commitment that it could make around or beyond 2020. It was only just prior to the Copenhagen summit that China pledged to cut its carbon intensity by 40–45 per cent by 2020 relative to its 2005 levels. Although this was consistent with China's longstanding opposition to hard emission caps — on the ground that such limits would restrict its economic growth — it marked a point of departure from its longstanding position on its own climate-related actions. Prime Minister Wen Jiabao made it clear at Copenhagen that China's pledges »are unconditional and they are not dependent on the reduction targets of other nations« (Watts 2009). Put another way, China would honor its commitments regardless of the outcome of international negotiations. In its 12th five-year economic plan (2011–15), the carbon intensity target was incorporated for the first time as a domestic commitment, with energy intensity required to be cut by

7. This section draws on Zhang (2011a, 2011c).

16 per cent nationwide (10–18 per cent across provinces) and carbon intensity by 17 per cent nationwide (10–19.5 per cent across provinces) relative to their 2010 levels.

While this unilateral commitment clearly pointed to China's determination to further decouple its energy use and carbon emissions from economic growth, it raised the issue of whether the pledge was actually ambitious or just »business as usual« (e.g., Qiu 2009; Carraro and Tavoni 2010). To put China's climate pledge into perspective, Zhang (2011a, 2011b, 2011c) examined whether it was as challenging as the energy-saving goals set in the 11th five-year economic blueprint, to what extent it would drive emissions below the projected baseline levels, whether China would fulfill its part of a coordinated global commitment to stabilize the concentration of GHG emissions at the desirable level, and whether the pledge was conservative with room for further increases. A balanced analysis of China's climate pledge suggested that the proposed carbon intensity target certainly did not represent business as usual, as some Western scholars (e.g., Levi 2009) argued. On the other hand, the target might not have been quite as ambitious as China argued. Given that it was already the world's largest carbon emitter, and its share in the world's total emissions continued to rise, even a few additional percentage reductions in its carbon intensity would translate into a significant amount of global emissions reductions. It would be hard, but not impossible, for China to increase its own proposed carbon intensity reduction target. Zhang (2011a, 2011b) suggested that China aim for a 46–50 per cent cut in its carbon intensity for the period 2006–20. That would put its absolute emissions reductions very much within the IPCC's recommended level for developing countries. As shown in Table 1, China plans to strengthen and extend its commitments to 2030 as indicated in its INDC submission (NDRC 2015).

3.2 Overview and Evaluation of Mitigation Measures

Burning coal contributes to the overwhelming majority of China's total dust and sulfur dioxide (SO_2), nitrogen oxides (NO_x), and CO_2 emissions and has given rise to unprecedented environmental pollution and health risks across the country (Zhang 2007a, 2011a; CCCCPPRP 2014). Moreover, given that China's energy mix is coal dominated, cutting its carbon intensity to meet its climate commitments by 2020 in fact means cutting its energy intensity, and abating CO_2 emissions is closely linked to reining in its energy consumption in general and its coal consumption in particular. Clearly, the timing of China's coal-use peak is crucial to determining when

Table 1: China's Energy and Environmental Goals, Five-Year Plans, 2006–2030

Time Frames	Target Goals
11th FYP (2006–10)	Cut energy use per unit of GDP by 20 per cent (actually achieved: 19.1 per cent) relative to 2005 levels; cut sulfur dioxide (SO_2) emissions by 10 per cent; close small thermal power plants with a total capacity of 50 gigawatts (GW) (actually achieved: 76.8 GW); through the Top 1000 Enterprises Energy Conservation Action Program, save 100 million tons of coal equivalent (tce) cumulatively (actually achieved: 150 million tce).
12th FYP (2011–15)	Cut energy intensity by 16 per cent (10–18 per cent across provinces) and carbon intensity by 17 per cent (10–19.5 per cent across provinces) relative to 2010 levels; cut SO_2 emissions by 8 per cent and nitrogen oxides emissions by 10 per cent; through the 10,000 Enterprises Energy Conservation Low Carbon Action Program, save a cumulative 250 million tce.
Year 2020	Cut carbon intensity by 40–45 per cent relative to 2005 levels and have alternative energy sources meet 15 per cent of national energy consumption, with an installed capacity of 200 GW for wind power and 100 GW for photovoltaics.
Year 2030	Cap carbon emissions around 2030 and make best efforts to peak early; increase the share of non-fossil fuels to around 20 per cent and reduce carbon intensity by 60–65 per cent compared to 2005 levels.

its carbon emissions will peak and to realizing the goal of an ecological civilization.

Capping coal consumption not only requires enhanced efforts in key energy-consuming sectors, but also unprecedented, coordinated regional efforts, in particular in the more developed and severely polluted regions. The Atmospheric Pollution Prevention Action Plan (State Council 2013) has set more stringent concentration targets for hazardous particles for more-developed areas, with the Beijing-Tianjin-Hebei region, Yangtze River Delta, and Pearl River Delta required to cut levels by 25 per cent, 20 per cent and 15 per cent, respectively. To that end, coal consumption in these more advanced and severely air polluted regions should not increase and should be further reduced in absolute terms in the 13th FYP period. Thus, the key challenge for China in the 13th FYP is to let coal consumption peak by undertaking strict measures. This would lead to estimations of the resulting CO_2 emissions peaking between 2025 and 2030 and coal's share in the total energy mix falling below 50 per cent in 2030 (Wang 2014; Zhang 2014a).

China implemented a variety of programs and initiatives, along with supporting economic and industrial policies and measures, targeting energy saving and pollution reduction for the 11th and 12th FYPs (Zhang 2015a). Flagship initiatives of a significant nature included but are not limited to the Top 1000 Enterprises Energy Conservation Action Program, the 10,000 Enterprises Energy Conservation Low Carbon Action Program, mandatory closures of small power plants while building larger, more efficient units, and a low-carbon city development pilot program. In the meantime, the government is making great efforts to promote widespread use of renewable energy, get energy prices right and reform resource taxes and is harnessing market forces to genuinely transform China into a low-carbon economy.

