


China's Clean Revolution



“In the move to a low carbon economy, we believe that China will no longer be a developing country following where others have led, but a pioneer leading the way.”

Steve Howard: CEO, The Climate Group

Changhua Wu: Greater China Director, The Climate Group

Foreword

Steve Howard & Changhua Wu

This report is based on research conducted by The Climate Group's team in China. Its findings show that far from ignoring climate change, Chinese Government and business leaders are now acutely aware of both the dangers and opportunities this environmental challenge brings. Even more importantly, it shows that significant actions to improve energy efficiency are already underway. China is now showing some of the strongest growth rates in the low carbon industries that reduce climate impacts of any country in the world and is creating jobs and generating profits in the process.

Many governments, businesses and even individuals have been wary of committing to action on climate change when they perceive that China – the world's largest greenhouse gas emitter – seems to be doing little to address the issue. To illustrate the challenge, if China continues to increase greenhouse gas emissions at the 2007 rate of 8% per annum and if the European Union continues towards its target of a 20% emission reduction, China's per capita emissions will be double those of Europeans by 2020.¹ Even China's goal to double renewable energy to 15% of total generation by 2020 will be overshadowed by a projected doubling in overall energy demand during the same period.²

But focusing on projections like this can be misleading. This report shows that significant changes are already occurring in China which present the real possibility of

60%

China has reduced the energy intensity of GDP by over 60% since 1980, and has set a target to reduce it by a further 20% by 2010.

the country's transformation into a global 'low carbon leader': that is, a nation at the forefront of developing policies, strategies and technologies that reduce emissions of carbon dioxide and other greenhouse

gases that contribute to climate change. Evidence is mounting of a trend towards stronger action and more ambitious targets. The demonstrated pace of change is also quickening – China is ahead of schedule to meet its renewable energy goals while, by comparison, progress in the UK has faltered.³

Nevertheless, the litmus test for China's low carbon learning curve will be whether it can contribute to two major milestones that the science states are required to avert dangerous climate change: firstly, a peak in global emissions by 2020; and secondly, progress towards a global 2050 emissions goal of two metric tons CO₂ per capita.⁴ In 2007, China reached a per capita level of 5.1 metric tons compared to the European Union's 8.6 metric tons and the USA's 19.4 metric tons.⁵

The jury is still out on whether China and other countries can reach these challenging targets, but the evidence contained in these pages shows that China has already started on a trajectory towards becoming an important global hub for low carbon investment, innovation and growth in coming decades. China's leaders have shown competence at engineering China's 'economic miracle'

over the last three decades and, more recently, skill at confronting major short-term challenges such as the tragic May 12, 2008 earthquake in Sichuan. The fact that the country's leadership is now putting a focus on climate change and has created greater than expected movement in renewable and alternative energy technology sectors gives us great hope that China could achieve a second miracle 30 years from now by moving to a low carbon economy. But this time, we believe that China will no longer be a developing country following where others have led, but a pioneer leading the way.

Steve Howard: CEO, The Climate Group

Changhua Wu: Greater China Director, The Climate Group

Contents

Executive Summary	5
Chapter One Low Carbon Power	8
Chapter Two Energy Efficient Products, Factories and Buildings	15
Chapter Three Low Carbon Transport	20
Chapter Four Low Carbon Finance	25
Conclusion	28
Sources	30
Acknowledgements	32

A man in a blue jacket and red gloves stands in a large parking lot filled with bicycles, looking down at a bicycle with a basket. The background shows a dense field of bicycles and a person in a dark jacket walking away. The scene is outdoors with trees and a building in the distance.

China is showing some of the strongest growth rates in 'low carbon industries' of any country in the world.



China is showing that moving to a low carbon economy is consistent with growth, development and energy security objectives.

Executive Summary

China has made significant progress in practically every low carbon economic sector in recent years and has already become a leader in a number of critical renewable energy markets. This report chronicles the rapid growth of low carbon industries and policies in China and turns the spotlight on several leading innovators. The evidence gathered here suggests that China not only has the potential to become one of the largest forces in low carbon development, but that in various industries and according to several key metrics, China is already leading, generating jobs and profits along the way.

China's important role in solving the climate change challenge

It has been widely reported in the media that China has become the largest national emitter of carbon dioxide (CO₂), a potent global warming gas, and that the country is and will continue to be one of the most important players in finding a solution to the climate change challenge.¹ Scientists have pointed out that in the period before 2002, when over 90%

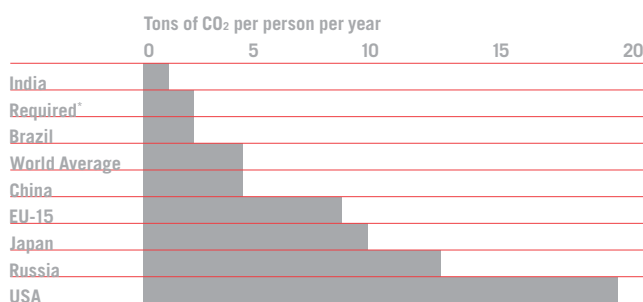
15BN

China is a leading manufacturer of solar photovoltaics and leading domestic solar companies have a combined market value of over US\$15 billion.

of human carbon emissions were released, China accounted for only 7% of the global total, compared to 26% and 29% for the European Union and United States respectively.² But since the turn of the century, the portion of emissions from China has been growing steadily and it now accounts for over 24% of the annual total, a figure which is growing every year.

Although China has a population of over 1.3 billion people, CO₂ emissions per person are relatively low. If China's citizens emitted as much CO₂ as America's, China's total emissions would be roughly equivalent to those of the entire planet today. A recent report by Sir Nicholas Stern and the London School of Economics proposed a target of two metric tons of CO₂ per person per year for all countries by 2050.³ From this perspective, while China's carbon intensity per person is barely above the world average, it is still far above where it needs to be by mid-century.

Per capita carbon dioxide emissions¹ for selected countries in 2006



¹Required world average per capita emissions by 2050 to keep atmospheric carbon dioxide concentration below 500ppm

When considering progress towards a low carbon economy, the well-known Chinese proverb comes to mind – *a journey of ten thousand miles begins with a single step*. By bringing together data in four key sectors – power, energy efficiency, transport and finance – this report highlights those steps China has already taken on the road towards a clean, green future. The headline findings are listed below and these challenge the perception of China's inaction on greenhouse gas emissions. They also demonstrate the scale of the opportunity for the Chinese economy associated with emerging low carbon markets.

Renewables investment and installed capacity are growing quickly

According to the *Renewables 2007 Global Status Report*,⁴ China is already the leading renewable energy producer in the world in terms of installed generating capacity, with the largest hydro-electric fleet and fifth largest wind power fleet in the world. China plans to almost double the proportion of renewable energy it uses from 8% in 2006 to 15% in 2020, with concrete targets for hydro power capacity at 300 gigawatts (GW), bioenergy power at 30 GW, wind power at 30 GW, and solar power at 1.8 GW.⁵ The country's renewable energy targets are close behind those of the most advanced countries such as those of the European Union which have set a renewable energy target of 20% by 2020.⁶

China ranked second for the absolute dollar amount invested in renewable energy in 2007 with approximately US\$12 billion, trailing the leader Germany which invested US\$14 billion.⁷ The nominal sizes of the Chinese and German economies were almost equal at US\$3.3 trillion in 2007,⁸ meaning that China trails leader Germany only slightly in renewable energy investment as a percentage of GDP. *New Energy Finance* predicts that another US\$398 billion of investment is needed to reach China's 2020 renewable energy goals, or an average of US\$33 billion per year mainly for wind, biomass, hydro and solar installations.⁹

China is or will soon be the No.1 manufacturer of various critical low carbon technologies

China is already a leading manufacturer of solar photovoltaic technology, with 820 megawatts (MW) of production by the end of 2007, second only to Japan.¹⁰ The country is set to capitalize on this growing export opportunity as the world transitions to a low carbon future.

In addition to its own local wind power installations which grew by about 120% in 2007, the Global Wind Energy Council announced in early 2008 that China will become the world's leading manufacturer of wind turbines by 2009 with leading companies such as Goldwind and Sinovel expected to branch into exports.¹¹

China is also competing for or taking the lead in the production of other critical renewable and low carbon technologies such as solar water heaters (holding 60% of the global market), energy efficient home appliances and rechargeable batteries.¹²

China is a leader in low carbon transport

Beyond its traditional reliance on bicycles and public transport, China is now introducing measures to limit oil consumption from its growing motor vehicle fleet, implementing fuel efficiency standards for cars 40% higher than those in the USA, although still lagging behind those in Europe and Japan.¹³

China has also succeeded in scaling up a range of low carbon transport technologies; over 21 million electric bicycles and 1.64 million energy efficient compact cars were sold in 2007,¹⁴ and domestic hybrid and electric vehicle technologies are progressing rapidly.

Biofuels also feature strongly, with China being the third largest ethanol producer in the world.¹⁵ The country has begun converting an area of marginal land half the size of England into biofuel forests, hopefully easing the competition between biofuels and grain crops that has contributed to food price increases.¹⁶ There are plans to produce 12 million metric tons of low carbon fuel per year by 2020.¹⁷

China is making successful efforts to reduce carbon intensity

The energy intensity of the Chinese economy has dropped by over 60% since 1980.¹⁸ Moreover, China has targeted a further 20% reduction between 2006 and 2010.¹⁹

Fossil fuels still provide 80% of China's power, but by replacing small and inefficient power stations with high efficiency super-critical technology, China hopes to avoid approximately 37.6 million metric tons of CO₂ emissions every year.²⁰

The Chinese Government has also put in place an ambitious monitoring, benchmarking and control system for China's 1,000 largest energy consuming companies, between them responsible for 33% of national energy usage. The programme stipulates that these companies must reduce their energy intensity to accomplish an overall energy saving of 100 million metric ton standard coal equivalent (approximately 833 million gigawatt-hours) by 2010.²¹

A strong and comprehensive low carbon policy framework is in place

In addition to the overarching 20% energy intensity reduction target and the 15% renewable energy target, a comprehensive set of complementary regulations have been developed

covering almost every sector of China's economy.

Fuel economy standards (see above) were issued in 2005; one of the world's most comprehensive mandatory energy efficiency testing and labeling standards for home appliances was

implemented the same year;²² a 20% tax on gas-guzzling SUVs was introduced in 2006 while compact cars are only taxed at 3%; strict building efficiency design codes have been introduced which aim to cut energy consumption of new buildings by 50%; and China's Renewable Energy Law, which also came into effect in 2006, mandates that the power grid purchase renewable power, giving subsidies for wind and biopower projects.

Chinese entrepreneurs are riding a low carbon wave

A low carbon wave has swept up literally tens of thousands of Chinese companies into new markets and created some of China's most successful business leaders. For example, China's six largest solar photovoltaics (PV) manufacturers, most of which did not exist ten years ago, had a total market value of over US\$15 billion in July 2008.²³ Some other rapidly growing areas are: the solar water heater market, which employs over 600,000 people in China, is worth over US\$2 billion per year and is growing at 20% annually;²⁴ the energy efficient compact car market, which was worth over US\$50 billion in 2007; the electric bicycle market, which was worth over US\$6 billion in 2007;²⁵ and China's leading wind turbine manufacturer, which has a rapidly rising market value of over US\$6 billion.²⁶

Across power, efficiency and transport, China has frequently taken the route followed by most countries focusing policies on new buildings, factories, vehicles or products, instead of replacing or retrofitting old ones, which is a more complicated and expensive approach. For this reason it will take several years to see the full effect of the initiatives which have been introduced. Many opportunities still exist for China to further speed up the phase-out of older technologies.

