17. Policies and Measures to Transform China into a Low-carbon Economy

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Introduction

China's Thirteenth Five-Year Plan period (2016–20) marks a shift in the focus of China's economic priority from a war against poverty to a war against pollution. Domestically, the drivers of the shift include the dense smog that frequently shrouds Beijing and other areas, and steeply rising oil imports that have raised concerns about a range of environmental problems, health risks and energy security. In addition, domestic concerns for climate stability have reinforced international pressure for China to play an ambitious part in the global effort to combat global climate change. In other words, for the sake of national and international interests, China can no longer continue along its conventional path of encouraging economic growth at the expense of the environment.

Chinese leaders have for some years been aware of the environmental challenges the country faces. In November 2012, the Eighteenth National Congress of the Central Committee of the Communist Party of China adopted a general policy of establishing an 'ecological civilisation'. This places ecological goals at the same level of priority as existing policies on economic, political, cultural and social development—and emphasises that the values of an ecological civilisation will be embedded in all aspects of economic development.

With the grand vision of creating an ecological civilisation in place, the issue becomes how China will deal with the environmental costs of energy consumption needed to fuel economic growth, especially the impact of climate change. This presents a tremendous climate policy dilemma, not only for China but also for the world given the scale of China's emissions and dynamic economy. This is true even in the context of the current slowdown of the Chinese economy, for even though the rate of China's growth has slowed, the incremental additions of this level of growth are still significant at the global level.

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Against this background, this chapter discusses China's energy and environmental goals and policies and the measures undertaken, and draws some concluding remarks from the discussion. The next section outlines China's energy and environmental goals, while the third section highlights 10 mitigation policies and measures being implemented to limit China's contribution to climate change. The final section summarises the significance of the goals and policies outlined and discusses the related challenges for the future.

Energy and environmental goals

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

Zhang (2000a, 2000b) envisioned that it would be about 2020 when China could make a voluntary commitment to reduce total greenhouse gas (GHG) emissions per unit of GDP. Zhang estimated that around or beyond that year, a combination of a targeted carbon intensity level and an emissions cap at the sector level would be the most stringent commitment. It was only just before the Copenhagen summit in 2009 that China pledged to cut its carbon intensity by 40–45 per cent relative to 2005 levels by 2020. Although this was consistent with China's long-standing opposition to absolute emission caps—on the grounds that such limits would restrict economic growth—this marked a point of departure from China's long-standing position on its own climate-related actions. Importantly, then prime minister Wen Jiabao made it clear at Copenhagen that China's pledges were 'unconditional and they are not dependent on the reduction targets of other nations' (Watts 2009). The Twelfth FYP (2011–15) adopted a carbon intensity target as a domestic commitment for the first time. Under the target, energy intensity was required to be cut by

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 2010 levels.

While this unilateral commitment pointed to China's determination to further decouple its energy use and carbon dioxide emissions from economic growth, it raised the issue of whether the pledge was truly ambitious or just 'business as usual' (for example, Qiu 2009; Carraro and Tavoni 2010). To give perspective to China's climate pledge, Zhang (2011a, 2011b, 2011c) examined whether it was as challenging as the energy-saving goals set in the Eleventh FYP blueprint and asked the following: 1) Would these goals drive emissions below the projected baseline levels; 2) would China fulfil its part of a coordinated global commitment to stabilise the concentration of GHG emissions at the level set as the target of the international community; and 3) was China's pledge conservative, leaving room for further increases. A balanced analysis of China's climate pledge suggested that the proposed carbon intensity target did not represent business as usual, as some Western scholars (for example, Levi 2009) have argued. On the other hand, the target might not have been hugely ambitious. Given that China was already the world's largest emitter of carbon dioxide, and its share in total global emissions was continuing to rise, even a few additional percentage point reductions in its carbon intensity would translate into significant global emissions reductions. It would be hard but not impossible for China to increase its proposed carbon intensity reduction target. Zhang (2011a, 2011b, 2011c) suggested that China aim for a 46–50 per cent cut in its carbon intensity for the period 2006–20. Achieving this type of goal would put its absolute emissions reductions very much within the Intergovernmental Panel on Climate Change's recommended level for developing countries.