The Top 1000 Enterprises Energy Conservation Action Program[8]

Given that industry accounts for about 70 per cent of China's total energy consumption, this sector was crucial in the country meeting its 2010 energy-saving goal of a 20 per cent energy intensity reduction relative to 2005 levels. Thus the government put much effort toward changing the energy inefficient, environmentally unfriendly pattern of industrial growth. To this end, China explored industrial policies to encourage technical progress, strengthen pollution controls, and promote industrial upgrading and energy conservation. On the energy-saving front, it established the Top 1000 Enterprises Energy Conservation Action Program in April 2006, involving 1,008 enterprises in nine key energy-supply and energy-consuming industrial subsectors. Each enterprise had consumed at least 0.18 million tons of coal equivalent (tce) in 2004, and together they accounted for 33 per cent of national and 47 per cent of industrial energy consumption. The program aimed to save 100 million tce cumulatively during the 11th FYP (2006–10) (NDRC 2006).

Although there are areas that still require improvement (Price et al. 2010), the Top 1000 program is very much going as planned as far as the energy-saving goal is concerned. In November 2009, the National Development and Reform Commission (NDRC 2009a) reported that the program had realized energy savings of 106.2 million tce by the end of 2008, reaching its cumulative goal two years ahead of schedule. In September 2011, the NDRC estimated that the Top 1000 program would achieve total energy savings of 150 million tce during the 11th FYP (NDRC 2011b).

The 10,000 Enterprises Energy Conservation Low Carbon Action Program

To help meet the goals of energy saving and carbon intensity reduction for the 12th FYP (2011–15), in December 2011 the NDRC and eleven other central government organizations introduced the 10,000 Enterprises Energy Conservation Low Carbon Action Program, an expansion of the Top 1000 program. The enlarged program involved 16,078 enterprises. These included industrial and transportation operations consuming 10,000 tce or more and entities in other sectors consuming at least 5,000 tce in 2010. Together, these enterprises consumed at least 60 per cent of the nation's energy that year. The program aimed to save a cumulative 250 million tce during the period 2011–15 (NDRC 2012).

In December 2013, the NDRC reported the 2012 performance results for the 10,000 Enterprises program. Of 14,542 enterprises examined, 3,760 (25.9 per cent) of

8. This and the following two subsections draw on Zhang (2014c).

them exceeded their energy-saving targets; 7,327 (50.4 per cent) fulfilled their energy-saving goals; and 2,078 (14.34 per cent) basically fulfilled their energy-saving goals. While 1,377 (9.5 per cent) failed to meet their targets, the program achieved total energy savings of 170 million tce during 2011–12, meeting 69 per cent of the total energy-saving goal during the 12th FYP (NDRC 2013).

Mandatory Closures of Small Power Plants While Building Larger, More Efficient Units

The NDRC instituted a series of incentives to shut down small, less efficient power plants. Feed-in tariffs for small plants were lowered, power companies were given the option to build new capacity to replace retired capacity, and plants designated for closure were given electricity generation quotas that could be used to continue operations for a limited time or sold to larger plants (Williams and Kahrl 2008; Schreifels et al. 2012; Zhang 2010b, 2011a, 2015a).

These incentive-based policies helped the government surpass its 2006–10 goal of closing small thermal power plants with a total capacity of 50 gigawatts (GW). By the end of 2008, China had closed small plants with a total capacity of 34.21 GW, compared to a total capacity of 8.3 GW decommissioned during the period 2001–05 (NDRC 2008). By the end of the first half of 2009, the total capacity of decommissioned smaller and older units had increased to 54 GW, having met and surpassed the 50 GW target one and half years ahead of schedule. By the end of 2010, the total capacity of decommissioned smaller and older units had increased to 76.8 GW, more than the entire power capacity of Great Britain and almost ten times the total capacity decommissioned during 2001–05 (Zhang 2015a).

Regarding the construction of larger, more efficient and cleaner units, by the end of 2012, 75.6 per cent of fossil fuel–fired units consisted of units with capacities of 300 megawatts or more compared to 42.7 per cent in 2000 (Zhu 2010; NDRC 2013c). The combined effect of shutting down small, less efficient power plants and building larger, more efficient plants led the average amount of coal (in grams) consumed per kilowatt-hour (gce/kWh) of electricity generated to decline to 326 gce/kWh by 2012, a 12.8 per cent reduction compared to 2005 levels of 374 gce/kWh (CEC 2011; CEC and EDF 2012; Zhang 2015a).

Supportive Economic Policies

Supportive economic policies have been designed to encourage technological progress and strengthen pollution control to meet China's goals for energy saving and environmental control. To support the Ten Energy-Saving Projects, launched by the NDRC in July 2006 aimed at helping to meet the 2010 energy-saving goal of a 20 per cent cut in energy intensity, the central government had in August 2007 begun awarding enterprises in the east RMB 200 and those in the central and western parts of the country RMB 250 for every tce saved each year. Such payments were made to enterprises with energy metering and measuring systems in place that could document energy savings of at least 10,000 tce through energy-saving technical transformation projects (Ministry of Finance and NDRC 2007). In July 2011, the awards were increased to RMB 240 for enterprises in the east and RMB 300 for enterprises in the central and western part of the country for every tce saved per year, and at the same time, the minimum requirements for total energy savings from energy-saving technical transformation projects were lowered to 5,000 tce from the previously required 10,000 tce (Ministry of Finance and NDRC 2011).

Since the World Bank introduced in 1997 the concept of energy management companies (EMCs) to China, the government also pushes forward this mechanism to promote energy savings. It awards EMCs RMB 240 for every tce saved, with additional compensation of no less than RMB 60 for every tce saved by local governments (State Council 2010). China only had three EMCs in 1998. They increased to more than 80 by 2005 and further grew to more than 800 in 2010. As a result of these increases and award policies, the total annual energy savings by EMCs increased to 13 million tce in 2010, up from 0.6 million tce in 2005 (NDRC 2011a).

