The Commission on
Sustainable Development

A Balancing Act:
China's Role in Climate Change

Karl Hallding, Guoyi Han and Marie Olsson

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Preface

In order to strengthen cooperation on and deepen analysis of issues related to sustainable development, the Swedish Government has set up an advisory Commission on Sustainable Development. The Commission serves as a forum for discussion, analysis and dialogue. It is chaired by the Prime Minister and consists of members from the business sector, non-government organisations, the research community and political life.

The Commission has adopted open working methods in the hope of encouraging broader dialogue in the community. The Commission may order studies and shorter reports from experts in Sweden or other countries. Such reports are published under the responsibility of the author(s).

At the end of this year, governments from all countries of the world will gather in Copenhagen and try to negotiate a successor to the Kyoto protocol. The outcome of these negotiations hinges in many respects on what China decides to do. There are many signs that China may come to play a much more important role in global mitigation of climate change than was thought only a couple of years ago. The report in question deals with this issue, and is a contribution to our understanding of Chinas possible role in a future global climate policy regime.

The Commission asked Karl Hallding, Guoyi Han and Marie Olsson at Stockholm Environment Institute to analyze the economic and political development in China with focus on climate change. The authors have continuously presented their analysis to the Commission as their work progressed. This is their final report. Karl Hallding, Guoyi Han and Marie Olsson are solely responsible for analysis, proposals and opinions presented in the report.

/ Joakim Sonnegård
Head of the Secretariat
Commission on Sustainable Development

Acknowledgements

This study was carried out between March 2008 and March 2009 by the Stockholm Environment Institute (SEI) for the Commission for Sustainable Development of the Swedish Prime Minister's Office.

The research builds on extensive literature reviews in both English and Chinese and a consultation process with leading decision makers, civil servants and researchers in China and around the world. The consultations were carried out from September 2008 to March 2009 as one hour face-to-face or, in a few cases, telephone interviews based on a questionnaire (see Appendix A). The consultations have been analysed in a separate SEI Working Paper (Olsson, 2009). All interviewed were asked to respond in their personal capacity and responses have been treated anonymously. A list of people interviewed is attached as Appendix B. We would like to extend our warmest thanks to the interviewees who generously gave of their time, insights, and experience.

We are especially grateful to Måns Lönnroth (former State Secretary for Environment, Sweden), Hongyan He Oliver (Harvard Kennedy School, U.S.), Jin Wang (Sun Yatsen University, China), and Tao Wang (Tyndall Centre, UK) for their invaluable help in reviewing the report, and to Richard Clay of SEI York for proofreading and greatly improving the readability of the text. Our particular gratefulness goes to Matthew Findlay of E3G for the help with drafting Chapter 8.

Many thanks also to Joakim Sonnegård and Lars Lundberg at the Secretariat of the Commission for Sustainable Development for their valuable support and comments throughout the whole process. We are also grateful to Åsa Dahlqvist of the Secretariat for turning the manuscripts into a printable report.

Finally this report would not have been possible without the patience and support of our families.

The authors alone are responsible for the views expressed in this report.

April 2009

Karl Hallding *Guoyi Han* *Marie Olsson*

Conclusions and Summary of Key Issues

Climate change has reached the apex of the global agenda at a time when China faces significant development and energy security challenges. The political leadership and leading intellectuals are debating the direction of a new development pathway that provides both growth to meet development objectives, and dramatically reduces energy intensity and pollution. While the official position has not changed significantly, there are four key aspects that illustrate how climate change is conceived by the Chinese leadership. This signals that China may come to play a much more important role in global mitigation of climate change than was thought only a couple of years ago.

Climate impacts: There is a growing realisation that climate change will cause significant damage. The leadership's main concern is with the impacts on economic and social stability and the interplay with other development and environmental challenges.

Low-carbon opportunities: There is growing awareness amongst both business and, to an increasing extent, political leaders that there are considerable low-carbon opportunities for China. These would mean coming to grips with energy security, pollution and exploitation of natural resources and, even more, in ascending the production value chain and moving towards an innovation and technology driven growth.

Geopolitics: With climate security increasingly being seen as a geopolitical issue, China's ambition to be seen as a responsible world actor influences its range of options within global climate talks. An indicator of this is the potential change from alignment with the G77 to a position where China negotiates to maximise its national interests.

Development: Climate change is still predominantly a development issue. Tradeoffs are currently being gauged between the harm that it can cause to development, the costs of mitigation and adaptation, and the opportunities it could offer. But development is fuelled by energy and in the foreseeable future it is a concern for energy security that will drive China's climate mitigation actions.

Energy security concerns have driven China to ambitious carbon mitigation policies...

Energy security is one of China's overriding priorities, being closely linked to the Hu-Wen administration's key concern's of economic development, poverty alleviation and social stability. As the legitimacy of the Chinese Communist Party depends on its ability to deliver continued reform and development, the government's focus on energy security is not merely an economic necessity – it is also about political survival. Since 1994, domestic oil supply has not keep pace with demand and China is presently covering half of its oil demand from imports. With increasing demands from transportation and petrochemicals, China's dependency on imported oil is bound to increase to about 80 percent by 2030. But China is also increasingly dependent on coal imports as domestic mining and transportation of coal and transmission of electricity from coal fields in the west cannot meet increasing demands in the rapidly developing eastern provinces.

Under the banner of the *Scientific Development Concept* the Hu-Wen administration has shown political commitment by setting ambitious targets that bear on climate mitigation and adaptation. The targets include:

- 20 percent reduction of energy intensity and 10 percent reduction of pollution discharge by 2010 compared to 2005 levels;
- 15 percent renewables in the primary energy mix by 2020; and
- Specific goals and programmes for reforestation, ecological conservation and green technology development.

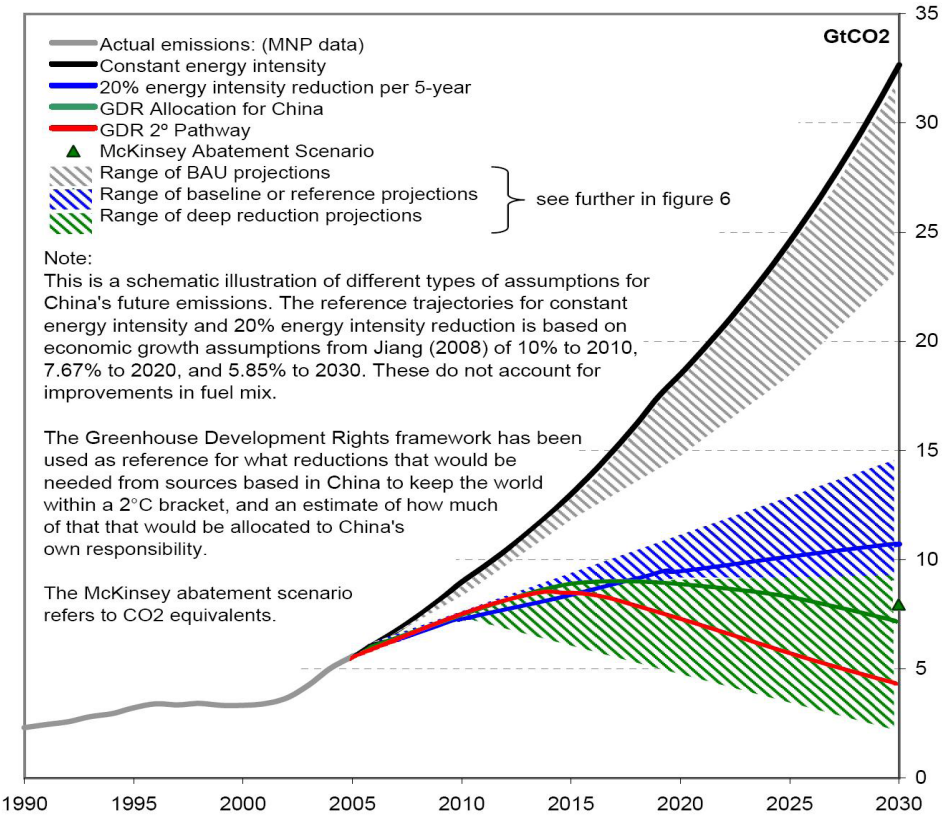
Participation in global efforts to mitigate climate change has the potential to reinforce all of these national policies, and, through ambitious strategies, China is now getting closer to meeting its 20 percent energy intensity reduction target. Were this target met China could, by the year 2010 alone, avoid emitting as much as 1.5 billion tons of CO_2 as compared to a trajectory without energy intensity gains – arguably a significant carbon mitigation effort by global comparison.

Whether or not China manages to meet its 2010 target will be a key factor in determining to what extent the Chinese leadership feels confident to take on further mitigation policies. Success in reaching the 2010 target is not unlikely to result in renewed political ambition to reduce energy intensity in the range of 20 percent per five-year period from 2010 to 2020. Compared to a trajectory without energy intensity gains this would imply a total potential carbon dioxide avoidance of more than 50 billion tons to 2020. Meeting this target, however, would require mobilising international investment for low-carbon technology and continued reform of China's regulatory system and incentive structure.

International voices are now being raised that China's recent progress in avoiding carbon emissions is already part of, and therefore not additional to China's strategic development driven energy policy. According to this line of argument, a *business as usual* projection based on constant energy intensity is not a relevant reference trajectory for measuring the ambitions and successes of China's climate action. Instead it should be the trajectory defined by China's current policies that constitutes the reference for additionalities. *(See Figure 1)* This highlights the difficulties of setting a baseline for a country like China and raises questions about how a pragmatic approach to climate mitigation, like the one taken by China, could be credited in a future climate regime.

There is international scepticism also about China's ability to tackle climate change and the reliability of its data. The wide gap between formulation of ambitious policies and their implementation in the real world is well documented and the uncertainties about Chinese official statistics are widespread. Oftentimes, when meeting a target becomes a political task, there are many ways to manipulate the data so that the target is "met" on paper. The ability to verify progress towards a target is critically important for most OECD countries when discussing China's involvement in a green deal.

Figure 1: Schematic overview of China's historical and possible future emission trajectories



...But China is also the world's leading carbon polluter

China accounts for near a quarter of global CO_2 emissions, and an incredible 57 percent of the global increase in carbon emissions within this decade. Furthermore, China's per-capita emissions are already above world average, but still only one-quarter of the US level. Consequently, China has less room than many other developing countries to argue its right to increase per-capita emissions. However, China does account for just less than one-tenth of global historical emissions since 1900 but could reach its global per capita share by the early 2020s if emissions continue to grow at the current pace.

Roughly one-third of China's emissions can be attributed to exports, with the net amount of carbon embedded in China's trade amounting to one-quarter of emissions. Numbers like this,

however, implicitly suggest that China thrives on carbon intensive exports, yet there are no indications that China's comparative advantage in world trade is connected to its high CO_2 intensity. Instead, the main reason for the current huge net export of embedded carbon is that the Chinese economy as a whole is less carbon-efficient than developed economies, and as China's economy develops towards higher carbon productivity and higher value added, the carbon intensity gap between exports and imports is bound to narrow.

China's emission growth trend is critical and uncertain. The rapid increase of China's carbon emissions over the last decade came as a surprise for international as well as Chinese institutions involved in energy trend forecasting. Actual 2006 global emissions exceeded even the worst-case IPCC scenarios, largely reflecting the growth in China. If China were to continue at its 2007 rate of eight percent annual increase of energy use and the EU were to meet its 20 percent reduction target, China's per capita emissions would be double those of the Europeans by 2020. Due to the exceedingly high energy and carbon intensities of the Chinese economy there is certainly room for improvement and China's emission growth could slow down considerably if the remarkable growth in renewables continues, if China's determination to reach its ambitious energy intensity targets bears fruit, and if the heavy industrial boom recedes.

With increasing emissions China's bargaining position is rapidly waning

China's position in negotiations is a balancing act between "playing hardball" and making "strategic choices". China knows it has to commit at some stage, but wants to push commitment as far as possible into the future. With its rapidly increasing emissions, China's negotiation position is weakening as its role shifts from being a victim of other countries' historical emissions to a dominant contributor to global emissions. China is likely to reach its global per capita share of historical emissions some time between 2020 and the early 2030s. This makes the coming decade a strategic window for China to balance opportunities and risks in relation to climate negotiations. It is also strategic because it coincides with

a period of massive infrastructure investment and development which could either provide a foundation for a low-carbon society or lead to China becoming locked in to energy intensive structures. No less significantly, this is a strategic window because the world is changing as low-carbon economic development is moving increasingly into the mainstream. The more convincing the developed world can be by coming together and acting decisively in Copenhagen, the more likely China will be convinced that it is in its long-term national interest to act now. The choice for China is, therefore, either to change with the world or to be left behind.

Climate security is increasingly seen as a geopolitical issue, where China's role as a responsible world actor is central to its range of options within global climate talks. With the new tone from the US, China will now have to face up to a more responsible and active US position on climate change. There are also indications of growing divergence within the G77 bloc. Some Least Developed Countries, such as Bangladesh, argue for differentiated treatment of large developing countries, notably China. China could therefore move to a position where it negotiates to maximise national interest rather than aligning with the developing world.

China feels hard-pressed from both industrialised countries and the developing world. The climate crisis is the result of centuries of industrialisation, and there are no international experiences to share on how to industrialise and urbanise along a low-carbon pathway. Although China is aware of the multiple potential opportunities of low-carbon development, there is also an uncertainty and, among certain conservative groups, even a suspicion that climate change is all just a foreign trap to keep China from developing. Developed countries therefore need to appreciate that going ahead in decarbonisation is an absolute requisite to get China and other developing countries to see the opportunities this creates. China does also need the self-confidence that would come from seeing its current energy intensity reduction targets met by 2010.

On the eve of climate negotiations China is trying new arguments, and seeking new openings to share with importing countries the cost of mitigation from export manufacturing in China. At the

other end of the spectrum, voices have been raised in the U.S. and several European countries in favour of border tax adjustments to correct the supposed comparative advantage of exporting goods from countries such as China that benefit from the absence of a carbon price or other efforts to reduce emissions.[1] The argument falls back on China's considerable net export of embedded carbon, which has been interpreted either as a confirmation that China reaps trade benefits from its cheap but polluting coal power, or as evidence that consumers in developed countries benefit from low-cost Chinese products for which China is unfairly held responsible. In reality neither position can easily be implemented. The Chinese proposal that countries buying Chinese goods should be held responsible for the greenhouse gas emissions during manufacturing in China, implies allowing countries to have influence to control emissions outside their borders. Border tax adjustments on the other hand build on the notion of a carbon emission related comparative advantage, which in the case of China is hard to prove. Both proposals, however, signal a strong moral basis for carbon mitigation obligations, which is not likely to provide a possible path towards a successful agreement. A more pragmatic line would be to focus on the real needs of the handful of specific, potentially affected industries, rather than changing the rules of international trade.

The bottom line for China is to balance development opportunities versus climate concerns

There are strong arguments that China has much to gain and little to lose by playing a more active role in global climate mitigation. China will be adversely hit by the impacts of climate change and has a strong self-interest in pushing for more stringent global and national commitments. A switch towards low-carbon development would be less costly than for most industrialised countries and provide opportunities for China to gain competitiveness, at the same time as low-carbon technology exports could offer comparative advantages for Chinese production. Finally, China could gain international recognition by proceeding with its ambitious climate mitigation programme.

1 Cappellio, Dina. "China: Importers need to share blame for emissions." AP Online. 2009. Retrieved March 24, 2009 from HighBeam Research: http://www.highbeam.com/doc/1A1-D96VCAEO0.html

But the Chinese leadership is faced with difficult domestic challenges and tradeoffs between long and short term development and security concerns. With half of the population living under two dollars (PPP) per day, development needs are immense and it is necessary to maintain stable growth. Moreover, the energy intensive stage of development makes it difficult to break out of coal dependence. In combination, this makes it exceedingly challenging to level off emission growth over the coming couple of decades, let alone to start making real carbon emission reductions. There is no precedent – no other country has been faced with the necessity to deal with the challenge of climate change during the same stage of development.

China is crucial for success in keeping global warming within the 2°C bracket

As one of the most carbon intensive economies in the world China's low-cost mitigation potentials are extensive, but fully realising those potentials requires transformative changes. A giant leap is required to move from the so-called *reference* or *baseline* scenarios to the level of emission reduction that is in line with reaching a global 2°C target. Yet to reach the *reference* or *baseline* scenarios already assumes a "grand achievement" of China's national ambition, which is far from certain and requires further sharpening of policies and effectiveness in their implementation. (*See Figure 1*)

China's emissions would have to peak around 2020 to keep the world on track towards a **2°C** target. The most ambitious vision from the Chinese economist Hu Angang argues that the peak should occur by 2020 and no later than 2030, and that by 2050 China should be able to cut its emissions by 50 percent compared to 1990 levels. Calculations for China using the Greenhouse Development Rights approach[2] indicate that the global share of emissions from China would have to peak at about eight $GtCO_2$ by 2015 and decrease to just over four by 2030 if global warming were to be kept within a **2°C** bracket. Out of this China's own responsibility would amount to seven $GtCO_2$ while the remaining three would be subject to international responsibility.

[2] See Baer, et al. (2007)

Yet, China has opportunities to move towards a low-carbon development path with considerably lower emissions. McKinsey & Company (2009) conclude that technically available abatement options could take China to an emission level of eight $GtCO_2e$ by 2030, which is four to seven $GtCO_2$ lower than the different *reference* or *baseline* scenarios. *(see Figure 1)* This potential, however, dwindles rapidly if mitigation actions are delayed. Any meaningful outcome of the current climate negotiations must focus on how joint action can be leveraged to help China move on to a low-carbon development path and provide opportunities for China to help bring down the global cost of mitigating climate change.

The additional investment needed to reach deeper reductions is considerable but manageable if the right financial instruments were applied. McKinsey estimates additional investments for the period 2011 to 2015 to €175 billion, which is less than a third of the 585 billion US dollars economic stimulus package announced by the Chinese central government last November. McKinsey's estimate of total additional investments up to 2030 amounts to €3.6 trillion which is a little bit more than double the amount of China's currently accumulated trade surplus of 1.7 trillion US dollars.

Time is of essence. While China is convinced of the need for a low-carbon future there is no proven international experience for China to "plug-in" right away. Meanwhile, as its economy risks further slowing, or even a hard landing due to the global economic crisis, the mounting pressures to maintain growth, employment, and social stability are much more urgent priorities for the Chinese leadership. China's climate change strategy and actions will depend upon how it attempts to address its current domestic economic crisis and its economic development challenges. Success or failure in combating climate change globally however, is determined by how well China and the rest of the world can find common ground for productive low-carbon co-operation for economic development.

China understands its role in global climate change and is fully aware of the fact that, at a minimal level, OECD countries will need some kind of assurance that China is sufficiently "in" for

there to be a realistic chance of containing global emissions. In return, at a minimal level, China will insist on developed countries demonstrating sufficient commitment (e.g., significant mid-term targets, clear response to China's proposal on technology transfer and adaptation). With those two minimal requirements met, trust building may start, and that is where the ultimate hope lies for an effective green deal.

Part One:
China's Growing Emissions and the Increasing Importance of Climate Change

1. China's Role in Climate Change

The issue of global climate protection has reached the apex of the global agenda at a time when China faces tremendous development and energy security challenges. After three decades of nearly ten percent annual economic growth China has come to a crossroads in its efforts to develop into a harmonious and globally responsible society.[1]

There is an urgent need for continued social reform to improve social stability and provide development opportunities for the half of the population that lives on less than two US dollars a day.[2] The environment is degraded to the point where it limits growth potential and adds to social instability, at the same time as it causes millions of premature deaths annually and contributes to a 40 percent increase in birth defects within the last decade alone.[3]

China's coal dependence and the dramatic increase in energy use since the turn of the century have created domestic worries about how to fuel China's future growth as well as international concerns about China's escalating carbon emissions. Energy security – and energy's role in providing economic and social development – have reached the top of the Chinese political agenda and are framing the Chinese view of the nation's climate policy options. China's leaders are currently debating how future economic development could be redirected toward social reforms, environmental protection and resource conservation without compromising the stable economic growth that would be needed to pay for these reforms.

From a foreign policy perspective the concept of climate change has long been a sensitive issue in China's relations with the outside world, but limited to scientific debate and diplomacy. Until recently China was seen as reactive and unyielding in the world of climate negotiations. But over the past few years the climate policy debate has opened up within China, at the same time as it has become obvious that China seeks a constructive dialogue in international discussions and negotiations about a post-2012 climate regime.

From a rational point of view China has much to win and little to lose by playing a more active role in global efforts to mitigate climate change. A growing global focus on low-carbon economic development provides opportunities for China to gain competitiveness, international reputation and environmental benefits, at the same time as it lays the foundation for more balanced economic and social development. International co-operation within a new climate regime could give China access to important technologies and investment capital and allow exports of low-carbon, high-technology products.

The consequences of China standing outside the global process would be dire. It would signal that China does not take the climate threat seriously, and would thwart the world's chances to solve the climate crisis. Without China as an active partner in a global climate compact the potential for global low-carbon economic development would also be reduced, particularly if the threats of carbon related border tax adjustments were to become a reality, or if China were hindered in its export of affordable low-carbon products to OECD markets.

China's ability and willingness to slow the growth of its carbon emissions, reaching a point within the coming couple of decades where total emissions start declining, is crucial for the success of a global effort to come to grips with the climate crisis. It is imperative, therefore, that the international community reaches a deeper understanding of the role that climate and energy security play in China's development and emergence as a global economic, political and cultural power.