As shown in Table 17.1, China plans both to strengthen and to extend its commitments to 2030. Under the joint China–United States climate statement announced by Chinese President Xi Jinping and US President Barack Obama in November 2014 (and formally released on 25 September 2015), China committed to cap its carbon emissions by about 2030,[2] to try to peak early and to increase the share of non-fossil fuels in primary energy consumption to about 20 per cent by 2030 (White House 2014). These commitments were officially incorporated into China's 'intended nationally determined contributions' 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 with 2005 levels. In March 2016, the National People's Congress, China's parliament, approved the aim to cut energy intensity by 15 per cent and carbon intensity by 18 per cent relative to 2015 levels by 2020 as part of the Thirteenth

2 How China's carbon emissions are likely to develop or at what level they will finally peak are still open questions.

FYP (State Council 2016). If these goals were realised, China would overshoot its pledge made in Copenhagen, and the eventual outcomes would very much fall within the range envisioned in Zhang (2011b, 2011c).

Table 17.1 China's energy and environmental goals, 2006–30

Time frames	Target goals
11th FYP (2006–10)	Cut energy use per unit of GDP by 20 per cent relative to 2005 levels (actually achieved: 19.1 per cent); cut sulphur dioxide emissions by 10 per cent; close small thermal power plants with total cumulative capacity of 50 GW (actually achieved: 76.8 GW); through the 'Top 1,000 Enterprises Energy Conservation Action Program', save a cumulative 100 million tonnes of standard coal equivalent (tce) (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 sulphur dioxide emissions by 8 per cent and emissions of nitrogen oxides by 10 per cent; through the '10,000 Enterprises Energy Conservation Low Carbon Action Program', save a cumulative 250 million tce.
13th FYP (2016–20)	Cut energy intensity by 15 per cent and carbon intensity by 18 per cent relative to 2015 levels; set an absolute limit for energy consumption of 5 billion tce; 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 about 20 per cent and reduce carbon intensity by 60–65 per cent compared with 2005 levels.

Mitigation policies and measures

The burning of coal is responsible for the overwhelming majority of China's total emissions of dust, sulphur dioxide, nitrogen oxides and carbon dioxide, and has given rise to unprecedented environmental pollution and health risks across the country (Zhang 2007a, 2011b; CCCCPPRP 2014). Cutting carbon intensity to meet climate commitments by 2020 is closely linked to reining in energy consumption in general, and coal consumption in particular. The timing of China's coal-use peak is thus crucial to determining when its carbon emissions will peak, and to realising the goal of an ecological civilisation.

Capping coal consumption requires not only enhanced efforts in key energy-consuming sectors, but also unprecedented regional coordination, especially among more developed and severely polluted regions. The 'Atmospheric Pollution Prevention Action Plan' (State Council 2013) sets 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 by 2017 relative to 2012 levels, respectively. Coal consumption in these more advanced

and severely air polluted regions should thus be reduced in absolute terms in the Thirteenth FYP period. The key challenge of China's Thirteenth FYP is therefore to undertake concerted measures that ensure the peaking of coal consumption during the period of the Plan. It is estimated that this would lead to carbon dioxide 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 2014c).

Under the Eleventh and Twelfth FYPs, China implemented a variety of energy-saving and pollution-reduction programs and initiatives, along with supporting economic and industrial policies and measures (Zhang 2015c). Flagship initiatives include but are not limited to the 'Top 1,000 Enterprises Energy Conservation Action Program', the '10,000 Enterprises Energy Conservation Low Carbon Action Program', mandatory closures of small power plants combined with construction of larger and 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, set energy prices at appropriate levels and reform resource taxes while also harnessing market forces to genuinely transform China into a low-carbon economy.

The Top 1,000 Enterprises Energy Conservation Action Program

Industry accounts for about 70 per cent of China's total energy consumption. To achieve China's 2010 goal of reducing energy intensity by 20 per cent, the government put much effort into changing the pattern of industrial growth. China explored industrial policies that encourage technological progress, strengthen pollution controls and promote industrial upgrading and energy conservation. On energy saving, it established the Top 1,000 Enterprises Energy Conservation Action Program in April 2006, involving 1,008 enterprises in nine key energy-supplier and energy-consumer industrial subsectors. Each enterprise consumed at least 180,000 tonnes of standard 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 Eleventh FYP (2006–10) (NDRC 2006).