In 1994, when China reformed its tax system, it had introduced an excise tax (levied at the time of purchase) to incentivize sales of energy-efficient cars. The tax rate, adjusted over time, increases along with the size of a car's engine. The excise tax on a car with an engine less than one liter was set at 1 per cent of its value, whereas a four-liter engine would be taxed at 40 per cent of the car's value (Zhang 2011a). From the beginning of October 2015 to the end of 2016, the purchase tax on a car with an engine of 1.6 liters or less will be cut in half.

Renewable-energy cars, like electric, hybrid, and fuel-cell cars, are exempt from purchase taxes until the end of 2017.

In January 1998, the Chinese government mandated that new coal-fired units must come equipped with a flue gas desulphurization (FGD) facility and that plants built after 1997 had to begin the process of retrofitting with an FGD facility before 2010. Other policies to promote FGD-equipped power plants have also been implemented, including imposition of an on-grid tariff incorporating desulphurization costs and giving FGD-equipped plants priority in being connected to grids and allowing them to operate longer than those plants without desulphurization capacity. Moreover, the capital cost of FGD has fallen significantly, thus making it less costly to install such facilities (Zhang 2010b, 2011a, 2015a).

Newly installed desulphurization capacity in 2006 was greater than the combined total over the previous 10 years, accounting for 30 per cent of the total installed thermal (mostly coal-fired) capacity. The coal-fired units equipped with FGD increased to 630 GW by 2011, up from 53 GW in 2005. Accordingly, in 2011 the portion of coal-fired units with FGD rose to 90 per cent of total installed thermal capacity, up from 13.5 per cent in 2005 (CEC and EDF 2012; Zhang 2015a). As a result, by the end of 2009, China had reduced its SO_2 emissions by 13.14 per cent compared to its 2005 levels,[9] having met its 2010 target of a 10 per cent cut a year ahead of schedule (Zhang 2010b, 2011a).

The Use of Renewable Energy[10]

The Chinese government initially supported solar energy through so-called Golden Sun investment subsidies (Zhang 2011a). After years of simply taking advantage of overseas orders to drive down the cost of manufacturing solar panels, feed-in tariffs for solar power were enacted in July 2011 to create China's own solar power market. Wind power had benefited from bidding-based tariffs since 2003 (Zhang 2010b, 2011a). In August 2009, this supportive policy for wind power was replaced by feed-in tariffs. Under the new policy, four wind energy areas were designated based on the quality of wind energy resources and the conditions of engineering construction (NDRC 2009b). On-grid tariffs were set accordingly as benchmarks for wind power projects.

Not only is China setting extremely ambitious renewable energy goals, more important, it is making a dramatic effort to meet these goals. China invested 39.1 billion US dollars in renewable energy in 2009, knocking the United States from the top spot in total investment for the first time in five years, leaving it a distant second, with 22.5 billion US dollars in investments. China continued to consolidate its lead, with 54.4 billion US dollars in renewable energy investments in 2010. In the meantime, with 41.2 billion US dollars in investment, Germany moved up to second place, pushing the United States to third place, with investments of 34 billion US dollars. In terms of renewable energy investment as a percentage of GDP, China, at 0.55 per cent, invested two times more than the United States, at 0.23 per cent in 2010. With an installed capacity of 103.4 GW, China also overtook the United States for the first time to lead in total renewable energy capacity in 2010, knocking it to a distant second in total installed capacity at 58 GW (Pew Charitable Trusts 2011). China now aims to increase its total installed wind power capacity to 200 GW by 2020. Given that it can take months before wind turbines are connected to the power grid, China needs to significantly improve its power grids and coordinate the development of wind power with the planning and construction of them, including smart grids. New transmission lines should be constructed at the same time wind power farms are built. Moreover, given the significantly scaled-up wind power capacity planned for 2020, China should now place more emphasis on companies ensuring the actual flow of power to the grid than on meeting capacity (Zhang 2010b, 2011a, 2014c).

Low-carbon City Development Pilot Program

In China, cities are responsible for more than 60 per cent of total energy consumption, and their contribution to energy use and resulting CO_2 emissions contin-

9. The reduction in SO_2 emissions could be even larger than the achieved, if the installed FGD were running continuously and reliably. Given that FGD costs are estimated to account for about 10 per cent of the power generation cost, combined with lack of trained staff in operating and maintaining the installed FGD facility and lack of government enforcement, power plants did not operate the FGD. Even if the installed FGD facilities were running, they do not run continuously and reliably. MEP field inspections in early 2007 found that less than 40 per cent of the installed FGD were running continuously and reliably (Xu et al. 2009; Zhang 2015a).

10. This subsection draws on Zhang (2010b, 2011a, 2014c).

ues to increase given the expected urbanization rate of 65 per cent by 2030. Given such unprecedented urbanization, cities will play an even greater role in shaping energy demand and CO_2 emissions. Therefore, cities are the key to meeting China's 2020 carbon intensity target of a 40-45 per cent reduction relative to its 2005 levels and its carbon emissions peaking commitments around 2030.

China began experimenting with low-carbon city development in five provinces and eight cities on 19 July 2010. The experiment was expanded to a second batch of twenty-nine provinces and cities on 5 December 2012. All these pilot cities and provinces are making efforts toward strengthening industrial restructuring and technological upgrading, improving energy mix and energy efficiency, prioritizing public transport and promoting efficient public transport systems, and optimizing the urban landscape (Wang et al. 2013). In the process, however, these cities have confronted a variety of problems and challenges (Wang et al. 2013). These include but are not limited to the absence of sound carbon accounting systems, lack of low-carbon-specific evaluation systems, insufficient government–enterprise interactions, and excessive budget dependence on land concessions. While these are areas that need improvement, there are encouraging signs that the low-carbon pilot program is moving in the right direction.

An NDRC evaluation revealed that ten pilot provinces of the two batches of all pilots cut their carbon intensity by 9.2 per cent in 2012 compared to their 2010 level, a rate much higher than the national average of 6.6 per cent (NDRC 2014). In addition, all the pilot provinces and cities set CO_2 emissions peaks in 2030 or earlier although it was not mandated by the central government. Fifteen pilot provinces and cities are aiming for a CO_2 emissions peak in 2020 or earlier, with Shanghai publicly announcing 2020 as its peak year. Suzhou's has been set at 2020 and Ningbo's for 2015. Zhang (2011a, 2011b) had argued from six perspectives that China could cap its greenhouse gas emissions in the years between 2025 and 2032 or around 2030. The practices and ambitions of the pilot regions have set good examples for keeping emissions under control, making positive contributions to overall low-carbon development in China and thus possibly contributing to its carbon emissions peak occurring sooner than the aforementioned timeline.