Another qualifying factor, when considering the data presented in this report, is level of implementation. It is inevitable that some companies will evade the system. However, China's clear improvement in energy intensity to this point indicates that it has been as successful in overcoming resistance to new efficiency policies as any country. For example, China's energy intensity²⁷ has recently shown two consecutive drops: 1.79% in 2006 and 3.66% in 2007.²⁸

As more Chinese companies and products begin to comply with the new regulation, China will face the continuing challenge of monitoring and ensuring compliance, encouraging innovation and continually pushing up standards to best-available technology.

Unleashing China's low carbon potential

With companies fielding strong investment, reaping impressive profits and seeing double or even triple digit growth in low carbon sectors, China and its new generation of low carbon entrepreneurs are already seeing significant economic benefits as a result of their push into the low carbon economy.

Last year, The Climate Group's *In The Black* report documented how, even in the absence of consistent policy, the low carbon economy is booming in four major industrialised countries. What this latest report shows is that this is not just a niche market for rich countries, but rather that – with their cost advantages and abundant abatement opportunities – investment in low carbon solutions can be equally, if not more profitable, job-creating and socially beneficial in developing nations.

China in particular has embraced this opportunity, once again showing that moving to a low carbon economy is consistent with growth, development and energy security objectives.

12BN

Investment in renewable energy in China, at approximately US\$12 billion in 2007, is almost level with world leader Germany as a % of GDP. In terms of installed capacity, China leads the world, reaching 151 GW by the end of 2007.



*“A journey of ten thousand miles
begins with a single step.”*

Chinese proverb

Chapter One

Low Carbon Power

Highlights:

- Investment in renewable energy in China, at approximately US\$12 billion in 2007, is almost level with world leader Germany as a percentage of GDP. In terms of installed capacity, China leads the world, reaching 151 GW by the end of 2007²⁹
- Since 2005, the Chinese government has required that all new large power plants use high efficiency super-critical coal fired technology and, during 2007, 553 smaller inefficient plants with total generating capacity of 14.38GW were shut down³⁰
- China's Renewable Energy Law gives subsidies for wind and biomass power and China's Medium- and Long-term Program for Renewable Energy Development states that 15% of total energy should come from renewable sources by 2020
- China's wind power capacity increased by around 125% in 2007.³¹ China now ranks fifth in the world and is expected to grow another 67% to 10 GW in 2008³²
- China is a leading manufacturer of solar photovoltaics, with 820 MW of production in 2007, second only to Japan. As of July 2008, the six largest solar companies had a combined market capitalisation of over US\$15 billion³³

Challenges:

- China has ample reserves of cheap coal which is currently the fuel source for 77% of energy supply.³⁴ Low carbon alternatives must be bought to scale and cost competitiveness improved
- Only 0.08 GW of solar photovoltaic power has been installed so far in China despite high levels of manufacturing for export³⁵
- Demand for electricity in China increased by 14.4% in 2007 and is expected to continue to grow strongly as China develops³⁶
- Some current projections show that China could expect to meet 30% of energy needs from renewable energy by 2050, short of IPCC recommendations for global emissions reductions³⁷

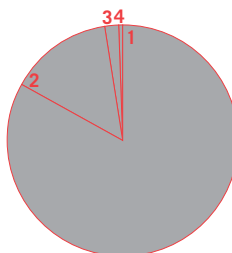
Future Opportunities:

- China has a potential biomass resource of up to 800 million metric tons of agricultural waste³⁸
- Targets and regulation in China and internationally will continue to create lucrative home export markets for China's renewable energy products

China electricity production in 2006¹

Total: 2730 Terawatt hours (TWh)

1. Fossil Fuel	83.3%
2. Hydro	14.3%
3. Nuclear	2.0%
4. Wind, Biomass, Solar PV	0.4%
Total	100%

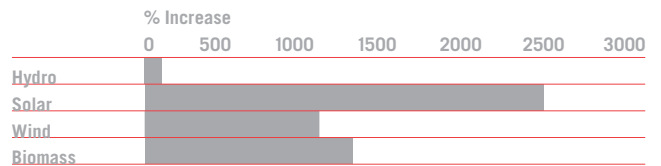


Renewable Energy:

China implements strong renewable energy targets

China's Medium- and Long-term Programme for Renewable Energy Development, which was announced on August 31, 2007, set a target to increase the share of renewable energy in total energy consumption from the current 8% to 15% by 2020. The Programme mandates that at least 3% must come from so-called 'new renewables', including solar, wind and biomass. To reach these goals, China's Renewable Energy Law and other regulations mandate that the state grid purchases power provided by renewable energy projects, giving preferential prices for wind power and biomass. Together with renewable tax-break policies of 50%, this has led to strong growth in these markets. The Programme also set specific targets for 2020 such as 30GW installed capacity for wind, 30GW for biomass, 300GW for hydroelectric and 1.8GW for solar – equivalent to almost half of global solar PV production in 2007.³⁹

China's planned growth in renewable electricity for 2020² compared to 2006 levels



Rapid expansion will be required in renewable industries to meet these targets and more than double the renewable energy base to 420GW by 2020.⁴⁰ But judging from growth trends between 2005 and 2007, the targets will be met well ahead of schedule. For example, the China Renewable Energy Industry Association has announced that China is on track to install 50GW of wind power by 2015, well above the 30GW by 2020 target.⁴¹

The scientific consensus suggests that global emissions need to peak no later than 2020 and then decrease by at least 50% by 2050 if we are to avoid the worst impacts of climate change. China has yet to officially make any targets past 2020, but energy planning experts have suggested that China could expect to meet 30% of energy needs from renewable energy by 2050,⁴² which would fall well short of the required amount. However, given the timeframe, there is still enough time for China to push renewable energy targets higher.

Renewable energy resource constraints are certainly not the limiting factor and China boasts rich wind and solar resources that could potentially provide for the entire country's energy requirements if effective energy storage methods were used.⁴³ The major short-term factors restricting the use of renewable energy in China are economic ones and, for this reason, government policy and potentially global carbon markets will need to play a strong role in managing power-related emissions.



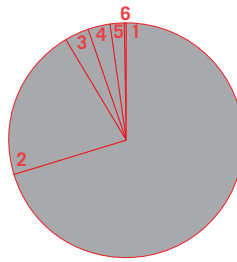
The ultra super-critical Yuhuan Power Station cost 15.6 billion yuan (US\$2.3 billion), or \$575 per kW installed compared to the average international cost of US\$1100-1200.



Estimated electric generating capacity 2020³

Total: 1422GW

1. Fossil Fuel	70.3%
2. Hydrn	21.2%
3. Wind	3.5%
4. Nuclear	2.8%
5. Biomass	2.1%
6. Solar PV	0.1%
Total	100%



China is the world's leading solar manufacturer

In terms of manufacture, China, with a production volume of 820 MW in 2007, is second only to Japan. Solar cell manufacturers in China now have an annual production capacity of 1,300 MW and plan to expand this to 4,000 MW by 2010 – more than the entire global production in 2007.⁴⁴

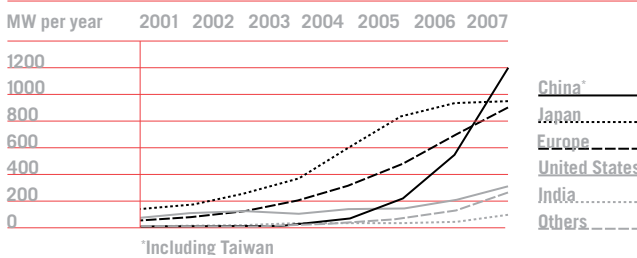
With more than 400 solar PV companies, China's growing solar manufacturing industry is positioned to become a

low-cost leader in the growing low carbon economy. There are already four Chinese solar companies with market capitalisations of over US\$2 billion: Suntech Power Holdings; LDK Solar; JA Solar Holdings;

and Yingli Solar. The rates of growth seen in these companies and many others in China are greater than 100% per year.

China's solar growth has largely been fuelled by growing international demand from countries like Germany, Spain and the USA, rather than by domestic policies, and solar technology still provides less than 0.2% of total electricity needs within China. The challenge of meeting domestic renewable energy targets could generate further strong growth for China's solar manufacturing leaders.

Solar PV production capacity by year end⁴ by country to 2007



Production capacity targets for top solar PV companies in China⁵

Company Name	Production capacity by 2007 (MW)	Announced Expansion Targets 2008-09 (MW)
Suntech Power Holdings Co.	480	1,000
LDK Solar Co.	100	800
JA Solar holdings	175	900
Yingli Solar	90	600
Trina Solar Ltd	75	500
Solarfun	120	360
China Sunergy Co.	190	600
BP Solar (China)	50	100
Ningbo Solar	100	100
Total	>1,300	>4,000

Suntech Power: US\$5 billion growth in six years

Suntech Power was founded in May 2002. By March 2008, it had become the third largest player in the global solar industry.

How it grew

Breaking into world markets

Suntech's first project was to design intelligent controller PV systems. Having completed this in 2003, the company received certification from the International Energy Commission to enter lucrative export markets in Europe and the USA.

To generate the capital it needed to grow, Suntech then floated on the New York Stock Exchange on December 14, 2005. This brought in billions of dollars – money used to make investments in technology development and new production facilities in China, and to acquire competitor companies to build Suntech's technical expertise.

Following a clear strategy

Suntech has a clear business goal driving its success and that is to be the world's lowest-cost solar producer. This has not only driven the company's growth, but also the continuing increase in solar electric applications around the world.

The future

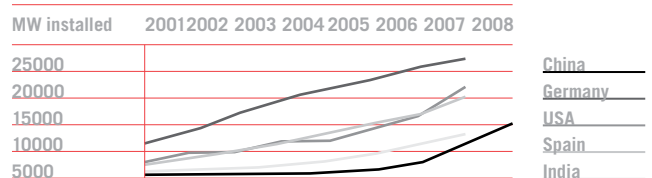
Suntech recently announced that it will reach a construction capacity of 1,000MW by the end of 2008. This is only marginally less than total global production of solar applications in 2007.

With a market capitalisation of over US\$5 billion, it also means that Suntech is the third largest player in the solar industry. According to Fortune Magazine, Suntech's global CEO, Dr Zhengrong Shi, has already become one of the richest men in China.

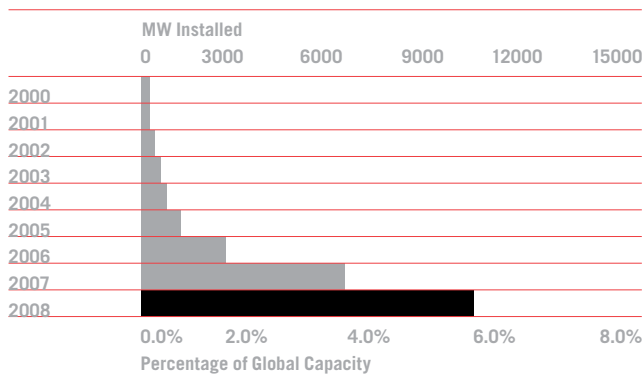
China on track to beat 2020 wind power target by 200%

Spurred by supportive government policies growth in China's wind energy industry has exceeded all expectations, with the market increasing by around 125% in 2007. China now has over 6GW of installed wind capacity, which is 7% of the world total and the country ranks fifth in the world after Germany, the USA, Spain and India. The original government target for wind production announced in 2005 was 30GW installed by 2020, but some experts are predicting that China could reach 20GW by 2010 and up to 100GW by 2020.⁴⁵ Although China still needs to catch up with international leaders such as Germany and Spain in terms of cutting-edge technology, the Chinese wind market is already relatively competitive, ranking alongside the likes of the UK and Australia in terms of price.⁴⁶

Installed wind capacity for leading countries⁶



Growth of China's wind generating capacity⁷



There are currently a number of restrictions in the market designed to encourage the development of local manufacturers. For example, regulations were passed in 2005 to ensure that at least 70% of each wind turbine installed must be locally manufactured and import taxes have been used to discourage imports of pre-assembled turbine systems.⁴⁷ These policies have led to the creation of over 50 local wind power technology companies in China and this group now controls over 50% of the domestic market, historically dominated by imports.