This report discusses China's ambitions and preconditions for active participation in global co-operation to mitigate climate change. It is divided into three main parts. Part 1 sets the scene for the report by discussing China's role in climate change in this first chapter, presenting China's general attitudes to and concerns about climate versus energy security in Chapter 2, China's perception of climate change in Chapter 3, and setting the policy context of how China deals with climate change in Chapter 4. Part 2 elaborates on the critical role that energy plays for China's develop-

ment where Chapter 5 reviews economic structure and energy use, while Chapter 6 addresses China's coal dependence and the opportunities for alternative energy sources. Part 3 concludes China's role in combating climate change with Chapter 7 examining the relationship between development, energy and the opportunity for economic recovery, Chapter 8 looking into China's role and positioning in the global climate negotiations, and Chapter 9 discussing China as a winner or loser in low-carbon development.

Partner or competitor?
A key to successful co-operation with China is that we understand the Chinese perception of climate change, as well as the long and short term implications that climate change policies may have on the Chinese society. If we do not comprehend China's basic preconditions – the driving forces that motivate China's attitude and position and the profoundly difficult tradeoffs that the Chinese leadership are forced into – then we cannot expect a genuine dialogue with China.

There is an undertone in western discourse of "engaging" or getting China "onboard" the climate negotiation process. But as a signatory to the Climate Convention, the Kyoto Protocol and the Bali roadmap, China is already very much onboard. Such western attitudes indicate a lack of awareness: the high income, industrialised countries need to be the front runners in demonstrating an attitude of responsibility in global negotiations.

Trust of each other's good intentions and understanding of each other's positions are basic conditions for reaching agreements where all parties feel like winners. To date, both of these aspects are largely missing. There is a general lack of trust from the Chinese side that the developed world will live up to declarations already made and take on their historical responsibilities. From the international side there is a lack of trust that China will live up to its promises, and a deep concern that it will not be possible to verify whether or not it does. At present all parties have been digging trenches, with the industrialised countries focusing on getting China to accept caps, and China maintaining its right to development before taking on binding commitments. The larger

points – that growth and mitigation of climate change need not be contradictory to one another, and that a low-carbon development path is a prerequisite for stable and sustainable growth in both developing and industrialised countries - are only beginning to be addressed, and are not yet recognized in the climate negotiations.

Where are China's emissions heading?

With about 7.5 $GtCO_2e$ China was in 2005, together with the US, the world's top greenhouse gas emitter. Both accounted for about 17 percent of total global emissions[4], but uncertainties are huge and several sources give different figures for different years.[5]

The great majority of China's greenhouse gas emissions are fossil fuel related. Emissions of CO_2 (shown in *Table 1*) account for more than 80 percent of the total. Methane (13 percent of total greenhouse gas emissions) is often emitted from coal beds, an additional source of fossil fuel emissions. On the other hand, China claims to have offset a total of more than three $GtCO_2$ between 1980 and 2005, mainly from afforestation.[6] While total greenhouse gas and CO_2 figures are both frequently referred to, and often mixed up, this paper focuses on China's CO_2 emissions.

Table 1: China's CO_2 emissions ($GtCO_2$), 1990-2007, selected sources[7]

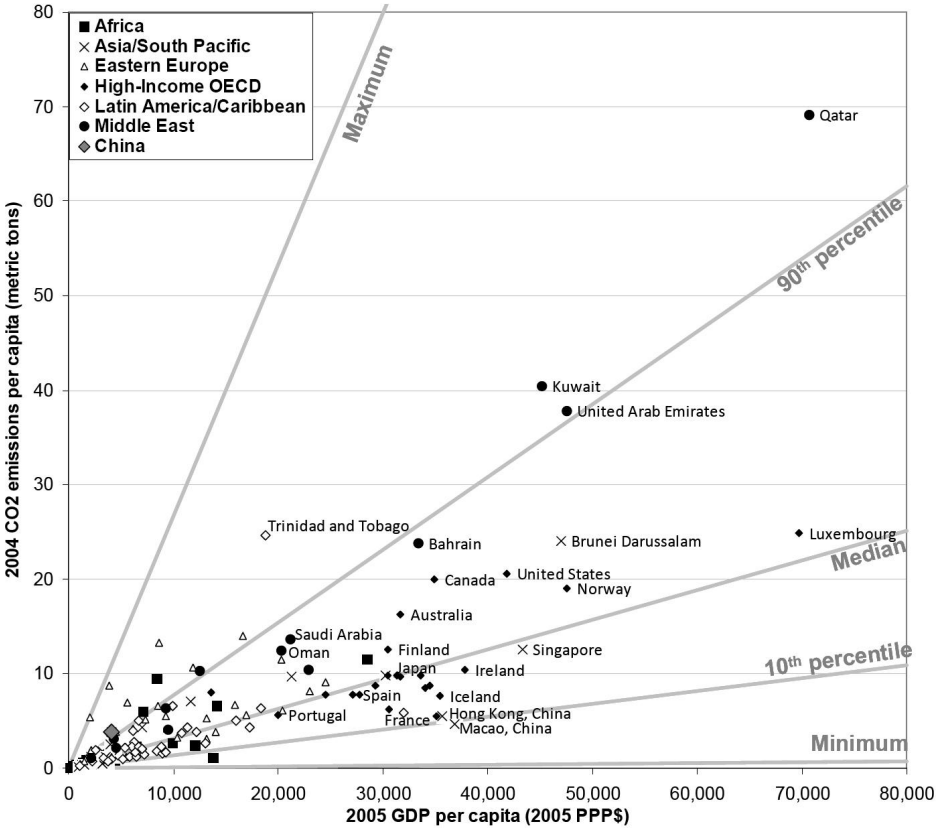
Source	1990	1995	2000	2005	2007
Chinese National Statistics	2.76	3.59	3.16		
MNP data	2.31	3.22	3.33	5.57	6.72
US EIA 2008	2.24			5.32	
IIASA GAINS Baseline08	2.35			6.31	

The latest figure from the Netherlands Environmental Assessment Agency (2008) for the year 2007 puts China at 6.7 $GtCO_2$ – nearly one-quarter of global carbon emissions and almost 20 percent higher than the US. This is also higher than China's roughly 20 percent share of global population.[8] Even more striking is that China accounts for an incredible 57 percent of the global increase in CO^2 emissions within this decade[9], which came as a surprise to the Chinese as well as international institutions involved in energy forecasting. Actual 2006 global emissions exceeded even worst-ca-

se IPCC scenarios from the turn of the century, largely reflecting the unexpected growth in China's CO_2 emissions.

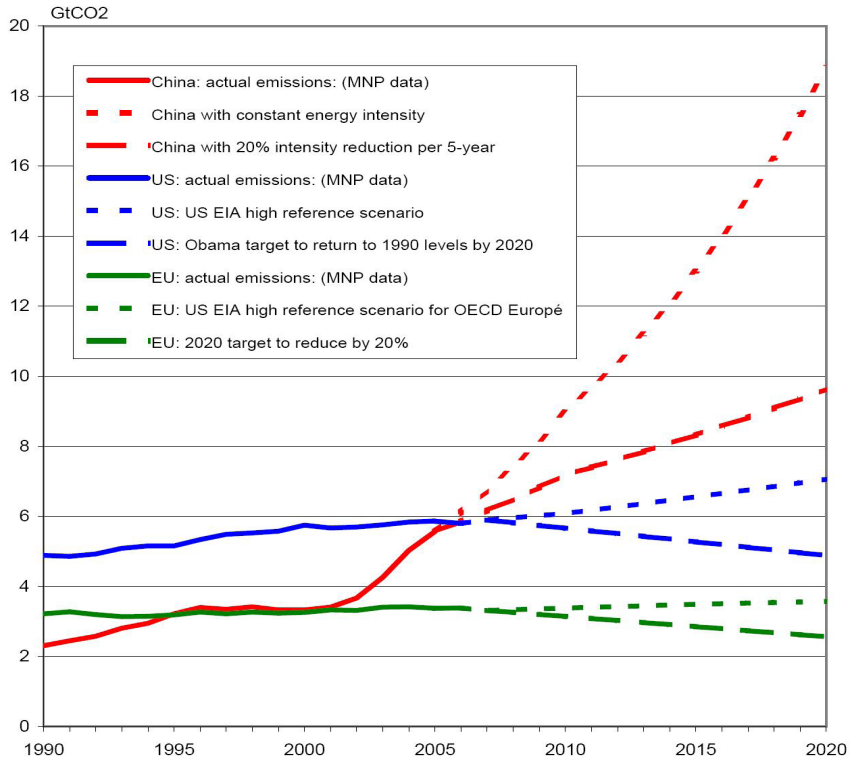
Carbon intensity improving – again – but from a very high level[10]
The trend in CO_2 intensity is crucial for China's future emission trajectory. As illustrated in *Figure* 2, China's emission intensity is in virtually a league of its own, with South Africa, a few of the ex-Soviet transition economies, and some – (otherwise a few is repeated twice) of the highest-income, small oil-producing nations being the only countries that reach or exceed China's level of 0.9 tons CO_2 emissions per 1,000 US dollars PPP (purchasing power parity[11]) income.[12]

Figure 2: CO_2 emissions per capita vs. GDP per capita (PPP)[13]



From the start of the reforms in the early 1980s to the late 1990s energy consumption grew only half as fast as GDP. What China had managed was a unique development path where national and per capita incomes grew while energy intensity (and thereby CO_2 intensity) was falling.[14] But from the turn of the century this trend was reversed and China entered a phase of increasing energy and CO_2 intensities. Current policies focus on getting back to a development path with growing wealth and falling energy intensity with the goal to reduce energy intensity by 20 percent percent of the 2005 level by 2010.[15] The ambitious policies have so far resulted in a significant slowing of the emissions growth with the energy intensity decreasing by 1.8 percent in 2006, 3.7 in 2007 and 4.6 in 2008.[16] If targets are met China would in the year 2010 alone avoid emitting roughly 1.5 billion tons of CO_2 compared to a development path with constant energy intensity (see *Figure* 3). This would arguably represent one of the largest policy driven cuts in CO_2 emissions worldwide.[17]

Figure 3: CO_2 trajectories to 2020 – BAU and political ambitions in China,U.S.and EU[18]



Data on actual CO_2 emissions in *Figure 3* shows how CO_2 emissions seem to slow down and even decrease towards the end of the 1990s, only to pick up speed again in early 2000 to reach up towards 15 percent annual increase in carbon intensity in the mid 2000s. It is still being debated to what extent this extreme increase in carbon intensity represents a short-term anomaly, or if it marks the start of a longer period of high carbon intensity growth. Clearly the rapid growth in carbon intensity is partly a result of China having entered a development stage of urban-industrial infrastructure expansion with a surge of investment in heavy industry that supplies the inputs for the entire expansion.[19]

However, without further CO_2 intensity reductions China will soon dominate global carbon emissions. *Figure 3* is drawn for illustrative purposes to demonstrate the huge difference between a path where energy consumption develops at the same pace as the economy, and a path where energy intensity is reduced by 20 percent per 5-year period, the latter which in itself would be an extremely challenging task to achieve.[20] With constant CO_2 intensity China will emit roughly 19 $GtCO_2$ by 2020 – roughly three timesU.S.or six times EU emissions.[21] If China keeps its current energy intensity as its per capita income grows, the country will approach a combination of CO_2 emission and income per capita similar to Middle East oil producing countries. It goes without saying that China developing along such trajectories would fall far outside any attempt to control greenhouse gas concentrations.

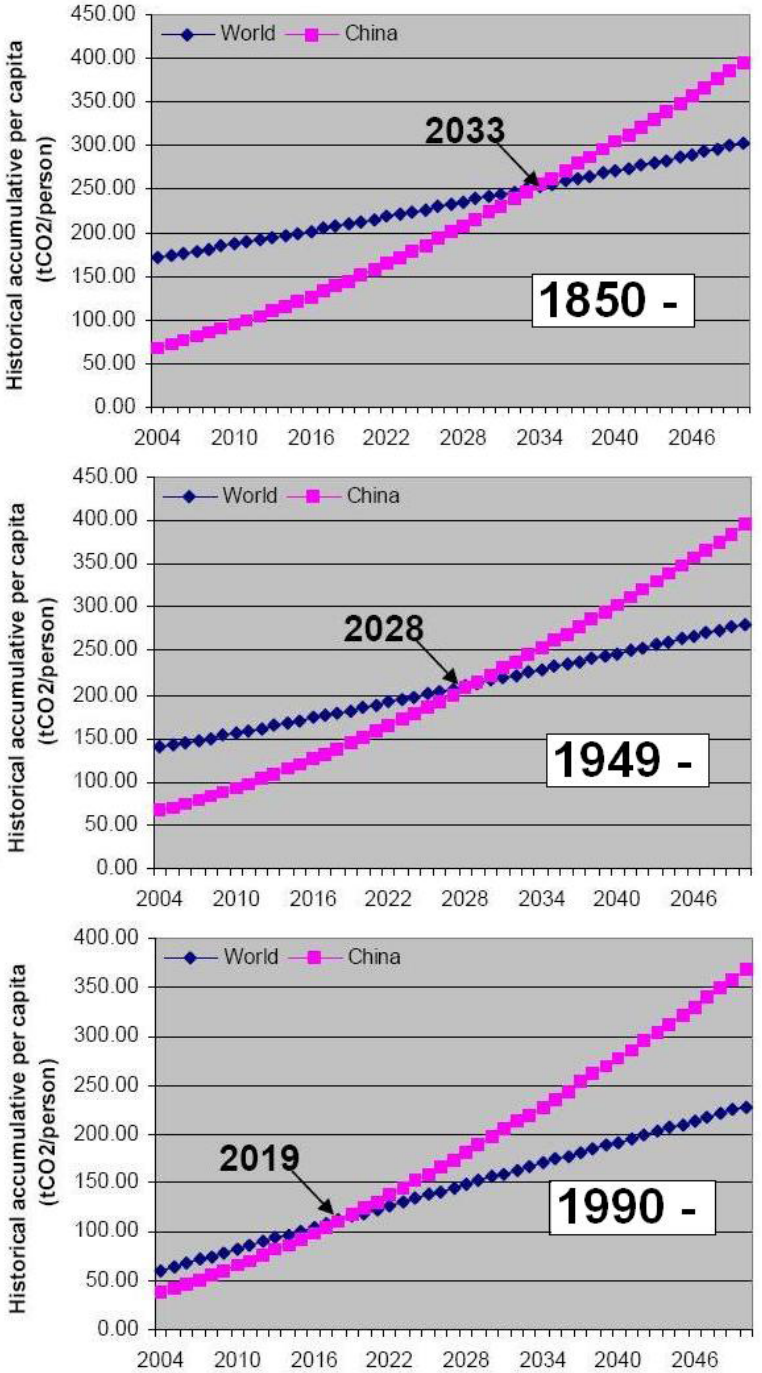
No country has yet managed to reduce its emission intensity during a development stage similar to the one China is in now. But neither are there examples of industrialised, high income countries with as high emission intensities as China, which suggests that there are opportunities for China to return to its earlier pattern of increasing incomes but decreasing emission intensity.[22] For China to increase incomes and keep emissions low enough to avoid jeopardising the global climate will require both economic restructuring and immediate application of existing renewable, energy efficiency technologies. *Figure 3* shows the critical role of China in global carbon mitigation, and indicates that the current political ambition is taking China in the right direction. If the

current targets to cut energy intensities by 20 percent per five-year period were extended into the 12th and 13th five-year programmes[23] this would represent a total of more than 50 Gt CO_2 avoidance compared to constant CO_2 intensity.

Per capita emissions soon to exceed European levels
China's per-capita emissions are already above world average, but they are still only one-quarter ofU.S.levels. But with the current momentum in CO_2 emissions China is rapidly catching up with the developed world. If China were to continue at its 2007 rate of eight percent annual increase of energy use and the EU meets its 20 percent reduction target, China's per capita CO_2 emissions would be double those of Europeans by 2020. With its current 0.9 ton emissions per 1,000 US dollars income (PPP) China would emit 32 tons per capita at Japan's current income level and 44 tons at theU.S.level.[24]

Historical contributions growing rapidly as well
Currently China accounts for just under one-tenth of global historical emissions since 1900. Although China's share of global cumulative emissions is greater with later starting years, it remains well under the country's one-fifth share of global population. Therefore, if countries would have the right to reach the world average for per capita cumulative emissions, China appears to have considerable space for further emissions. If countries would have the right to reach the level of cumulative emissions per capita of Annex 1 countries, China has room to expand even further.[25] But as *Figure 4* shows even in the case of historical emissions China will soon reach its global share if emissions continue to grow at the current pace.

Figure 4: Year when China will reach its per capita share of historical emissions based on different assumptions for starting year of cumulative emissions[26]



Substantial amounts of carbon embedded in trade
A large fraction of China's carbon emissions can be attributed to international trade, meaning that substantial emissions occur in China to produce goods that satisfy a final demand in other countries. Carbon embedded in exports far exceeds that in imports, so China is a large net exporter of carbon. Wang & Watson (2008b) conclude that the net exported carbon was 23 percent, whereas IEA (2006) come to the conclusion that the gross amount of carbon embedded in exports amounted to 34 percent of total emissions. Guan et. al (2009) claim that half of China's 45 percent increase in CO_2 emissions between 2000 to 2005 is due to export production.

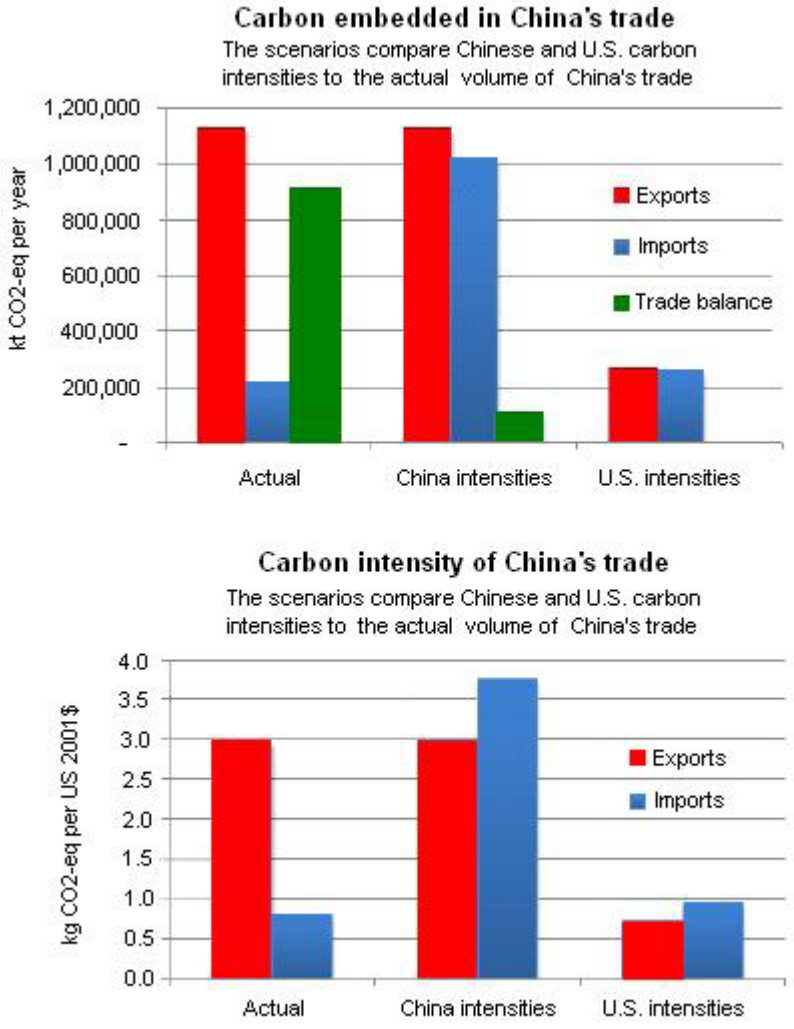
Numbers like this give the impression that China thrives on carbon intensive exports. However, a closer look at the carbon intensities of Chinese imports and exports shows that the main reason for the current huge net export of embedded carbon is that the Chinese economy is less carbon-efficient than developed economies. Other reasons includes China's ever rising trade surplus and the particular trade structure of China, whose exports are based on low value added products, or low value added parts of high tech products, and high value-added imports. The latter means China has to export more units to counter the imports.

As China's economy develops towards higher carbon productivity and higher value added, the carbon intensity gap between exports and imports will narrow. *Figure* 5 compares the carbon embedded in China's trade (left-hand bars) to two hypothetical cases: one in which China's imports and exports were both produced at Chinese intensities (middle bars) and another in which China's imports and exports were both produced atU.S.intensities (right-hand bars). In both hypothetical cases, China's net export of embedded carbon largely or entirely disappears.

The conclusion is that China's position as a net exporter of carbon does *not* result from exporting uniquely carbon-intensive products. China is a net exporter of many manufactured goods, including both high-technology products and traditional goods, and a net importer of chemicals, metals, minerals, and oil, among other

things. At any one level of technology, either Chinese or American, China's imports would be moderately more carbon-intensive than its exports. Analysis of the relationship between revealed comparative advantage[27] and carbon intensity shows that China's advantage in world trade is not closely connected to its high CO_2 intensity.