Getting the Energy Prices Right[11]

To have the market play a decisive role in allocating resources requires getting energy prices right, because it sends a clear signal to both producers and consumers of energy. The overall trend of China's energy pricing reform since 1984 has been to move away from pricing entirely set by the central government in the centrally planned economy and toward a more market-oriented pricing mechanism, but the pace and scale of reform differ across energy products (Zhang 2014a).

To date, reform of electricity tariffs has lagged far behind, and accordingly the government still retains control over electricity tariffs. This has complicated implementing the pilot carbon-trading schemes in the power sector. Implementing emissions trading, however, will provide impetus for power-pricing reforms to allow the pass-through of carbon costs in the electricity sector. For this reason, power-pricing reforms should be a key area for reform in the 13th FYP.

Natural gas prices are also a pressing area for further reform. Given China's coal-dominated energy mix, increasing the share of cleaner fuel, like natural gas, has been considered the key option in achieving the twin goals of meeting energy needs while improving environmental quality. To that end, the government adopted a new pricing mechanism in Guangdong province and the Guangxi Zhuang Autonomous region (NDRC 2011c). Under the new mechanism, pricing benchmarks were selected and pegged to prices of alternative fuels generated by market forces to establish a price linkage mechanism between natural gas and alternative fuels.

Gas prices at various stages would then be adjusted accordingly on this basis. The pilot schemes in Guangdong and Guangxi point in the right direction of establishing a market-oriented natural gas pricing mechanism. In the 13th FYP, China needs to heed the lessons learned from the two pilot schemes and examine what kinds of adjustments and improvements are needed regarding the choice of alternative fuels and the selection of a pricing reference point in order to implement the Guangdong and Guangxi pilot reform programs across the country (Gao et al. 2013; Zhang 2014a).

11. This and the following subsection draw on Zhang (2014a, 2015a).

Resource Tax Reform

Even if energy price reform is undertaken, energy prices still would not fully reflect the cost of production from the perspective of the entire value chain of resource extraction, production, use, and disposal. Thus, combined with the pressing need to avoid the wasteful extraction and use of resources, getting energy prices right calls for China to reform its current narrow coverage of resource taxation and to significantly increase the levied level (Zhang 2014a, 2015a). The resource tax levied on crude oil and natural gas by revenue rather than existing extracted volume — a practice began in Xinjiang June 2010 and was then applied nationwide beginning November 2011 — is the first step in the right direction. China has further broadened that reform to coal, overhauling the current practice and levy on coal based on revenue beginning 1 December 2014. The Task Force on Green Transition in China of the China Council for International Cooperation on Environment and Development (CCICED, 2014) recommends that a higher resource tax be imposed on fossil fuels, with tax rates raised to at least 10 per cent, but preferably 15 per cent, for domestic and imported coal and to 10–15 per cent for domestic and imported oil by 2025. This will also help to increase local governments' revenue and alleviate their financial burden, incentivizing them not to focus on economic growth alone (Zhang 2010b, 2011a).

Environmental taxes

The introduction of environmental taxes to replace current charges for SO_2 emissions and discharged chemical oxygen demand has been discussed in academic and policy circles in China for quite some time. The draft tax law on environmental protection was released in June 2015 for public comment (Legislative Affairs Office of the State Council 2015), but the timing of its revision and eventual passage into law is unknown. Accordingly, the exact date of implementation has not been set. The sooner environmental taxes are imposed in the 13th FYP, the better, but it should not be later than 2020. Other countries' experience with environmental taxes suggest that such taxes initially be levied at low rates and be of limited scope, with their levels increasing over time. Moreover, environmental taxes should be shared taxes, with the majority of the revenue going to local governments. In terms of timing, however, given that China has not yet levied environmental taxes, it is better to introduce them as part of the 13th FYP, not least because such a distinction will enable disentangling the country's additional efforts toward carbon abatement from the broader energy-saving and pollution-cutting programs.

Pilot Carbon-trading Schemes

The NDRC in October 2011 approved seven pilot carbon-trading schemes in Beijing, the business hub of Shanghai, the sprawling industrial municipalities of Tianjin and Chongqing, the manufacturing centers of Guangdong province, Hubei province, and Shenzhen.[12] These pilot regions were deliberately selected for their varying stages of development and given considerable leeway to design their own schemes. These pilot trading schemes have features in common, but vary considerably in their approach to such issues as sector coverage, allocation of allowances, price uncertainty and market stabilization, potential market power of dominant players, use of offsets, and enforcement and compliance (Zhang 2015b, 2015c).

Beijing, Guangdong, Shanghai, Shenzhen, and Tianjin launched their first trading schemes prior to the end of 2013. Their first compliance deadlines were set for the end of June 2014. As shown in Table 2, the first-year performance of these five pilots was generally good. Shanghai and Shenzhen fully or almost fully met their commitments before the original deadline. Beijing, Guangdong, and Tianjin performed well after their compliance deadlines were extended (by less than one month). Guangdong achieved compliance rates of 98.9 per cent and 99.97 per cent, measured against enterprises and allowances, respectively (GPDRC 2014). Moreover, through technical innovation, 80 per cent of the covered enterprises were estimated to have reduced their emissions per unit of product to differing degrees (Li and He 2014). This is a significant accomplishment for a big manufacturing province like Guangdong. The relatively low rate of compliance in Beijing is mainly because the Beijing pilot not only involved a large number of entities, but the entities were also broad in scope, ranging from Sinopec, Microsoft, universities, hospitals, media, and such public entities as ministries. The lowest rate

12. See Zhang (2015b, 2015c) for detailed discussion of the features and compliance of pilots and their transition to a nationwide scheme.