Goldwind: Leading China's wind-power boom

Goldwind Science and Technology Company is one of China's largest domestic wind turbine manufacturers. With its HQ in Urumqi, in China's windy north-western Xinjiang Autonomous Region, the company has been a driving force behind wind power development in China since the 1980s. By 2006, it possessed a 33% share of the Chinese market.

How it grew

International collaboration for research and development (R&D)

Goldwind was born back in 1986 as a small research project collaborating with the Dutch Government importing small 150 kW turbines to test in China. By 1995, it was also receiving loans from the German Government to develop 600kW turbines. In 1999 the Chinese Ministry of Science and Technology began directly supporting Goldwind to become a world leader in wind power.

All-round expertise

With its focus on low-cost, large-scale wind power, the company has developed expertise in every area of the market. This ranges from assessing wind fields to designing, building, installing and maintaining wind farms.

Being part of a thriving market

Goldwind has benefited from a thriving wind power market in China. In 2007, Goldwind's sales reached 3.24 billion yuan (US\$460 million), with profits of 600 million yuan (US\$85 million). Main local competitors, including Huarui (Sinovel), Zhejiang Windey and Dong Fang, have also thrived.

The future

Investment in R&D

At the moment, Goldwind produces 600kW, 750kW, 1.2MW and 1.5MW wind turbine sets. But the company is investing billions of dollars in both R&D and capacity expansion, and has already begun researching larger and more efficient 2.5, 3.0 and even 5.0MW wind turbines. These would be over 100 metres high.

Global expansion

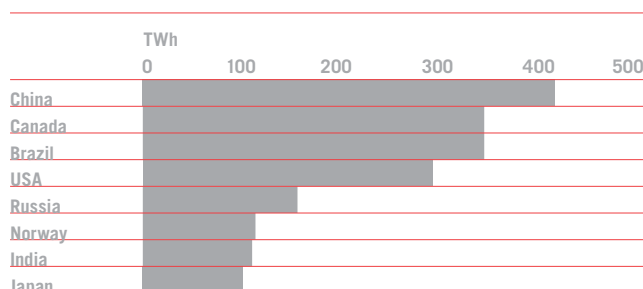
At the moment, the company does not export its turbines. But, anticipating this next step, international investors have already pushed up the listed value of the company to over US\$6 billion. These predictions are backed up by the

company president, who has announced that Goldwind has 'big export plans' for 2009.

Plans to double capacity of Chinese hydro generating fleet by 2020

China has the largest hydroelectric generating fleet in the world and the energy it produced in 2006 avoided over 450 million metric tons of CO₂ emissions.⁴⁸ With plans to more than double the 142GW hydro generating fleet by 2020, China's dams could avoid over 1,000 million metric tons of CO₂ emissions every year by displacing coal power,⁴⁹ although adverse social and environmental impacts would need to be taken into account. Meeting the goal would require an investment of over US\$110 billion dollars.⁵⁰

Leading hydro electricity generating countries, 2006⁸



For the next 20 years at least, hydroelectricity will continue to contribute more to reducing China's carbon emissions than new renewable technologies such as solar and wind.

Exciting plans for biomass and waste-to-energy

China's biomass power generation capacity is growing steadily and in 2007 the Government implemented a subsidy of 0.25 yuan (US\$3.2c) per kilowatt hour to help the country meet its target of 30 GW by 2020.⁵¹

According to government sources, existing biomass power capacity is 2GW, and China has installed over 1,600 industrial scale biogas plants and over 18 million household biogas digesters for cooking, heating and power.⁵² However, traditional biomass from agriculture and livestock waste remains an under-utilised resource. The majority of China's rural biowastes are discarded or burned because of difficulties in collection and transport. Perhaps one of the most sought-after technologies for biomass is cellulosic ethanol (see Chapter 3, page 24) which would allow crop residues to be converted to liquid fuel to replace oil. This technology, however, is still some years away from commercialisation.

In China's growing cities there are currently over 50 municipal solid waste (MSW) incinerators, also known as waste-to-energy plants, producing about 1,000GWh of electricity from 3 million metric tons of garbage each year.⁵³ Waste-to-energy technology is becoming more attractive as China's cities run out of landfill space and the energy content of city refuse increases due to rising proportions of plastics and paper.

Non-Renewable Energy

Nuclear could contribute 4% of China's power by 2020

Although there are associated waste and cost issues, nuclear energy is a low carbon alternative to coal power producing almost zero carbon and zero air pollution which makes it an attractive option for Chinese energy planners. Chinese nuclear generating capacity is currently relatively small, accounting for about 2% of electricity output due to the high

prices of nuclear fuels compared to coal.⁵⁴

However, the Chinese Government is slowly ramping up investment in nuclear power which could contribute up to 4% of China's power by 2020.⁵⁵ China's

4000

China will become the world's top wind turbine producer in 2009 with a capacity of 10,000MW per year up from the current 4,000MW.

State Nuclear Power Technology Company recently signed a US\$5.3 billion dollar deal with Westinghouse (US) to build four new reactors and, with the blessing of Chinese President Hu Jintao and French President Nicolas Sarkozy, French company Areva has been awarded €8 billion (US\$12 billion) in construction and uranium fuel contracts in a deal with the China Guangdong Nuclear Power Group.

Chinese power companies are working in cooperation with international partners to increase nuclear power capacity from the present 8.6GW in 2007 to 40GW in 2020⁵⁶ and this could increase if China develops its own nuclear plant construction capability or if fossil energy prices continue to rise.

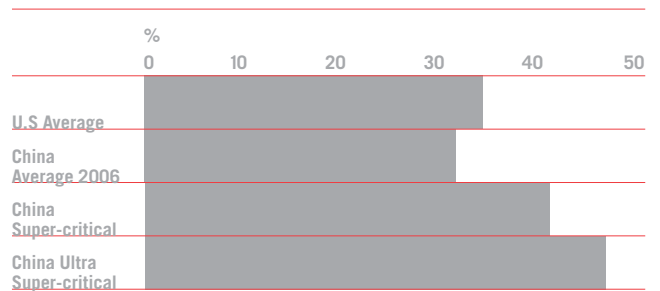
Clean coal – ultra super-critical power plants are the new standard

As coal power stations have an operating lifetime of 40-50 years, large investments made now will continue to have a significant impact on carbon emissions towards the middle of this century. This has been described as a 'carbon lock-in' effect and it is of particular significance in developing countries such as China and India with rapid growth in energy demand.

China is the largest coal producer and consumer in the world using 2.4 billion metric tons of coal in 2006, almost 40% of the global total.⁵⁷ Coal is the most carbon intensive fuel, and China's older and inefficient coal plants add 25% or more to these already high carbon emissions. However, with the growth of economic resources, tighter government policies and increased experience in the construction sector, there has been a transformation in new plant efficiency in the last three years. Building on efficiency improvements and making low carbon alternatives more cost competitive are ongoing challenges.

Since 2005, construction of large new power plants in China has almost exclusively used efficient super-critical technology, increasing the thermal conversion efficiency of the Chinese coal fleet to over 30% – a level close to that in developed countries. By 2007, Chinese companies had started constructing the even more advanced ultra super-critical power plants which have become the new standard.

Thermal conversion efficiencies of coal power plants⁹



As new technology is introduced, less efficient plants are being shut down. Older and smaller power plants with capacities below 100MW can emit over 2000 grams of CO₂ per kWh (almost three times higher than best available technology) and the Chinese Government closed 553 such installations, totaling over 14.38GW, in 2007 alone.⁵⁸ Similar policies have been brought in to reduce the number of plants with capacities under 300MW which currently make up 30% of the power generating fleet. The National Development and Reform Commission in China requires that large power companies 'buy out' and close down inefficient sites equivalent to 60% of proposed construction capacity before projects will be approved.

The Huaneng Group: Cutting emissions from coal by 50%

The Huaneng Group is China's largest electricity generation company. With sales of 84.5 billion Chinese yuan (US\$12.2 billion) in 2006, it produces around 12% of all China's power. It also leads the way in the Chinese Government's drive to be more energy efficient and last year opened one of the most efficient coal plants in the world at Yuhuan.

How it led the way

While the Huaneng Group invests in renewable technology and biofuels, its main success has been in developing high-efficiency coal-burning technology. This has helped China begin to 'leapfrog' the less efficient coal technology that much of the developed world is currently locked into using.

First to go super-critical

Back in 2002, Huaneng began constructing China's first super-critical plant. The first 600MW units were finished by the end of 2004. These have a thermal conversion efficiency around 30-40% higher than the average in China. In 2005, the Chinese Government issued a regulation requiring all new coal power stations over 600MW to use super-critical technology.

First to go ultra super-critical

Even before the construction of the super-critical plant had been finished, Huaneng had already started developing an ultra super-critical (USC) power station. The USC technology, which had never previously been tried in China, reduces greenhouse gas emissions by almost 50% compared to other plants in China and has a thermal conversion efficiency of over 45%.

The result is the Yuhuan power station. Its first two 1GW USC units started working in December 2006, and were followed by two more 1GW units in November 2007. This makes it the largest USC plant in the world, able to provide power to around 10 million Chinese households.

Compared to China's average coal-fired power station, running the plant saves 11 million metric tons of CO₂ per year from reaching the atmosphere. What's more, the plant cost 15.6 billion yuan (US\$2.3 billion). This equates to only US\$575 per kW

installed – well below the equivalent cost for most international projects of US\$1100-1200 per kW installed.

The future

According to its former chairman, Mr Li Xiaopeng, the group aims to double its generation capacity by 2010 and become a Fortune 500 company.

Demand for USC is also increasing fast, partly thanks to support from the Chinese Government. By March 2008, over 100GW of USC plant capacity had been ordered in China.


New carbon capture and storage (CCS) projects and partnerships are in development

China does not have any existing carbon capture and storage (CCS) plants but there are at least two full-scale pilot projects underway which will be completed by 2014. Opinion is divided in China on the feasibility of CCS due to concerns about high cost and the environmental risks associated with storing massive amounts of CO₂ gas. But even with such doubts, China's heavy reliance on coal makes CCS a potentially critical technology requiring investigation. CCS has the potential to reduce CO₂ emissions from coal power plants by about 85%.

A billion dollar Chinese project named 'Green-gen' led by the Huaneng Group and with strong support from the Chinese Government has begun developing a CCS coal power station in Tianjin City. Green-gen has received investment from seven of China's major energy companies and aims to push forward the boundaries of integrated gasification combined cycle (IGCC) coal, hydrogen production, fuel cell and CCS technology. Stage I requires an investment of 2.5 billion yuan (US\$360 million) to construct a 250MW IGCC plant by 2009; stage II will add another 400MW as well as hydrogen production, fuel cell power generation and CCS technology by 2012. Stage III will develop a commercial-scale CCS plant, although the details have yet to be ironed out. A second project dubbed 'near zero emission coal' (NZEC) was launched in November 2007 in China by the UK Government which has released plans to design and construct a 300MW CCS coal power station in China by 2014.⁵⁹

2020

China has implemented targets for 2020 to increase installed wind power capacity to 30GW, hydro power capacity to 300GW, bioenergy power capacity to 30GW, and solar power capacity to 1.8 GW.



“China now has one of the most thorough appliance energy efficiency standard programs in the world.”