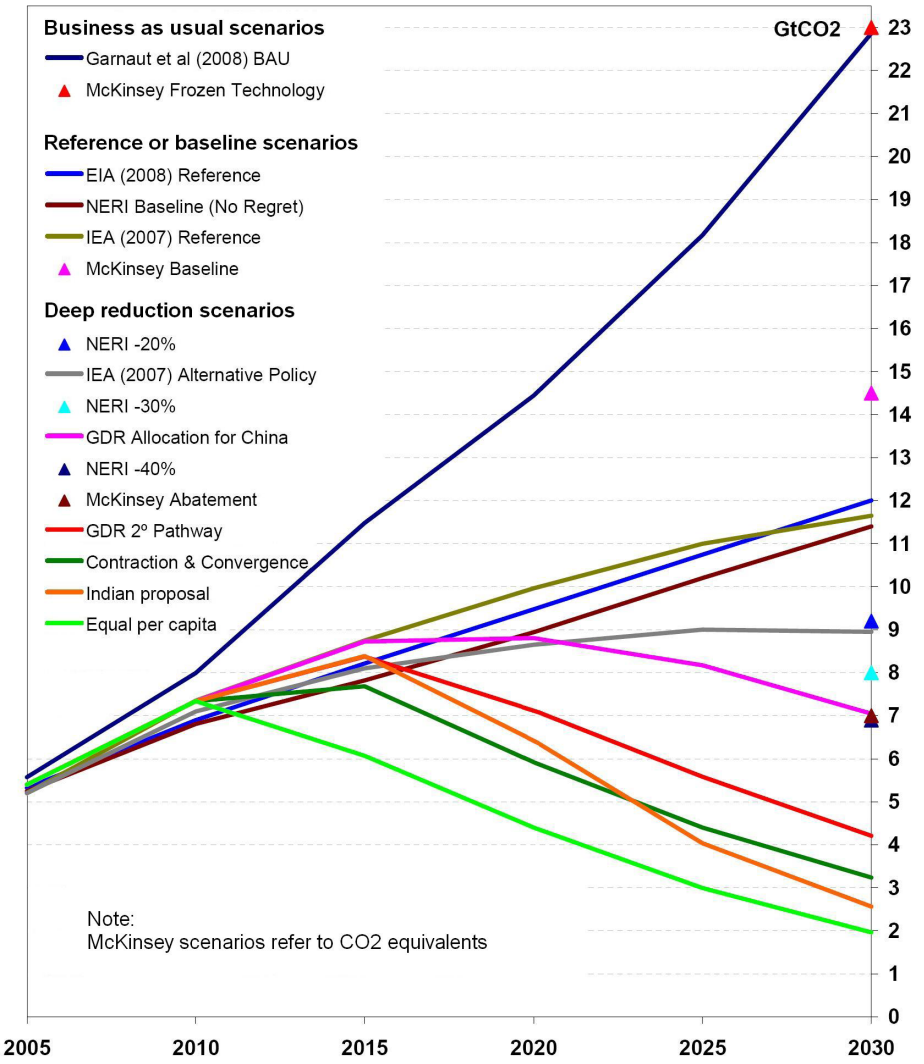
Figure 5: Carbon embedded in, and intensity of China's trade[28]



China's future emissions

As illustrated in *Figure 6* different scenarios and projections for China's future CO_2 emissions show a wide divergence between *business as usual (BAU) scenarios* (assuming no CO_2 intensity improvements), *baseline or reference scenarios* (assuming a development in line with the Chinese government's intentions to reduce CO_2 intensity by up towards 20 percent per five-year period to 2020), and *deep reduction scenarios* (backcasting how much reduction is needed in China to keep global temperature within 2°C, or assuming the maximum technically realistic abatement opportunity).

Figure 6: Compilation of CO_2 Emission Projections for China[29]



The spread is well represented by the three scenarios for 2030 presented in the recent greenhouse gas abatement cost curve study for China from McKinsey & Company (2009) with a BAU scenario (*"frozen technology"*) at 23 $GtCO_2e$, a baseline scenario at 14 $GtCO_2e$, and a scenario representing the technical abatement potential of only eight $GtCO_2e$. The different scenarios and projections indicate that China has opportunities to move towards a low-carbon development path with considerably lower growth of emissions, and that there are *technical opportunities* for China to reach an emission level by 2030 that begin approaching what would be needed to reach a future within 2°C bracket. Another key conclusion, however, is that this potential dwindles rapidly if mitigation actions are delayed.

Saviour or threat?

Throughout history the western view of China has tended to reflect our own hopes and illusions about China rather than its realities. Ever since Marco Polo's journey to China in the 13th century, the western image of China has been swinging back and forth between periods of reverence and fright. Supposed Chinese virtues or vices have been used as arguments in domestic debates that have nothing to do with China. The wish to see one's own hopes and desires realised in the mythical oriental empire has time and again led passionate China-watchers to swallow utopian Chinese aspirations without really thinking about the country's real conditions, and to confuse political rhetoric with real world limitations.[30]

The past year or two has seen a tremendous span in the image of China either as threatening our entire existence or as a potential savour; either as the world's environmental enemy number one or the country with the most ambitious targets and rapidly developing low-carbon tech sectors.[31] Which of the images is right? In fact neither extreme adequately conveys the complex reality of the world's largest country, illustrating the need to get beyond stereotypes and understand the deliberations and driving forces that shape China's climate policy and action. Only then can we engage with China in a way that leads to a mutually beneficial global climate compact.

2. *China's Climate and Energy Securities Dilemmas*

With a growing economy and rising emission levels comes growing global responsibility. In the case of China, the country has reached a crossroads in its ambition to act responsibly in global climate mitigation, while simultaneously ensuring domestic growth.[32] This chapter addresses the transitional challenges facing China and shows how these challenges ought to be perceived in the context of (domestic) energy security, and (international) climate security.

Fundamental challenges

While its Western predecessors took centuries to modernise and build up industries, China has undergone an equivalent process in just a few decades. The speed of the process adds further complexity to the already challenging task of managing, at the same time, domestic energy intensive development and global climate change mitigation. Additionally, the country currently faces three deep-seated sustainability problems that have implications on the country's willingness and ability to respond to climate change:

Firstly, China's population growth increases the pressure on already notoriously scarce and unevenly distributed resources. Estimates of the size of China's population by the middle of this century fluctuate by a few hundred million, making it extremely difficult to estimate China's future resource needs.[33]

Secondly, growth has come at a high social and environmental cost. Due to its uneven distribution and rapid pace, economic growth has not improved living standards for all citizens. This unbalanced economic development adds pressure on already limited resources and concurrently deepens already wide chasms between those who have a lot and those who have very little. China's ecological footprint is growing fast, with rampant domestic pollution and ecological degradation.

Finally, a combination of China's socialist heritage and capitalist enthusiasm creates a basis for large scale exploitation of human and natural resources. Consumption goods such as water and

petrol are subsidised by the government, giving cheap prices for consumers and a large turnover for producers, a system that in itself inherently supports (and encourages) over-exploitation.[34]

At this difficult time of struggle towards sustainability China is also undergoing a number of complex transitional processes towards modernisation that each by itself constitutes a monumental challenge. An ongoing demographic shift to low fertility and longer life expectancy radically changes not only China's demographic curve but also the expected societal carrying capacity. In addition, the country's rapid urbanisation will in just over a decade have turned previously rural China into a highly urbanised society, implying a larger proportion of the population leading energy intensive lifestyles. The scope of these challenges, and the context within which they must be perceived, clearly illustrates the depth of the modernisation burden that China is struggling to master.

China takes on the task of modernisation with the baggage of increasing social disparities, draining resources and a lingering environmental disaster at a time when climate mitigation has been put at the top of the international political agenda. As pointed out by a European climate expert, no other country has previously taken on a modernisation process as extensive as the one China is currently struggling to balance, and there is an apparent lack of off-the-shelf best examples to follow.[35] Climate and energy security are at the very core of China's challenges and have to be understood in that context.

China's energy security – not only a Chinese issue

Even after three decades of near two-digit economic growth, China still has immense developmental needs. In its ambition to attain a *harmonious society*, the Chinese government has identified three main goals: economic development, social stability and poverty alleviation. While only about five percent of the country's population live under OECD-like conditions, almost half of China's estimated 1.3 billion sized population still lives below a poverty line of two US dollars (PPP) a day. There is no doubting China's justifiable right to development, but development is dependent on growth, and growth must be fuelled by energy. The

question that remains unanswered is whether or not this desired development can be generated more efficiently, and be fuelled by resources other than coal, gas and oil.

Energy security has traditionally been seen as a national concern of establishing resilient energy systems and securing sufficient and predictably priced energy supplies for economic development and growth. China's focus on energy security is not only a matter of keeping an enthusiastically growing economy healthy, but also about political survival. In China, growth and political legitimacy are intricately linked, and the political leadership take very seriously the prognoses that estimate that social stability will be jeopardised if growth falls.[36]

With increasing global energy prices and the prospect of dwindling global oil reserves, it is becoming increasingly clear that narrow national strategies will not be sufficient to secure national energy security. Consequently, national energy security strategies are becoming intricately entwined. As Chinese growth has increased, so has its importance for global growth at large. In fact, for a couple of years Chinese growth has made a greater contribution to global growth than the US.[37] Therefore, a halt in Chinese growth due to insufficient energy supplies would have far-reaching consequences for the world economy.[38]

Climate security, on the other hand, is inherently a global matter of avoiding large-scale damage from climate change that could have far-reaching global economic and security implications. The only viable strategies for reaching climate security rest heavily on global or multilateral institutions, and are much dependant on international co-operation. Still, individual countries can and must take measures to strengthen climate security by limiting the potential damage from climate change impacts through national and local adaptation strategies.[39] There are increasing concerns also that individual countries will begin developing hard security responses to protect against consequences of climate change.

The climate and energy security dilemma

The challenge for the global community as well as for individual countries, and perhaps for China in particular, is therefore to develop energy security strategies within the limitations of climate security. In its search for energy security strategies constrained by climate security China runs into several underlying dilemmas.

To begin with, China is at a development stage of rapid industrialisation and urbanisation at a time when climate security has been put at the top of the global agenda, and the sheer size of the Chinese economy means that its development related emissions have large impacts on global climate change. To decouple its carbon emissions from growth, China faces a challenge that no other country has previously mastered at a similar stage of development.[40]

Secondly, mounting domestic development challenges make it imperative for China to maintain high economic growth to finance a wide variety of much needed social reforms.[41] It is particularly urgent to reduce growing social disparities and provide development opportunities for the near half of the population that lives on under two dollars (PPP) a day. Equally important is to halt the rampant environmental degradation that limits growth potential and adds to social instability.[42]

Thirdly, with coal forming the foundation of its energy system, it is highly challenging for China to transform its energy structure to such extent that the global two °C is within reach.[43] Committing to a climate deal implies massive structural transformation for China, not only of the energy mix, but also of the energy intensive transport and building sectors.

Finally, China's tradition of aligning with the G77[44] view that climate change is predominantly an OECD-world problem is becoming more and more contradictory as China has recently become the world's largest carbon emitter. With escalating emissions it will also prove increasingly difficult for China to keep up its foreign policy ambition to act as a "responsible great power", and convince the world that its development is not a threat to global security.

The issue of climate change is prominent on the Chinese political agenda but it is unlikely that the government will agree to any climate mitigation actions that compromise the national targets of sustaining economic growth, maintaining social stability and alleviating poverty. A steady energy supply is vital to sustain economic growth (the foundation of the government's targets), and energy security is a key driving force behind most of the development related political decision-making in China. Therefore, any proposed climate mitigation deal must be understood in the context of China's development strategy, and its close connection to energy security.

3. *China's Perception of the Climate Challenge*

During the last couple of years understanding of the climate challenge has been changing in China. This change of perception is partly driven by China's exposure to climate impacts, and partly by a growing recognition that China has become the world's largest and fastest growing carbon emitter.

China is already affected

China is already suffering from climate impacts which result mainly from the OECD countrie's industrialisation since the mid 19th century, with theU.S.being the main culprit of accumulated carbon emissions. With escalating climate change China is bound to be excessively exposed to climate impacts. While it is theU.S.and Europe that have been the dominant carbon emitters since the 19th century, China will become one of the leading emitters over the coming century.[45]

Up until just a year or two ago, China perceived the climate challenge to be very much a problem for the Western world. This belief was conveyed not only through its attitude towards responsibility sharing, but also in terms of problem framing. However, China's first *National Assessment Report on Climate Change* published in early 2007 showed that China will be hit very hard by climate change.[46] As a response to the report, China's increasing emission levels, and higher rates of climate abnormalities in China over recent years, the Chinese perception of the climate challenge is beginning to change.[47]

The *Chinese National Assessment Report* illustrates that climate change impacts are already evident in China. Over the past few years temperatures have risen and there has been an increase in extreme meteorological events. Severe droughts in the north have led to an acute shortage of water and failing harvests threatening the livelihood and sustenance of millions of farmers living in the area. At the same time, southern regions are experiencing severe flooding, and are, like their northern counterparts, victims of failed harvests and reduction in arable farmland.[48]

In 2006 the southwest region experienced its worst ever drought as the Yangtze River reached its lowest recorded level in a century. As a response to destroyed crops and lost income, the government transported 100,000 poverty stricken farmers more than 3,000 kilometres away from their native Chongqing to pick cotton in the far northwest of Xingjiang.[49]

Due to the high frequency of extreme weather events during the past few years there seems to be a growing awareness that environmental stability has been compromised. Not least the unusual snowstorm that hit large parts of eastern and southern China just before the spring festival in 2008, preventing hundred thousands of migrant workers from travelling back home for the holidays, and stranding tens of thousands in train and bus stations, have played a role in making the connection between climate change and societal impacts.

The Chinese media has increased its coverage of climate change and greater knowledge and personal experience of the effects of climate change have started to shape worries among the public about future consequences. Concerns among government officials together with mounting international pressures have caused the central leadership to raise China's profile on climate change through official statements and by communicating the problem though the media. As will be further described in the next chapter 2007 became the year when China brought together its first coordinated climate change policy.

Severe future impacts

A disquieting picture emerges from the *National Assessment Report* of how China will be affected by a changing climate. Already by 2020, China's average temperature is expected to increase by 1.3°C to 2.1°C. In reality this means that many parts of the country will experience drastic temperature increases. Temperatures are expected to rise by a total of 3.3 degrees Celsius by 2050 and precipitation is expected to increase by two percent by 2020, and seven percent by 2050. Unfortunately, these temperature and precipitation rises will not alleviate chronic water shortages in the north, but rather intensify flooding problems in the south. Increased precipi-

tation will also increase flooding and drought disasters in general, with significant impact on the country's development potential.[50]

Given China's precarious water situation, the pronounced temperature increase in the Himalayas is particularly worrying. Rising glacial runoff increases risks for large-scale flooding until the melt-off peaks between 2030 and 2050, at which point the head-flows of China's largest rivers will diminish, with huge consequences for all human activity along the big rivers.[51]

Other climate change consequences include agricultural impacts that will dramatically undermine domestic food security. China's densely populated coastal zone, including the economically important southern regions of the Pearl and Yangtze River deltas will be increasingly vulnerable to flooding, typhoons, salt water intrusion and erosion.[52] A rise in sea level could not only threaten the lives of millions of China's coastal settlers but also have devastating effects on the country's economic production. The Pearl and Yangtze River deltas in the south, together with the more northern Bohai Gulf area, produced 38 percent of China's GDP in 2002, and are predicted to produce 65 percent of total GDP by 2020. This not only makes them China's most endangered costal regions but also implies that any extreme climate impact on these regions will have grave consequences for the country's GDP.[53]

China has undergone massive urbanisation in recent decades, and is expected to have an urban population of a billion by 2030[54]. The same estimates predict that 66 percent of the Chinese population will be urban in 2025, compared to 44 percent in 2005 and roughly 20 percent in 1980. However, there are ecological limits even for asphalt-covered metropolises. As the number of people leading urban lives increases, cities will expand at the expense of arable land in their vicinity. Increased urban resource demands will radically enlagre China's ecological footprint as the energy demands of cities will increase and urban air and water pollution will become severe.[55] It is difficult to predict what the effect of environmental and climatic extremes in combination with rapid urbanisation will be, but likely these factors will have an immense impact on the carrying capacity of densely populated regions.[56]

The climate threat, must be perceived in the context of China's developmental needs, and through the eyes of the Chinese political leadership. To the central government, the climate challenge is yet another destabilising factor that not only constitutes an overall menace to national food supply, but is also a peril that will potentially worsen the situation for China's poorest and most susceptible citizens. It is unpredictable what the synergy of the social and environmental reactions will mean for a China increasingly exposed to global warming, except that it will undoubtedly add further strain to China's development challenge.[57]

Increasing awareness about threats and opportunities

This litany of potential climate impacts, many of which will challenge economic and social development even in the near future, should arguably constitute strong arguments for China to become an active driver of international joint efforts to cope with climate change. *The National Assessment Report* stresses the importance of China's active contribution to solving global warming and urges the Chinese leadership to start seeing the climate challenge as a conclusive driving force for the development of new energy technologies, energy efficiency and alternative energy sources.[58]

Concerns about climate change are beginning to play a role in political decision-making and synergies between the national goals of energy efficiency and the emerging perception of the climate crisis is regarded by many observers to add to the willingness of the Chinese leadership to address climate change. But China would not be what it is if there were not those also who have already begun seeing the low-carbon opportunities inherent in the climate challenge. Certain business sectors, and increasingly also political leaders, regard low-carbon and clean technology as a field where China has opportunities for comparative advantage and Chinese companies have already reached leading positions in manufacturing a number of low-carbon technologies.

Text Box 1: Views on Chinese perceptions of the climate challenge[59]

The consultations carried out in the scope of writing this report indicates that the climate challenge is no longer portrayed as solely a Western problem in China. Many Chinese and international observers claim that the awareness of climate change in China has been growing over the past few years both among leaders at different levels but equally importantly also among the public. It is the opinion also that the government has realised that it is imperative to participate constructively in international decision-making on climate mitigation. It is worth noting, however, that the top-down approach is still very prevalent in China. Any incentive for increased response to the climate issue must therefore be initiated from the central government, and the opportunity for bottom-up initiatives is still very limited.

Chinese business is also seen to begin realising the role it can play in cutting costs during a green changeover. However, only a minority of the respondents are positive about the near-future scope for China to be exporting green technology to the international market. Most respondents assert that on a relative world scale, China is still technologically too far behind. However, not all respondents are pessimistic on the issue: according to a Chinese scholar particularly lucrative business incentives have been created through the Clean Development Mechanism, and some are even beginning to see opportunities in developing low-carbon products. However, it is recognised that China is still technologically immature and will need external assistance and guidance when committing to the production of large-scale technological innovations.

A European civil servant consulted on overarching problems of the threats and opportunities related to climate change is carefully optimistic about how China might tackle the problem. He asserts that there are potential co-benefits in securing energy and mitigating climate change which can turn the over-arching threat of climate disaster into an incentive for steering societal development in a more energy efficient direction.

4. *From Energy Security to Climate Change Policies: The Scientific Development Concept*

Well into the mid-2000s China had no climate policy as such, but had from the early 2000s started developing an extensive set of policy measures and programmes in the pursuit of energy security and energy efficiency. Because of the close link between energy use and greenhouse gas emissions, the same policies became the foundation when China, from the mid 2000s, begun putting together a coherent climate policy. This policy development process is closely associated with the political focus of the current fourth leadership under president Hu Jintao and premiere Wen Jiabao.

Transition of power from the third to the fourth generation leadership meant a decisive shift in focus from growth-only during the former president Jiang Zemin's leadership to a broader social development palette during the Hu-Wen administration – in particular the search for alternative development pathways under the new guiding principals of the *Scientific Development Concept*[60] and the building of a *Harmonious Society.*[61] Alongside China's increasing equity gap energy, resources and pollution intensities became key areas of concern when the Hu-Wen administration took office in 2003.

Unpacking the Scientific Development Concept

When the Hu-Wen administration came to power in late 2002[62] they inherited an increasingly divided society with devastating environmental conditions, mounting resource scarcities, alarming social and regional disparities, and increasing international fears about the global implications of China's rise.[63] The vice chairman of the National Development and Reform Commission, Zhang Xiaoqiang, expressed China's predicament as "after more than twenty years of remarkable economic growth, China has grown to be a giant with one leg – the economic – too long, and the other leg – the social - being too short so that the giant can hardly walk without falling down".[64] To address these concerns, and build a "pro-people" image the Hu-Wen administration set off to shift the focus of the national agenda from economic growth to social harmony.[65]

Building a "well-off society in an all-round way" and the "five co-ordinations"

Once in office Hu Jintao wanted to assert power and distance his administration from the single-minded growth policies of the Jiang Zemin era that had resulted in mounting social and ecological problems. As a first step he reconnected to the goal that Deng Xiaoping had set up at the beginning of the reform period, that China by the turn of the millennium should have developed into a modestly *well-off society*. The goal focused on economic growth and was expressed as a quadrupling of per capita income to reach 1,000 US dollars by the year 2000. The target was reached a few years ahead of time, but many people felt that the wealth was not well distributed, that the country was facing difficult social and ecological problems, and that China needed to strive for a *well-off society* of higher quality.

