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China and climate change: Impacts and policy responses

Note

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1. Background

There is a strong, though not universal, consensus that climate change, or global warming, poses one of the most serious challenges to future economic and social development throughout the world. The most recent report published by the Intergovernmental Panel on Climate Change (IPCC) notes that global greenhouse gas (GHG) emissions increased by 70% between 1970 and 2004. It expects this momentum to be maintained during the coming decades. The key to future growth of GHG emissions will, as in the past, be the energy supply sector. At the heart of the problem of global warming is the dominance of fossil fuels as the principal source of energy. Thus, IPCC projections show that carbon dioxide (CO_2) emissions will rise by between 40% and 110% (2000-2030), compared with 80% during 1970-2004. Although efficiency in the use of energy has improved in recent years, its impact on reducing GHG emissions has been more than offset by global population and income growth. Rapid GDP growth in both China and India will continue to fuel the expected rise in CO_2 emissions in the future.

Many believe that the coming decade will prove decisive for the world's climate. In particular, efforts are urgently needed in order to halt and reverse the increase in greenhouse gas emissions. If this is to happen, ways must be found of developing new sources of energy and of using traditional sources more efficiently. Fulfilment of these goals requires a political commitment by governments. It also demands recognition that their economic policies should not only seek to accommodate the immediate consumption aspirations of today's populations, but also serve the long-term welfare interests of future generations. Reconciling such claims may well entail a sacrifice of current income growth for

the sake of future sustainable global development. Neither the Chinese government nor tens of millions of Chinese citizens, for whom rapid GDP growth offers the prospect of removal from abject poverty, regard this as an acceptable trade-off.

> *"If nothing is done to stop climate change, losses from extreme weather will be larger than global GDP by 2065"* (**The Climate Group**, 2007)

2. China: growth, development and the domestic environment

China's GHG emissions are only part of a much wider range of environmental problems which have escalated under the impact of accelerated GDP growth associated with the country's post-1978 economic reforms. For more than 20 years after the institution of these reforms, growth maximisation was the core developmental task to which all other goals, including environmental improvements, were secondary. This emphasis served China well, propelling it towards economic superpower status and simultaneously bringing major gains in material living standards to its citizens - especially those living in cities and eastern coastal provinces (the primary beneficiaries of the gains of reforms). Meanwhile, the delivery of growth became the touchstone by which the government was judged: the basis on which its legitimacy and authority were predicated.

Rapid economic growth has, however, also entailed a high social and environmental cost (see Box 1). In recent years Beijing has become acutely aware of the potentially destabilising effects of environmental degradation and increasing social malaise in both urban and rural sectors. This is the background against which, in 2004, the Chinese government decided that it must shift towards a strategy of development sustainability. The ethos of this new approach towards development is captured in slogans that highlight the importance of achieving a better balance between economic growth, environmental protection and social harmony.

BOX 1: CHINA'S ENVIRONMENTAL CRISIS

China's environmental problems have manifested themselves in terms of the steady contraction of arable land, worsening water shortages, and increasing pollution of land, water and air. The State Environment Protection Agency (SEPA) estimates the economic loss from pollution at about 3% of GDP, although independent analyses suggest that the true figure may be closer to 9%. Land loss affects some 5 million farmers each year, while desertification reduces northern pastures by almost 6,000 square miles annually. Industrial waste emissions have almost doubled since 2000 and with car sales rising rapidly, urban air pollution is already severe. 16 of the world's 20 most polluted cities are located in China. Some 70% of lakes and rivers in China are polluted, and nearly two-third of cities in China suffer from water shortages. Meanwhile, water pollution is exacerbated by the inadequacies of drainage, sewage and wastewater treatment, giving rise to water-born diseases, such as cholera, dysentery and typhoid. Pollution of land by chemicals and industrial minerals takes a similar toll. Some 400,000 premature deaths are thought to occur each year as a result of pollution-related illnesses. Pollution is the source of 70-80% of cancer deaths in Beijing. A heavy social cost also attaches to deteriorating environmental conditions, as increasing numbers of urban and rural citizens give vent to their discontent through complaints, petitions and street protests, which frequently turn to violence.