Dr Jiang Lin: Senior Vice President, Energy Foundation, United States

Chapter Two

Energy Efficient Products, Factories and Buildings

Highlights:

- China has reduced the energy intensity of GDP by over 60% since 1980 and aims to reduce it by another 20% between 2006 and 2010
- China introduced a new Building Code, the Design Standard for Energy Conservation in Civil Buildings, in 2006 requiring all new buildings to reduce energy consumption by 50%, or 65% in some cities such as Beijing and Shanghai⁶⁰
- Over 10% of Chinese homes use solar water heaters and the domestic market was worth US\$2.6 billion in 2006, 60% of the global market⁶¹
- China has developed one of the world's most comprehensive mandatory energy efficiency standards and labels for home appliances which will allow China to avoid construction of 27GW of power generation capacity by 2020⁶²

Challenges:

- China's urban population is projected to increase by over 350 million people between 2006 and 2025, so increased demand for energy, buildings and products must be carefully managed⁶³
- An estimated 23% of China's energy demand (and CO₂ emissions) came from making products for export markets in 2004. Exports are still growing rapidly, reaching US\$1.2 trillion in 2007, raising the issue of who is responsible for what, in terms of global emission reductions⁶⁴
- China has a building stock of over 43 billion square metres of which only 4% meets the recently released Building Code energy efficiency standards⁶⁵

Opportunities:

- The Building Code will generate a huge demand for green building design and materials companies estimated to be worth US\$1.5 trillion between now and 2020⁶⁶
- The Government is targeting thousands of factories which have efficiencies in the lowest quartile to improve efficiency or shut down and this is requiring hundreds of billions of investment in energy efficient technology
- As well as the domestic target to have solar water heaters in 30% of Chinese households by 2020, there is also a potentially large export market

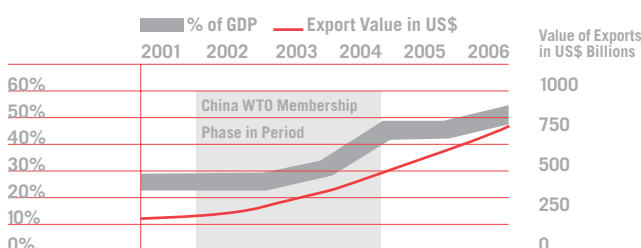
Industry dominates emissions but efficiency is improving

Industry is the single largest carbon emitter in China's economy, consuming 70% of China's energy,⁶⁷ compared to only 33% in the US. However, due to efforts by business and government to modernise industry and improve energy efficiency in recent decades the national energy intensity indicator, 'Standard Coal Equivalent consumption per 10,000 yuan (approximately US\$1,450) GDP', was reduced from 3.39 metric tons in 1980 to 1.21 metric tons in 2005 (calculated using the 2005 constant price) – a reduction of 63%.

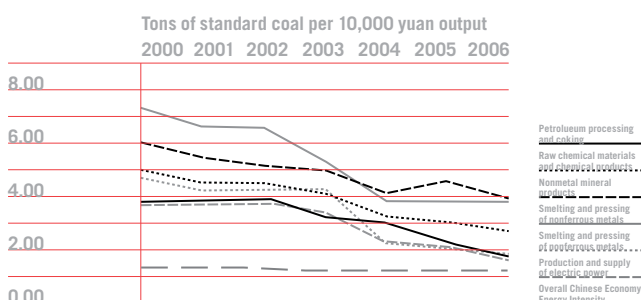
The Chinese government has set a target to reduce the energy intensity of GDP by a further 20% between 2006 and 2010,⁶⁸ the most aggressive energy efficiency improvement target in the world. To reach the target, the Chinese Government has increased investment in energy saving and efficiency incentives to about US\$6 billion per year in 2008.⁶⁹

China's entry into the World Trade Organization in 2001 had a profound impact on energy consumption by contributing to a rapid growth in manufacturing and energy intensive industries for export, making energy intensity targets harder to reach than expected. Although the Chinese Government supports large trade volumes as a net positive for the Chinese economy, there is increasing concern about the environmental and energy costs inflicted at home as a result. The Government is therefore making use of financial and trade controls to restrict some energy intensive products and sectors. For example, in November 2006, the Ministry of Finance added a 15% export tax on copper, nickel, aluminum and other metal products; a 10% tax on primary steel products; and a 5% tax on petroleum, coal and coke.

China's six largest energy consuming industries as a proportion of total GDP¹



Declining energy intensities of China's six largest energy consuming industries²



China's Top-1000 Enterprises Programme: Cutting emissions from industry

In 2005, China's top 1000 energy-consuming companies accounted for 47% of the energy used by Chinese industry and 33% of the energy used by the country as a whole. For China to move successfully to a low carbon future, it's crucial these industries take the lead in cutting emissions. To encourage them to do so, the government set up the Top-1000 Enterprises Programme.

How it works

Company targets

The programme aims to cut energy consumption in China by setting energy efficiency targets for China's 1000 largest energy-consuming companies. These targets came into effect in April 2006.

To meet them, companies need to show that products meet domestic best practice standards for efficiency. There are also stricter, international best practice targets for industry leaders. All companies in the

programme have also signed energy conservation agreements with local governments to improve operational energy efficiency by on average 25%, forming the basis of the 20% national energy intensity goal.

Close monitoring

Each company carries out regular energy audits, reporting monthly and annually to local governments and the National Development and Reform Commission. They also develop energy-saving action plans and provide information and training workshops for management and staff.

Personal targets

As a further incentive to make sure targets are met, local officials and heads of state-owned businesses are measured against them. Bonuses are also offered to leaders of successful companies and regions.

The future

The programme is an important part of the Government's strategy to meet China's 20% energy intensity improvement goal. To put its potential into context: if all the targets set under the programme are met, it would cut China's energy consumption by 100 million metric tons of standard coal by the 2010 deadline – equivalent to shutting down 381,000MW coal-fired power plants.

China's new product standards and labels will avoid over 10 million metric tons of CO₂ per year.

China is the largest producer of electronic and home appliances in the world, with approximately half of these products sold in the growing domestic market and the remainder exported to international consumers. This has implications for China's energy and resource consumption patterns from a manufacturing standpoint and also affects energy consumption by consumers both at home and abroad.

In 2005, China developed mandatory energy efficiency standards and labels for consumer appliances such as refrigerators, washing machines, air conditioners and other products. A recent study from the Lawrence Berkeley National Laboratory found that the standard will enable China to avoid over 100 million metric tons of CO₂ emissions per year.⁷⁰

The government has forbidden the sale of unlabeled products in China and has also issued green procurement policies for government offices and state-owned companies. Further standards are under development for microwaves, water heaters, electric fans, rice cookers and other appliances.

Meeting China's new building standard will require 5 trillion yuan of investment by 2020

China's construction industry is booming with a predicted 20 billion square metres to be constructed by 2020 – equivalent to Europe's entire building stock.⁷¹ China's buildings currently consume around 18% of the country's total energy, but this could reach up to 40% by 2030 when China's urban population is projected to more than double to a billion people.⁷²

To tackle this, the *Design Standard for Energy Conservation in Residential Buildings* (the Building Code) went into effect on January 1 2006, requiring new buildings to use energy efficient materials and insulation and to adopt energy saving technologies for heating, air conditioning, ventilation and lighting systems.⁷³ The Building Code requires new structures to have an in-use energy consumption level 50% lower than the current Chinese average and higher standards are specified for more economically developed cities such as Beijing and Shanghai. In addition, in the summer of 2007, the Government mandated that all government offices must keep air conditioning at no lower than 26°C in summer and no higher than 20°C in winter,⁷⁴ and encouraged citizens to do the same.

At the moment it is estimated that, of the existing 43 billion square metres of building stock in China, only 4% meet the new standards.⁷⁵ The Building Code is undoubtedly a great improvement, but it is still below international standards in certain areas.⁷⁶ Current building energy consumption per square meter is more than double the average in developed countries, so continuous improvement in this area is a key challenge for China. As around half of the world's new buildings go up in China each year, the push for green housing represents a significant market opportunity to many players. The Government estimates that an additional investment of 1.5 trillion yuan (US\$220 billion) in energy efficient buildings will be required before 2020 to meet the new building standards.

40%

China's buildings currently consume around 18% of the country's total energy, but this could reach up to 40% by 2030 when China's urban population is projected to more than double to a billion people.

Beijing: improving energy efficiency of buildings by 65%
The Chinese government has identified Beijing as one of four 'relatively economically developed' cities that needs to improve the energy efficiency of its buildings. As a result, the city has been set a target to cut energy consumption from buildings by 65%. With a population of over 16 million people and over half a billion square metres of apartment, office and factory floor space, this presents a big challenge for the city.

How the city is going about it

Monitoring consumption

Until recently, the energy consumption of buildings was largely unmonitored in Beijing – as in most of China. So in October 2007, the Beijing Municipal Construction Committee (BMCC) announced plans to carry out energy audits on all large buildings.

The first step of these audits was to install separate metres to measure the energy used for functions like lighting, ventilation, heating and air conditioning. The data then gets collected by an online monitoring system to help streamline the city's energy demand.

These energy audits now cover every state-run building and all private buildings over 20,000 square metres in the city, as well as 20% of other smaller buildings chosen at random. The process has also made Beijing one of the leading examples of building energy management in China.

Encouraging inefficient buildings to improve

During the energy audit process, any highly inefficient buildings will be asked to retrofit voluntarily. To do this, building owners will work with Energy Service Companies (ESCOs), who help to finance and manage the upgrades. Since efficiency improvements reduce energy bills and the improvements pay for themselves in a few years, building owners are usually happy to comply.

The future

The Beijing municipal government is investing significant

resources into collecting, storing and analysing the data from these audits. It's already using the analysis to help identify inefficient older buildings – estimated to include around 40 million square metres of floor space. These buildings will then be retrofitted with energy efficient

systems and materials. The work should be completed by 2010, with the target of reducing the average energy use of Beijing's building stock by 10%.

Officials estimate that the city's efforts will reduce CO₂ emissions by 1.8 million metric tons per year by 2010. This will help the city save billions of dollars on power investment. It could also help alleviate the city's pollution problems.

BROAD is a worldwide brand of central heating and cooling systems. Last year they had sales of US\$460 million in over 60 countries. Using their non-electric technology, they have heated and cooled over 56 million square metres of energy efficient buildings, and saved over 3 million metric tons of CO₂ in the process. BROAD makes units which emit only 0.15 kg of CO₂ per kWh of cooling – about 75% less than the traditional electric units which most buildings use. In buildings near power stations or industrial facilities, BROAD's equipment can also make use of waste heat, which often reduces its carbon emissions to zero.

Despite lucrative opportunities to start selling traditional electric air conditioning technology, BROAD is solely focused on becoming a leader in low carbon technology. This means continuing to research and build non-electric systems, now and in the future.

Vanke is China's largest residential property developer, selling over 48,000 apartments in 2007 alone. The company is also one of the leaders in the effort to make China's building industry greener, investing over 100 million yuan in greener construction techniques. Last year, it completed two buildings in Shanghai using techniques that cut waste from construction by up to 91%. The success of these experimental buildings has encouraged Vanke to use their new methods more widely, and the company is now on target to construct over 1 million square metres of green buildings by 2009.

20%

China's 1,000 most energy intensive companies have been set a range of efficiency based targets for products and operations. These form the basis of the overall target to reduce the energy intensity of the economy by 20%, against a 2006 baseline, by 2010.