The concept of a *well-off society* implies that economic growth needs to be balanced with the sometimes conflicting goals of social equality and environmental protection. In order to show their adherence to Deng Xiaoping and signal a departure from the economic growth focused development during the Jiang era the Hu-Wen administration brought up the idea of a *well-off society* as a new target for 2020 rebranding it a *well-off society in an all-around way*, with the *all-around way* suffix signalling a focus on a more balanced and comprehensive growth model. This was further emphasised through the proclamation of the *five co-ordinations*[66] that should characterise the Chinese development process. Thus social and economic development under the Hu-Wen leadership should strike a balance between urban and rural areas, between costal and inland regions, between economic and social dimensions, between human society and natural systems, as well as between domestic issues and continued opening up to the outside world.

The "Scientific Development Concept" and the vision of a "Harmonious Society"

The conception of a *well-off society in an all-around* way based on the *five co-ordinations* evolved into what became the *Scientific Development Concept*, which was first introduced in the autumn 2003 and formally endorsed by the National Peoples Congress in March 2004. Since the 11th National People's Congress in March

2008 the *Scientific Development Concept* is incorporated into the constitution, and as such it constitutes the guiding principal for China's socio-economic development.

Parallel to the evolvement of the *Scientific Development Concept*, yet another term – *the harmonious society* – begun being circulated by the leadership as a long-term visionary goal for the Chinese society.[67] The *harmonious society* is described by Hu Jintao as "democracy, the rule of law, justice, sincerity, amity and vitality" as well as a better relationship between the people and the government and between man and nature.[68] If the *harmonious society* is the endpoint for Chinese development endeavour then the *Scientific Development Concept* outlines the path to that goal. What has happened since the Hu-Wen administration took the helm is that a broader notion of economic development, rather than a narrow-minded focus on economic growth, is now China's top priority, and the issue of how to provide development while at the same time dramatically reducing energy and pollution intensities has become a key part of it.

The emergence of energy and climate policy under the Scientific Development Concept

Already by the early 2000s the rapidly increasing dependence on oil imports had begun alerting the leadership to energy security. This was further emphasised with the endemic energy shortages and blackouts in 2003, and by 2004 a picture began emerging of a sudden increase in the energy intensity that had started at the turn of the millennium.[69] When China's top policy-makers met for the Central Economic Work Conference[70] in late 2004 they decided – in the spirit of the *Scientific Development Concept* – that energy and resource saving should become important targets in economic restructuring.[71]

Both the 9th and the 10th five-year plans had failed badly on both energy and pollution reduction targets, so the Hu-Wen administration showed its political commitment to reverse these trends during the 11th five-year programme period (2006-2010) by setting ambitious compulsory targets to reduce energy and pollution intensities from their 2005 levels by 20 and 10 percent respectively.[72]

Other targets, although not compulsory, included increasing the share of renewables in the nation's energy mix to 10 percent by 2010, from the current seven percent, and to 15 percent by 2020, and strong efforts on forestation, tree plantation and protection of the ecological environment.

It was not until 2005-2006 that climate change began surfacing as a serious issue on the Chinese leadership's agenda and it coincided with the rapid advance of the global climate change debate that was driven by Al Gore's movie "An Inconvenient Truth" and the Stern Report. Domestic research about the severe climate impacts on China had also drawn the Hu-Wen administration's attention to China's role in climate change. The climate issue moved rapidly up the agenda and by 2007 the Hu-Wen administration were able to present a coherent climate policy framework. The following chronology of events during 2007 shows how climate change had suddenly been lifted to the highest political priority.

- *January:* China's *National Climate Change Assessment Report* is released and emphasises the devastating impacts of climate change to China.
- *January:* Immediately following the release of the report the National Expert Group on Climate Change is established to advise the government on climate change issues.
- *June:* China publishes its *National Climate Change Programme*, the first developing country to do so. The climate change co-ordination group under the National Development and Reform Commission is elevated to a National Climate Change Leading Group directly under the State Council and led by Premier Wen Jiabao.
- *September:* A special "mechanism on external relations on climate change" is established under the Ministry of Foreign Affairs, and a designated top climate change representative is appointed.
- *September:* President Hu Jintao delivers an important climate speech at the annual APEC[73] meeting outlining China's stand on climate change.

- *November*: Premier Wen Jiabao delivers a keynote speech on combating climate change during the 3rd East Asia Summit in Singapore.
- *December*: The Chinese delegation at the climate conference in Bali is widely praised for its constructive and flexible attitude.[74]

The activity continued through 2008 with climate change being one of the key issues during the 11th National People's Congress in March, and the China Development Form in April, the highest level policy debate forum in China. In October a White Paper on Climate Change[75] was published and China announced initiatives for international climate talks.

From energy and climate security to low-carbon economic development

The evolution of energy and climate policy under the Hu-Wen administration shows on several important developments. To begin with, an ambitious climate change programme has been established by repackaging policies that were originally developed because of energy security and ecological concerns. The climate change strategy that has emerged fits very well under the *Scientific Development Concept* and the Hu-Wen administration's ambition to build a "resource-saving and environmentally friendly society".[76]

Moreover, a climate change debate, although contentious and politically sensitive, has gained momentum, and the idea of "low-carbon economic development" is being discussed and explored as a comprehensive way to solve challenges of resources, energy and environment in the rapid industrialisation and urbanisation process.[77] Leading economists are exploring the macroeconomic consequences of a low-carbon economy, with expectations that it may also have positive side-effects on stabilising growth, creating jobs, and developing competitive advantages.[78]

Last but not least, one of the central features of the *Scientific Development Concept* is to develop China into an innovation society as an essential prerequisite for competitiveness in the global economy. Clean technology is an area where China wants to reach a world leadership position, and China's has considerable potentials

to be inspired by, and in turn drive, a global transition to a low-carbon future.[79]

Energy and climate related targets and ambitions
There are three key sets of interrelated climate and energy targets in China:

- The compulsory energy intensity targets of the 11th five-year programme[80];
- The renewable energy targets for 2010 and 2020; and
- The goals and emission mitigation targets stipulated in the *National Climate Change Programme*.

After the failure to reach targets of reduced energy intensity during the 10th five-year plan (2001-2005), the Hu-Wen administration showed political clout by setting compulsory targets to reduce energy intensity by 20 percent and pollution intensity by 10 percent within the 11th five-year programme (2006-2010).

Ambitious goals for renewable energy development have been set for long-term energy security purposes. In 2005, a target was set to increase the share of renewable energy in the nation's energy mix to 10 percent by 2010 and 15 percent by 2020. This will require an investment of about 120 billion US dollars by 2020. Since 2006 China has maintained an annual investment above 10 billion US dollars, second only to Germany. By 2050 China has set a less ambitious objective of having 30 percent or more of its total energy requirements satisfied by renewable sources.[81]

China's rapid development in both investment and production of renewable energy has received international recognition. In wind power China has moved well ahead of the targets set and is now expected to have more than 100 gigawatt installed by 2020, as compared to the original target of 30 gigawatt, and China is already regarded as one of the most attractive countries for renewable energy investment.[82]

China sees climate change as a key development challenge. China's *National Climate Change Programme* from June 2007 made China the first developing country to publish a national strategy addressing global warming. The overall goal of the national programme is to "make significant progress on controlling greenhouse gas emission, continue to enhance the national adaptive capacity to climate change, enhance climate change related scientific and technological research to reach a new level; greatly improve public awareness of climate change, and strengthen the organizational and institutional development in the area of climate change".[83]

The *National Climate Change Programme* does also set specific yet indicative targets for 2010. A successful implementation of the programme would result in 950 million tons of avoided CO_2 emissions by 2010 (see *Table 3* below for specifics).[84]

Table 2: Main targets of Renewable Energy Development (gigawatt, if not specified)[85]

Development Target	2005	2010	2020	Potential
Big hydro	80	120	225	540
Small Hydro	35	60	75	
Wind	1.3	5	30	1000
Biomass	2	505	30	500 Mtee
Solar PV	0.07	0.3	1.8	5000 MJ/m^3
Solar hot water	80 Mm^2	150 Mm^2	300 Mm^2	
Ethanol	0.80Mt	2 Mt	10 Mt	150 Mtce
Biodiesel	0.05 Mt	0.2 Mt	2 Mt	
Biomass pellets	0	1 Mt	50 Mt	
Biogas and biomass gasification	8 G m^3/y	19 G m^3/y	44 G m^3/y	
Geothemal energy	30 MW	110 MW	0.5-1.0	6
Share of total primary energy (incl. big hydro)	about 7.5 %	10 %	15 %	

Table 3: Mitigation targets set with the National Climate Change Programme

Target	Avoided emission
More efficient thermal electricity production and transmission, including developments in the cogeneration of heat and power	110 million tons
Increase share of hydro power	500 million tons
Increase share of nuclear power	50 million tons
Reuse of coal-bed and coal-mine methane for electricity generation	200 million tons
Biomass energy development	30 million tons
Wind, solar, geothermal, ocean energy etc.	60 million tons

Energy and climate related policies and their implementation
There are numerous reviews and analyses of China's mitigation policies and mitigation options.[86] From this extensive literature, several observations can be made.

- Since China until only a few years ago paid limited attention to climate change there are no policies with the overarching aim to mitigate climate change[87]. Instead China's climate-relevant actions have been positive side-effects of polices aimed at improving energy efficiency, increasing non-fossil energy sources, increasing forest coverage, and improving environmental conditions (mostly air quality related). Since the release of China's *National Climate Change Programme* in 2007 these climate related policies have been revamped as the main structure of China's climate policy.
- The fact, however, that China's climate related policy framework is driven mainly or partly by other concerns than climate change neither reduces the value of China's considerable progress in reducing its carbon intensity, nor does it make these policies less effective.
- China's climate policy should be reviewed against the backdrop of the shift in development policy under the banner of the *Scientific Development Concept*, which highlights the delicate balance between economic growth, energy security, environ-

ment, and climate change.[88] The quick adoption (at least at the rhetoric level) of low-carbon development, as well as rapid growth and strong momentum in some of the renewable energy sectors (such as wind and solar) and green technologies are clear indications that China's political ambitions and determination are strongly in favour of alternative and more sustainable development paths.

- China already has developed an extensive set of energy efficiency policies and programs, ranging from national general policy frameworks such as the *Energy Conservation Law*, *Renewable Energy law*, *Promotion Law of Clean Production*, *Circular Economy Law*, etc. to an array of more specific policy measures and programmes in all sectors from industry, building, transportation to electricity and renewables.

However, there are serious concerns about China's institutional and administrative capacity to implement laws and regulation.[90] The barriers are many. Some are closely related to the development and transitional stage that China is currently in, such as inadequate overall monitoring and data collection capacity, and lack of information and technological supporting systems at the local level, etc. Others are more deeply rooted in the Chinese political system: the administrative structure and the decision making process, such as absence of effective and independent legal institutions and lack of real opportunity for bottom-up initiatives.

Thus far a majority of the policy measures have been administrative measures to distribute targets down through the hierarchy from central to provincial and local levels, combined with standards, subsidies and investment programmes. In practice, it is a complex mixture that relies more on administrative measures than on market-based instruments, which reflects China's transitional stage from a strictly central-planed to increasingly more market based economy (see *Text Box 2*). The effectiveness of the macro control, particularly in the energy sector, has been undermined by the lack of institutional capacity, but also by decentralisation.[91] Conflicting priorities between central and local governments and inefficient and inadequate regulation have been underlying causes of the lack of environmental performance in general.[92]

Text Box 2: Administrative measures and market-based instrument for energy conservation – the cases of Beijing and Guangdong Province[93]

The case of Beijing: Strong regulation and administrate measures

In 2005, the energy intensity of Beijing - one of the richest regions in China – was 0.86 tce per 10000 RMB of GDP, and GDP 6000 US dollars per capita. In the year 2002, when it was included in the Olympic Action Plan, Beijing made a sub-plan for Energy Development and Energy Mix Re-adjustment which started the switch for primary energy from coal to a higher proportion of clean energy. A series of administrative decisions were made on restructuring the industrial and product structure to reduce the growth rate of energy consumption. Continuing with this plan, in the 11th FYP, Beijing has set local goals and policies for energy switch and conservation, sub plans for energy development and conservation, electricity development, heating, construction, transportation as well as circular economy. Targets have been set for all the sectors.

Building sector – strict building energy efficiency design standard: in 2005, the building sector had a 28 percent share of total energy consumption in Beijing. In its 11th FYP, Beijing's ambitious goal is to achieve a 65 percent energy saving from the building sector. Beijing adopted a stricter energy efficiency design standard than the national one for new construction.
Transportation sector – high fuel economy standards to control vehicle emissions. Beijing is the first city in China to adopt EU IV. An environmental labelling system was also launched to label vehicles according to their emission standard, which in turn determines the permitted zones for driving. Also, a tight fuel quality standard has been implemented since 2005.
Green Lighting Project – from 2004 to 2007, the Beijing government provided 30 percent subsidies for consumers who purchased energy saving lamps.
Subsidies for heating systems –to encourage the usage of heat pumps and clean energy (e.g., natural gas) in buildings for heating and cooling, the government provided financial subsidies (35 RMB/m^2 for water source heat pumps and 50 RMB/m^2 for ground source heat pumps).

Subsidies for public transportation – a subsidy is provided to develop and promote Compressed Natural Gas (CNG) buses which has made Beijing the city with the most CNG buses (around 3000) in the world.

The case of Guangdong Province: strong market based instruments

In 2005, Guangdong's per capita GDP exceeded 3000 US dollars, and its energy intensity was 0.69 tce per 10000 RMB of GDP, among the lowest in China. Guangdong faces the most serious energy challenge in China. At the per capita level, Guangdong's reserves of conventional energy are only 1/20th of the national average, and 90 percent of the energy needs of Guangdong are imported from outside. The challenge has also necessitated Guangdong adopting the highest energy prices in the nation. The retail price of electricity is about 0.65 RMB/kWh, the highest in China and 30 percent higher than the national average. Residents of Guangzhou pay more (0.1USdollars/kWh) for electricity than residents of San Francisco (Levine 2008). The higher energy price has proved to be a strong economic incentive for restructuring industry and improving energy efficiency in Guangdong.

The 11th FYP of Guangdong aims to double the GDP share of the service and high-tech sectors from nine percent to 18 percent, reducing energy intensity by 13 percent compared to its 2005 level. To achieve these goals, in addition to strengthening standards (for high energy consuming industries such as iron and steel, chemical and paper industrial; adoption of EU III emission standard for vehicles, etc), the most notable change in Guangdong is the implementation of a range of market instruments, relying on macro-control policies and market-based mechanisms. Most notably of these is the SO2 *emission trading system* designed jointly by Guangdong and the Hong Kong government and planned to be in operation by 2010.

Viability of China's future climate related policy

Thirty years of reform has increased the role of markets dramatically; yet it remains a challenge to establish clearer roles for government and markets.[94] While market reform has made steady progress, the corresponding reforms of administrative systems have been lagging behind. And in many ways, it still remains "too much government and too little market". The distorted energy price system is an acute example of this. China needs to develop more economic and financial instruments and policies, as well as investment on energy efficiency, which has been sliding since the beginning of the new century.[95] In addition, rent-seeking behaviour and corruption in the public sector are widespread serious concerns, particularly in the current context of massive public spending on economic recovery.

Looking ahead, it is clear that achieving the 20 percent energy intensity goals in the remaining years of the current 11th five-year programme, and to make progress towards the grand goal of decoupling economic growth from energy consumption by 2020, will require continued reforms in the energy sector. China will also have to place climate security at the core of its national development strategy. Without strong incentives to support energy-efficient technology, discouraging wasteful practices, and shifting to less energy-intensive and more economically productive sectors, it is unlikely that those targets will not be met.[96]

Part Two:
The Critical Role of Energy

5. *Economic Structure and Energy Use*

By being closely tied to China's main priorities of economic development, poverty alleviation and social stability, energy security has become a fundamental driver of the Hu-Wen political agenda. [97] As the legitimacy of the Chinese Communist Party (CCP) is closely linked to its ability to deliver continued reform and development, the government's focus on energy security is not merely an economic necessity – it is also about political survival.[98]

Chinese growth has gradually become increasingly important for the global community, and now contributes more to global GDP growth than does the US.[99] China's energy security has therefore also become an issue with global repercussions. During the Chinese energy crunch in 2004, domestic companies began securing themselves against blackouts by installing backup diesel generators. This resulted in a sharp increase in oil imports which played a key role in the global 2004 oil price hike.[100]

Energy intensity, and in a wider context the issue of resource intensity, is a high priority on the central government's agenda, demonstrated, among other measures, through the 41 billion US dollars planned investment in energy efficiency projects in 2008.[101] Energy is not only needed to feed development; from a long-term perspective Chinese competitiveness cannot be sustained in a world of constantly increasing energy prices unless the energy intensity of the economy is decreased.

Energy development during China's economic emergence

Between 1980 and 2000, China quadrupled its economic activity while energy demand grew at only half the rate of economic growth.[102] The initial success of China's energy decoupling at the end of the 1970s was partly due to the very low energy efficiency in China's economy at the time. During almost three decades of Maoist rule, China built an exceedingly energy-intensive and economically inefficient industrial structure. Using a particularly inefficient command and control approach, economic resources were directed out of agriculture and into energy-intensive heavy industries like steel and cement. This had the effect that industry's

share of economic output grew from 18 to 44 percent, while the amount of energy required to produce each unit of economic output tripled. Running counter to what China's resource base could support, this approach triggered an immense energy efficiency induced loss in production. Ironically, this tactic also created the potential for catch-up growth once Deng Xiaoping's reforms were launched.[103]

The Deng reforms began with fiscal decentralisation and a gradual expansion of rural property rights, which in essence redistributed land tenure from the commune to the household level. The reforms created a dramatic increase in agricultural productivity at the same time as the strengthened property rights provided incentives for productivity gains and competition-driven efficiency.

In 1983, the reforms moved to include rural industry when township and village enterprises (TVEs) began replacing the former commune and brigade enterprises. This provided further growth incentives by increasing local economic autonomy, and surplus cash generated at the rural household level was invested in labour-intensive light manufacturing TVEs. The TVEs became the engine of growth through much of the 1980s and 1990s, and transformed the industrial structure from heavy, energy intensive industry to light industry with higher economic output in relation to energy input.[104]

In addition to the gradual shift from heavy to light industry, this remarkable period of decoupling energy from GDP growth can be explained by efficiency gains across Chinese industry. When reforms began China's energy infrastructure could not keep pace with the sudden near ten percent annual GDP growth, so energy was rationed, at the same time as the government ran energy conservation and technology improvement programmes. In the increasingly deregulated economy of the 1990s, energy prices were allowed to rise gradually, which came to play an important role for companies in their search for more energy efficient production technologies.[105]

But as the new millennium dawned, the two-decade trend of continuous improvements in energy efficiency came to a halt. In the 1990s China had begun entering a development stage where rapid urbanisation and industrialisation led to expansive infrastructure development, which accelerated demand for steel, cement, aluminium and other heavy industrial products. In order to strengthen the economy in the wake of the 1998 Asian financial crisis the Chinese government had rolled out a comprehensive investment programme for infrastructure development, which at the turn of the century caused additional demands for heavy industry products. China's accession to the World Trade Organisation (WTO) in 2001 opened up the Chinese manufacturing industry for cheap production of consumer goods for global markets, which generated a surplus in Chinese foreign trade and created increasing profits in the Chinese financial system. With cheap capital accumulating in the banking system, investment flows turned towards heavy industry, and energy demand skyrocketed.

China's energy challenge: from industry led to consumption driven demand

In 2006, China generated half of the world's cement and flat glass production, one-third of the world's steel, and one-fourth of the world's aluminium production. The industrial sector currently uses over two-thirds of China's primary energy – a very high figure compared with both industrialised and developing countries.[106] Additionally, residential use, transportation and services account for ten, seven and two percent of total energy use respectively, internationally very low figures.[107]

While China's current challenge is to generate energy for investment-led urbanisation and expansion of traffic infrastructure, it is the heating, cooling and lighting of buildings, and the traffic rolling on China's rapidly extending highway network that will drive future demands. This raises crucial questions about how consumption driven demand will grow and how the existing trend of energy intensive capital investments will develop.[108]

Ever expanding industries
Although industry's share of energy demand has increased due to accelerated investments since the start of the new millennium, industry has in fact always dominated China's energy demand. What is new is that China now produces, rather than imports energy intensive heavy industry products. A number of factors, other than China's energy intensive infrastructure expansion, can be used to explain China's rapid expansion of heavy industry. Profit levels have been high for state owned industries due to large depreciation on new investments, favourable borrowing from state owned banks, and an absence of important costs such as land use and environmental protection investments. Short construction times and cheap labour have further paved way for this exceptional expansion.[109]

Furthermore, increasing profit levels and the "China factor" have attracted international firms to join Chinese heavy industry projects with capital and technology. Here it appears as though China's WTO membership has played an increasingly important role; the rapid increase of output volume would have created profit-eroding overcapacity were it not for the opportunity to keep up margins by selling surplus production on international markets. Rosen and Houser (2007) maintain that export of surplus heavy industry products added up to a sizable part of China's 177 billion US dollars trade surplus in 2006.

Consumer driven growth
For most countries, residential, service-based, and commercial energy use make up well over half the energy demand; in China, these sectors do not even total one-third. As GDP rises energy demand in these sectors is likely to increase. How fast this will happen, however, depends not only on GDP growth and income distribution, but also on how energy efficient current and future infrastructure investments are.