Neither the genuine nature of this commitment nor the likely impact of the new strategy's successful implementation is in doubt. To date, however, most indicators suggest that the environmental goals are not being met. In part, this failure reflects Beijing's concerns about the consequences of sacrificing the material gains of economic growth to the less tangible benefits of greater environmental harmony, especially as perceived by the many millions of impoverished peasants living in central and western regions of the country. The Chinese government has been consistent in insisting that developed countries should take the lead in reducing GHG emissions, while refusing to accept mandatory reductions in its own emissions on the grounds that they place an unacceptable limitation on China's right to develop. But failure to fulfil China's environmental goals also reflects a dysfunctional system of governance, captured in the serious disjunction that exists between policy formulation by the central government and implementation of policy at local (provincial and sub-provincial) levels.

> *"China argues that other countries polluted their way to development; capping emissions now would unfairly punish those who come late to the game" (The Economist, 27 April 2007).*

3. China's contribution to global climate change

China is a significant contributor to the problem of global warming. Until quite recently, China's GHG emissions were low. In 1950, for example, when the industrial sector accounted for barely 15% of GDP, China's CO_2 emissions from burning fossil fuels accounted for just 1.13% of the global total. Subsequently, under the impact of sustained industrialisation – especially the rapid expansion of heavy industry - energy consumption rose sharply. Thus, China's cumulative contribution to global GHG emissions during 1959-2002 was 9.33%. Concealed in this figure is increasing intensity in energy use associated with GDP growth in excess of 10% p.a. since the 1980s. According to Beijing, China's GHG emissions grew, on average, by 4.2% annually between 1994 and 2004. Most of this growth came from increased CO_2 emissions, their share of total emissions having risen from 76% to 83% (see table).

Table: Changing GHG emissions in China, 1994-2004

	GHG emissions (m. tons of CO_2 equivalent)	of which (m. tons of CO_2 equivalent):		
		Carbon dioxide	Methane	Nitrous oxide
1994	4,060	3,070	730	260
2004	6,100	5,050	720	330
Change (%)	+50.2	+64.5	- 1.4	26.9

Source: China, Initial National Communication on Climate Change.

Concealed in these figures is an average rate of annual expansion of CO_2 emissions of 5.1%.

Until 2005, China ranked second to the United States as an emitter of GHGs throughout the world. Despite the faster growth of Chinese emissions, most observers believed that China would not overtake the US to become the biggest single source of CO_2 and GHG emissions until around 2015-2020. However, in June 2007 a report by the Netherlands Environmental Assessment Agency (NEEA) showed that in the wake of a continuing rise in coal consumption and a surge in cement production, in 2006 China had overtaken the US to become the world's largest producer of CO_2. NEEA found that between 2005 and 2006, China's CO_2 emissions from fossil fuels had risen by 9%, compared with a 1.4% increase in the US (the corresponding global figure was 2.6%). Although NEEA figures did not embrace all sources of GHGs and CO_2, an informed consensus view is that China has now become the largest emitter of GHGs in the world. The alarming implications of these findings is highlighted in projections made by the International Energy Agency (IEA), which show that if current trends continue, Chinese GHG emissions between now and 2030 will be double the cumulative total of all other industrialised countries.

The rapid rise in its $C0_2$ emissions reflects China's disproportionate reliance – far greater than in developed countries - on coal as the main source of energy. In 2006, coal accounted for 69.3% of total energy consumption, compared with 70.7% on the eve of reform in 1978 (the corresponding global figure is about 20%). Oil accounts for a further 20.8%. Coal is a dirty source of energy, in contrast to natural gas, nuclear and Hydro-power, which use cleaner technologies. It is therefore a significant finding that these clean sources contribute only about 9% of China's energy consumption, compared with 40% worldwide.

> *"The root of China's energy problems is its dependence on coal" (Barry Naughton,* ***The Chinese Economy: Transitions and Growth****, 2007).*

In addition, low efficiency has long characterised the Chinese coal industry – and, by implication, the energy sector as a whole. Lack of investment – especially, from an environmental perspective, in coal treatment facilities – has constrained improvements in efficiency. So has the persistence of small-scale mines, in which technology is backward and the incentive to invest in environmental maintenance is largely absent. The failure to take account of negative externalities means that environmental costs are largely overlooked. Indeed, even expensive coal treatment plants are sometimes left unused, because of the excessive cost of running them. The presence of high levels of unadulterated impurities in Chinese-mined coal also reduces the energy efficiency of coal users: most coal in industry is burned in small, inefficient boilers; in homes, it is burnt directly in stoves and fires. Closure of polluting power-generating units in the first half of 2007 saved an estimated 17 million tons in CO_2 emissions. But You Quan (Chairman of the State Electricity Regulatory Commission) has explicitly acknowledged that China faces a serious challenge in its efforts to combat pollutant discharge by small-scale coal-fired generating units and by other polluting industries, such as steel, oil refining, chemicals, metals and construction materials.