China's solar water heater market is growing at 20% per year

While solar water heaters have not been successful in most other countries, the market in China has grown rapidly and accounts for about 60% of global capacity. China had an estimated installed capacity of 90 million square metres in 2006 and that year the domestic market had a turnover of over 20 billion Yuan (US\$2.6 billion). Installed capacity is still growing at about 20% per year and this thriving industry has created over 600,000 jobs.⁷⁷

The success of this simple technology is largely due to its low cost and high safety compared to gas or electricity and

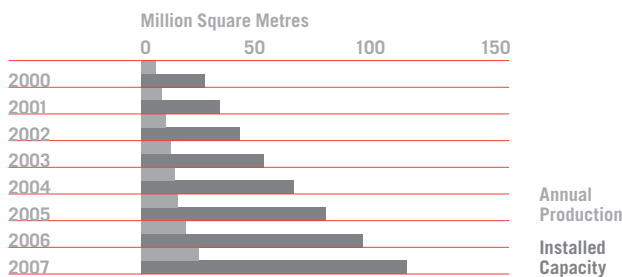
also the numerous environmental benefits it brings, including reduced urban air pollution. Typical units cost as little as 1,500 yuan (US\$180),⁷⁸ compared to an annual running cost of US\$120 to power an electric water heater. This makes the payback on investment around

two years while the expected lifetime of the unit is 10-15 years. Many municipalities such as Rizhao and Shenzhen have mandated that solar water heaters must be installed on new residential buildings. Solar water heaters are now installed in 10% of all Chinese homes and the market continues to grow.

2006

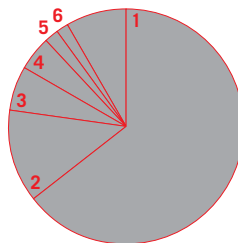
In 2006, Chinese companies produced over 35 million washing machines, 35 million refrigerators, 68 million air conditioning units, 144 million electric fans, 480 million cell phones, 83 million televisions, 93 million computers and billions of other products of every size and description.

Rapid growth in China's solar water heater market, 2000–2007³



**China leads global solar water heating installations, 2006
Total: 105 GW⁴**

1. China	64.5%
2. European Union	12.8%
3. Turkey	6.3%
4. Japan	4.5%
5. Brazil	2.1%
6. USA	1.7%
7. Other	8.1%
Total	100%



Himin Solar Energy Group: hot water from renewable sources

Himin Solar Energy Group has grown in under a decade to become the world's leading manufacturer of solar water heaters. With sales of over 2 billion yuan (US\$280 million) in 2007, the group is an industry pioneer, and has helped to bring solar energy into 40 million Chinese homes.

How it grew

From small beginnings

In 1987, Himin's CEO and founder, Mr Huang Ming, decided to build a solar water heater as a gift for his grandmother. Encouraged by feedback from his friends, Huang soon began producing more. He became well known locally, eventually making over 1,000 heaters for neighbours and friends.

An independent business

In 1992, Huang was encouraged by government officials to set up a state-owned company as part of China's economic development. However, the state took 70% of the profits. So three years later Huang and several colleagues left to start Himin.

By the year 2000, the company's sales had reached 500 million yuan (US\$60 million). Himin's hometown was Dezhou City and during this period it became known as the solar capital of China. Practically every house used a solar water heater, and the technology soon spread to other cities in Shandong province.

Diversifying

In 2003, the company started building higher quality units, with prices increasing from 1,500 yuan to 3,000 yuan (US\$219-430) for basic models. Now, the price can be as high as 20,000 yuan (US\$2,900) to install solar hot water in a luxury home. Himin is still market leader with over 14% market share and in 2007 the company was also awarded the Most Influential Contribution to Renewable Energy prize.

The future

Himin's solar water heaters have saved enough energy to reduce China's coal consumption by 20 million metric tons. Himin has also begun creating a 'China Solar Valley' in Dezhou, which could deal with over 100 billion Yuan (US\$14.6 billion) of solar investment going forward.

Chapter Three

Low Carbon Transport

Highlights:

- China's low carbon vehicle market is growing rapidly and produced over 79 million bicycles, 21 million electric bicycles and 1.64 million energy efficient compact cars in 2007⁸⁰
- In 2008, China implemented a 36 miles per gallon (mpg) fuel economy standard for passenger vehicles, almost 40% higher than US equivalents and the Government has put an excise tax of up to 20% on gas-guzzling SUVs⁸¹
- The Chinese Government has begun planting an area of marginal land half the size of England with biofuel forests which could produce 6 million metric tons of biodiesel per year by 2020⁸²

Challenges:

- The further scale-up of low carbon transport solutions is essential, as traditional automobile sales are also on the rise, up 21% in 2008 and could overtake the US market by 2015 to be the world's largest⁸³
- As the urban population in China is expected to double by 2030, large-scale investments are required in public transport systems
- As more efficient transport technologies, such as compact cars, come to scale and become affordable, this will encourage people to switch from less efficient modes of transport (e.g. larger cars), but could also encourage people to switch from more efficient options (e.g. electric bikes)
- China currently imports 47% of its oil, so improved fuel economy and the development of alternative fuels are critical for energy security. However, biofuel development in China needs to take into account concerns over food security and pricing

Opportunities:

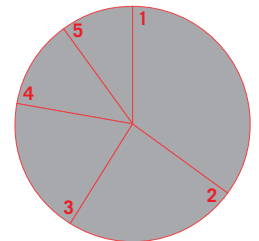
- China is the world's number one battery producer and is strategically positioned to become the leading global supplier of electric and hybrid electric vehicles in the future
- China has around 100 million hectares of marginal land, which can potentially be used for biomass forests without competing with food crops. This would also help to prevent soil erosion and desertification⁸⁴

China's on-road vehicle population will more than triple by 2035 to over 400 million

Automobiles are a symbol of high energy and high carbon lifestyles. China currently has one of the lowest carbon transport sectors in the world, with a motorised vehicle use rate of around one passenger car per 70 people in 2007, compared to almost one per person in the USA.⁸⁵ Overall, transport accounts for less than 10% of total energy use, much lower than the 25-30% typically seen in the developed world.⁸⁶ This reflects the fact that the majority of the Chinese population still uses public transport, bicycles, motorcycles and old fashioned foot-power.

Fuel consumption shares of chinese vehicles, 2006¹

1. Trucks	35%
2. Buses	24%
3. Cars	19%
4. Rural Vehicles	12%
5. Motorcycles	10%
Total	100%



However, this could change in the future as China's middle class continues to expand rapidly and demand more energy intensive transport. The Asian Development Bank projects that the total on-road vehicle population in China will more than triple by 2035 to over 400 million vehicles, including over 192 million personal passenger vehicles, approaching the size of the current US fleet.⁸⁷ Steps are therefore being taken by policy makers and business leaders to keep transport-related CO₂ emissions in check.

Energy security is a key consideration: 47% of Chinese oil is imported

One of China's major motivations for improving fuel economy and developing alternative fuels is energy security. Oil imports account for 47% of the country's 347 million metric ton per year oil consumption, making China the third largest oil importing nation after the USA and Japan. Oil imports grew by 12.4% in 2007 alone.⁸⁸

Chinese gasoline prices have been increasing steadily in recent years, although they are still controlled by the government. After the latest price hikes on June 20, 2008, the oil price in Beijing increased from 5.34 yuan per litre (US77c per litre) to 6.20 yuan (US89c per litre).⁸⁹ Moreover, there is ongoing debate in China over the introduction of a fuel tax to suppress energy demand and pay for the environmental and security costs of oil.

China currently gives large subsidies to state-owned oil refiners to compensate for controlled prices. In 2007 the largest refiner, Sinopec, was given 12.3 billion yuan (US\$1.76 billion) in subsidies⁹⁰ which only partly offset the company's losses. Going forward, China's domestic oil price can be expected to remain below international levels, as over half of domestic consumption is from oil produced locally for far less than the global market price which was over US\$140 per barrel in June this year.

Stringent fuel economy standards have been introduced

In October 2004, the Chinese Government implemented the country's first ever fuel economy standards for passenger vehicles. The standard has been going up year-on-year, and by 2008 it had reached 36.7mpg, higher than many developed countries including Australia, Canada and the USA.⁹¹ However, China still lags behind standards set in Japan and the European Union.⁹²

果园方向

GUOYUAN



往四惠东方向

TO SIHUI EAST



“China’s electric bicycles accounted for roughly three-quarters of the electric vehicles (EVs) sold worldwide last year.”

Frank E. Jamerson: former electric vehicle researcher at General Motors Corp⁷⁹



Actual and projected fuel economy for new passenger vehicles by country 2002-2016²



Taxation policy helps compact car market reach 1.64 million vehicles in 2007

In 2006 the Chinese Ministry of Finance rolled out a heavy excise tax to discourage the use of large and inefficient vehicles. The tax is based on engine displacement and adds up to 20% to the price tag of gas-guzzling SUVs, an amount typically over US\$8000. The policy also encourages the use of small vehicles and buses, which are only taxed at 5% or less.

Vehicle manufacturing excise tax rates in China³

Vehicle Category by Engine Displacement	Tax Rate
Automobiles	
1.0 to 1.5 litres	3%
1.5 to 2.0 litres	5%
2.0 to 2.5 litres	9%
2.5 to 3.0 litres	12%
3.0 to 4.0 litres	15%
4.0+ litres	20%
Commercial Buses	5%
Motorcycles	
<250cc	3%
>250cc	10%

With these policies in place, the market for mini or compact cars⁹³ reached 1.64 million vehicles in 2007, with an estimated sales volume of over US\$50 billion.⁹⁴ However, the market for SUVs still grew rapidly to 357,400 vehicles in 2007. Furthermore, it should be noted that although compact cars are more efficient than larger models, as costs come down this could also encourage people to stop using even more efficient modes of transport, like electric bikes and buses.

Domestic hybrid vehicle technology undercuts international competition

Sales of Toyota's famous Prius hybrid, which has sold over 1 million units around the world, have been disappointing in China with only 414 vehicles sold in 2007.⁹⁵ This is largely due to the already high price tag which, when capped with an additional 25% import tax, hits over US\$40,000, well beyond the reach of most Chinese consumers.

Last year several Chinese companies, including home-grown industry leaders Dongfeng, Chery and Chang'An announced that they had started production of hybrid vehicles in China. After six years of R&D with financial support from the Government's '863' research programme, Chang'An's first hybrid model rolled off the production line in December 2007. It cost 150,000 Chinese yuan (US\$21,500), almost halving the Prius' price tag. Chang'An's gasoline hybrid technology improves fuel economy by 20% compared to regular gasoline vehicles. Although this is less than the Prius' 40% reduction, it is expected to improve quickly in coming years.⁹⁶ Simultaneously, the Chinese auto market has been making rapid innovations in electric and plug-in hybrid/electric technology (see BYD case study).⁹⁷

BYD: From phone batteries to hybrid cars

Based in the industrial city of Shenzhen, BYD (short for *Build Your Dreams*) is the largest manufacturer of cell phone batteries in China and the second largest in the world. The company has over 130,000 employees, with sales of 12.9 billion yuan (US\$1.8 billion) in 2006. Five years ago, it moved into the auto sector and has since created the world's first plug-in hybrid car.

How it made the change

Acquisition

In 2003, BYD's founder, Mr Wang Chuanfu, saw an opportunity for a battery company to start creating low carbon, battery-driven vehicles. He used money raised on the Hong Kong stock market to buy Qinchuan Automobile, a small Chinese car maker. By 2007, BYD had created a successful car-manufacturing subsidiary business, with an annual output of over 100,000 vehicles, mostly for the Chinese market.

Battery expertise

BYD then started combining its battery and car-making expertise to create hybrid engines. In January 2008, it unveiled the world's first plug-in hybrid production model at the Detroit Motor Show. Called the 'F6DM', it has a range of 100km as a pure electric vehicle, 330km as a hybrid, and a top speed of 160km/hr. The vehicle's battery can be recharged from a 240V plug socket. More importantly, it only emits 70g of CO₂ per kilometre, barely half the European passenger vehicle standard of 130g/km.