Historical experience suggests that, as a rule of thumb, service and transportation begin overtaking industry as prime drivers of a country's energy demand at a GDP per capita of 5,000 US dollars; China is today at half that level. However, given the country's

enormous population and huge income differences, a total of 33 million people in Shanghai and Beijing have already reached this level of GDP; another 225 millions in Tianjin, Zhejiang, Jiangsu and Guangdong are well on their way. The choices of these emerging consumers are therefore going to matter greatly for China's future energy development.[110]

A look into the future

Even with the best intentions of future consumers there is a considerable risk that China is locked in by an energy intensive infrastructure. Currently, construction cost and time frame is far more important than ensuring low running costs of buildings where energy efficiency plays a major role in lifetime cost. For a country like China with a conspicuously scarce resource base, limited economic strength and a large labour force, it does seem odd to look for comparative advantages in resources and capital intensive industrialisation that creates few jobs. A key question for the future therefore, is how energy intensive capital investments could be phased out in favour of investment in a low-carbon economy.

To begin with, policies and reforms against ill-advised investments in energy intensive sectors must be permitted to bite. Still, the considerable sunk costs and long life span of energy intensive investments make it profitable to keep existing facilities running as long as possible.[111] Even if the government stopped directing resources to energy intensive industries in favour of such things as social security, health care and education, this would not necessarily reduce the value of energy intensive capital investment. There is already a mass of international and Chinese private investors lining up to buy in on the booming Chinese infrastructure market. China thus runs a considerable risk of seeing consumption driven increases in energy demand add to, rather than replace, the present investment led energy demand.[112]

In search of energy efficiency

One must remember that China's economic development has not just been a relentless exploitation of resources. As previously noted, China's search for energy efficiency is a real political prio-

rity. China's energy intensity has decreased by 60 percent since the 1980s, and an ambitions economy-wide target that mandates to reduce energy intensity by 20 percent during the current five-year plan ending in 2010 is currently in operation.[113] The target is not only a very ambitious one, but also one that is crucial to be met continuously in order to warrant future energy efficiency goals.

The political sharpness of this over-aching efficiency goal is furthered by a whole range of sector-specific low-carbon policies that have been launched during the past four years to improve China's energy efficiency. Considering the large contribution of Chinese industries to total country emissions, a special programme called the *1,000 Enterprise Programme*, targeting the country's one thousand most energy intensive industrial companies, was launched in 2006. The industries in the programme have been assigned different targets, of the order of 25 percent, related to their ability to improve energy efficiency, while concurrently working to further the instalment of energy efficient techniques and introducing criteria for job performance improvements.[114]

The policies launched not only strive for isolated energy efficiency improvements. The measures are also aimed directly at consumers and producers, where an obligatory reduction of the energy intensity of Chinese household appliances has been in operation since 2005. This efficiency improvement will not only decrease domestic energy usage in China, but also make Chinese appliances more competitive on the international market.

The highly energy- intensive construction industry has also been targeted with energy efficiency policies. As of 2006, all new buildings must be constructed in accordance with an energy-saving design standard, which, if followed, could improve energy conservation by as much as 50 percent.[115] A recent study by the McKinsey & Company (or whatever they are consitently referred to in the rest of the document) on the economics of greenhouse gas abatement in China found that the building sector had the best economic incentive for implementing energy efficiency standards. Through retrofitting, innovative design and strategic direction placement the sector can both cut energy needs and experience positive economic turnover.[116]

Even if the transport sector currently constitutes a small part of China's total energy use, demand is rising even faster than the number of new car owners on the east coast roads. Given that a majority of motor vehicles are fuelled by oil – half of which China currently has to import – much can be gained from introducing energy efficient norms and standards in the transport sector. The government has already adopted emissions policies for cars that are 40 percent stricter than those of the U.S. It can also be pointed out that fuel thirsty SUV-vehicles are subject to additional taxes.[117] Fuel prices are still controlled by the government but there are strong indications that reform is underway to liberalise these, which would provide additional incentives for increasing energy efficiencies in the development of the transport sector. A key issue in these reforms is how to compensate groups such as farmers and taxi drivers, which are already vulnerable to increasing prices.

But market forces are already beginning to shape new transport subcultures in China's cities. Over 60 million electric bikes have appeared on the roads seemingly out of nothing. The development is driven by Chinese innovation companies that are world leaders in advanced battery technology. Chinese companies have 80 percent of the world market for these so called *e-bikes* and the experiences are now being turned into the emerging market for plug-in hybrid and fully electric cars.[118]

The combination of targets to reduce energy intensity and market driven development of energy efficient appliances, infrastructure and buildings is a huge change for China's energy development, and a step in the right direction. The question that remains unanswered is whether the combined synergies are good enough to not just improve energy efficiency, but on a long-term basis to reduce total domestic energy consumption. In order for that to happen China will have to reduce its coal dependence and develop near-zero emission energy sources.

6. *The Coal Challenge – Alternatives for Expanding China's Energy Supply*

China's economic miracle is fuelled by cheap coal, like the western world's industrialisation during the 20th century was driven by oil.[119] The Chinese leadership defined coal as the base in the energy system for its current 11th five-year programme,[120] and the economy, planning apparatus and power structure is permeated by the dependence on coal. The dominance of coal is one of the key reasons for China's exceedingly high energy intensity; coal is at the heart of China's carbon emissions and health related pollution problems. The goal of keeping global warming within two degrees centigrade is not likely to be achievable unless China manages to achieve substantial reductions in the share of unabated coal in the energy mix and carbon capture and storage proves feasible for all new power plants from the mid 2020s.[121]

Energy mix – over 90 percent fossil energy

China is considered rich in energy reserves. With coal and hydropower reserves that account for 12 and 17 percent of global reserves respectively China is seemingly richly endowed. But considering that one-fifth of the world population lives in China per capita figures become more modest even for coal. Still, China's coal reserves are alone sufficient to push climate change far beyond what the world community currently defines as acceptable.[122]

Coal accounts for more than two-thirds of the primary energy mix, oil one-fifth, hydropower just over six percent, and gas almost three percent. Nuclear and other energy sources constitute less than one percent.[123] The 77 percent[124] share that coal has in the power mix is, however, expected to sink to 70 percent by 2010 in favour of expansion of renewable energy.

The coal driven economy

China burns almost two-fifth of the world's total coal consumption – more than the US, Russia and India combined. This is not only due to China's abundant coal reserves, but is also a result of a series of laws, measures, and plans enacted in the 1980s to stimulate coal production. Driven by the fast expansion of heavy indu-

stry and increased electrification of both households and industry, coal consumption has accelerated by almost 40 percent since 2000. China has accounted for more than 60 percent of the global increase over the past decade.[125]

Roughly half of the coal is used directly in industry, for boilers, coking ovens, or for on-site generation. Residential use has gone down from 20 percent in the early 1980s to four percent today, reflecting the extension of gas and electricity for household use. A little less than half of China's coal is used for generating power on the grid. Since 2000 China has created as much new demand for power as the total combined power demand of Germany, France and the UK.[126]

Electricity shortages in the early reform days and disappointment at the failure of domestic oil production to provide higher yields were key reasons behind the increased use of coal in the 1980s. It is the exceptional growth of local, small-scale coal mining that has provided the increasingly coal dependent industry with cheap energy.[127]

As for many other goods China runs a two-tiered price system for coal – one set by the government for plan-allocated quotas, and the other set by the market for production above or outside the plan. As the small mines were outside the plan they were able to sell all their production at market prices. As the state-owned mines had to sell at loss-making rates specified by the plan the main expansion in coal production came from small often privately owned mines. The growth of small-scale mining also played an important role in stimulating rural employment and economic growth. The mines employed rural surplus labour, and local coal production supplied local industry – most of which also operated outside the plan – with cheap energy.[127]

As the coal sector continued to boom in the 1990s it became increasingly evident that unchecked local mining had severe environmental, human safety, and market distortional consequences. According to official statistics 6,000 miners die annually in mining accidents, but the actual numbers may be substantially higher.

Coal mining causes large numbers of deaths from occupational diseases, with a recent World Bank estimate of 350,000–400,000 premature deaths a year. Cancer rates and birth defects are also many times higher in coal mining districts.[129]

In spite of its abundant coal reserves China became in 2007 a net importer of coal. Imports – especially from Australia and South America – are likely to continue to expand.[130] To have plenty of coal in the ground is one thing; to mine, distribute and burn it in large quantities, and to transmit power to end-users is something else. Currently China lacks efficient industrial structures, reliable data, responsive pricing and effective regulation to make this happen, and the lack of transport infrastructure makes it difficult to transport coal between northern and southern China so parts of the country will remain highly dependent on imported coal. McKinsey & Company (2009) estimate that China may need to import 10 to 20 percent of its coal consumption by 2030 even to meet current policy ambitions.

Clean coal?

With a lifecycle of about 50 years the huge investments in coal fired power today will have considerable impact on the climate well into the middle of the century. Coal is the dirtiest of the fossil fuels. In addition to its low energy content in relation to CO_2 emissions coal is more energy consuming to mine and transport, and comes with a host of other harmful consequences such as widespread acidification and extensive health effects. For 2007 alone China's social and environmental costs of coal have been estimated at a barely conceivable €170 billion.[131]

But coal can be more or less polluting. Over the past three to four years the Chinese coal power sector has achieved a considerably higher coal to power efficiency. Since 2005 the government has required all new power plants larger than 600 MW to be built using supercritical technology which pushes the coal to power efficiency from just above 30 percent – all that is achievable with conventional furnaces – to over 40 percent. China is even building so called ultra supercritical facilities reaching over 45 percent efficiency, which in essence means a 50 percent efficiency improvement com-

pared to only five years ago. This means that new coal fired power plants produce nearly 50 percent more power per unit of coal and CO_2 emission, and with increasing coal prices it is becoming less and less profitable to run conventional, inefficient power plants. The government has pushed for renewal of the sector towards higher efficiency and ordered in 2007 the closure of more than 500 furnaces under 100 MW, amounting to a total decrease of 14,000 MW. Similar directives are now being implemented to close power plants under 300 MW, which today supply one-third of China's electricity.[132]

But not even ultra supercritical coal power provides a long-term solution to the climate dilemma. Instead there are high expectations of the technology for carbon capture and storage (CCS) to make it possible to continue burning coal without its current climate impact. The feasibility of CCS is currently being studied in several pilot scale research facilities around the world but it is not likely that the technology will be available for full scale application before 2020 or commercially competitive against other low-carbon alternatives before 2030.[133]

China has an ambivalent attitude to CCS. Even if CCS were a viable low-carbon alternative by 2030 it does come with a price tag. It is not only the cost that concerns the Chinese leaders. Since part of the power generated is consumed by the process of capturing and storing CO_2, CCS reduces the coal to power efficiency, which conflicts with China's energy security policies, particularly the key target of reducing the energy intensity of the economy. As a technology, however, CCS is as interesting to Chinese companies in the energy sector as to any other energy company around the world. China's largest energy utility, *Huaneng Group*, is leading the *Green-Gen* initiative where the applicability of CCS is studied in combination with other advanced technologies such as hydrogen and fuel cells[134].

A key limiting factor for CCS is that it is not available *now* when it is needed to avoid locking China further into high emission coal power. Therefore joint international efforts are needed to speed up the CCS trials in order to verify that it works, and then to scale up

size and drive down costs for the technology to meet requirements for commercial feasibility as soon as possible. In its communications with the *UNFCCC*, China has declared its requirements to be part of joint research and development projects. One such is the Brittish – Chinese joint *Near Zero Emission Coal project*.[135]

CCS is not only a potential low-carbon coal alternative for China, but also offers commercial prospects for the Chinese energy business. The *Huaneng Group's* and China's first ultra supercritical power plant in *Yuhuan* is, with its four units of one gigawatt each, the largest facility in the world and was built at half the cost per installed kilowatt compared to an international project. This indicates China's potential to drive down the costs of large-scale technology and, with the right kind of international co-operation, it is not unlikely that China could be the place where full-scale CCS is first applied at a reasonable cost.

Oil and gas

Oil accounts for just over one-fifth of China's energy demand, a share that has increased only marginally since the early 1990s. In absolute terms, however, China's oil demand has doubled over the past decade, with a particularly strong increase from 2000–2005 when China accounted for roughly one-quarter of global oil demand growth.[136] Unlike most OECD countries industry is by far the biggest oil consumer accounting for about two-thirds of total demand. With the number of vehicles on the road doubling over the past five years transportation represents the biggest growth in oil demand, accounting for over two-fifth of growth in oil consumption since the mid-1990s. The boom in heavy industry and power shortages since the early 2000s have also caused accelerating oil demand in later years.

China is the fourth largest oil producer outside the Middle East, yet, since 1994, domestic oil supply has not kept pace with demand and China is presently covering half of its oil demand from imports.[137] Given increasing demands from transportation and petrochemicals China's dependence on imported oil is bound to increase toward 80 percent by 2030.[138] With its increasing reliance on international markets and growing exposure to global oil prices

finding substitutes for oil, particularly for transportation, is high on the Chinese agenda.

Natural gas accounts for only four percent of energy consumption but demands are growing driven by the chemicals industry and residential use. China seeks to extend the use of natural gas both through expanded domestic production – with a few new discoveries in Sichuan Province and the Erdos plateau – and through increased imports, but will remain a minor importer for at least another five years due to lack of infrastructure to receive and distribute Liquid Natural Gas.[139]

Hydro and Nuclear

China has 17 percent of the world's hydropower potential, yet it provides merely six percent of primary energy supply, or 15 percent of total power output. Official figures estimate China's exploitable hydropower resource at more than 500 million kilowatt (kW). Installed capacity by the end of 2005 was 117 million kW, or about 24 percent of the potential.[140]

China's hydropower development peaked at the beginning of reform. Since the mid-1980s it slowed down due to heavy upfront investment requirements combined with low, government controlled electricity prices, long construction periods and costly transmission from hydropower rich areas in the west to the population centres on the coast. Particularly the low short-term return on investment compared with coal contributed to the shift from small scale hydropower to small scale coal mining. As a result hydropower's share of total power generation has been reduced by more than half from its peak of 32 percent in 1984.

In spite of its high investment cost and low return on investment, the government has continued promoting large, centrally administered hydropower projects for energy security and environmental reasons. At a current investment level of 6–10 billion US dollars annually, the aim is to boost the total hydro power capacity to 180 million kW by 2010, rising to 300 million kW by 2020.[141]

Although nuclear plays a marginal role in the national energy mix, it is important in coastal areas that are remote from the coalfields and where the economy is developing rapidly. In March 2008 the newly-formed *State Energy Bureau* (SEB) set a target of doubling the nuclear share of power generation from 2.5 to five percent by 2020. This would imply roughly 50 gigawatt installed nuclear capacity, corresponding to five times the Swedish nuclear capacity. Currently, China relies on international co-operation with the aim to increase nuclear capacity to 40 gigawatt by 2020. If China could develop its own domestic nuclear industry it is possible that even more nuclear power could come on the grid by 2020. Among other bottlenecks to reach these ambitious plans China needs to invest in the education of qualified personnel.[142]

The **Renewable Revolution**

"China, the world's largest CO_2 polluter" is the popular image. That China has the world's largest installed capacity of renewable energy is less well known. China is committed to becoming the world leader in low-carbon technologies and there is considerable potential to achieve this.[143] The pace of Chinese development, though, means that even with remarkable growth rates across many different low-carbon technologies it will still prove challenging to increase the share of renewables in the energy and power mix.

China is relatively richly endowed with sun and wind power potential and there are about 100 million hectares of marginal land – an area roughly double the size of Sweden – where biomass forest could be cultivated without competing with food crops. With an investment level in 2007 of 12 billion US dollars in small-scale hydro, solar water heating, solar PV and wind, China is, together with Germany, the world's largest investor in renewable energy. On top of this, between six and ten billion dollars is invested annually in large-scale hydro power.[144]

Parallel with the energy-security motivated efficiency policies the government has enacted laws and economic incentives that provide a spawning ground for Chinese low-carbon technology innovation companies, some of which have established themselves as

world leaders within their fields. The *Medium and Long-term Development Plan for Renewable Energy (2007)* sets a target of 15 percent renewables in the primary energy mix by 2020, of which at least three percent should come from the so called three renewables – solar, wind, and biomass. In order to reach these goals the *Renewable Energy Law (2006)* and other directives prescribe that the state grids shall purchase renewable power by offering competitive prices modelled on the German feed-in tariffs. In combination with 50 percent tax-breaks this has led to a surge in these markets.[145]

To realise these ambitious targets requires a huge growth in renewables, but with strong development over the past couple of years – growth rates of over 100 percent per year for leading manufacturers in both wind and solar PV sectors – there are good prospects that China could actually reach these targets early. The drivers for growth vary between the different renewables sectors but the *Renewable Portfolio Standard* for big power companies (i.e., a certain percentage of their power generation must come from renewable sources) seems to play a major role. Feed-in tariffs and requirements that at least 70 percent of wind turbine components be locally manufactured has spurred Chinese companies in the wind sector to learn and build capacity, and will likely be very competitive in a growing world market. Chinese solar PV producers on the other hand thrive from advantageous policies in other countries where they have gained market shares by being competitive on low-cost solar panels, and China is now the second largest producer after Japan. 10 percent of Chinese households have solar water heaters, and China has 60 percent of the world market.[146]

China's energy supply – an international matter

It is not only China that needs large-scale investment in the power sector. While China needs to expand its power generating capacity by roughly 1,200 gigawatt by 2030 the European Union and United States require similar amounts of new capacity, mostly to replace old facilities. A joint demand for almost 3,000 gigawatt of new built power capacity by 2030 is a huge market with equally huge opportunities for co-operation to find more optimal solutions than more coal based power. But it is urgent to build that co-operation. For each new coal power plant the world is locking itself

further into an energy system that becomes increasingly costly to get out of.[147]

The growth potential that low-carbon technologies have shown in China in the last couple of years is important not only for China but also for the world at large. China based emissions need to begin declining within the coming couple of decades and that can only be achieved by expanding the share of low-carbon alternatives in the energy mix. In a global perspective, however, what the world need is co-operation to get low-carbon energy options onto the market as fast as possible. And maybe it is with the help of affordable Chinese low-carbon technology, rather than expensive western technology, that the world will be saved.

Part Three:
China's Role in Combating Climate Change

7. Development, Energy and Green Recovery

There is nothing extravagant about China's desire to develop. It is important to remember that the China so often portrayed on Western TV, with mirror-covered skyscrapers and roads filled with traffic, is not a reality for a majority of the Chinese population. China does have an increasingly growing number of US dollar millionaires whose carbon-consumption levels are equivalent to that of any OECD-country, but most Chinese people still lead lives that generate modest amounts of carbon. To this group, economic growth is an opportunity to live under more tolerable conditions, not about further elevating already high standards of living.

Growth necessary for development and stability

By international standards, China has alarmingly large income gaps. The wide income chasm between the rich and the poor is constantly growing, and the problem has reached a level where it must be dealt with urgently. According to a recent World Bank study, China is poorer than was previously believed. The study finds that around 200 million people live under a poverty line of 1.25 US dollars a day, and are therefore far below the global wealth average.[148] China has a legitimate right to development, a development that coincides with the fact that the world's resources simply cannot provide for current American or European lifestyles – neither in China, nor in the high income industrialised world. We all need to find alternative ways of development that combine welfare with considerably lower carbon and environmental footprints.

Economists have long predicted that China's social stability will be threatened if growth falls considerably. The Chinese leadership takes this prediction very seriously, and considers growth mandatory as both a social and economic stabilising factor. This was recently confirmed by Premier Wen Jiabao in his address at the opening of the Congress in early March 2009, where he also stressed the importance of increasing spending on infrastructure and construction.[149]

Over the past five years, China has mantained an annual growth rate of roughly ten percent[150], reaching an all time high of 12 per-

cent in 2007. In the wake of the global financial recession, economic growth is predicted to slow down, and a decline in national GDP was already apparent by the end of 2008.[151] Some estimates predict that, due to increased competition from other low-wage countries, growth might fall below the magic eight percent even as early as 2009.[152]

The Chinese economy has made its wealth through a highly successful export strategy, and its economic well-being is thus heavily reliant on continued high export rates. In 2007, China was the second largest merchandise exporter in the world and net exports contributed to roughly one third of the country's economic growth in the same year. China is furthermore said to be the largest developing country recipient of Foreign Direct Investments (FDI), and the Chinese government claims that around 80 million people are professionally engaged in the export sector.[153] It is therefore safe to predict that a general global economic recession is likely to have significant impact on both Chinese growth trajectories and employment figures, thereby posing a direct threat to Chinese social stability.

There are two ways for the Chinese government to tackle the threat of decreased growth: either stimulate domestic consumption through subsidies and other purchase stimulus incentives, or make crucial investments in infrastructure to ensure energy efficient and reliable transportation. At first glance, neither of these examples seem very green nor feasible in today's global economic climate. However, it is possible to argue that this era of financial difficulties is precisely the window of opportunity China needs to lay the foundation of a more carbon efficient society.[154]

Financial crisis impact
As climate and financial crises concurrently preoccupy policy makers across the globe there is no doubt that tricky times are ahead. The question that remains unanswered is how high a priority will climate be in times like these?