> *In Jan-July 2007 China shut down 156 small coal-fired generating units. But it is still building coal-fired power plants at a rate of more than one a week.*

Recourse to inefficient practices rightly invites condemnation. In fairness, it deserves to be said that there has also been a significant improvement in China's energy efficiency since 1978. During 1978-2005, for example, annual real GDP growth was 9.7%, while energy consumption increased by 5.3% p.a. This means that China today produces about ten times more real GDP than it was in 1978 with only three and a half times more energy. According to the World Bank, China's energy consumption per US dollar of GDP at power purchasing parity fell from 0.92 kg. of oil equivalent (1978) to 0.24 kg. in the mid-1990s.[1] But concealed in these figures is the finding that since 2003 high investment in energy-intensive industries, such as steel, cement and aluminium, has caused energy efficiency once more to decline. Meanwhile, international comparisons show China in both a favourable and unfavourable light. On the one hand, its energy efficiency is now quite close to that of Indonesia, Malaysia and South Korea. On the other hand, it is still below that of Brazil and India, as well as of the US, many EU member states and – above all - Japan. IEA data show that between 1990 and 2004, China's CO_2 emission per dollar of GDP [2] fell by almost half – from 5.47 kg. to 2.76 kg.

[1] GDP measured at purchasing power parity; energy consumption measured in standard oil equivalent.
[2] Measured in constant 2000 US dollars (*China's National Climate Change Programme*, 2007).

The corresponding global decline was 12.6% - and for OECD countries, 16.1%.

> *China uses seven times more energy per US$ of GDP than Japan.*

There is of course an inevitable correlation between country size and GHG emissions, and Beijing has often argued that per capita emissions offer a more useful basis for comparison. In relation to its huge population (1,314.5 million in 2006), China's ranking as a source of GHGs is much more encouraging than aggregate estimates indicate. During 1959-2002, average cumulative CO_2 emissions per head were 61.7 tons, placing it 92nd in the world league. In 2004 China's per capita emission of CO_2 as a result of fossil fuel burning was 3.65 tons – 13% below the global average (4.2 tons) and just one-third of that of OECD members (10.95 tons). The IPCC has estimated that *current* levels of per capita CO_2 emissions are of the order of 5, 10 and 20 tons of CO2-equivalent for China, EU and the United States. Comparisons such as these offer a different and salutary perspective from which to view China's emergence as the world's largest emitter of GHGs. As Ma Kai (Minister in charge of the National Development Reform Commission [NDRC]) put it earlier this year, "Even if China overtook the US … in total CO_2 discharges, China's per capita GHG emission would remain low compared with the US"[3]. It is also estimated that in the absence of strict family planning policies, an extra 138 million people would have been added to China's population since 1979, which in turn would have generated an additional 330 million tons in GHG emissions (see also Box 2 for another interpretative perspective on China's GHG emissions).

> *"The carbon footprint of the average Chinese citizen is less than a fifth of that of an American, and just over a third of a European's" (London, **The Guardian**, 4 June 2007).*

[3] Beijing, Xinhua [New China] News Agency, 4 June 2007.

BOX 2: THE EMBODIMENT OF GHG EMISSIONS IN EXPORTS

China is frequently described as the 'workshop of the world'. Comparisons of its emissions with those of developed countries (MDCs) should make allowance for the fact that a significant portion of goods produced in China's manufacturing sector is subsequently shipped overseas. Many of these exports go to high-income industrialised countries in the West. In other words, consumers in countries such as the USA and EU member states have helped generate the rapid growth in China's GHG emissions. Stated slightly differently, the sharp rise in China's emissions owes much to its increasing share in the global production of goods for international markets. Although it is difficult to quantify this effect precisely, the strong likelihood is that a significant part of Chinese emissions are attributable to the behaviour of consumers in MDCs.

(See Netherlands Environmental Assessment Agency (MNP), 22 June 2007: http://www.mnp.nl/en/service/pressreleases/2007/20070622ChineseCO2emissionsinperspective.html.)