Research support

BYD has received support from the Chinese Ministry of Science and Technology under the '863' research programme. With this help, it has developed a new iron-phosphate battery which can be recharged more than 2,000 times and could theoretically power a car for over 600,000 miles.

The future

New models

BYD is spending over 2 billion yuan (US\$280 million) developing its vehicle business this year, and has announced targets to double domestic sales to 200,000 units. In total, BYD is bringing out four hybrid models in 2008 – including the F6DM, which will cost 180,000 yuan (US\$26,000) – and two pure electric vehicles in 2009.

New markets

BYD plans to float on China's Shenzhen Stock Exchange this year. It also aims to introduce the electric-hybrid model into Europe within 2-3 years and to increase its sales to 1.5 million vehicles by 2015.

China leads world in electric bicycle market

In the last few years China's entrepreneurs have brought the humble bicycle, a symbol of Chinese development, into the 21st century by adding a nickel-cadmium rechargeable battery and an electric engine, producing a highly efficient form of electric transport known as the 'e-bike'. With a typical engine size of 250W, e-bikes emit at least 90% less CO₂ than passenger cars, making their per-passenger carbon footprint smaller even than public transport. 80% of global e-bike sales are in China which has almost 60 million e-bikes in use. In 2007 e-bike sales outpaced those of automobiles by two to one, representing an annual market worth 42 billion yuan (US\$6 billion).⁹⁸

Electric bicycles are relatively cheap with a price tag of only 1500 – 2500 yuan (US\$200-350) per vehicle. The increasingly sophisticated technology has a lifetime of 10



A company should assume societal, historical and moral responsibility. We will continue to produce compact vehicles to promote energy conservation in the automobile industry.

Yin Tongyao, board chairman of Chery Automobile

years and offers a range of 60km between charges, perfect in an urban setting.⁹⁹ During operation, air pollution emissions are zero and power consumption is only about 2kWh per 100 km. Batteries can be used for up to two years and can be

cheaply and conveniently traded in for a replacement. Reaching speeds of up to 30km/hour, e-bikes have become the vehicle of choice for many city commuters. Moreover, proponents are now calling for the wider adoption of e-bikes to replace China's 80 million plus motorcycles, a move which could eliminate 15 million metric tons of fuel consumption per year.

Giant Bike Co.: leading bicycle technology

Giant Bike Co. is one of the largest bicycle companies in the world, operating in over 50 countries and with over 10,000 distribution outlets worldwide. Well known internationally for its traditional bicycles (sales of which reached 5.5 million in 2007), the company is also a leader in China's electric bicycle market. In 2007, it sold over a quarter million of these e-bikes.

How the e-bike was born

An international idea

In the early 1990s, Giant started working and sharing technical expertise with both Ford and Renault. The result was the launch of its first electric bicycle, which hit the headlines at the 1995 Taiwan International Bicycle Exhibition.

A false start

Due to some teething problems with the first models, including an under-powered engine and unreliable battery, total sales of the model only reached 15,000. This slow start forced Giant's engineers back to the drawing board. No bad thing, as within a few years they had developed a range of new technologies that pushed the boundaries of the e-bike concept further.

Continuous improvement

Over recent years, Giant has improved most areas of the e-bike, from its design, battery and electric motor to the materials and methods used to make it. Some models now have intelligent energy recovery systems, similar to some hybrid cars, which recharge the battery while braking. The price of an e-bike has also come down considerably, with new models now starting from 1,500 yuan (US\$220).

The future

In 2007, Giant had the capacity to make 350,000 e-bikes. With rising demand from both China and abroad, Giant has 150 engineers focused on bringing out at least five new models

and five upgrades of previous models every year. As a result, the company is gearing up to ship over a million e-bikes per year by 2011.

Ambitious growth targets for bio-fuels

In 2005, China, already the third largest ethanol producer in the world,¹⁰⁰ announced plans to ramp up biofuel production to 6 million metric tons per year by 2010 and 12 million metric tons by 2020. However, rapid inflation in food prices through 2007 and 2008 has put biofuel development in the spotlight because of its effect on food markets and the environment. Chinese policy makers have halted further conversion of corn and other grain crops into biofuels and have begun developing alternatives such as cellulosic ethanol and biofuel forests, which grow on marginal land. Although the biofuel debate is ongoing, the Government looks to be standing by the 2020 target. According to a recent announcement by the Minister of Science and Technology, the total output value of the bioindustry will reach 500 to 800 billion yuan (US\$71-114 billion) by 2010 and 2 to 3 trillion yuan (US\$285-428 billion) by 2020, more than 4% of China's current GDP.¹⁰¹

Ethanol and cellulosic ethanol

Cellulosic ethanol technology, which has already been shown to successfully convert agricultural wastes such as wood, dead leaves and corn stalks into ethanol, could represent the future for bioethanol production. China produces up to 800 million metric tons of agricultural and forestry biowaste each year, which represents a huge resource for future cellulosic ethanol development. The main problem is the high cost of enzymes needed to catalyse the breakdown of biomass. Chinese universities and companies are working closely with the Government to try and solve this technical barrier and a number of pilot projects are underway. However, experts predict that cellulosic ethanol technology could take five or more years to commercialise.

Biodiesel forests

Biofuel forests look to be the favourite choice for reaching China's biofuel targets. There are currently plans to cultivate 13.3 million hectares, an area half the size of the UK, by 2020, which could produce 6 million metric tons of fuel. The most popular biofuel forest species identified so far is the *Jatropha* tree which can live for over 40 years and needs only about 25cm of rainfall per year to survive. These trees can be grown on hilly or marginal land where they will not compete with food crops. They also help stop soil erosion and desertification which are serious problems in China. It has been shown that a full grown tree can absorb about 9 kilograms of CO₂ every year which equates to more than 20 metric tons per hectare.¹⁰²

Production of various vehicles in China 2006⁴

Vehicle Type	Annual Production
Bicycles	78,900,000
Motorcycles	20,500,000
Electric Bicycles	15,600,000
Cars	3,870,000
Trucks	1,790,000
Buses and Public Vehicles	1,520,000
Train Carriages	41,400

An aerial photograph of a city skyline. The central focus is a tall, cylindrical glass skyscraper with a distinctive conical top. The building's glass facade reflects the surrounding urban environment. To the left and right, other high-rise buildings of varying architectural styles are visible. In the foreground, a multi-level highway interchange with several lanes of traffic is shown. The sky is overcast with soft, diffused light. A semi-transparent red banner with white text is overlaid on the lower portion of the image.

Meeting China's renewable energy target will require around \$400 billion of investment to 2020.

Chapter Four

Low Carbon Finance

Highlights:

- China is the second largest recipient of sustainable energy investment after Germany with approximately US\$12 billion invested in 2007¹⁰³
- China is the leading beneficiary from the United Nations Clean Development Mechanism (CDM) and has developed projects to reduce 900 million metric tons of CO₂ emissions by 2012, valued at over US\$10 billion¹⁰⁴
- The Chinese Government plans to invest over 41 billion yuan (US\$6 billion) in energy efficiency projects in 2008¹⁰⁵

Challenges:

- Funneling international investment and assistance aid into carbon reduction projects in China has had mixed success and there has been criticism of the effectiveness of some CDM projects such as those reducing hydrofluorocarbons (HFCs)
- Most local banks remain unfamiliar with financing energy efficiency projects and continue to focus on large infrastructure development projects

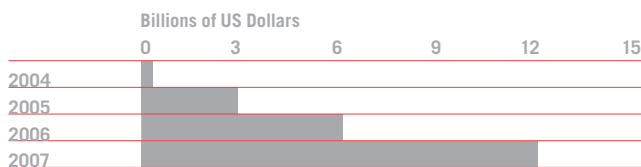
Opportunities:

- Stronger policies from the Chinese Government are creating increased demand for low carbon investment, including a projected US\$398 billion for renewable energy in the next 15 years¹⁰⁶
- China's Energy Service Companies (ESCOs), which provide innovative financing for energy efficiency projects, are growing strongly and the market is expected to grow to US\$1 billion by 2009¹⁰⁷

China ranks No.2 in renewable energy investment

Investment in renewable energy capacity in China (excluding large hydropower) was approximately US\$12 billion in 2007, an amount second only to Germany. Most of this was small hydro, solar water heating, solar PV and wind power, all of which have been booming in recent years.¹⁰⁸

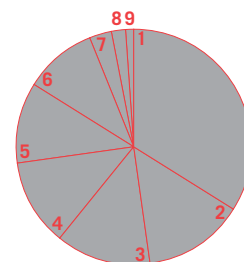
Investment in renewable energy in China¹ does not include large hydro



The Chinese National Development and Reform Commission estimates that US\$251 billion of investment is needed to reach the government target to produce 15% of primary energy from renewable sources by 2020. Independent estimates released by *New Energy Finance* in 2008 put the required figure at US\$398 billion or US\$268 billion not including large hydro.¹⁰⁹ This includes US\$91.1 billion in new wind capacity, US\$29.5 billion in solar PV, US\$26.4 billion for solar water heating, US\$37.5 billion for small hydro, US\$32.5 billion for biomass power generation, US\$11.9 billion for biofuels and US\$34.6 billion for biogas installations.

Total investments of \$268bn in new renewable energy in China by 2020² (does not include large hydro)

1. Wind	34%
2. Small Hydro	14%
3. Biogas	13%
4. Biomass Power	12%
5. Solar PV	11%
6. Solar Water Heating	10%
7. Bioethanol	3%
8. Biodiesel	2%
9. Geothermal	1%
Total	100%

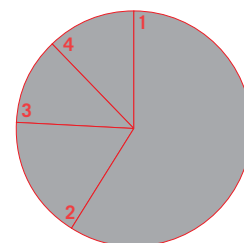


Broad range of investment sources

Figures from the *United Nations Environment Program* show that asset finance was the main source of investment in renewable energy in China in 2006 with about 60% of the total.¹¹⁰ Other sources of investment were public markets, venture capital funds and over US\$500 million in mergers and acquisitions. China has a rapidly developing venture capital community not only in renewable energy but also as part of the larger 'Cleantech' investment movement. According to the Cleantech Group, over 30 venture capital deals were completed in China between January 2006 and April 2007, totaling US\$980 million in value.¹¹¹

Breakdown of investment sources for renewable energy in China, 2006³

1. Asset Financing	59%
2. Venture Cap/Private Equity	17%
3. Mergers and Acquisitions	12%
4. Public Markets	12%
Total	100%



Although investment source figures for 2007 have not yet been released, it is clear that the proportion of funding from public stock markets will have increased, with over a dozen renewable energy initial public offerings (IPOs) seen last year.

China's solar PV manufacturing industry alone has seen numerous billion dollar IPOs in the last few years, helping China become the second largest global solar producer in 2008 (see Chapter 1). As of March 2008, China's top six publicly listed solar manufacturing companies had a market value of over US\$15 billion.¹¹²

China's six largest publicly listed solar manufacturers⁴

Company Name	Market Capitalization as of July 2008 (\$ millions)
Suntech Power Holdings Co.	5,60
LDK Solar Co.	3,76
JA Solar Holdings	2,47
Yingli Solar	2,08
Trina Solar Ltd	0,72
Solarfun	0,71
TOTAL	15,340

Leading Chinese banks loaned US\$15.8 billion for industrial efficiency in 2007

Investment in China's low carbon economy is not limited to renewable energy capacity. Other major investment areas include low carbon buildings, appliances, factories and

transport and also the traditional power sector, particularly high efficiency super-critical plants and high voltage distribution cables to cut down power losses. Figures from the China Banking

Regulatory Commission (CBRC) show that China's top five banks gave out 106.3 billion yuan (US\$15.18 billion) in loans for industrial energy efficiency projects in 2007 alone.¹¹³

One group of companies that has been very successful in increasing investment in efficiency is the so-called ESCOs (See Box). As banks have lacked understanding and shied away from sometimes technical and hands-on energy efficiency retrofits, ESCOs have developed expertise and are helping to leverage more funds into such projects.