China has the benefit of entering the financial crisis with a huge foreign exchange reserve that, in combination with a modestly si-

zed budget surplus, can be used to stimulate domestic growth that has been damaged by the declining global demand for Chinese exports. Chinese domestic policies will therefore be of the utmost importance.[155] The stimulus package released by the Chinese government in November 2008 gives some indication of where Chinese priorities currently lie: out of a total of RMB four trillion, RMB 350 billion has been apportioned to environmental projects such as renewable energy and waste-water treatment.[156] The stimulus package also allocates large investment sums to other low-carbon sectors such as health and education, in addition to putting aside roughly RMB 300 billion for the development of low-carbon railway transportation.[157]

As a direct response to decreased exports, the Chinese government continues to work actively to encourage domestic consumption as a means of keeping growth high.[158] However, Chinese consumers are not known for their tendency to spend but are famous for determined saving to secure their own welfare. So despite the government's ambitious measures to stimulate spending behaviour – executed, among other measures, through subsides on the purchase of electrical appliances and cars – it is important to bear in mind that rural peasants might not provide the boost the Chinese economy needs.[159]

From an international viewpoint, a slow-down in Chinese economic growth is likely to have grave economic consequences for the world at large. But since China is also currently the largest emitter of greenhouse gases, the choices made by China, and the future of both its economy and environment, are going to matter to the world at large. As pointed out by China's former Chief Climate Negotiator and current director of the UNFCCC Legal Department Gao Feng, the global community has reached a crossroads in terms of both climate negotiations and different attempts to come to grips with the economic slump. If climate talks can steer the world in the direction of low-carbon high-scale technological innovations (and the employment opportunities that come with them), the world can both help itself mitigate climate change and assist China in its search for new growth models.[160]

Climate change mitigation as a driver for future growth

Ever since releasing its first national strategy to mitigate climate impacts in June 2007, the Chinese government has demonstrated through a series of programs and policies that it is serious about shifting towards a low-carbon economy. Policies and measures already adopted include the setting of ambitious energy efficiency targets, a national renewable energy law and the closing of inefficient factories and power plants. The government has also gradually increased its spending on energy efficiency and emission reduction.[161]

Climate change mitigation is estimated to cost the Chinese government 200 million US dollars annually, and given the green choices made during the past few years, it is becoming increasingly clear that climate mitigation can be a very efficient way of cutting government costs in times of crisis.[162] Considering the central leadership's desire to increase energy efficiency and reduce production emissions it is not impossible to imagine a successful Chinese transition to green growth.

Given the current financial situation and the receding world demand for Chinese products the country must find new ways to sustain economic growth. It could very well be that the upcoming climate negotiations in provide a much needed framework to develop low-carbon technology.[163] For China a serious global transition to a green economy could, among other things, generate new employment opportunities in the white-collar sector and steer its focus away from heavy industries that have generated heavy pollution but relatively few jobs.[164]

The Chinese government has also, over recent years, been actively encouraging so called green consumption. Through issuing green purchasing rules, the state and its institutions have actively supported more climate friendly consumption and production patterns. In an attempt to cut both costs and environmental strain, the State Council issued regulations that temperatures in official buildings must not go below 26 degrees Celsius in the summer and not above 20 degrees Celsius in the winter. Other examples of measures taken include the lowering of tariffs on environmental

goods and services to make way for the use of cleaner technology.[165] But also awareness raising and energy efficiency labelling is playing an increasing role in shaping green consumption among general consumers.

If the choice is made to take on a low-carbon, high-technological innovation path, the developed world has everything to gain by inviting China to join the ride. China has already demonstrated a wide-spread enthusiasm for the development of clean technology, and has announced that it intends to spend vast sums on renewable technology in the next fifteen years.[166] But as the situation looks now, China lacks much of the know-how needed to execute this changeover.[167] However, China's comparative strength lies not only in low-end production, but also in its talent to drive down the costs of already existing products, goods which could then become competitive on the international market.

Both China and the rest of the world therefore have very much to gain from transfers of clean technology into China. In times of financial strain, these transfers not only create incentives for environmentally friendly behaviour, but also prove helpful in minimising costs and streamlining economic incentives.[168] The financial crisis could, if the world leaders in Copenhagen decide to follow the line of cooperation and progress, open a window of opportunity for both the development and deployment of clean technology. China's commitment to climate abatement should be reassuring to the international community, and it should be remembered that promoting investment in low-carbon technology could not only help China re-awaken economic growth, but also lay a foundation for global climate salvation in the midst of financial hard times.[169]

8. *The Global Climate Game*

Some have used the story of "the blind man and the elephant" to highlight the risks there are trying to understand China.[170] If there is anything certain in predictions about China it is the deep uncertainty among China observers. This is especially true in the context of climate change negotiations, and trying to understand where China is headed.

China's pursuit of international recognition

Over recent decades China's foreign policy has reflected the endeavour to be seen as a "responsible great power". As a result of rapid economic development and more substantial integration with the global economy China has grown in confidence and become more actively supportive of international norms and multilateral institutions.[171]

China's position on climate and energy security must be seen in the context of its larger foreign policy regime. The position has changed from the 1980s' spirit of opening up, through the post-Tiananmen reconsolidation of party power and focus on growth, to the current leadership's increasing focus on social stability and resource intensities.[172] Still shy of claiming a leading role in international politics, China has over the past decade enacted important changes in its foreign policy practice.

By becoming a WTO member and supporter of UN peacekeeping forces, China has come a long way from its former reactive and obstructive stereotype.[173] China is playing an active role in international climate negotiations and does not want to be seen as blocking a global deal at the UNFCCC Conference of the *Parties* in Copenhagen in December 2009.[174] The foreign policy transformation also reflects the evolution of China's domestic policy priorities, as well as clearly showing the Chinese desire for development towards a multi-polar world.

As a developing country, China does not have a legally binding emissions reduction target under the Kyoto Protocol of the *UNFCCC*. It negotiates in the *UNFCCC* as part of the "G77 + China"

coalition of developing countries, and stresses the need for developed (Annex I) countries to show leadership in tackling climate change. As outlined in earlier chapters, China's per capita income remains relatively low – around 2,500 US dollars per year. Economic growth and job creation are seen as vital for preserving social stability and the political legitimacy of China's leadership. Anything that might undermine this objective is viewed with intense suspicion. At the same time, China demands recognition for its ambitious domestic intensity targets, as well as the remarkable decoupling of energy consumption from GDP growth through much of the reform period (see also Chapter 5).

One should however not confuse what China is actually doing in terms of reducing energy intensity with what China may or may not commit to in global climate negotiations. There is every reason for China to go low-carbon, but not necessarily – at least in the very near future – to commit itself to an international agreement.[175]

At the same time, China recognises that it is vulnerable to climate change and that it has a major role to play in tackling it. In addition China is fast becoming a world leader in the renewable energy sector and has a strategic interest in reducing its dependence on imported fossil fuels. It is therefore potentially a big winner from an international climate agreement.

The success or failure of international climate negotiations will depend to a large degree on whether China can find a way of managing these conflicting pressures. These in turn depends critically on the three way relationship between China, the U.S. and the EU – which together account for over 50 percent of global emissions and have the technological prowess to lead the global transition to a low-carbon economy. On the other hand, one also needs to remember that "China's behaviour abroad will depend fundamentally on its domestic circumstances more than any other factor".[176]

China's position on the Bali roadmap

China consistently emphasises a number of overarching principles: "common but differentiated responsibilities" between developed

and developing countries; the need for action on climate change to be placed "in the context of sustainable development"; and the need for adaptation and mitigation to be placed on an "equal footing"[177]. Building on these principles, China's has adopted strong positions on the five main "building blocks" of the "Bali roadmap"

Shared vision and mitigation targets of developed (Annex I) countries
In China's view, the existing UNFCCC already provides a strong shared vision for international action on climate change. The problem is the failure of developed countries to implement their commitments under the UNFCCC by reducing their emissions and supporting adaptation and mitigation efforts of developing countries. This includes, in particular, the refusal of the U.S. to ratify the Kyoto Protocol and the rapid increase in U.S. emissions since 1990. As a result China is cautious about proposals to be included in the shared vision a global emissions reduction goal – e.g. halving global emissions by 2050, as endorsed at the 2008 G8 Summit. Without a stronger commitment from developed countries to reduce their own emissions a global goal would, in effect, constrain the "atmospheric space" left for developing countries such as China.

China sees mid-term goals (2020) as more "down-to-earth" and wants the U.S. to adopt a target comparable to that of other Annex I countries. In its most recent submission to the UNFCCC China stated: "All developed country Parties to the Convention shall commit to a reduction in greenhouse gas emissions, by at least 25-40 percent below 1990 level by 2020".[178]

Nationally appropriate mitigation actions (NAMAs) of developing countries
China has stated that NAMAs "shall be country-driven and subject to the determination of each country taking into account its respective capacities and specific national circumstances". In addition, "MRV (Measurement, Reporting and Verification) requirements on NAMAs by developing countries are only applicable to the mitigations per se and shall be undertaken by their national entities in accordance with their national circumstances and practice". In other words, MRV should focus on the actions taken

by developing countries (e.g. improving power station efficiency) rather than the results of those actions (e.g. reduction in greenhouse gas emissions). And the actions of developing countries should not be subject to international verification.

On sectoral approaches, China echoes the view of other developing countries that they should be used as a mechanism for technology transfer rather than defining mitigation targets: "Cooperative sectoral approach and sector-specific actions shall strictly focus on sectoral cooperation on promoting development, deployment, diffusion and transfer of greenhouse gas emission control technologies, practices and processes (instead of developing global sector-specific standards or benchmarks)".

Adaptation, technology transfer and finance
China has repeatedly stressed the need for faster diffusion of mitigation and adaptation technologies, adding that: "technology transfer, financial assistance and capacity building from developed countries should be MRVed in a proper manner." Specifically, its submissions to the UNFCCC have called for:[179]

- Creation of a Subsidiary Body for Development and Transfer of Technology;
- Accelerating technology diffusion through compulsory licensing and innovative joint IPR arrangements;
- New, additional, adequate, predictable and sustainable financial support, at the level of 0.5-1 percent of GNP in addition to ODA;
- Establishing a Multilateral Technology Acquisition Fund (MTAF) supported mainly by public finance from developed countries;
- Creating innovative financial instruments such as a Venture Capital Fund and a Climate Insurance Fund.

On adaptation, China has proposed a comprehensive and enhanced framework for action including planning, institution building, knowledge sharing, technology transfer and financial support.

For multiple reasons China is highly unlikely to agree to a binding national cap on its emissions as part of a post-2012 international agreement. On the other hand, some argue that it might be more technically and politically feasible for China to commit to national policies that will lead to absolute reduction; or to intensity targets, indexed to economic growth.[180] There has also been some encouraging, though unspecified, signs pointing towards such a direction.[181]

How a deal of this kind might be structured is still far from clear and remains one of the critical issues in the negotiations. South Africa, South Korea and the EU have proposed a system in which "enhanced actions" commitments by developing countries are matched with "enhanced support" for developed countries and tracked through a UNFCCC Registry. "Enhanced actions" could take various different forms, including sectoral targets or economy-wide efficiency targets. The key would be consistent already explained above. MRV should be enough covering both the actions of developing countries and the support provided by developed countries.

The EU Proposal may fall short of China's expectation

The EU and China are currently taking a critical step to move beyond off-set focused cooperation, towards joint efforts for a global low-carbon transformation. In his recent trip to Europe, Premier Wen and EU president Barroso made a joint declaration to work together to confront the global economic crisis and climate change, and signed the Forestry Agreement and an agreement on a Europe-China Clean Energy Centre in Beijing to promote greener technologies.[182]

In January 2009 the European Commission published a Communication add spacing- *Towards a comprehensive climate change agreement in Copenhagen*, setting out a proposed EU negotiating position on the key issues.[183] Following intense negotiations by Member States this resulted in Conclusions adopted by EU Heads of Government at the Spring Council on 19-20 March. The Conclusions recalled the EU's commitment to reduce its own emissions 30 percent below 1990 levels by 2020 "provided that other

developed countries commit to comparable emissions reduction and developing countries contribute adequately according to their responsibilities and capabilities". They set out new proposals in a number of areas, building on language agreed by EU Environment Ministers on 2 March. Points of particular interest to China include the following:

Developing country mitigation:

- According to recent scientific scenarios consistent with limiting global warming to 2°C, developing countries as a group need to limit the growth of their greenhouse gas emissions 15-30 percent below the business-as-usual baseline by 2020.
- All developing countries, except Least Developed Countries, should commit to adopting low-carbon development strategies by the end of 2011. Robust and verifiable low-carbon development strategies will be prerequisites for access to international support.
- Developing country action should be entered into an international registry and there should be international review of developing country plans.

Finance and carbon markets:

- Reducing global emissions fast enough to keep global warming below 2°C will require net incremental investment of around €175 billion per year by 2020, of which at least half (€87.5 billion) is needed in developing countries. One third of mitigation costs in developing countries could be covered by carbon markets.
- The EU will take on its fair share of financing climate action in developing countries. Future discussions on generating financial support should focus on, *inter alia*, a contributory approach based on an agreed scale (i.e. the Mexican proposal), market-based approaches based on auctioning arrangements (i.e. the Norwegian proposal), or a combination of these and other options.
- Technological assistance should be based on assessments of the needs of developing countries listed in their low-carbon development strategies.

- Greater cooperation on RD&D efforts between developed and developing is essential. Global energy-related RD&D should double by 2012 and increase to four times current levels by 2020.
- The EU will determine well in advance of Copenhagen 1) the EU positions on main approaches for financing mitigation, adaptation, technology support and capacity building, 2) the specifics of the EU's contribution and 3) principles of burden sharing among Member States. This will be done on the basis of concrete proposals by the Commission. In this context, the European Union will pay special attention to the needs of the most vulnerable developing countries.
- The EU should promote the creation of a robust OECD-wide carbon market by 2015, to be extended to more economically advanced developing countries by 2020.
- The CDM should be reformed to include only projects that deliver real additional reductions and go beyond low cost options. For advanced developing countries and highly competitive economic sectors, project-based CDM should be phased out in favour of moving to a sectoral carbon market crediting mechanism.

Early drafts of the Commission Communication contained relatively detailed proposals on the overall amount of financing that the EU should provide and on innovative mechanisms to generate the necessary financing – building on proposals by Norway and Mexico, among others. However many of the numbers were removed from the final version of the Communication and since then the proposals on financing have been steadily weakened by Member States. When combined with Europe's inadequate response to China's proposals on technology transfer, the failure to make a credible offer on financing is a significant setback to prospects for a global climate deal at Copenhagen. As long as the EU cannot come back with a number for finance, there is a looming risk of "No money, no deal".[184]

On the other hand, depending on how the "business-as-usual baseline" is defined and negotiated, China's deviation of 15-30 percent

by 2020 could mean very different things for China and the world, as the wide range of business-as-usual, as well as baseline and reference scenarios illustrated in Chapter 1 (*Figure 6*).

Breaking of the US-China stalemate?

Less than two months after the new American administration took office, a distinct attitude change towards climate change has been noted. The commitment to climate mitigation demonstrated by the Obama Administration gives a new rhythm to the US-China dialogue, and as Todd Stern[185] very simply puts it: "We're back"![186]

One of the notable focuses of theU.S.to move the climate process forward is a series of signals and ensued dialogues on forming a tighter bilateral relationship on climate change between theU.S.and China. Almost immediately after the presidential inauguration, a report, lead by the now U.S. Secretary of Energy, Steven Chu (and with all the key climate people involved from both China and the U.S.) was published to layout a roadmap for U.S.-China cooperation on clean energy[187]. Then another report was released in a workshop that the Chinese Ambassador to the U.S. was invited to comment on[188]. With the two reports out, Hilary Clinton addressed the Asian Society prior to her first foreign visit as the U.S. Secretary of State.

While she was in China, Secretary Clinton made clear that climate change is now amongst the top priorities and strategic concerns for U.S.-China relationship. They have agreed to expand the China U.S. Strategic Economic Dialogue into a "dual track" one adding to the climate and clean energy development talks. Acknowledging China's development rights, Clinton told China that "we hope you won't make the same mistakes we made."[189]

This bilateral approach is consistent with the "small group process" that the U.S. is trying to lead. In his recent speech at the U.S. Climate Action Symposium in Washington, Todd Stern stated the following: "to promote agreement under the Framework Convention as well as to make rapid progress on actions to cut emissions, we need to invigorate a small group process in which leaders of the world's major economies come together in a dialogue on energy and climate."[190]

Furthermore, the focus of the U.S.-China climate cooperation is the development of clean energy and energy efficiency rather than climate change *per se*. This difference, while subtle, demonstrates a pragmatic approach of avoiding debates and disputes on moral responsibility and instead, getting right down to business. The notion of a climate and energy partnership, rather than just a climate partnership, coincides well with China's view of its own climate mitigation actions. As noted previously in the report (Chapter 2 and 4), to China, climate mitigation is very much a co-benefit of ensuring its national energy as well as environmental security.[191]

Finally, the U.S. approach is "to be guided by science... appreciating the art of the possible, and at all times using our common sense for the common good". Accepting this general point of departure, China would have to be the part of a global deal because "this is not a matter of politics or morality... it is simply about the unforgiving math of accumulating emissions"[192] This statement is also an indication confirming that the U.S. has left the "ethics approach", and will in future negotiations rely more on science than principled responsibility. The lack of mid-term (2020) EU-equivalent reduction commitment from the U.S., i.e., 25-40 percent reduction below the 1990 level, is, however, going to be a significant obstacle for China.[193.]

The next steps are likely to become clearer following the first bilateral meeting between President Hu and President Obama, scheduled for early April. In addition, it remains to be seen to what extent the U.S. Congress will be prepared to support technological cooperation with China and back this with necessary funding.

While the negotiation will certainly remain tough between the U.S. and China, this "climate diplomacy" has established a constructive and more open atmosphere for future climate talks prior to the Copenhagen conference. It may serve as the first step to open a window for change, and to eventually break the previous U.S.-China suicide pact, in which each refuses to act and commit before the other.[194]

China's bargaining position and the proposals

International understanding of China's national actions to combat climate change, as well as the understanding of China-specific circumstance in terms of energy security concerns and dependency on coal, has gradually increased. China will still face increasing international pressure when the Copenhagen talks approach because of its rapidly increasing emissions (Chapter 1 and 5) and not least in the face of the reengagement of the new Obama administration in the climate change dialogue. The prospect of a stronger transatlantic link changes the game plan for a China that can no longer play hide-and-seek with the U.S. At the same time, China needs to be convinced that industrialised countries are taking their responsibility in emission reduction, in particular as there is a significant trust deficit between the parties at the current stage.[195]

The most inconvenient truth for the Chinese leadership is that if China does not deviate significantly from its current trajectory of emission growth, not only average carbon emissions per capita – China is already higher than the world average – its cumulative per capita emission levels could reach the world average as early as 2020. This could significantly weaken China's bargaining position.[196] The coming decade is therefore a strategic window for China to balance the opportunities and risks in the context of climate change and international negotiation (see also Chapter 9).

During *COP14* in Poznan last December, two proposals from China showed quite different rationales and underlying assumptions, which illustrate the range of uncertainties in terms of an "acceptable" base for the post-2012 global climate agreement architecture. One is the *Cumulative per capita emission convergence* discussed at the AWG-LCA Shared Vision workshop. The other is the *Carbon budget proposal* presented by a group of scientists from the Chinese Academy of Social Sciences in a side event, but attended by high ranking Chinese climate change officials.

The *Cumulative per capita emissions convergence proposal*, presented as an illustrative example of a more elaborated Chinese proposal to be revealed by March this year, is considered more as an official position. In short, with the *Cumulative per capita emissions conver-*

gence proposal, China demands the ultimate "equity", which is not equal per capita emissions by 2050, but a convergence of the cumulative per capita emissions by 2100. It is a proposal that departs from an "equity" viewpoint only and disregards the urgency of containing the global emission called for by science. Under this proposal, the global total greenhouse gas emissions are not halved but rather 25 percent increased by 2050 compared to 1990 levels. Alternatively, if the greenhouse gas emissions be halved by 2050 and the per capita cumulative converged by 2100, then the absolute Annex I countries' emissions will have to turn negative by around 2040. Under this proposal, the CO_2eq concentration will be stabilizing at 550 ppm and the chance of keeping the warming to lower than 2°C is minimal.

The *Carbon Budget Proposal (CBP)* was presented by a group of researchers from the Chinese Academy of Social Sciences. The CBP is built on two concepts – to provide for basic needs for human development (i.e., the rights issue) and to provide for the geophysical needs of the globe (i.e., the targets guided by science). Therefore, the departing point for the CBP is to set the discussion within an overall framework of halving the global emission by 50 percent by 2050 (i.e., "the 450 ppm/2°C target"). The initial allocation of the carbon budget is then made on meeting basic needs, modified by factors such as historical accumulation, geography, energy endowment structure, etc. According to the CBP, China would have an available carbon budget of 366 $GtCO_2$ (almost exactly 100 GtC), very much within the range of scenarios proposed by, for example, the Tyndall Center.[197] This would require China's emission to peak at 2030 with 45 percent higher emission than 2005. Then reduce to 55 percent below the 2005 level by 2050[198]. Comparing this to the current U.S. plan (i.e., down to 1990 levels by 2020 and 80 percent below 1990 levels by 2050, which would equate to around 15 percent below 2005 levels by 2020, and about 85 percent below those levels by 2050[199]), the CBP sets up tough goals for China as well. In addition, the CBP also includes two transfers and a progressive carbon taxation scheme – transfer of carbon budget from developing to the developed and transfer of financial resources the other way. Under this proposal, countries like the U.S., Canada and Australia will be required to purchase 70 percent of their emissions, but it

also requires China to have substantial deviation from business as usual.

If China is playing "hard ball" with the cumulative per capita emissions convergence proposal, we see the CBP as much more constructive for a global agreement, and at the same time, for China's strategic position.