Although there are areas that still require improvement (Price et al. 2010), in November 2009, the National Development and Reform Commission (NDRC 2009b) reported that the program had realised energy savings of 106.2 million tce by the end of 2008, thus reaching its goal two years ahead of schedule. In September 2011, the National Development and Reform Commission (NDRC) estimated that the Top 1,000 program would achieve total energy savings of 150 million tce during the Eleventh FYP (NDRC 2011a).

The 10,000 Enterprises Energy Conservation Low Carbon Action Program

To help meet the energy saving and carbon intensity reduction goals of the Twelfth FYP (2011–15), in December 2011, the NDRC and 11 other Central Government organisations introduced the 10,000 Enterprises Energy Conservation Low Carbon Action Program—an expansion of the Top 1,000 program. The enlarged program involved 16,078 enterprises, including industrial and transportation operations that in 2010 consumed 10,000 tce or more and entities in other sectors that consumed at least 5,000 tce. 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) had exceeded their energy-saving targets; 7,327 (50.4 per cent) had comfortably fulfilled their energy-saving goals; 2,078 (14.3 per cent) had basically fulfilled their energy-saving goals; and 1,377 (9.5 per cent) had failed to meet their targets. The program achieved total energy savings of 170 million tce during 2011–12—equivalent to 69 per cent of the total energy-saving goal of the Twelfth FYP (NDRC 2013b).

Mandatory closure of small power plants while building larger, more efficient units

The NDRC established a series of incentives to shut small, inefficient power plants. Feed-in tariffs for small plants were lowered. Power companies were given the option to build new capacity to replace retired capacity. 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 2010a, 2011b, 2015c).

These incentive-based policies helped the government surpass its 2006–10 goal of closing small thermal power plants with total capacity up to 50 GW. By the end of 2008, the sum of small plant capacity closed had reached 34.2 GW, compared with just 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, exceeding the 50 GW target 18 months 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 the United Kingdom and almost 10 times the total capacity decommissioned during 2001–05 (Zhang 2015c).

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

As the Chinese economy enters the 'new normal', the policy of building more efficient coal-fired power plants is being supplanted by restrictions on all-new coal generation facilities. On 23 March 2016, the National Energy Administration ordered 13 provincial governments to stop issuing approvals for such plants until the end of 2017. It also directed 15 provinces to cease the construction process for new coal-fired power plants that had already been approved. This was a result mainly of changed market conditions for coal-fired power utilities, which face a greater threat of asset writedowns and prospective asset stranding due to displacement by renewable energy sources, falling utilisation rates and lower than expected demand for electricity (China Carbon Forum 2016).

Supportive economic policies

Economic policies have been designed to encourage technological progress and to strengthen pollution control so China can meet its goals for energy saving and environmental control. To support the 'Ten Energy-Saving Projects' plan, launched by the NDRC in July 2006 and aimed at helping to meet the 2010 energy-saving goal of cutting energy intensity, the Central Government in August 2007 began to offer financial incentives of RMB200 to enterprises in eastern areas and RMB250 to those in central and western China for every tonne of standard coal equivalent saved annually. Such payments were made to enterprises with energy metering and measuring systems 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, these rewards were increased to RMB240 for enterprises in the east and RMB300 for others for every tonne of standard coal equivalent saved per year. Concurrently, the minimum threshold for total energy savings from energy-saving technological transformation projects was lowered to 5,000 tce from the previously required 10,000 tce (Ministry of Finance and NDRC 2011).

Since 1997, when the World Bank introduced the concept of energy management companies (EMCs) to China, the government has also pushed forward this mechanism to promote energy savings. The system awards EMCs RMB240 for every tonne of standard coal equivalent saved, with additional compensation of

no less than RMB60 for every tonne of standard coal equivalent saved by local governments (State Council 2010). China had only three EMCs in 1998. By 2005, that number had increased to more than 80, and to more than 800 by 2010. As a result of these incentives and the increasing number of firms to which they apply, the total annual energy savings by EMCs increased to 13 million tce by 2010—up from 600,000 tce in 2005 (NDRC 2011b).