2007

2007 saw over a dozen renewable energy Initial Public Offerings to raise finance.

ESCOs: cutting CO₂ at only US\$6/tonne

ESCOs focus solely on energy efficiency projects. As a group of companies, they invested US\$280 million and cut CO₂ emissions by an estimated 50 million metric tons in 2006 alone.

How ESCOs work

ESCOs are independent profit-making businesses that finance energy efficiency projects – either through Energy Performance Contracts (EPCs) or Energy Management Contracts (EMCs). In a typical project, the ESCO provides money for a customer's energy efficiency improvement and then takes about 80% of the cost savings until its investment is paid off. This usually takes about one to three years.

In this way, ESCOs make money by finding factories or buildings that aren't energy efficient and helping them install more efficient technology. The customer benefits, too: they get to use more efficient equipment without paying for it up front and also benefit from the cost savings once the ESCO has had its investment repaid.

The ESCO concept was introduced to China in 1997. By the following year, three ESCOs were started by the Government and backed by the World Bank, the Global Environment Facility (GEF) and the European Commission. These were in Shandong province, Liaoning province, and Beijing. By 2007, over 100 ESCOs were up and running.

The future

Some ESCOs, such as China's Broad Group, have begun working in other developing countries in Asia. With their average cost for reducing a tonne of CO₂ standing at less than US\$6, ESCOs are a cheaper way of reducing emissions than other carbon reduction schemes.

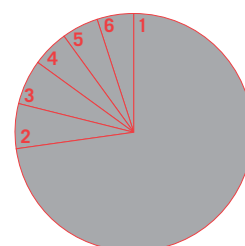
ESCOs are also popular with governments, because they reduce the need for government intervention. As a result, the market has grown strongly and is expected to be worth one billion dollars by 2009.

China dominates global CDM market with 900 million metric tons reduced so far

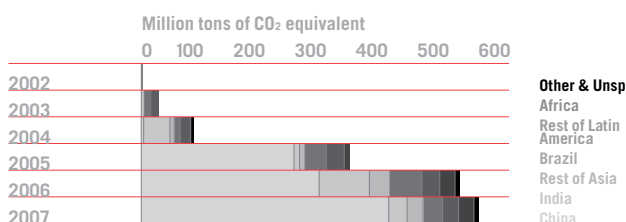
China has benefited greatly from the CDM, which allows voluntary carbon emission reductions from developing nations to be sold to developed countries which can use them to meet their Kyoto targets. The CDM was set up by the United Nations under the Kyoto Protocol and is a key element of the global carbon market. China has been extremely active in providing voluntary reductions for the CDM market and by the end of 2007 had already completed transactions for reducing over 900 million metric tons of greenhouse gases with a market value of over US\$10 billion – equal to 13% of the country's total emissions in that year. China has been so successful in the CDM market that it supplied 73% of all global CDM emissions reductions in 2007.¹¹⁴

China's share of CDM transactions in 2007⁵

1. China	73%
2. India	6%
3. Brazil	6%
4. Africa	5%
5. Rest of Asia	5%
6. Rest of Latin America	5%
Total	100%



Rapid growth in China's Primary⁶ CDM volume transactions since 2004



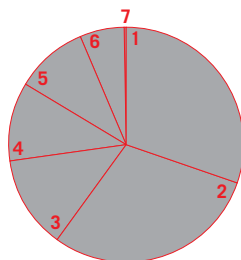
CDM projects in China cover a wide range of greenhouse gas-reducing technologies including wind turbines, methane capture from sewage plants and energy efficiency improvements. One of the biggest sources of CDM credits has been from the elimination of HFCs,

a byproduct from making industrial refrigerants. HFC projects have made a considerable contribution to mitigating climate change because each ton of HFC has a global warming potential over 11,700 times the equivalent mass of CO₂.¹¹⁵ HFC projects have been

criticised, however, because their low cost means that they have sometimes happened at the expense of renewable energy and efficiency projects. By the end of 2007, most HFC-emitting factories in China had installed control equipment and it is expected that this type of project will decrease sharply in 2008. The Chinese Government has also brought in differential tax policies to encourage CDM developers to focus on energy efficiency and renewable energy projects in future.

CDM investment by type of project in China, 2007⁷

1. Renewable Energy	30.32%
2. HFC Destruction	29.78%
3. Energy Efficiency	12.74%
4. Methane	10.88%
5. Nitrogen Oxide Destruction	9.96%
6. Fossil Fuel Switch	6.28%
7. Afforestation/Reforestation	0.03%



Financial reforms stimulate further investment

Despite the evolving policy framework supporting low carbon development there are still regulations in China that slow down clean energy investment in the country. High import taxes which restrict the movement of clean technology into China, for example, and lending and investment controls which funnel money into traditional 'low-risk' projects such as coal-fired power stations. There are also designated economic development zones which give tax breaks to energy intensive industries.

But the Chinese financial system is beginning to show signs of change. For example, the Renewable Energy Law which came into force on January 1, 2006 (see Chapter 1), authorises financial institutions to offer preferential loans with subsidised interest rates to projects involving renewable energy. Another positive sign is the increasing availability of financing for energy efficiency projects for small- and

medium-sized private companies, a segment which has been traditionally underserved by the country's giant state-owned banks.¹¹⁶

Returns on investment for energy efficiency improvements often exceed 50% per year, equivalent to a pay-back period of only two years – an extremely attractive return. However, Chinese banks are still limited in their ability to invest in this type of project because interest rates are regulated by government and are generally not allowed to exceed 10% – not enough to justify the perceived risk. In addition to the growing ESCO sector, other international financial institutions such as the International Finance Corporation (IFC) have created new financial tools to meet this market demand. The IFC is just one of a number of institutions supplying 'Green Loans' to reduce China's CO₂ emissions.

China's rapidly evolving financial markets can ultimately be expected to self-finance the energy efficiency improvements required, but innovative programmes such as those from the IFC are important to speed up the process and train Chinese financial institutions in the principles and methods of low carbon lending.

IFC and China Industrial Bank: green loans worth US\$776 million

Since 2006, the International Finance Corporation (IFC) and China have been developing ways to finance energy efficiency. The result is CHUEE – the China Utility-based Energy Efficiency Finance Program'. Through this programme, the IFC has started working with the China Industrial Bank. Together they have provided over US\$126 million of energy efficiency loans, with US\$650 million worth of projects in the pipeline.

How the programme works

Guarantees for banks

Banks normally give loans for large capital investments, which produce products and revenue. They have less experience in energy saving investments which don't create revenue but which reduce energy costs instead. To encourage Chinese banks to fund these energy saving investments, the IFC set up a fund worth US\$25 million to help reduce the risks banks face.

This guarantee mechanism was originally developed by the IFC in Russia. It puts the IFC in a 'first loss' position, and guarantees private banks that they will not lose more than 25% of their loans for the first few energy saving projects they fund. This way, local banks can get experience of investing in energy efficiency technologies without risking too much.

Cost-saving technology for business

CHUEE also helps companies to learn about cost-saving technology upgrades and then get access to money so they can implement them. So far, 46 projects have received these green loans. The majority are for small and medium sized companies to install energy efficiency measures, from retrofitting industrial boilers and wasted heat recovery systems to installing co-generation equipment. Typically the savings these companies make from the reduced energy costs can pay back the loan in two to five years.

The future

The first stage of the CHUEE project was a success. As a result, in February 2008, the IFC announced that the risk-sharing fund in the second phase would be expanded to US\$210 million. The agreement will allow the China Industrial Bank to extend guaranteed energy efficiency loans to 1.5 billion yuan. Very recently, the IFC has also signed agreements with Beijing Bank and Shanghai Pudong Development Bank to extend the scale of the CHUEE programme in China.



As a major commercial bank in China, we attach great importance to corporate social responsibility. We are proud to offer a market-based financing model to help the country save energy and improve its environment.
Li Renjie, President, China Industrial Bank

Conclusion

The rapid growth of clean technology markets in China is integral to international efforts to tackle climate change. Chinese citizens on average emit less than half the amount of CO₂ that people in developed countries do; but because of its large population of 1.3 billion and rapid economic development, China is one of the main contributors to global carbon emissions. The evidence gathered in this publication shows that contrary to popular belief, China is starting to take targeted action to mitigate greenhouse gas emissions. The Chinese low carbon economy, as in most other countries, is in its infancy and major challenges still exist. For example, energy intensity, although more than 60% lower than it was in 1980, is still significantly higher than in the US. However, this report demonstrates that the transition to low carbon solutions in China is already generating jobs, profits and increased energy security. Some of the key strategies that are being used in China to drive low carbon growth are:

Clear government vision and strong policy support

The Chinese Government has rolled out a comprehensive series of medium- and long-term goals for low carbon development covering almost every major carbon emitting industry. Coupled with other supporting policies, these targets have given companies in China the incentive and confidence to move into low carbon sectors – often exceeding targets, as has been seen in the wind power sector.

The Chinese Government has also helped fund energy efficiency and renewable energy projects. Spending has been justified not only by the reduction of energy costs and carbon emissions, but also by other co-benefits such as increased energy security, technology development and reduction of air and water pollution.

Moving into low carbon sectors with global demand

China's solar PV market has grown from almost nothing five years ago to be the world leader, with very little support from government policies or subsidies. The main driver behind this US\$14 billion industry has been government regulation in countries such as Germany, Spain and the USA, which has created an international demand for low cost solar panels. A similar pattern has been seen in many of China's export industries. In some cases, refrigerators and washing machines for example, Chinese companies initially develop efficient products for export and then move on to sell them in the domestic market. In other cases, companies first cultivate a local market and then use this as a base to expand overseas. This has been the case with electric bicycles, mini-cars and could also happen in the case of solar water heaters.

Taking advantage of international capital opportunities such as public markets, cooperating with international technology providers, and expanding exports to generate economies of scale have all been winning strategies for Chinese low carbon companies operating in an increasingly globalised world.

Cultivating low carbon tastes among domestic consumers

Both government and businesses are playing a role in steering the tastes of Chinese citizens away from high carbon products and lifestyles towards more sustainable alternatives. Government policies such as mandatory

efficiency labeling of consumer appliances and fuel economy standards have been acting to change behaviour and create markets for low carbon products. Companies, for their part, have responded rapidly with a range of environmentally-friendly products, green cars and efficient appliances along with strong marketing campaigns to stimulate markets. Just two examples of this are the markets for electric bicycles and solar water heaters, both of which are the largest in the world and developed from almost nothing at the turn of the millennium.

Breaking down barriers to low carbon finance

After a slow start in the carbon emission reductions market, China has now become the largest supplier of CDM credits in the world. This has been achieved, in part, because of considerable support and training given to Chinese companies from the Government, international institutions and consulting companies. As a result, the CDM is now funding billions of dollars worth of carbon reductions in China.

China's success in attracting renewable energy investment has been complemented by government efforts to increase the availability of green loans. This has included encouraging energy service companies (ESCOs) and other financial mechanisms to build on the capacity of banks to fund energy efficiency projects. In a world of increasing energy costs, China's low carbon lenders are finding that replacing inefficient technology is a profitable and growing market.

Allowing low carbon companies to reap profits

A vibrant and innovative low carbon business community has grown up in China in response to consumer demand, government targets and policy, export opportunities and greater availability of finance. This community has already gained a momentum of its own, and is giving positive feedback in the form of marketing efficient products to consumers, lobbying government for supporting policies, increasing investments in low carbon R&D, lowering prices to increase international demand, and returning high profits therefore attracting further investment.