Seeking a balancing act

As the recent twists and turns have demonstrated, China does not have much more clue than any international actor about where its emission trajectory is heading. After the experience of rapidly increasing energy intensity in the early part of this century, the Chinese leadership does not feel certain about how emissions will develop. The 2010 target of 20 percent energy intensity reduction is crucial to build confidence within China about the ability to take on future international commitments. In this regard, what matters is not pressure from outsiders but examples and demonstrations of China's own capabilities.

If China felt confident about its own ability to extend the energy intensity reduction target through the 12th and 13th five-year programmes (2011–2020), one option would be that China submits its national targets as its UNFCCC commitment in the period 2012 to 2020. A key issue in such a case is to what extent these targets are measurable, reportable and verifiable. The U.S. would be likely to have high requirements for external verification in order to feel reassured about China's intentions, and China would consider such external verification an infringement. There are speculations that China could be willing to take on more far-reaching targets provided there are fewer requirements for verification.

Despite increased pressure and a less favourable negotiation position, China is unlikely to agree to a cap on its greenhouse emissions in the form of an absolute emission reduction target in Copenhagen. In the face of such conditions, there is an urgent need for exploring alternative approaches to engage China in more ambitious and effective mitigation activities. China's position in the international negotiations is also getting increasingly "interac-

tive", as a result of the new U.S. administration and its implication for a new EU-China-U.S. trilateral relationship in climate dialogue and cooperation.

China's position and actions in reaching a global deal in December 2009 depend on how national mitigation and adaptation actions serve its economic recovery and development; on how ambitious the mitigation actions of Annex-1 countries, in particular the EU and the U.S. will be; in addition to how promising their support to non-Annex 1 countries is.

Ultimately much will depend on the level of trust that exists by the time of Copenhagen between China, the U.S. and the EU. Each needs to be convinced that the others are intent on moving to a low carbon economy – not just to prevent catastrophic climate change but also as part of a wider strategy to improve energy security and develop first mover advantage in the low carbon industries of the future. The fiscal stimulus packages currently being designed and implemented in all the world's major economies will be a critical test of this strategic intent. If invested in a "green new deal" they could not only boost growths and jobs but also help to prevent another sharp rise in oil prices and jump start the global transition to a low-carbon economy.

9. *China as a Winner or Loser in Low-carbon Development*

China is at a critical crossroad in climate change and low-carbon development. With a great low-carbon leap forward China could not only start bending its own carbon emission curve but also provide the world with experience and affordable clean technology, helping to bring the transition to a low-carbon world within reach. If China stumbles, the world effort to combat climate change may be in vain. China is likely to suffer more than many others in a warming world, so it is too simplistic to evaluate China's choices in terms of "winner" or "loser". The chance to play the low-carbon development game may never come again.

Costs of inaction and window of strategic opportunity

While no one has put a single number on it, everyone agrees that the costs of inaction on climate change for China would be enormous. In fact, climate change may have already compounded China's water crisis[200]. There is also a global cost of China's inaction. Delaying action in China would not only increase the cost of mitigation in China, but also add a considerable burden for the rest of the world.[201] As the Chinese economy has become more globalised, there is also an opportunity cost for China if the world at large is changing towards low-carbon development. Either China changes with the world or gets left behind.

Inaction, however, seems neither an option nor a desire for the Chinese government. The question is not if China will act on climate change but whether the action will be large enough and soon enough for the world to have a reasonable chance to contain the risks[202]. The question is also what the rest of the world could do to leverage the deep greenhouse gas reduction path that is needed in China if we are to stand a chance of keeping within 2°C warming (see Chapter 1).

Based on the principle of common but differentiated responsibilities China has made clear that it will not accept any absolute caps in a post-2012 climate agreement. This opens up two key questions: How long would China be able to hold on to this position, and what would China do in the meanwhile? Sooner or later the "window of not capping" will close for China. The timing depends on:

- China's per capita emissions relative to other countries, particularly the high income industrialised world; and
- When China's cumulative emissions per capita, reach the world average.[203]

As indicated in Chapter 1 *(Figure 4)*, unless major actions are taken to deviate from the current emission path, both of these could actually happen as early as 2020 to 2030, which makes China's "window of not capping" as short as 10 to 20 years.

Coincidently, this time span is also what many believe to be the critical period for investment in new infrastructure.[204] While negotiating to delay the time for capping would give China a grace period during which the country could increase emissions, the risk is that without the international support and scrutiny that would be likely to be the result of capping, China would be further locked in to its carbon intensive development structure – which in turn would add enormous costs for China in the long run.

On the other hand, earlier within this window China has the most negotiating power to maximize its long-term strategic national interests of gaining external assistance for low-carbon development. That, however, will not come without some sort of commitment. If negotiating only to buy time, China could lose the opportunity of maximizing international support to lower the country's transition cost.

Mitigation costs, economic crisis, and green recovery
The figures on mitigation costs and investments required remain sketchy. McKinsey & Company (2009) has studied greenhouse gas mitigation cost curves for China within five key sectors (power, emission intensive industry, buildings and appliances, road transportation, and agriculture and forestry). The study does not present an overall cost picture but provides an idea of the investment needs. (*see Table 4*)

Table 4: Incremental capital investment needed for abatement scenario (Real 2005 Euro Billion)

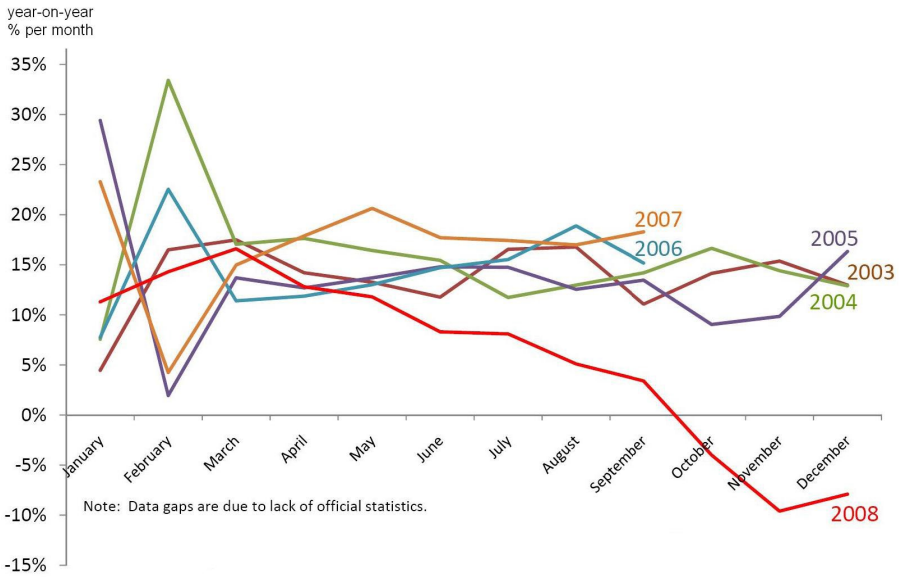
Period	annual average	total	cumulative
2011-15	35	175	175
2016-20	145	725	900
2021-25	240	1200	2100
2026-30	300	1500	3600

From 2010 to 2030, the McKinsey analysis puts the average annual incremental capital investment needed at €150-200 billion per year to reach the full technical abatement potential.[205] In comparison NERI[206] estimated the additional annual investment costs to reach 20 percent, 30 percent and 40 percent below a "no regrets" baseline to €16.5, €43, and €82 billion respectively.[207] It is important to stress that these costs and investment requirements refer to the additional costs to reach deeper reductions than the respective baselines, which by themselves will require major investments that are not reflected in the above estimations.

Seen in the light of the financial crises, the McKinsey investment estimates for 2011 to 2015 totals €175 billion, which is less than a third of the 585 billion US dollars economic stimulus package announced by the Chinese central government last November one-tenth China's 1.7 trillion US dollars accumulated trade surplus.[208] The key question, therefore, is how the stimulus package will be used. If used wisely, it could create a major part of the infrastructure for China to move toward a low-carbon development path. On the other hand, should the 1997-1998 investment pattern be repeated, it would further lock China into the current high emission path for decades to come. "Countries that sink their treasure now into a dirty coal infrastructure or high-carbon production methods are not only jeopardizing the health of the planet, they are jeopardizing their own economic future".[209]

The current economic crisis already has had and will continue to have considerable impacts on the development of emissions in the near future. *Figure 7* shows the rapid decrease in power generation that has occurred since mid 2008.[210] This might result in an avoidance of power sector emissions in the range of two $GtCO_2$ in the period up to 2010.[211]

Figure 7: Growth Rate of Chinese Power Generation[212]



Many have argued that the needs for restructuring and recovery set off by the economic crisis offer golden opportunities for green development. The Chinese government is well advised on the danger of missing the opportunity to integrate economic recovery with green development.[213] Roughly 50 billion US dollars has been earmarked for green recovery in the Chinese stimulus package, an amount that measures up well next to plans in the U.S., where about 80 billion US dollars out of the 780 billion US dollars stimulus package is designated for green recovery.[214,215] *The National Development and Reform Commission* (NDRC) also announced in March 2009 that the government would accelerate its plans for regional climate change programmes and shut small coal mines and inefficient power plants. It said it would also press ahead with plans announced last year to pilot regional cap-and-trade emissions programmes.

Trade and globalisation

In terms of trade and globalisation China's role as a menace or saviour, a culprit or victim, is debated in relation to its climate impacts. China's considerable net export of embedded carbon has been interpreted either as a confirmation that China reaps trade

benefits from its cheap but polluting coal power, or as evidence that consumers in developed countries benefit from low-cost Chinese products for which China is unfairly held responsible[216]. Voices have been raised in the U.S. and several European countries in favour of border tax adjustments to correct the supposed comparative advantage of exporting goods from countries such as China that benefit from the absence of a carbon price or other efforts to reduce emissions. In theory this would also hinder leakage of carbon intensive production from countries that have "put a price on carbon" to those that have not. At a first glance this may look like a good proposal, which would also put pressure on reluctant countries to take on commitments. It builds, however, on the notion of a carbon emission related comparative advantage, which in the case of China is hard to prove.

On the contrary, export products from China are not particularly carbon intensive, compared to the rest of the Chinese economy. Statistically speaking, there is no relationship between carbon intensity and comparative advantage within the Chinese economy. China is currently a net exporter of embedded carbon because so many of its imports come from the less carbon-intensive economies of Japan, Europe, and North America. If China's imports were produced at Chinese carbon intensities for the same industries, there would be little or no net export of embedded carbon. Or, looking forward, if China's export industries reached the (comparatively lower) level of carbon intensity of developed countries, there would again be no net export of carbon.[217] Thus the "green leap forward" for Chinese industry, when it occurs, is likely to eliminate, or sharply diminish, the net export of embedded carbon.

Meanwhile, any attempt to set up trade barriers that discriminate against specific countries would also risk escalation into trade wars, since China could respond with other carbon related trade barriers, for example based on historical per capita emissions. Most studies have found that the threat of increased trade competition from countries that do not adopt a carbon price is potentially important only in a small number of industries (those which are both highly carbon-intensive and internationally competitive), including steel, aluminium, cement, and paper. China's exports

of these products to developed countries are an insignificant part of global trade: these are not China's leading export sectors. Nor are these industries a large fraction of European (or North American or Japanese) manufacturing and employment. The developed countries that are contemplating border tax adjustments would be better advised to focus on the real needs of the handful of specific, potentially affected industries, rather than changing the rules of international trade across the board. (The details do matter: Sweden's relatively low-carbon electric power reduces the risks to Swedish industry, for example.)

Trade also offers the opportunity to drive down the costs of low-carbon technologies. If China continues its efforts of promoting and unleashing independent innovation capacity the transition to a low-carbon future could become considerably more affordable for the global economy.

China is the key to success in global climate change mitigation
Given that the Chinese economy remains one of the most carbon intensive economies in the world,[218] there are extensive low-cost mitigation potentials. As this report demonstrates, there are considerable differences between a development path with further CO_2 productivity improvements and the so-called *reference* or *baseline* scenarios. While these projected scenarios assume a "grand achievement" of national targets, reaching those targets is far from certain and requires further sharpening of policies and effectiveness in their implementation.

China has opportunities to move towards a low-carbon development path with considerably lower emissions. McKinsey & Company estimate that the maximum technical abatement potential could put China at greenhouse gas emissions of eight $GtCO_2e$ by 2030, which would be a significant leap towards what is needed in China for the world to stand a fair chance of keeping within 2°C of warming.[219]

This potential, however, dwindles rapidly if mitigation actions are delayed. Any meaningful outcome of the current climate negotiations must focus on how joint action can be leveraged to help

China move on to a low-carbon development path and provide opportunities for China to help bring down the global cost of mitigating climate change. Time is the essence.

Throughout this report, we tried to present a balanced comprehensive view on China's perception, concerns, position, and challenges in the face of climate change. We highlighted the dilemmas that China faces in balancing economic growth, energy and environmental security and climate change, in the midst of rapid industrialization and urbanization, with a coal dominated energy structure. We also emphasized the dynamics in terms of both international relation and the current plan of economic recovery. Lastly, we argued strongly China's decisive role in global climate change, as well as the strong opportunities that a low carbon transition would bring for China.

While all the factors will certainly contribute to China's actions in a possible global climate deal, the time dimensions of those factors may prove to be the most important. While China is convinced of the need for a low-carbon future there is no proven international experience for China to "plug-it-in" right away. Meanwhile, as its economy risks further slowing, or even a "hard landing" in a global economic crisis, the mounting pressures to maintain growth, employment, and social stability are no doubt much more urgent priorities. All in all, it is our belief that China's climate change strategy and actions will depend upon how its attempts to address its imperative domestic challenges.

China understands its role in global climate change and is fully aware of the fact that, at a minimal level, OECD countries will need some kind of assurance that China is sufficiently "in" for there to be a realistic chance of containing global emissions. In return, at a minimal level, China will insist on developed countries demonstrating sufficient commitment (e.g., significant mid-term targets, clear response to China's proposal on technology transfer and adaptation). With those two "minimals" met, trust building may start, and that is where the ultimate hope lies for a truly effective global climate deal.

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Notes

[1] Liu and Diamond (2005), Zeng, et al. (2008).
[2] This estimate is made on the basis of the latest update of purchasing power parity (PPP) dollars from the World Bank (2008). Ljungwall (2008) mentions that 300 million live under 1.25 US dollars PPP and another estimated 450 million in the interval 1.25-2 US dollars PPP per day.
[3] Mao, et al. (2008) provide stunning, well researched figures about the social costs associated with coal in China. According to Reuters (2007) "Birth defects in Chinese infants have soared nearly 40 percent since 2001, a government report said, and officials linked the rise to China's worsening environmental degradation." Chen (2009) states that "Every 30 seconds, a baby is born with physical defects in China, all thanks to the country's degrading environment" quoting an official at the National Population and Family Planning Commission. The same article cites professor Hu Yali from Affiliated Drum Tower Hospital of Nanjing who maintains that environmental pollution accounts for ten percent of the causes of physical defects in Chinese infants.
[4] International Energy Agency (IEA) greenhouse gas Emission Database cited in Leggett, et al. (2008). The latest official reporting of the greenhouse gas by China is the 2004 *National Communication on Climate Change to the United Nations*, which reported China's total greenhouse gas emissions in 2004 as 6.1 $GtCO_2e$, of witch approximately 5.05 Gt is CO_2.
[5] There are various figures from different data sources e.g., WRI/CIAT, CDIAC, IEA/WEO, US EIA/IEO, Netherland Environmental Assessment Agency (MNP)), as well as studies by research groups e.g., the IIASA GAINS, the Harvard climate project, etc.
[6] China's National Climate Change Programme National Development and Reform Commission (NDRC) (2007b) quoted in Leggett, et al. (2008).
[7] China National Statistics from Hu and Guan (2007), MNP data retrieved from Netherlands Environmental Assessment Agency (2008), EIA 2008 retrieved from Energy Information Administration (US) (2008), IIASA Gains Baseline08 scenario with actual figures from IIASA (2009).

[8] It is difficult to get accurate numbers on China's CO_2 emissions. This is partly due to the inadequacy and inaccuracy of the existing reporting and statistical system in China and lack of international access to existing data. Neither is it always clear what type of CO_2 sources are being accounted for. Various estimates for the years 2004 to 2006 put China at roughly one-fifth of global CO_2 emissions or 4.7 to 6.2 $GtCO_2$. See for example Auffhammer and Carson (2008), Environment Department (2007), Hu (2007b), Hu and Guan (2007), Netherlands Environmental Assessment Agency (2007) Yet recent estimates from WorldWatch Institute (Russell (2008)) for 2007 put the figure for China's share at more modest 18.3 percent and slightly behind the US's 19.5 percent. One possible explanation for the lower figure from WorldWatch Institute could be that the dataset does not cover emissions from the cement industry.

[9] Ibid.

[10] Energy intensity is the ratio of energy consumption to GDP. Given the dominant role of CO_2 in China's greenhouse gas emissions, energy intensity could be used as a reasonable proxy for China's carbon emissions, but it should be noted that with a gradual change towards more natural gas, nuclear and renewables in China's energy mix the actual avoidance of CO_2 emissions will be higher than the improvements that result from gains in energy intensity.

[11] PPP adjustments to GDP per capita are an output of the International Comparison Project (ICP). According to the World Bank: "The ICP uses a series of statistical surveys to collect price data for a basket of goods and services. For meaningful inter-country comparisons, the ICP considers the affordability and price level of necessities and luxuries, which exchange rates ignore. Surveys are held every three to five years, depending on the region. The data collected are combined with other economic variables from countries' national accounts to calculate Purchasing Power Parities or PPPs, a form of exchange rate that takes into account the cost and affordability of common items in different countries, usually expressed in the form of US dollars. By using PPPs as conversion factors, the resulting comparisons of GDP volumes enable us to measure the relative social and economic well-being of countries, monitor the incidence of poverty, track progress towards the Mil-

lennium Development Goals and target programs effectively." World Bank (2009).

[12] Stanton (2009) has done statistical analysis covering data from 174 countries of the relation between per capita GDP in terms of purchasing power parities (PPP) from 2005 and emissions in terms of CO_2 per capita emissions from 2004. These figures are preliminary results from the China Economics of Climate Change project and should not be further cited. A simple calculation based on 2007 estimates of GDP (PPP) of just over 7,000 as referred by IMF and World Bank, and CO_2 emissions of 6.7 $GtCO_2$ from Netherlands Environmental Assessment Agency (2008) give the result of 0.96 tons per 1,000 US dollars income (PPP).

[13] From Stanton (2009).

[14] As Rosen and Houser (2007) points out this unprecedented achievement was partly due to the extremely high energy intensity of the Chinese economy before reforms began, with very low per capita income and an oversized and exceedingly energy thirsty heavy industry sector.

[15] This is a key legally binding target in China's 11th Five-year Programme.

[16] 2006 and 2007 figures from China Sustainable Energy Programme China Sustainable Energy Programme (2008) and 2008 figure from PointCarbon News (Reklev (2009).

[17] Lin, et al. (2008).

[18] Economic growth assumptions for the Chinese trajectories from Jiang (2008): 2006-2010: 10.04 percent; and 2011-2020: 7.67 percent. US and EU upper trajectories are based on US EIA High reference scenarios from Energy Information Administration (US) (2008), lower trajectories are based on Obama declaration to reduceU.S.emissions to 1990 levels by 2020 and EU's target to reduce emissions by 2020 by 20 percent.

[19] It has also been suggested that the end of 1990s "hump" in China's CO_2 emissions is a result of the reorganisation of the energy sector that took place after the 1998 government reform and that power plants that were built in the late 1990s and early 2000s were not formally registered until mid-2000s, which would also add explanation to the extreme increase in both carbon emissions and power generating capacity during those years.