When China reformed its tax system in 1994, it introduced an excise tax (levied at the time of purchase) to provide an incentive for sales of energy-efficient cars. The tax rate, adjusted over time, increases with the size of a car's engine. Excise tax on a car with an engine of less than 1 L was set at 1 per cent of its value, whereas a 4 L engine would be taxed at 40 per cent of the car's value (Zhang 2011b). From the beginning of October 2015 to the end of 2016, the purchase tax on cars with an engine of 1.6 L or less was halved. Renewable energy-fuelled cars, such as 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 desulphurisation (FGD) facility and that plants built before 1998 had until 2010 to begin the process of retrofitting an FGD facility. Other policies to promote FGD-equipped power plants include imposition of an on-grid tariff incorporating desulphurisation costs, giving FGD-equipped plants priority in grid connection and allowing them to operate longer than plants without desulphurisation capacity. All the while, the capital cost of FGD has fallen significantly, making it cheaper to install such facilities (Zhang 2010a, 2011b, 2015c).

As a result of these policies, newly installed desulphurisation capacity in 2006 alone was greater than the combined total over the previous 10 years, and had reached 30 per cent of total installed thermal (mostly coal-fired) capacity. Coal-fired power units installed with FGD increased from 53 GW in 2005 to 630 GW by 2011. The same year, the proportion of coal-fired units with FGD rose to 90 per cent of total installed thermal capacity—up from just 13.5 per cent in 2005 (CEC and EDF 2012; Zhang 2015c). By the end of 2009, China had reduced its sulphur dioxide emissions by 13.1 per cent compared with its 2005 levels,[3] and had met its 2010 target of a 10 per cent cut one year ahead of schedule (Zhang 2010a, 2011b).

3 The reduction in sulphur dioxide emissions could be even larger than that achieved so far if the installed FGD facilities were running continuously and reliably. FGD costs are estimated to account for about 10 per cent of power generation costs, there is a lack of staff trained in operating and maintaining the FGD facilities and a lack of government enforcement, which means many power plants do not operate an FGD facility, even if one is installed. Ministry of Environmental Protection field inspections in early 2007 found that less than 40 per cent of the installed FGD facilities were running continuously and reliably (Xu et al. 2009; Zhang 2015c).

The use of renewable energy

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

China is not only setting ambitious renewable energy goals, but is also making dramatic efforts to meet these goals. In terms of committing finance, as far back as 2009 China's renewable energy investments of US$39.1 billion exceeded the United States' US$22.5 billion—knocking it from the top spot for the first time in five years. China consolidated its lead in 2010, with US$54.4 billion in renewable energy investments. Germany moved into second place that year, with investments in renewables of US$41.2 billion, pushing the United States to third place, with US$34 billion.

China's investments as a share of GDP are more striking again. In 2010, renewable energy investments reached 0.55 per cent of GDP, meaning that China's relative domestic investment was more than double that of the United States, at 0.23 per cent. With an installed capacity of 103.4 GW, in 2010, China overtook the United States (total installed capacity of 58 GW) for the first time to lead in total renewable energy capacity (Pew Charitable Trusts 2011). China aims now to increase total installed wind power capacity to 200 GW by 2020 and to implement a green dispatch system to favour renewable power generation in the electricity grid. However, since it can take months for wind turbines to be connected to the power grid, China needs to substantially improve both its power grids, including through introduction of smart grids, and the planning and coordination of the development and construction of wind power. That is, as wind farms are built, new transmission lines should be constructed at the same time. Moreover, given the scaled-up wind power capacity planned for 2020, China should already be placing more emphasis on companies ensuring flow of power into the grid rather than just on meeting capacity generation goals (Zhang 2010a, 2011b, 2014b).