Table 2: Five Carbon-trading Pilots' Compliance Rate in the First Compliance Year 2013

	Measured against enterprises (%)	Measured against allowances (%)
Beijing	97.1	Not available
Guangdong	98.9	99.97
Shanghai	100.0	100.0
Shenzhen	99.4	99.7
Tianjin	96.5	Not available

Source: Zhang (2015b).

of compliance among the five pilots subject to compliance obligations for 2013 emissions was found in Tianjin and could be related to the enterprises covered not being required to pay a penalty if they failed to meet their emissions obligations.

4. Impact of Recent Policy Shift on Prospects for COP21

China and the United States are the world's biggest and second-biggest emitters of CO_2, respectively, so to what extent they are involved in combating global climate change is extremely important for lowering compliance costs of climate mitigation and adaptation and for moving international climate negotiations forward. For quite some time, however, the United States and China have pointed at the other as the culprit blocking the negotiation process (Zhang 2007b). Unless the United States has made credible commitments itself, it does not have the moral right to push developing countries to take meaningful abatement actions. International climate negotiations prior to the US withdrawal from the Kyoto Protocol in 2001 suggest that the United States taking on commitments first and then jawboning developing countries, including China, had some impact on the position of developing countries and the timing of their commitments (Zhang 2000b).[13]

Although some progress in Sino-US cooperation on climate change was made, neither country undertook significantly sufficient moves to potentially change the prospects of international negotiations — until the joint China-US climate statement announced by President Xi Jinping and President Barack Obama on 11 November 2014 in Beijing. According to their statement, China committed to capping its carbon emissions around 2030, and to trying to peak early, and increasing the share of non-fossil fuel use to around 20 per cent by 2030 (White House 2014). These commitments were officially incorporated into China's INDC submission, dated 30 June 2015 (NDRC 2015). In addition, China pledged to reduce the carbon intensity of its economy by 60–65 per cent by 2030 compared to 2005 levels.

Sino-US cooperation on climate change in general and recent hard commitments to absolute emissions caps specifically have been viewed positively around the world. In particular, because this is the first time that China has moved to cap its total emissions, it has sent a clear signal encouraging the remaining major economies to follow suit and thus help increase the prospects for COP21. Reaching a long-awaited deal covering all major economies at COP21 depends, however, among other matters, on whether the commitments are ambitious or comparable among the major economies.

A recent joint Tsinghua-MIT study suggests that in the so-called continued effort scenario under which China

13. Prior to Kyoto, developing countries' had demanded that Washington demonstrate leadership, and the EU proposal for a 15 per cent cut in emissions of a basket of three GHGs below 1990 levels by 2010 put collective pressure on the United States, which led the world in greenhouse gas emissions. At Kyoto, the United States had made legally binding commitments. After Kyoto, the ball was kicked into China's court. Washington had made it clear that bringing key developing countries, including China, on board had been and would continue to be its focus in international climate change negotiations. According to some U.S. senators, it would be countries like China, India, and Mexico that would determine whether the United States ratified the Kyoto Protocol. It was even conceivable that the pressure mounted for China to make some kind of commitment at the negotiations subsequent to Buenos Aires in 1998. The world's media undoubtedly drew attention to China's non-participation, which was seen as holding up ratification of the protocol by the U.S. Senate and possibly even blamed for »blowing up« subsequent negotiations aimed at dealing with developing countries' commitments. The U.S. commitments at Kyoto and diplomatic and public pressure on China had put Beijing in a very uncomfortable position. It looked like China would be pressured to take on commitments at a much earlier date than it wished (Zhang 2000b). This situation changed once the United States withdrew from the Kyoto Protocol.

will maintain its Copenhagen pledge momentum and achieve a carbon intensity reduction rate of approximately 3 per cent per year from 2016 through 2050, China's carbon emissions would not peak until 2040, while its carbon emissions under the baseline scenario would not peak until 2050 (Zhang et al. 2014). This means that China will now bring its peak year forward, to 2030, at least ten years earlier than under the so-called continued effort scenario, under which it commits to cap its carbon emissions around 2030. Therefore, from this perspective, the new commitment is ambitious.

Regarding China's carbon intensity reduction pledges by 2030, one way to evaluate the challenge of the proposed carbon intensity target is to assess whether the 2030 goal is as difficult as the carbon intensity goal of a 40–45 per cent reduction by 2020 relative to its 2005 levels. Zhang (2011a, 2011c) argued that the 20 per cent energy-saving goal set out in the 11th FYP (2006–10) economic blueprint was very challenging and that the carbon intensity goal for 2020 is just as challenging as the 2010 energy-saving goal. As far as an annual reduction in carbon intensity is concerned, a decrease of 65 per cent by 2030 would require an average annual reduction of 4.4 per cent beginning in 2020, while meeting the carbon intensity goal of 45 per cent reduction by 2020 would require an annual reduction of 3.9 per cent, beginning in 2006. Clearly, the 2030 pledge represents an acceleration and strengthening of China's 2020 pledge. In particular, the low-hanging-fruit opportunities to reduce carbon emissions intensity that can only be captured once will have been exhausted by 2020 and it is thus even more challenging.

The picture differs, however, if measured by other means. One way is to examine whether an emissions peak in 2030 is consistent with the 2 °C target. The LIMITS (Low climate IMpact scenarios and the Implications of required Tight emission control Strategies) models project that China's emissions should peak in 2020, under 450 parts per million (ppm) and 500 ppm scenarios, to achieve the 2 °C target by the end of 2100 (Tavoni et al. 2015). The results under the Energy Modeling Forum scenario and the SSP (Shared Socio-ecosystem Pathways) scenario suggest that China's emissions should peak during 2020–25 to achieve the same 2 °C target. Clearly, China's commitment to let GHG emissions peak in 2030 does not seem to be consistent with the 2 °C target in any of the three scenarios. Moreover, China's GHG emissions must quickly decrease for the 2 °C target to be achievable. This suggests that even if China were successful in reaching this target, it would be unlikely to achieve the necessary emissions reductions after the peak year (Carraro 2015).