[20] The constant intensity path loosely corresponds to the BAU sce-

narios and projections, while the 20 percent reduction path loosely corresponds to the baseline or reference scenarios in Figure 6.
[21] Based on GDP growth assumptions from ERI's 2020 of 10 percent annually from 2006-2010 and 7.67 percent from 2011-2020.
[22] Stanton (2009).
[23] 12th five-year programme 2011-2015 and 13th 2016-2020.
[24] Stanton (2009).
[25] Such rights have been proposed but remain very controversial; no position on those controversies is implied by the discussion here.
[26] These figures are from Fan, Cao, Yang, Li, & Su Fan, et al. (2008). China's emission trajectory is based on a no regrets baseline scenario developed by the National Economic Research Institute in Beijin. As shown in Figure 6 this scenario is in line with most other baseline scenarios for China. The global accumulative emissions are from WRI/CAIIT, and population data: U.S. Census Bureau, International Data Base.
[27] Revealed comparative advantage (RCA) is often measured by the Balassa index: the RCA for sector j is j's share of China exports, divided by j's share of all world exports. That is, RCA(j) = [China exports(j) / all China exports] / [world exports(j) / all world exports] If RCA(j) > 1, then j is more important in China's exports than in world exports in general; hence China is said to have a revealed comparative advantage in that sector. Ackerman (2009).
[28] Ibid.
[29] This selection includes both CO_2 and CO_2e emission scenarios and projections for China. Given the uncertainties of projections we have chosen to place all of them in the same diagram. The different projections and scenarios are derived from the following sources: Baer, et al. (2007), Fan, et al. (2008), Garnaut, et al. (2008), International Energy Agency (2007), McKinsey & Company (2009), Energy Information Administration (US) (2008), Kartha (2008).
[30] Karlsson (1989).
[31] The Times article (Mortished (2007)) "China's drive for wealth means end of our low-carbon dreams" is representative of a large number of news articles that generalise China as a runaway train of carbon emissions. "China's Clean Revolution" by the Climate Group (2008) represents a type of well-researched policy paper

that focuses on marginal but still very positive low-carbon developments in China.
[32] Liu and Diamond (2005), Zeng, et al. (2008).
[33] 2004 UN population projection for China gives a span of almost 450 million people between the high and low projection variants.
[34] Stockholm Environment Institute and United Nations Development Programme (China) (2002).
[35] Olsson, et al. (2009).
[36] The figure of 8 percent is often referred to e.g. the Economist (2009b) but it is more important to understand the larger dynamics of falling growth rates than to focus on the exact figure. In his government work report to the National People's Congress in March 2009 Premier Wen Jiabao gave 8 percent as economic growth target for 2009, but the Chinese leadership and many scholars have agreed that this specific number does not hold the line of instability alone. In fact, they worry concentrating on growth target may risk ignoring equity and environmental issues, which will then add more instability.
[37] Economist (2007).
[38] Hallding (2008).
[39] For discussions on relationships between climate and energy securities see Ding, et al. (2008b), WWF (2006), Yergin (2006).
[40] Pomfret (2008).
[41] Zheng and Tok (2007).
[42] Day (2005), Hu (2007a), Liu and Diamond (2005), Warburton and Horn (2007).
[43] Hallding (2008).
[44] The G77 (Group of 77) is a coalition of developing nations within the United Nations, designed to promote its members' collective economic interests and create an enhanced joint negotiating capacity in the United Nations.
[45] Hallding (2008).
[46] For English summaries of the National Assessment Report see Ding, et al. (2007), Lin, et al. (2007).
[47] Leggett, et al. (2008).
[48] Ding, et al. (2007).
[49] Lieberthal (2009).
[50] Ding, et al. (2007).
[51] Economist (2008a).

[52] Lin, et al. (2007).
[53] Lieberthal (2009).
[54] For more details on China's future urbanisation, see Wotzel, J. et al (2008), Preparing for China's Urban Billion, McKinsey Global Institute.
[55] McKinsey Global Institute (2008).
[56] Lieberthal (2009), McGranahan and Tacoli (2005).
[57] Leggett, et al. (2008).
[58] Economist (2008a), Gao (2005).
[59] These views and opinions are results from consultations that the authors have done with about 50 Chinese and international decision-makers, academics and civil servants summarised by Olsson, et al. (2009).
[60] The Scientific Development Concept is also often referred to as the Scientific Outlook on Development.
[61] In addition, the Hu-Wen administration has also formulated a range of strategic concepts to provide the 'scientific theoretical guidance for development of the Party and the society, including strengthening the Party's governance capacity and advanced nature *(zhizhen nengli yu xianjinxin)*, making China an innovative country *(chuangxin shehui)*, building a new socialist countryside *(jianshe shehuizhuyi xinnongcun)*, instilling in society a socialist concept of honor and disgrace *(shehuizhuyi rongruguan)*, and taking the path of peaceful development *(heping fazhan)*.
[62] Jiang Zemin stepped down as the Central Military Commission Chairman in September 2004, many China analysts suggest that the Hu-Wen administration was only be able to consolidate power after then. Other suggests Jiang's influence on the current administration remains until this day.
[63] Zheng and Tok (2007).
[64] Personal note from meeting between Zhang Xiaoqiang and Mr Måns Lönnoroth, then the international vice chairman of the China Council for International Co-operation on Environment and Development (CCICED), September 2004, Beijing.
[65] Fewsmith (2004), Zheng and Tok (2007).
[66] Also referred to as the "five balanced aspects".
[67] For a more extensive interpretation of the harmonious society, see Zheng and Tok (2007).
[68] Ibid.

[69] Jiang (2004a), Jiang (2004b).
[70] An annual event where economic strategy and policy for the coming year is laid out.
[71] Xinhua News Agency (2004).
[72] OECD (2007).
[73] Asia-Pacific Economic Cooperation (APEC) is a forum for 21 Pacific Rim countries or regions (styled 'member economies') to discuss the regional economy, cooperation, trade and investment.
[74] The UN Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) meeting in Bali, December 2007. See for example articles from Associated Press Casey (2007) and Inter Press Service Bezlova (2007).
[75] The State Council Information Office (2008).
[76] Xinhua News Agency (2005).
[77] Yet another key component of the *Scientific Development Concept* has been the "new mode of industrialisation", meaning good economic performance, low resource consumption, minimal environmental pollution and full utilization of human resources. These features resemble some of the ideas behind the concept of "low-carbon economic development", which may explain the enthusiasm by which Chinese leaders and academics have taken on the concept. See also Ding, et al. (2008).
[78] Hu (2007).
[79] See for example Climate Group (2008), Climate Group (2009).
[80] Government of China (2006), National Development and Reform Commission (NDRC) (2007a), National Development and Reform Commission (NDRC) (2007b).
[81] Government of China (2006), Martinot and Li (2007), National Development and Reform Commission (NDRC) (2007b).
[82] Climate Group (2009).
[83] China's National Climate Change Programme (2007).
[84] For reference, 950 million tons is about 19 percent of the total CO_2 emission in China in 2004, the latest year China has reported emission data under the UNFCCC. National Development and Reform Commission (NDRC) (2007b).
[85] Source: The Medium and Long-term Development Plan for Renewable Energies in China (NDRC 2007).
[86] For example, Information Office of the State Council (2008), Lin, et al. (2008), Price, et al. (2008), Rommenney (2008), Teng and

Gu (2007) Information Office of the State Council (2007), National Development and Reform Commission (NDRC) (2007b), Pan, et al. (2006), Richerzhagen and Scholz (2008), Rosen and Houser (2007), Pew Center (2007), McKinsey & Company (2009).
[87] Richerzhagen and Scholz (2008).
[88] Brookings Institution (2008a).
[89] For a detailed review of all those policies and programs, see Remmeney 2008).
[90] The gap between declared ambitions, policy formulation, and policy implementation in the field of environmental policy was one of the main conclusions from OECD's Environmental Performance Review for China, OECD (2007).
[91] See for example Christoffersen (2005), Climate Group (2008), Climate Group (2009), Cunningham (2007), Downs (2008), Pan, et al. (2006), Sheehan and Sun (2007). In the past thirty years, China's energy institutions have undergone major changes, which some categorized as waves of central- vs. decentralisation (see Cunningham (2007)) and others stated as a shift from a strict hierarchical power and resources from centralized planning agencies and ministries to state-owned energy companies (Sintin et al. 2005). The overall direction of reform is for broad liberalization. Economic including energy decisions that are in conflict with the energy efficiency and emission reduction goals are increasingly locally made, despite the fact that officials have been warned that violating energy conservation and environmental protection laws will lead to criminal proceedings, while failure to achieve targets will be taken into account in the performance assessment of officials and business leaders. As one example, Chinese government sources estimated that approximately 120,000MW of electric capacity currently in the process of installation has not received approval from Beijing and is, therefore, illegal. This illegal capacity alone is greater than that of Germany's national grid, the largest in the European Union (Cunningham (2007).
[92] Williams and Kahrl (2008).
[93] Compiled based on info from Teng and Gu (2007).
[94] See Wang Xiaolu (2008), Rethinking thirty years of reform in China: implications for economic performance, in Song and Woo (2008).
[95] Lin, et al. (2008).

[96] Ibid.
[97] Aden and Sinton (2006).
[98] Economist Intelligence Unit ViewWire (2007).
[99] Economist (2007).
[100] Economist Intelligence Unit ViewWire (2007).
[101] Climate Group (2008).
[102] Aden and Sinton (2006), Bradley and Yang (2006), Sheehan and Sun (2007).
[103] Rosen and Houser (2007), Sheehan and Sun (2007).
[104] Aden and Sinton (2006), Rosen and Houser (2007).
[105] Aden and Sinton (2006).
[106] Rosen and Houser (2007).
[107] Economist Intelligence Unit ViewWire (2007), Hu and Guan (2007).
[108] Aden and Sinton (2006), Rosen and Houser (2007).
[109] For a discussion on alternative explanations for the rapid growth in heavy industry see The Economist (2008b).
[110] Constantin (2007), Downs (2006), Pan, et al. (2006).
[111] Auffhammer and Carson (2008), CCICED (2007).
[112] Constantin (2007), Downs (2006).
[113] Climate Group (2008), Leggett, et al. (2008).
[114] Hallding (2008), Leggett, et al. (2008).
[115] Leggett, et al. (2008).
[116] McKinsey & Company (2009).
[117] Climate Group (2008).
[118] Ee for example Motor Authority (2008).
[119] Deutsch and Monzi (2007).
[120] This term has, however, been removed from the future energy strategy published in the China Energy White Paper in 2007.
[121] This is our own estimate based on comparing a number of different assumptions about China's future energy needs, the amounts of emissions that China could realistically be allowed to emit, and technology development.
[122] Li, et al. (2005), State Council Information Office (2007).
[123] International Energy Agency (2007), State Council Information Office (2007).
[124] 2007 figures presented Chinese ambassador to Sweden H.E. Mingning Chen (2008).
[125] Pan, et al. (2006), Russell (2007).

[126] Rosen and Houser (2007). The extreme figures from the mid 2000s have been debated and it has been suggested that part of the explanation could be a change in the structure of the power sector that followed the 1998 government reform, which led to power plants being built in the early 2000s that were not registered until later.
[127] Aden and Sinton (2006).
[128] Ibid.
[129] Ibid, Chen (2009), Mao, et al. (2008), Reuters (2007).
[130] Economist Intelligence Unit ViewWire (2007).
[131] Mao, et al. (2008).
[132] Climate Group (2008).
[133] McKinsey & Company (2008).
[134] Climate Group (2008).
[135] Ibid.
[136] Economist Intelligence Unit ViewWire (2007), International Energy Agency (2007), Rosen and Houser (2007).
[137] Economist (2007), Economist Intelligence Unit ViewWire (2007), Lieberthal and Herberg (2006).
[138] Downs (2006), Jakobson and Zha (2006) indicate that the 80 percent oil dependency could happen before 2030. McKinsey & Company (2009) give a figure of 80 percent reliance on imported oil by 2030 for the baseline scenario, but estimates that net imports could be 30 – 40 percent lower if China's full technical abatement opportunity was realised.
[139] Pan, et al. (2006).
[140] Aden and Sinton (2006), Xinhua (2004), Yang (2007), Zhang, et al. (2000).
[141] National Development and Reform Commission (NDRC) (2007a).
[142] Climate Group (2008), National Development and Reform Commission (NDRC) (2007c), World Nuclear Association (2008). There have been even more ambitious targets set by NDRC to have 160 gigawatt nuclear power capacity by 2030. McKinsey & Company (2009) maintain that 145 gigawatt or no less than 16 percent of total power demand 2030 could be satisfied by nuclear if full technological opportunities were implemented.
[143] Climate Group (2008), Li, et al. (2005), Zhang, et al. (2000).
[144] Climate Group (2008).

[145] Ibid.
[146] Ibid, Li (2008).
[147] Chatham House (2007).
[148] Chen and Ravallion (2008).
[149] Wines (2009). See also note about the need to keep growth above 8 percent in Chapter 2.
[150] Even with the considerable slowdown, China still managed a growth rate of 9 percent in 2008.
[151] Economist (2009b).
[152] Hallding (2008), Morrison M. (2008).
[153] Morrison M. (2008).
[154] Hallding (2008).
[155] Lieberthal (2008).
[156] Cheung (2008).
[157] Seligsohn (2008).
[158] Wines (2009).
[159] Economist (2009a)
[160] Feng (2009).
[161] Leggett, et al. (2008).
[162] Cheng (2008), Morrison M. (2008).
[163] Feng (2009).
[164] Seligsohn (2008).
[165] Kim (2008).
[166] Ibid.
[167] Olsson, et al. (2009).
[168] Kim (2008).
[169] Feng (2009), Seligsohn (2008).
[170] Brookings Institution (2008b).
[171] Gill (2007).
[172] Guo (2008), Zheng and Tok (2005).
[173] Guo (2008), He (2007).
[174] Hallding. K. and Han G., 2008. China's climate and Energy Securities Dilemma: Shaping a New path of Economic Growth.
[175] Hallding (2008).
[176] Brookings Institution (2008b).
[177] See for example China's comments on the Bali Action Plan, UNFCCC (2008), page 18-20.
[178] See http://unfccc.int/files/kyoto_protocol/application/pdf/china060209.pdf

[179] Watts (2008).
[180] Wara and Victor (2008).
[181] For instance, Premier Wen indicated to EU president Barroso during the Commission's visit to China in April 2008 that, China *"would include its own domestic emission reduction policy in an international agreement"* on the condition that developed countries committed to mid term reduction targets for 2020 and that an effective financial mechanism is put in place to promote technology transfer.
[182] EU Business (2009).
[183] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0039:FIN:EN:PDF.
[184] EuroActiv (2009).
[185] The newly appointedU.S.Special Envoy for Climate Change.
[186] Stern (2009).
[187] Asia Society and The Pew Center on Global Climate Change (2009).
[188] Lieberthal and Sandalow (2009).
[189] Landler (2009).
[190] Stern (2009).
[191] Olsson, et al. (2009).
[192] Stern (2009).
[193] Todd Stern has described 25-40 percent as "neither scientifically nor politically feasible for the US."
[194] Chandler (2008).
[195] Hallding (2008).
[196] Hallding (2009).
[197] See Wang and Watson (2008a).
[198] See Pan and Chen (2008).
[199] See Stern (2009).
[200] Asia Society and The Pew Center on Global Climate Change (2009), Ding, et al. (2007), Gao (2005), Hu (2007b), Lieberthal and Sandalow (2009), Lin, et al. (2007), Song and Woo (2008), Zhang, et al. (2008).
[201] Bosetti, et al. (2008).
[202] As indicated by the recently release cost curve analysis by McKinsey, the major mitigation potentials would disappear quickly with delayed actions, see McKinsey & Company (2009).
[203] As detailed in Chapter 8, China is now already driving the argu-

ment to go beyond the "accumulative per capita average by proposing a "per capita accumulative convergence by 2100".
[204] See for example Aldy (2008), Levine (2008).
[205] The costs are not and should not only be seen as "climate mitigation cost"; but are necessary for health and environmental improvements as well. According to various estimations, environmental and health impacts could cost as much as 10 percent of the GDP, a considerable cost to the Chinese economy.
[206] The National Economic Research Institute, China.
[207] Fan, et al. (2008).
[208] China's (about 585 billion US dollars) last November. Given the fiscal policy and investment pattern in China, with the local "matching" investment, the RMB 4 trillion two-year economic stimulus package could add up to actual investments as large as 18 to 20 trillion RMB.
[209] Stern (2009).
[210] In addition to the economic crisis, there are also several possible explanations behind the unprecedented drop in electricity generation, including the Olympic Games during the summer months and an overall impact from energy conservation policies.
[211] Richard Morse of Stanford University's Program on Energy and Sustainable Development has made estimates in the range of 1.9 to 2.6 $GtCO_2$ for the period 2008 – 2010 Moore (2009).
[212] From Morse (2009).
[213] For example, the China Council for International Cooperation on Environment and Development (CCICED, http://www.cciced.org/), in its 2008 annual policy recommendation to the top Chinese leadership explicitly stated that China ought to focus on "preventing one risk and seizing three opportunities". The one risk referred to is the risk of sacrificing environment for economic recovery. A well-publicized letter from environmental NGOs was sent to the recently concluded National People's Congress, urging the government to "use the 4 trillion yuan investment to pioneer a green, low-carbon economy," and not to "sacrifice the long-term objectives of conserving energy and reducing emissions for the sake of protecting high energy-consuming industries that have no future." http://www.reuters.com/article/idUSTRE5281LH20090309
[214] Stern (2009).

[215] According to a recent assessment by the HSBC Climate Change Centre of Excellence, the Chinese stimulus plan actually assigns more than 30 percent for spending on low-carbon projects.
[216] The latest heated debate on this very issue was stirred by a comments made by Mr. Li Gao, one of China's top climate change negotiators, who said that China should not pay for cutting emissions caused by the high demands of other countries. "We produce products and these products are consumed by other countries, especially the developed countries. This share of emissions should be taken by the consumers but not the producers." Mr Li also criticized proposals by theU.S.to place carbon tariffs on goods imported from countries that do not limit those gases blamed for a rises in global temperatures "If developed countries set a barrier in the name of climate change for trade, I think it is a disaster."
[217] Based on unpublished research in progress by Frank Ackerman, at the Stockholm Environment Institute.
[218] See for example Stanton (2009) and Levine & Aden Levine and Aden (2008).
[219] Baer, et al. (2007), McKinsey & Company (2009).

Appendix A: Questionnaire – China in a Low-carbon Future: Position, Strategy and Challenges

China's understanding of the climate challenge

1. How is the climate challenge perceived in China, both in the global and domestic contexts?

2. Using a scale from 1 (minor) to 10 (major) please estimate to what extent concerns about climate change play a role in China's domestic and international politics.

Development versus climate concerns

3. The Scientific Outlook on Development, launched by the Hu-Wen leadership, outlines how China could develop into a more resource efficient society. Do you think this indicates a departure from a prevailing notion of economic development as more important than environmental concerns, towards a new concept of energy and environmental efficiency as prerequisites for China's future economic development?

4. Using a scale from 1 (low) to 10 (high) please estimate to what extent synergies between China's national goals (e.g. energy efficiency) and global climate change mitigation have an impact on China's willingness to engage actively in international climate mitigation.

Trade and globalisation

5. The carbon content of traded goods is increasingly seen as a key problem in reaching a post-Kyoto agreement. What is China's view on embedded carbon?

6. The notion that it will amount to unfair competition if developing countries such as China were allowed to emit more carbon in their production processes has led to protectionist voices in both theU.S.and Europe. How does China view the idea of carbon-related border-tax adjustments being an implicit or explicit part of a post-2012 agreement? Could this make China more willing to enter into constructive discussions about an agreement?

7. What is the view in China and internationally about the role China could play in providing low-cost green technology for international markets?

8. Using a scale from 1 (Bali most important) to 10 (Doha most important) please estimate the relative importance of the Bali Action Plan on the one hand, and the Doha round of WTO negotiations about sustainable development and trade on the other, for involving China in global mitigation of climate change.

*China's climate action in relation to its international image and changing foreign policypractic*e

9. Under the foreign policy banners of "a responsible great power" and "China's peaceful rise" China's de-facto foreign policy has changed markedly over the past decade, indicating a willingness to engage constructively with the international community, but without aiming to take on leadership positions. Using a scale from 1 (low) to 10 (high) please estimate to what extent this changing foreign policy context, and the apparent willingness to improve China's international image, could influence China's attitudes and ambitions in relation to international climate negotiations.

China's role in the Bali process

10. Is China's position in the international climate negotiations changing, and if so in which direction?
11. What are China's expectations and reqirements on a fair deal to join a post-2012 agreement?
12. What is China's view towards, and understanding of technology transfer?
13. How do the United States and the European Union, respectively, view the role of China in the negotiations?
14. Using a scale from 1 (unlikely) to 10 (likely) please estimate the extent to which China could play the role of a deal-breaker in the Bali process.

China's capacity to mitigate climate change

15. Several international reports and much media coverage describe how a "clean revolution" is taking place in China, and how the country could "leapfrog to higher energy productivity". How significant is the current trend of "green development"? Is

it a marginal trend, or can we expect real improvements in the carbon intensity of the Chinese economy, and/or carbon productivity in specific sectors?

16. To the extent that a "clean revolution" is under way, is it mainly driven by Chinese politics, international politics, or market-driven development?

17. In the course of the climate negotiations, and as a result of informal international climate discussions and joint research projects, an international cadre of experts on a variety of climate change related topics has emerged. Using a scale from 1 (limited) to 10 (considerable) please estimate to what extent shared values among this cadre of experts (including Chinese experts) might play a role in finding constructive solutions in the global climate change negotiations.

Major obstacles for China's transition to a low carbon economy as well as taking on far-reaching climate commitments

18. Using a scale from 1 (low) to 10 (high) please estimate to what extent the combination of China's development stage, energy endowment structure, and the anticipated need to keep up economic growth set limits on China's willingness or ability to take on far-reaching commitments.

19. Having considered all the above, what are the top three obstacles that could hinder China from taking on climate commitments and/or shifting toward a low-carbon economy?

Appendix B: Interviewees in the consultation process

The people that were interviewed in the consultation process have made their responses anonymously and in person capacity. To emphasise this we are listing the interviewees' names only without their affiliations. Family names are given in capitals.

Stefan BUNDSCHERER
Xavier CHEN
CHEN Dongmei
Lincoln CHEN
Chris NIELSEN
David DOLLAR
DONG Wenjie
Elisabeth ECONOMY
FENG Fei
GUAN Qingyou
Art HANSEN
Ping HÖJDING
Leo HORN
HU Angang
HU Tao
JIANG Kejun
Jonathan JOO-THOMSON
Mark KENBER
C.S. KIANG
Bernice LEE
Lars-Erik LILJELUND
LIU Jian
LIU Xiaowei
Nannan LUNDIN
Nick MABEY
Jennifer MORGAN
Dermot O'GORMAN
QI Ye
Maurice STRONG
TANG Min
Ernst VON WEIZSÄCKER
WANG Jinzhao
Tao WANG
WU Changhua
Sabine WU
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