Low-carbon city development pilot program

In China, cities are responsible for more than 60 per cent of total energy consumption. Their contribution to energy usage and resulting carbon dioxide emissions is expected to increase given the target urbanisation rate of 65 per cent by 2030. Cities will therefore play an increasingly greater role in shaping energy demand and carbon dioxide emissions. They are crucial to China meeting its 2020 carbon intensity reduction target of 40–45 per cent relative to 2005 levels and the target of peak carbon emissions 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 29 provinces and cities on 5 December 2012. All of these pilot cities and provinces are making efforts towards: 1) strengthening industrial restructuring and technological upgrading; 2) improving the energy mix and energy efficiency; 3) prioritising the use of public transport; 4) promoting efficient public transport systems; and 5) optimising the urban landscape (Wang et al. 2013). In the process, these cities have, however, confronted a variety of problems and challenges (Wang et al. 2013), including but 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 in 2012, 10 provinces of the two batches of pilots had successfully reduced their carbon intensity by 9.2 per cent compared with their 2010 level and compared with the national average of 6.6 per cent (NDRC 2014a). In addition, all pilot provinces and cities have set 2030 or earlier as the target for the carbon dioxide emissions peak even though this was not mandated by the Central Government at the time the pilot programs were launched. Shanghai and Suzhou are among the 15 pilot provinces and cities that have set 2020 as the year for their peak in carbon dioxide emissions. Ningbo, a key industrial port city in Zhejiang province, set its peak emission target as 2015.

The practices and ambitions of the pilot regions have set good examples for keeping emissions under control and making positive contributions to overall low-carbon development in China. Zhang (2011b, 2011c) has argued that China's GHG emissions could peak between 2025 and 2032 or around 2030. The efforts of China's low-carbon pilot cities may contribute to the country reaching peak carbon emissions sooner than planned.

Getting the energy prices right

To have the market play a decisive role in allocating resources requires getting energy prices right, so both producers and consumers of energy receive clear signals. The overall trend in China's energy pricing reform since 1984 has been to move away from prices set exclusively by the Central Government and towards a more market-oriented pricing mechanism. The pace and scale of the related reforms differ across energy products (Zhang 2014c).

Reform of electricity tariffs has lagged particularly far behind. The government retains control over electricity tariffs, which has complicated the implementation of a pilot carbon-trading scheme in the power sector. Introduction of emissions trading, however, will offer impetus to power pricing reforms to allow the pass-through of carbon costs in the electricity sector. For this reason, power pricing should be a key area for reform in the Thirteenth FYP.

Natural gas prices are an additional area in pressing need of reform. Given China's coal-dominated energy mix, increasing the share of cleaner fuels, such as natural gas, has been considered the key option for achieving the twin goals of meeting energy needs and improving environmental quality. In this way, in December 2011, the government adopted a new pricing mechanism in Guangdong province and in 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 between natural gas and alternative fuels. Gas prices at various stages would then be adjusted accordingly. The pilot schemes in Guangdong and Guangxi point to a move in the direction of establishing a market-oriented natural gas pricing mechanism. Under the Thirteenth FYP, China should heed the lessons learned from the two pilot schemes and identify the kinds of adjustments and improvements that are needed in terms of the choice of alternative fuels and selection of a pricing reference point to implement the Guangdong and Guangxi pilot reform programs successfully across the entire country (Gao et al. 2013; Zhang 2014c).

Resources tax reform

Even were energy price reform to be comprehensively undertaken, energy prices still would not fully reflect the cost of production in terms of the entire value chain of resource extraction, production, use and disposal. Combined with a pressing need to avoid the wasteful extraction and use of resources, getting energy prices right requires that China reform its current narrow coverage and level of resource taxation (Zhang 2014c, 2015c). At present, resource tax is levied on crude oil and natural gas according to revenue (ad valorem) rather

than volume—a practice that began in Xinjiang on 1 June 2010 and was applied nationwide from 1 November 2011. This is a first step in the right direction. Beginning on 1 December 2014, China broadened these reforms to include coal by levying a tax on coal based on revenue. 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, as well as providing them with an incentive not to focus on economic growth alone (Zhang 2010a, 2011b).

Environmental taxes

The introduction of environmental taxes to replace current charges for sulphur dioxide emissions and chemical oxygen demand has been discussed in academic and policy circles in China for some time. A draft tax law on environmental protection was released for public comment in June 2015 (Legislative Affairs Office of the State Council 2015), but the timing of its revision and eventual passage into law is unknown. Accordingly, the date for implementation has not been set. Clearly, however, the sooner environmental taxes are imposed in the Thirteenth FYP, the better. This is expected to be no later than 2020. Other countries' experiences with environmental taxes suggest that these are best initially levied at low rates and in limited scope, with their levels then increasing over time (Andersen and Ekins 2009; Zhang 2011b; Zhang and Baranzini 2004). Moreover, environmental taxes should be shared taxes, with the majority of the revenue going to local governments (Tian and Xu 2012; Zhang 2016). Given that China has not yet levied environmental taxes, in terms of timing it may be better to introduce them as part of the Thirteenth FYP—not least because such a distinction will enable the country's additional efforts towards carbon abatement to be disentangled from the broader energy-saving and pollution-cutting programs.