Another angle is to examine at what cost the emissions peak could be achieved. *China and the New Climate Economy* suggests that under the moderate growth scenario, capping China's carbon emissions around 2030 would cost 0.02 per cent and 0.06 per cent of China's GDP in 2020 and 2030, respectively, without consideration of other benefits of carbon abatement (He et al. 2014). The European Union's commitments to cut its GHG emissions by 30 per cent relative to 1990 levels are widely considered less stringent, partly because European Commission analysis found that a 30 per cent internal reduction would cost 0.2–0.3 per cent of GDP in 2020. If a 30 per cent reduction were part of an international agreement, GDP impacts would vary between -0.6 per cent and 0.6 per cent in 2020 (Klaassen et al. 2012). In percentage terms, the estimate of China's loss is very small and one magnitude of order less than that of the European Union's. While China is not expected to exhibit greater ambition than Europe, the latter being seen to have greater capacity, capability, and responsibility, the small loss projected for China could be interpreted as meaning that China's commitments to peak level would be less stringent or that the peak year could be brought forward.

During the course of the international climate change negotiations, the major points of contention between developed and developing countries have revolved around the distinction between developed countries and developing countries, the principle of common but differentiated responsibilities and the scope of its guidance, and finance support and technology transfer for helping mitigation and adaptation in developing countries. Amid these issues, a lack of hard, absolute emissions commitments from China has been a focus. Now that China has made such commitments to be achieved by 2030 — and these commitments are ambitious despite that they could be made even more ambitious in terms of the peaking time and peaking level of China's carbon emissions — the prospects for COP21 are markedly increased. Meanwhile, China continues to coordinate its position with the other BRICS countries — Brazil, Russia, India, and South Africa — and still fights for the principle of common but differentiated responsibilities for the sake of other developing countries (even if China has committed to emissions caps) as well as finance and technology transfer for the solidarity of the G77 and China as a group. Whether China's commitments are ambitious enough remains an open question. Whether a consensus on these outstanding issues can be reached will determine the COP21 outcomes.

5. China's Incentives and Scope for Action

Concerns about a range of environmental stresses and climate change impacts, along with worries over energy security as a result of steeply rising oil imports, have sparked China's determination to improve energy efficiency and cut both conventional pollutants and GHG emissions and to increase the use of clean energy to aid its transition to a low-carbon, green economy. This was clearly reflected by the key decisions of the Third Plenary Session of the 18th Central Committee of the Communist Party of China in November 2013 to assign the market a decisive role in allocating resources and to build ecological civilization systems and mechanisms. On the one hand, given that environmental compliance costs will be higher now than before, and are increasing as emissions targets become increasingly stringent, and on the other hand that dodging environmental regulations is widespread and common in China, the issue becomes what the key incentives and scope of action are.

First, maintaining social harmony and stability has been the top priority in China, and the environment — reflected in pollution disputes and sudden, unexpected environmental incidents — has been one of the leading causes of social unrest (Zhang 2007a). If not adequately addressed, widespread dissatisfaction and disputes could eventually challenge the authority and legitimacy of the Communist Party's rule.

Second, China, for its own sake and from the international community's, cannot afford to continue along its conventional path of encouraging economic growth, given that three decades of almost uninterrupted double-digit growth came at the high price of air pollution and intensive exploitation of natural resources. Local governments are being incentivized not to focus on economic growth alone. Rather, in the new phase of mid- to high-speed growth under the »new normal,« the economic structure will undergo comprehensive and fundamental changes aimed at higher efficiency and lower production and social costs. To that end, the 13th FYP should place more emphasis on economic restructuring, upgrading economic models, and promoting innovation than previous FYPs (China Securities Journal 2015). With per capita GDP of 7,575 US dollars in 2014, China has an opportunity to become an upper-income country, but at the same time it risks falling into the »middle-income trap,« confronted by an aging population and a declining labor supply. Thus, efforts to increase labor productivity will also be key to helping China avoid the middle-income trap (Jin 2015).

Third, dense smog and haze have become a major issue. The combination of mounting public complaints about smog and higher standards of living makes people sensitive to the necessity for more anti-pollution measures and also increases public support for related policies and measures.

Fourth, there is increasingly scientific evidence confirming man-made climate change and its resulting negative effects. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change, the most comprehensive assessment of the science relating to climate change, reported with 95 per cent certainty that the major cause of global warming was increasing concentrations of GHGs produced by human activity (IPCC 2014). Continued GHG emissions will cause further warming and have the potential to seriously damage the natural environment and affect the global economy, making it the most pressing long-term global threat to future prosperity and security.

Taken together, the need for improved environmental quality has been elevated to unprecedented importance internationally. After nearly every Chinese city monitored for pollution failed to meet state standards in 2013, in March 2014 Chinese Premier Li Keqiang told the 3,000 delegates in China's legislature that the country would »declare war against pollution as we declared war against poverty.« If China's accomplishment and worldwide recognition in eradicating poverty could be considered any kind of predictor, it would provide some credibility toward the prospect of winning the fight against pollution.

In line with this public acknowledgment at the highest levels that China faces an environmental crisis, the government is attempting to cap coal consumption to let it peak in the 13th FYP period, cut coal consumption in absolute terms in severely polluted regions, take unprecedented steps to keep energy consumption and carbon emissions under control in key energy-consuming industries and cities in the context of government decentralization and unprecedented urbanization, strengthen and expand flagship programs and initiatives and supportive economic policies, and increase the widespread use of renewable energy. Moreover, given the many environmental issues of a cross-border nature, neighboring regions — such as the Beijing-Tianjin-Hebei region and the Yangtze River Delta and Pearl River Delta — now increasingly act collectively rather than independently. These coordinated efforts significantly increase their effectiveness in combating pollution.

Furthermore, government at all levels is taking broad approaches to tackling environmental issues. While having relied mostly on administrative measures to date, China now realizes that they can be effective but are often not efficient. It is increasingly harnessing market forces to reduce energy consumption and cut carbon and other conventional pollutants and genuinely transform into a low-carbon, green economy. Such market-based instruments include but are not limited to moving away from energy pricing entirely by the central government in the centrally planned economy and toward a more market-oriented pricing mechanism, reforming its current narrow coverage of resource taxation and the resource tax levied by revenue rather than existing extracted volume, experimenting with seven pilot carbon-trading schemes and preparing for the transition to a nationwide trading scheme, and implementing a system for chargeable use of resources and a system for ecological compensation. These are solutions to save energy, cut pollution, and abate climate change in the 13th FYP and beyond, and at the same time they represent key challenges and directions for China.