4. The impact of climate change on China

The scholarly literature reveals that in the 1990s Chinese scientists were by no means agreed on the likely impact of global warming on Chinese agriculture. Only in the more recent past has a consensus emerged that the net overall economic effect of climate change, including the forced resettlement of people from inundated land, will be negative.

After four years in preparation, in December 2006 the Ministry of Science and Technology, China Meteorological Association and Chinese Academy of Science released China's first-ever *National Assessment Report on Climate Chang*e. Following 20 consecutive warm winters (1986-2005), it predicted that the average temperature in China would increase by between 1.3 and 2.1 degrees Celsius by 2020, and by 2.3-3.3 degrees by 2050. During the same time periods, average rainfall would rise by 2-3% (2020) and 5-7% (2050). The higher precipitation was expected to be offset by increased evaporation, thereby exacerbating already serious water shortages in northern China.

Increased incidence of extreme weather conditions would also cause more natural disasters. In this regard, it was significant that in 2006 Zhejiang Province experienced its most destructive typhoon in 100 years, while Chongqing Municipality and Sichuan Province were affected by the worst drought conditions for 50 years.

> *In 2006 natural disasters caused 2,704 deaths and economic losses of 212 bn. yuan (c. US$27 bn.) in China.*

The most recent authoritative Chinese statement on the impact of global warming is contained in the *National Climate Change Programme* (*NCCP*), issued by the NDRC in June 2007. It presents clear evidence that the deleterious effect of climate change is already apparent, as shown in trends observable in China during the past 40-50 years:

- 21% shrinkage of glacier area in northwestern China
- reduction of thickness of frozen earth in Qinghai-Tibet Plateau region by up to 4-5 metres
- decline in runoff of waters of China's six main river systems (Haihe, Yellow, Pearl, Yangtze and Songhuajiang)
- increased frequency of drought in southern China
- accelerated rise, above global average, of coastal sea level

In the face of continuing rises in GHG emissions, the *NCCP* predicted that the consequences of global warming would become even more pronounced in the future:

Likely impact on agriculture, livestock and forestry

- decline in rice, wheat and corn yields
- changes in distribution and structure of cropping systems
- rise in farm production costs and investment requirements
- accelerated desertification and reduction in grassland pasturage
- higher disease and morbidity among animals
- differentiated increases in forest productivity and output (highest in cold temperate regions, lowest in tropical and subtropical regions)
- increased incidence of forest fires, insect infestations and animal disease

Likely impact on water resources

- accelerated drying of inland lakes and wetlands, and contraction of coastal wetlands, with serious implications for agriculture
- 27.7% reduction of area of glaciers and frozen earth by 2050, reducing the supply of water to the Yellow and Yangtze Rivers
- major reduction in snow cover
- increased incidence of northern droughts and southern floods
- sharp decline [rise] in annual water run-off in arid northern [water abundant southern] areas, causing water demand-supply imbalances in most provinces

In addition, the continued rise in sea level would precipitate further coastal erosion and seawater intrusion, as well as causing damage to marine ecosystems. Although not mentioned in the *NCCP* document, previous reports suggest that the rise in sea level would threaten industrial production in vulnerable areas, such as the Pearl River and Lower Yangtze deltas – incidentally the most affluent regions of China - and necessitate large-scale population movement. Other expected effects of climate change include a reduction in biodiversity, an increase in illness and deaths associated with extreme fluctuations in weather (e.g., from cardiovascular disease, malaria, dengue fever, etc.), higher electricity demand for air conditioning, and a reduction in the tourist attraction of some regions. Even the recently-opened and much vaunted railway that links Tibet to the rest of China may be affected, if the rise in temperature thaws the permafrost on which it was built.

A sea level rise of 1 metre could flood 92,000 m^2 of coastal China, causing major arable land loss and necessitating the resettlement of some 70 m. people.

5. Chinese government policy to combat the effects of climate change

China's strategy to address the problems of climate change is couched in characteristically fine words. It embraces a wide range of measures - institutional, scientific and technological, legal and economic. Underlying this strategy, several key policy thrusts can be detected (see Box 3).