Pilot carbon-trading schemes

In October 2011, the NDRC approved seven pilot carbon-trading schemes: in the national capital, Beijing, the business hub of Shanghai, the sprawling industrial municipalities of Tianjin and Chongqing, the manufacturing centres of Guangdong and Hubei provinces and Shenzhen.[4] These pilot regions were

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

deliberately selected for their varying stages of development and capacity to design tailored schemes. These pilot schemes have features in common, but vary considerably in their approach to issues such as sectoral coverage, allocation of allowances, price uncertainty and market stabilisation, the potential market power of dominant players, use of offsets and enforcement and compliance (Zhang 2015a, 2015b).

Beijing, Guangdong, Shanghai, Shenzhen and Tianjin launched their first trading schemes before the end of 2013. The remaining two schemes, Hubei and Chongqing, began trading on 2 April and 19 June 2014, respectively, marking the start of the pilot scheme as a whole. As shown in Table 17.2, the compliance rate in the 2014 cycle improves markedly. For example, in Beijing, 257 entities had not complied by the deadline set for the 2013 cycle, but only 14 entities had failed to do so for the 2014 cycle. Overall, for the 2014 cycle, four pilot schemes had a 100 per cent compliance rate and two had an almost 100 per cent compliance rate. In 2013, in contrast, only Shanghai had realised full compliance. Chongqing, however, had an approximately 70 per cent compliance rate one month after the deadline. The path forward from pilots to a national scheme is expected to be a bumpy but ultimately successful one.

Table 17.2 Compliance rates of seven carbon-trading pilot schemes for the 2014 compliance cycle (per cent)

	Measured against entities[a]	Measured against allowances[b]
Beijing	100 (97.1)	100
Chongqing	..	..
Guangdong	100 (98.9)	100 (99.97)
Hubei	100.0	100.0
Shanghai	100 (100)	100 (100)
Shenzhen	99.69 (99.4)	100 (99.7)
Tianjin	99.1 (96.5)	..

.. not available

[a] Share of the total number of entities that meet their compliance obligations in the total entities covered in a given carbon trading pilot.

[b] The total combined allowances of entities that meet their compliance obligations as a percentage of the total allowances allocated in a given carbon trading pilot.

Note: Numbers in parentheses are for the 2013 compliance cycle.

In the joint China–United States climate change statement, China announced that it would launch a national emissions trading scheme (ETS) by 2017. Initially, the national ETS will cover eight sectors: petrochemicals, power generation, metallurgy, nonferrous metals, building materials, chemicals, papermaking and aviation. The threshold for an entity to be part of the national scheme has been

set at 10,000 tce annually. It is expected that initially the national ETS will cover about 10,000 entities, with an estimated market size of 2–3 billion tonnes of carbon dioxide equivalent emissions. Following a three-year pilot phase, a nationwide carbon market will become fully functional after 2019 (DCCNDRC 2015; Zhang 2015a, 2015b; NDRC 2016).

It appears the management of the national ETS is being instituted at two levels. First, the Central Government will be in charge of setting national rules for, among other things, the coverage and scope of the ETS, uniform standards for measurement, reporting and verification (MRV), the allocation of allowances and the rules for compliance across provinces or equivalent. Second, provincial governments will be assigned responsibility for implementation and enforcement of the rules. This includes, but is not limited to, identifying the entities covered and determining their emissions, calculating the amount of free allowances to the entities covered and, once approved by the Central Government, distributing these allowances to the entities and implementing compliance rules. Provincial governments, however, are also to be allowed to set rules that are stricter than the national rules. For example, they could increase the coverage of sectors and the scope of entities and have even stricter allocation rules for allowances (NDRC 2014b).

There will be a number of challenges, of which two are highlighted below. First, to create reliable allowances that are comparable across sectors and regions, it will be important to ensure that all emissions data are properly measured, reported and verified. For that, national ETS legislation needs to be established to provide uniform guidelines for and methodologies on the design and operation of the ETS and enforcement of MRV, including penalties for noncompliance. Such legislation would also define allowances as financial assets and environmentally credible reductions.