Finally, it should be emphasized that implementation holds the key to actually achieving desired outcomes, and there are encouraging signs that the Chinese government is strengthening existing efforts and taking additional steps in this direction. Indeed, enacting the policies and measures targeted for energy saving and pollution cutting signals the goodwill and determination of China's leaders. To ultimately achieve the desired outcomes, however, requires strict implementation and coordination of these policies and measures. This will be a decisive factor in determining the prospects for whether China will clean up its development act and meet its carbon intensity target in 2020 and honor its commitments to cap carbon emissions around 2030.

While the aforementioned argues that China is motivated to take actions, it does not necessarily suggest sole reliance on domestic action without action at the international level. In fact, to effectively control climate change and the CO_2 emissions inherent in China's trade, action needs to be taken internationally as well as domestically. China is, like every other country, concerned about a potential loss in competitiveness in taking unilateral climate abatement measures. At the international level, cutting China's CO_2 emissions related to exports creates impetus for strengthening international technological cooperation and coordination on climate change. With China still dependent on coal to meet the bulk of its energy needs, carbon capture, utilization, and storage (CCUS) has been identified as a crucial element in the country's efforts to reduce GHG emissions. China and the European Union have cooperated in this area within the framework of the Near Zero Carbon Initiative, developing CCUS demonstration projects in China by 2020 based on EU advanced, near-zero emissions coal technology. If more efficient, advanced low-carbon or near-zero carbon technologies were to be widely used, it would significantly reduce overall carbon emissions in China, including those embedded in trade. Cutting China's CO_2 emissions in exports would also create impetus for establishing a global carbon price framework. The absence of a global carbon price has impeded internalizing carbon costs. Given that the internalization of such costs would send a clear signal to producers and consumers, China and the international community need to strengthen coordination in this regard, ensuring that the costs of carbon emissions embedded in traded goods is reflected in the price for consuming countries as well as goods for domestic use. This is a feasible means of passing through carbon cost to consumers without consumption-based accounting of CO_2 emissions, which is more data-intensive and complex than production-based accounting of CO_2 emissions (Zhang 2012a).

Carbon emissions trading pilots are a significant step in the right direction toward this end. While these pilots have experienced ups and downs, with built-in incentives and mechanisms and a variety of measures and policies in place to enhance their compliance, their first-year performance is generally good. Their positive start and performance in the first year of compliance provides useful lessons for improving their operation and compliance in coming years and developing national emissions trading scheme (Zhang 2015b, 2015c). Given that the European Union has been the frontrunner in carbon emissions trading from the beginning, it has provided useful advice and lessons for developing China's own trading schemes through the on-going EU-China emissions trading capacity-building project. Bilateral cooperation on carbon markets is expected to be further enhanced in the years ahead (Ministry of Foreign Affairs 2015).

Broadly speaking, putting a price on carbon can be done by means of cap and trade, carbon taxation, or a hybrid approach. Nordhaus (2006) argues for a harmonized carbon tax approach, while the proposal led by Christian de Perthuis and Jean Tirole for an ambitious and credible agreement in Paris favors a cap-and-trade scheme.[14] Based on my observations, there are two major approaches being used in international climate change negotiations to break the Kyoto impasse. First, if negotiations continue along the Kyoto-style, quantity-based approach, discussion should not focus on how every country has a similar kind of commitment. Given that only a few countries contribute most of the CO_2 emissions, what matters most is the commitment of these key players. Therefore the focus should be on the big players because the top 20 countries generate almost 80 per cent of emissions. Second is a harmonized carbon price, an approach that acknowledges that the Kyoto-type approach has failed to deliver results, at least from a long-term point of view. That China and the United States have committed to emissions caps raises the relevant issue of a harmonized carbon tax.

Is China interested in a harmonized carbon tax? This can be assessed from three angles: appealing aspects, unappealing aspects, and comparison to the alternative cap-and-trade alternative. First among the appealing aspects is setting a minimal tax level so that individual countries can exceed that level. This practice is already common in China, which is using it for pollutant charges, differentiated power tariffs, and for a nationwide carbon-trading scheme being established. The basic idea is to set a minimum and let the regions do more if they feel the need.

The second appealing aspect is that the revenues of a harmonized carbon tax will be retained domestically. Third, pledge and review for INDCs is complex, so a harmonized carbon tax would simplify matters, particularly if an international deal on emissions cannot be reached. A harmonized carbon tax is intended to make climate efforts across countries comparable and thus remove the possibility or at least reduce the impetus to impose carbon tariffs. Fourth, carbon pricing tends to converge, at least in the short term. Prices in key markets are now getting closer than previously, but this trend might shift in the longer term. This makes implementation of a harmonized carbon tax possible.

One of the unappealing aspects is that to achieve the climate goal, the harmonized carbon tax is not trivial if mitigation effects are to be realized. The issue for China is that because the existing price of fossil fuels is lower, the price inclusive of the harmonized carbon tax in China will increase relatively faster. Combined with its coal- and carbon-intensive nature, the Chinese economy probably will be affected the most. Another argument involves differentiated responsibility: Why would China take on the same harmonized carbon tax given that major emitting developed countries have huge historical responsibilities.