BOX 3: COMBATING CLIMATE CHANGE – THE CHINESE WAY FORWARD

Promotion of research and development (R&D) and scientific and technological (S&T) innovation in order to curb and accommodate the effects of climate change

Optimisation of energy mix through development of low-carbon and renewable energy sources

Implementation of major reforestation and afforestation initiatives to extend forest cover

Formulation of more effective fiscal and investment policies in support of environmental harmony

Participation in international and multilateral forums in order to accommodate the effects of climate change

The Chinese government has also published some of the targets it hopes to fulfil through the implementation of these policies. They include the following:

Item	Target
Energy efficiency per unit of GDP	To fall by 20%, 2005-2010
Reduction in GHG emissions	By 950 m. tons by 2010 (i.e. by 17% from 2004 level)
Creation of new hydropower capacity	To offset 500 m. tons of CO_2 by 2010
Creation of new nuclear capacity	To offset 50 m. tons of CO_2 by 2010
Creation of biomass energy	To offset 30 m. tons of CO_2 by 2010
Improvements in thermal electricity production and transmission	To offset GHG emissions by 110 m. tons by 2010
Use of coal bed methane (CBM) for electricity generation	To offset GHG emissions by 200 m. tons by 2010
Ratio of renewables to total primary energy supplies	To reach 10% by 2010; to reach 20% by 2020
Forest cover	To reach 20% by 2010

Few will find cause to quarrel with either the policy principles or quantitative targets in the *NCCP* document. But behind the fine words of the Chinese leaders, some observers have voiced concern that the *Programme* remains too imprecise in explaining how exactly the stated targets are to be fulfilled.

As energy analyst Stephen Knell has put it, "[t]he problem with China's commitment to climate change is that it fails well short of what the international community expects and the scientific evidence points to as urgently required." Nor, on the basis of recent trends in reducing energy consumption and improving energy efficiency is there room for excessive optimism that official targets will be met.

> *"In its course of modernisation, China will not tread the traditional path of industrialisation, with high emissions and high energy consumption. It should blaze a new road of fast and efficient economic growth in concert with low resources consumption and low waste discharge" (Ma Kai, June 2007).*

The Chinese government's rejection of mandatory capping of GHG emissions and refusal to commit itself to a precise quantitative target for reductions in overall GHG emissions have also elicited criticism. At the heart of China's official position is the difficulty of simultaneously mitigating global warming and maintaining rapid economic growth. This tension undeniably presents China – as it does all developing countries – with a fundamental policy dilemma. From it derives Beijing's belief that climate change should be regarded as both a problem of development and of the environment. From it too derives Beijing's insistence that already-industrialised countries should take the lead in combating the effects of global warming.

> *"The international community must respect developing countries' right to develop… [They] have undeniable responsibility in the emission of GHGs" (Ma Kai, 2007).*

In the wake of the publication of the 2007 *National Climate Change Programme*, the Ministry of Science and Technology (MoST), in conjunction with 13 other ministries and government bodies, has also issued scientific and technological (S&T) guidelines on climate change. In addition, Beijing has put Premier Wen Jiabao in charge of a 'National Leading Group', with the specific remit of addressing problems relating to climate change, energy conservation and pollution control. The following excerpt is taken from Wen Jiabao's speech to the first meeting of the group, held in Beijing on 9 July):

> *"Currently, China has significant problems with its high energy consumption and serious environmental pollution. Many difficulties lie in the way of achieving the … goals for reducing energy consumption, pollution and emissions. China faces an extremely grave situation in this regard. In particular, the string of serious pollution incidents which have occurred recently in certain locations rings an alarm bell for us. We need a strong sense of crisis and urgency about this. We must understand in full that carrying out the work of energy conservation and emissions reduction and coping with climate change is a requirement of the scientific development concept, it is a mission in the building of a resource conserving and environmentally friendly society, it is a topic affecting the overall situation of sustainable social and economic development, it is a test of the Government's ability to govern and the extent of public trust in it, and it is a responsibility to the international community which China must shoulder."*

There could hardly be a clearer statement of the urgency of the climate change issue facing China and the major difficulties it faces in addressing its consequences.

6. Summary conclusion

This briefing paper seeks to demonstrate that the challenges for China posed by climate change are real. The consequences of global warming are already apparent. The scientific evidence of investigations by Chinese and international bodies overwhelmingly indicates that the threat to the sustainability of China's future social and economic development, as well as to fragile ecosystems, will intensify. That the Chinese government recognises the scale of the problems that China faces as a result of climate change is beyond doubt, as is its commitment to address those problems, subject to its insistence that industrialised countries bear the major responsibility in meeting the challenges of global warming. More questionable, however, is whether the policies Beijing has so far put in place will be capable of halting, let alone reversing, the recent inexorable and accelerating increase in China's GHG emissions.