The second and most thorny issue is the allocation of allowances in the national ETS because this involves dealing with unused allowances from the seven pilot markets. It is estimated that, by the time of the national launch, the seven pilot markets will have accumulated 50–100 million tonnes of surplus allowances (Carbon Pulse 2015). Ruling out banking of these allowances into the national scheme would likely cause regional carbon prices to crash towards zero, but allowing all or some of the units to be carried forward, while maintaining their value, would risk burdening the national market with a sizeable oversupply on its launch. But there are other options. One is to consider a conversion mechanism that would allow pilot allowances to be eligible in the national market, but at a discounted value. A conversion rate would depend on the degree of overallocation and the price levels in the market from which they originated, giving surplus allowances from highly overallocated pilot areas a higher discount rate than those from markets with much smaller surpluses.

Another option is to allow pilot permits to be used, but only for a portion of the allowances carried forward each year and for a limited period. The option announced by Shanghai's government on 9 May 2016 is very much along this line (SMDRC 2016). A third option is to link the level of allowances with bankable surplus allowances from each pilot region. This will allow allowances from the pilot carbon markets to be banked in the national ETS, but at the expense of reduced allocation levels in that region. Which option prevails will depend on the outcome of intense negotiations between the Central Government, regional governments and industry over how to treat up to 100 million tonnes of unused allowances from the seven pilot markets in the national ETS. This could have a huge bearing on the success of the world's biggest carbon market.

Conclusion

The need to improve the quality of the environment has been elevated to unprecedented importance internationally. In China's case, this is demonstrated by the fact that in 2013 nearly every Chinese city monitored for pollution failed to meet state standards. In March 2014, Chinese Premier Li Keqiang told 3,000 delegates in China's national legislature that the country would 'declare war against pollution as we declared war against poverty' (State Council 2014). If China's internationally recognised accomplishments in reducing poverty can be considered any kind of predictor, there is some credibility to prospects of winning the fight against pollution.

In line with public acknowledgement at the highest levels of China's government that the country faces an environmental crisis, attempts are being made to cut coal consumption in absolute terms in severely polluted regions, and to take unprecedented steps to keep energy consumption and carbon emissions under control in key energy-consuming industries and cities in the context of government decentralisation and unprecedented urbanisation. Steps are also being taken to strengthen and expand flagship programs and initiatives, alongside parallel supportive economic policies, and to increase the widespread use of renewable energy. Moreover, given that many environmental issues have a cross-border nature, neighbouring regions—such as the Beijing–Tianjin–Hebei region and the Yangtze and Pearl river deltas—are now increasingly acting collectively rather than independently. These coordinated efforts should significantly increase their effectiveness in combating pollution.

Governments at all levels are now taking broad approaches to tackling environmental issues. While having relied mostly on administrative measures to date, China now realises that while these can be effective, they are often not efficient. In turn, China's government is increasingly harnessing market

forces to foster reduced energy consumption and to cut the emissions of carbon dioxide and other conventional pollutants—and to genuinely induce the shift to a low-carbon, green economy. Market-based instruments include but are not limited to moving away from central government energy pricing and towards a more market-oriented pricing mechanism; reforming the current narrow coverage of resource taxation; shifting the resource tax to being levied ad valorem rather than by volume; experimenting with seven pilot carbon-trading schemes and undertaking preparation for the transition to a nationwide scheme; and implementing a system for chargeable use of resources and ecological compensation.

Meeting the domestic emissions intensity reduction goals for 2020 and the absolute commitments for 2030 will require significant economic restructuring and technological upgrading. Carbon emissions reduction provides a variety of ancillary benefits, such as reductions in conventional air pollutants and associated health risks. This creates new impetus for structural economic reforms to maximise synergies between climate change mitigation efforts and structural economic reforms. These synergies could be further enhanced by capping nationwide coal consumption to realise peak consumption in the Thirteenth FYP period and a peak in carbon dioxide emissions 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. It needs supportive economic policies that can genuinely induce the creation of a low-carbon economy across the entire country. China's current pilot carbon trading schemes have made encouraging progress. 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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