An alternative approach like cap-and-trade comes into play in China because of mounting public complaints about environmental pollutants. One way to get this under control is to cap emission pollutants. This situation is extremely serious, and from a short-term perspective, the cap approach is appealing. Furthermore, tax levels are set by the national government, but firms (in particular, large state-owned enterprises) have bargaining power to be granted allowances under cap-and-trade. They might therefore prefer cap-and-trade, because whereas they have no say in national tax levels, they would have a lot to say under cap-and-trade on a regional and national basis. Firms also realize that under an emissions, environmental, or carbon tax, any unit of emissions would be subject to these taxes, but only those units above the quotas would be subject to taxes under cap-and-trade. In theory, as long as China is a party to an international climate agreement, Chinese firms can engage in inter-

14. The proposal being led by de Perthuis, Chairman of the Scientific Committee of the Climate Economics Chair, and Tirole, the 2014 Nobel laureate in economics, was released in late June 2015 after soliciting signatures from the world's top 40 general economists and environmental and resource economists. See details at TSE-CEC Joint Initiative, https://sites.google.com/a/chaireeconomieduclimat.org/tse-cec-joint-initiative/home.

national carbon trading. Thus companies are very eager to do it, and financial institutions prefer to engage in international cap-and-trade, because they have more roles to play.

It is good that China is embracing these market instruments. Domestically speaking, carbon trading seems to be doing well. On the other hand, the system does not cover all regions and sectors, so an environmental tax certainly could play a complementary role, especially because local governments need the revenue. Internationally, a harmonized carbon tax approach depends on whether the pledge and review process in international climate change negotiations can work. If that is not the case, a harmonized carbon tax and other options should be considered.

6. Conclusions

In international climate change negotiations, China's role is an issue of perennial concern. In particular, the lack of quantitative, absolute emissions commitments from China has been the focus. In line with changing domestic and international contexts, China is recalibrating its stance and strategy. Its participation in international climate change negotiations has evolved from playing a peripheral role to gradually moving to central stage. This is clearly reflected in its hard commitments to cap its carbon emissions by 2030.

These long-awaited commitments are ambitious, encourage other major parties to follow suit, and thus markedly increase the prospects for COP21. China is certainly doing its part to help reach a legally binding agreement in Paris. It would be most hard hit if climate change continues unabated. Moreover, the past three decades of Chinese economic reforms witnessed a shift in control over resources and decision making to local governments. This devolution placed environmental stewardship in the hands of local officials and polluting enterprises more concerned with economic growth and profits than the environment. The central government has had great difficulty getting effective cooperation from local governments in meeting energy-saving and pollution-cutting goals (Zhang 2012b). From this perspective, having a legally binding international agreement, under which China has hard commitments, allows the central government to pressure local governments and enterprises to meet their energy and environmental goals in the name of fulfilling national commitments to the international agreement (Zhang 2014b).

How China's carbon emissions are likely to develop or at what level they will finally peak is still an open question. This, however, is what determines whether China's commitments are sufficiently ambitious and could be among the contentious issues affecting the outcomes of COP21 or subsequent negotiations. There are two ways to increase China's ambition. One is to indicate peaking level. Just like estimates of peaking time differ, estimates of peaking level also differ significantly across studies. An optimistic estimate puts the peaking level at 8.5 gigatons (Gt) CO_2 under the enhanced low-carbon scenario (Jiang et al., 2013), assuming widespread adoption of more advanced low- or zero-carbon technologies without factoring in adoption costs and behavioral changes. Teng and Jotzo (2014) suggest China's carbon emissions peaking during the 2020s and returning to below the 2020 level by 2030 and then to around current levels by 2040. Having CO_2 emissions in 2013 estimated at 9.1 Gt CO_2 — based on the revised energy statistics released in February 2015 by the National Bureau of Statistics of China (2015), which adjusts coal consumption in 2013 upwardly by 589 million tons — suggests a peaking level of 10.6 Gt CO_2 in 2030. The aforementioned Tsinghua-MIT study suggests that China's carbon emissions will peak at 12.1 Gt CO_2 around 2040 in the so-called continued effort scenario and at 10.2 Gt CO_2 around 2030 in the so-called accelerated effort scenario (Zhang et al. 2014). Taking these estimates together, my educated estimate is that China is most unlikely to reveal its peaking emissions level in 2030, and if so, it would not be lower than 10 Gt CO_2.[15]

Another way to show ambition would be to set emissions targets for 2025. The current levels of ambition for China and the rest of the world under the 2030 time frame is not consistent with limiting the global average temperature increase below 2 °C. There is still a significant emissions gap in meeting this goal. If China sets stringent emissions targets for 2025, and parties in Paris agree on emissions targets for 2025, that would help avoiding the risk of locking in insufficient actions and an inadequate emissions pathway for fifteen years. It has

15. Indeed, China did not reveal its carbon-peaking emissions level for 2030 in its 30 June INDC detailing its commitments to climate change mitigation and adaptation in the post-2020 period.

been proposed to launch a process in Paris of regular, periodic updating of contributions, for example, every five years, with parties expected to progress in the levels of ambition in each round in line with their national circumstances (Moosa and Dovland 2015; Yamin et al. 2015). If that can be agreed upon, then binding goals for 2030 could be set by 2020.

While the second option is even more stringent than the first, neither is easy for China. To what extent China is willing to go along will no doubt be based on a combination of Beijing's own assessment of its responsibility, economic and political benefits, and climate change impacts, while also taking into consideration mounting diplomatic and international pressure and the give and take of international negotiations. Whether a consensus on these outstanding issues can be reached will determine the COP21 outcomes.

Regardless of these or the outcomes of later negotiations, however, China for its own sake will honor its commitments incorporated in its submitted INDCs. China is working on its 13th FYP, and the carbon emissions target is expected to be incorporated as a domestic commitment for the first time in Beijing's five-year economic planning. Meeting the 2020 domestic goal and the 2030 hard commitments will require significant economic restructuring and technology upgrading. Both are conducive to carbon mitigation, and mitigation provides a variety of ancillary benefits, such as reductions in conventional air pollutants and health risks, so this creates a new impetus for structural economic reforms to maximize synergies between climate change mitigation efforts and structural economic reforms. This synergy could be further enhanced by capping nationwide coal consumption to let it peak in the 13th FYP and carbon emissions to peak during 2025–30. To that end, China needs to put in place new policies and measures while strengthening and expanding existing flagship programs and initiatives and supportive economic policies to genuinely transform into a low-carbon economy. China's current pilot carbon trading has shown encouraging progress, and a well-designed, well-implemented and well-operated national carbon scheme is expected to play a crucial role in helping China meet its carbon-control targets.

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