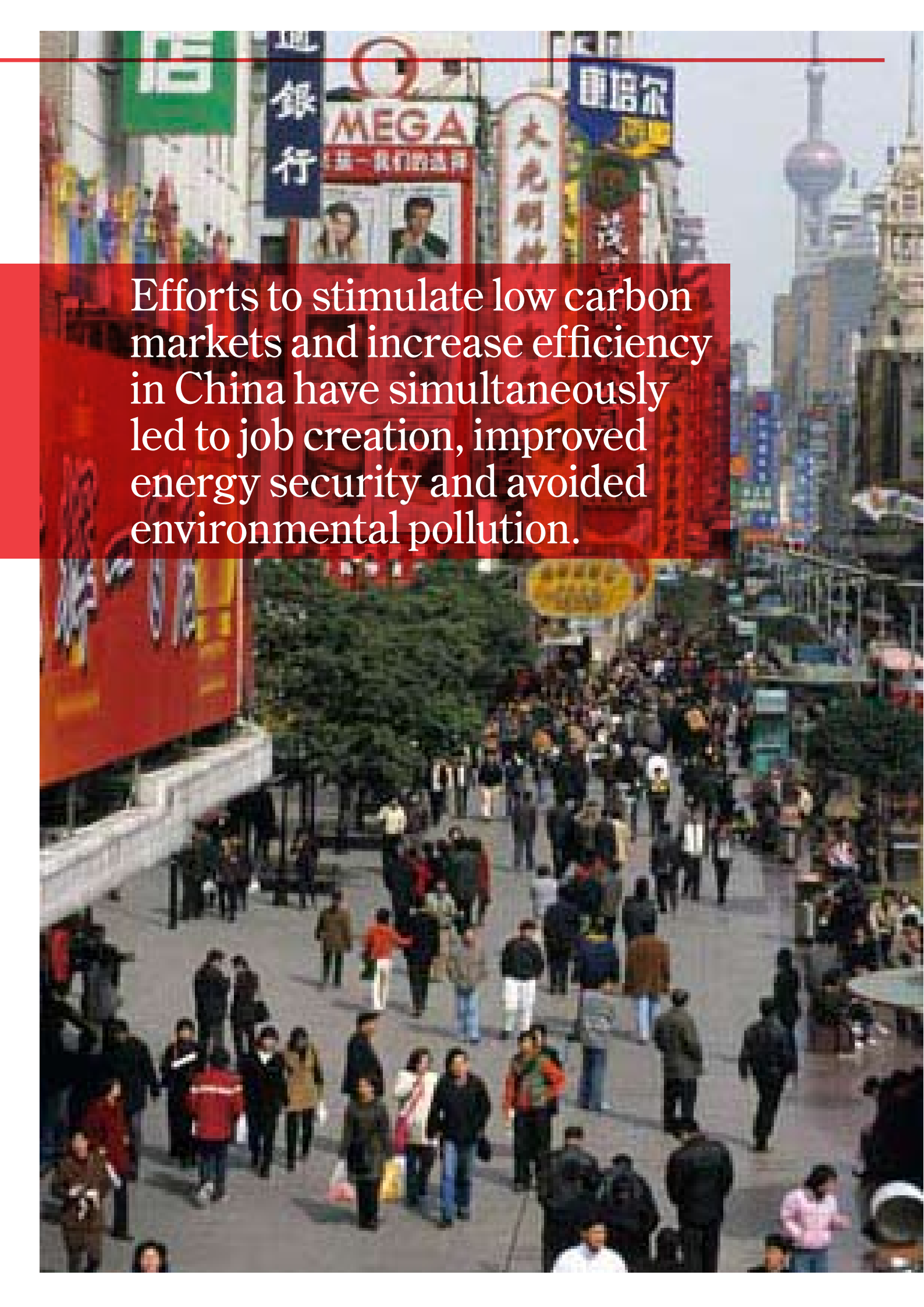
The future

This report has chronicled the key initial developments in China's journey to a sustainable future and has profiled some of the country's leading low carbon innovators. The data, trends and case studies speak for themselves and are a cause for hope that both developed and developing countries around the world can move away from carbon-intensive lifestyles.

The steps taken so far in China, and documented in these pages, demonstrate that the opportunities associated with the move to a low carbon economy are not just relevant to developed nations. Efforts to stimulate low carbon markets and increase efficiency in China have simultaneously led to job creation, improved energy security and avoided environmental pollution. Furthermore, they are the vital first steps in putting China on a track to peak domestic greenhouse gas emissions by 2020.

However, it remains to be seen if this strong growth in renewable and low carbon industries can expand over the next decade on the scale required to replace traditional carbon-intensive energy sources and industries and begin to significantly reduce China's carbon emissions towards two metric tons per capita by 2050.

This report shows, in no uncertain terms, that China's Clean Revolution is well underway. But China will need to cooperate with other nations in order to rise to the challenge of delivering a global low carbon economy which can sustain prosperity and security in the future.

A high-angle photograph of a crowded pedestrian street in a city, likely Shanghai. The street is filled with people walking. In the background, there are several large, colorful billboards and signs. One prominent sign features the word "MEGA" in red letters. To the right, the Oriental Pearl Tower is visible in the distance. A semi-transparent red rectangular box is overlaid on the upper portion of the image, containing white text.

Efforts to stimulate low carbon markets and increase efficiency in China have simultaneously led to job creation, improved energy security and avoided environmental pollution.

Sources

Foreword

- 1 – Calculated from per capita CO₂ emissions data from the Netherlands Environmental Assessment Agency. In this scenario, China's per capita CO₂ emissions increase from 5.6 metric tons in 2007 to 12.6 metric tons in 2020; EU-15 per capita CO₂ emissions decrease from 8.6 metric tons to 6.1 metric tons in the same period
- 2 – International Energy Agency, *World Energy Outlook 2006*, <http://www.worldenergyoutlook.org/2006.asp>
- 3 – Martinot, Eric and Li Junfeng, *Powering China's Development: The Role of Renewable Energy* (Worldwatch Institute, November 2007); UK House of Commons Innovation, Universities, Science and Skills Committee, *Renewable electricity generation Technologies Fifth Report of Session 2007–08 Volume I*, 11 June 2008, <http://www.publications.parliament.uk/pa/cm200708/cmselect/cmduus/216/216.pdf>
- 4 – As set out by Nicholas Stern in *Key Elements of a Global Deal on Climate Change*, published by the London School of Economics, April 2008
- 5 – Netherlands Environmental Assessment Agency. <http://www.mnp.nl>

Executive Summary

- 1 – Lewis, Joanna I., *China's Strategic Priorities in International Climate Negotiations*, Washington Quarterly, Winter 2007-8, 31:1 pp. 155–174, http://www.twq.com/08winter/docs/08winter_lewis.pdf
- 2 – World Resources Institute, *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy*, 2005, http://pdf.wri.org/navigating_numbers.pdf
- 3 – Stern, Nicholas, *Key Elements of a Global Deal on Climate Change*, London School of Economics, April 2008, http://www.lse.ac.uk/collections/granthaminstitute/publications/KeyElementsOfAGlobalDeal_30Apr08.pdf
- 4 – Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007 Global Status Report*, 2008, www.ren21.net/pdf/RE2007_Global_Status_Report.pdf
- 5 – Medium- and Long-term Program for Renewable Energy Development, 2007
- 6 – Announcement made at the EU Spring Summit, Brussels, March 2007
- 7 – REN21, *Renewables 2007 Global Status Report*, 2008
- 8 – International Monetary Fund data, 2007
- 9 – New Energy Finance, *Interesting Times 2.0 – Second Focus Report on Clean Energy Investment Opportunities in China*, January 2008, <http://www.newenergyfinance.com/?n=19>
- 10 – Sawin, Janet, *Another Sunny Year for Solar Power*, Worldwatch Institute, May 2008
- 11 – According to the Global Wind Energy Council, Chinese production capacity for wind turbines is expected to reach 10 Gigawatts per year by the end of 2009 (<http://www.windfair.net/press/4193.html>)
- 12 – Business Week, *China's Plucky Plug-in Hybrid*, January 2008; US News and World Report, *China's Renewal: Hungry for fuel, it emerges as a leader in renewable energy*, June 2006
- 13 – International Council on Clean Transportation (ICCT), *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, 2007
- 14 – China Electric Bicycle Business Info Net (in Chinese), www.ddc.net.cn; China Auto News (in Chinese), *Overall Profitability Improves, Rapid Growth in China Auto Market in 2007*, January 2008, <http://www.qiche.com.cn/files/200801/16016.shtml>
- 15 – Green Car Congress, *China Targeting Growing Biofuels 12x by 2020*, August 2006, http://www.greencarcongress.com/2006/08/china_targeting.html
- 16 – China State Forestry Administration, *Fuel from forests is new clean energy goal*, February 2007, http://english.gov.cn/2007-02/08/content_521544.htm
- 17 – Green Car Congress, *China Targeting Growing Biofuels 12x by 2020*, August 2006, http://www.greencarcongress.com/2006/08/china_targeting.html
- 18 – Energy intensity dropped from 3.39 metric ton Standard Coal Equivalent per 10,000 RMB of GDP in 1980 to 1.21 in 2005, a drop of 63% with calculation based on the 2005 constant price
- 19 – Target contained in the Chinese National Development and Reform Commission, *11th 5 Year Plan for 2006-2010*, 2005
- 20 – Chinese National Development and Reform Commission, January 2008, http://nj.ndrc.gov.cn/sdyx/t20080203_190031.htm
- 21 – Chinese National Development and Reform Commission, *Program of Energy Conservation among 1000 Enterprises*, 2006
- 22 – Fridley, David, Nathaniel Aden, Nan Zhou and Jiang Lin, *Impacts of China's Current Appliance Standards and Labeling Program to 2020*, The Collaborative Labeling And Appliance Standards Program, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, March 2007, <http://www.osti.gov/bridge/servlets/purl/920173-qvrmDX/920173.PDF>
- 23 – The six largest solar companies in China are: Suntech Power Holdings (US\$5.6bn), LDK Solar (US\$3.76 bn), JA Solar Holdings (US\$2.47bn), Yingli Solar (US\$2.08bn), Trina Solar (US\$0.72bn), Solarfun (US\$0.71bn). Figures taken from Google Finance on 21st July 2008, <http://finance.google.com>
- 24 – Renewable Energy World, *Powering China's Development: The Role of Renewable Energy*, March 2008
- 25 – Financial Post, *China Market Powers Growth for Electric Bike Manufacturer*, March 2008
- 26 – Goldwind Science and Technology Company, market value as quoted by *Google Finance* in March 2008.
- 27 – Measured by metric ton Standard Coal Equivalent per 10,000 RMB of GDP
- 28 – Statistical Communiqué for Each Province (Autonomous Region, Municipality) on Energy Consumption per GDP in 2007, July 14, 2008

Chapter One

- 29 – Xinhua News Agency, *Mr. Zhao Xiaoping, Deputy Minister of the Department of Energy* (in Chinese), http://news.xinhuanet.com/fortune/2008-06/23/content_8420968.htm
- 30 – National Development and Reform Commission, *China shuts down 14.4 million KW of thermal power capacity in 2007*, January 2, 2008, http://www.china.org.cn/business/news/2008-01/02/content_1237701.htm
- 31 – Global Wind Energy Council, *Global Wind 2007 Report*, 2007, <http://www.gwec.net/index.php?id=90>
- 32 – Global Wind Energy Council, *Global Wind 2007 Report*, 2008, <http://www.gwec.net/index.php?id=90>
- 33 – The six largest solar companies in China are: Suntech Power Holdings (US\$5.6bn), LDK Solar (US\$3.76 bn), JA Solar Holdings (US\$2.47bn), Yingli Solar (US\$2.08bn), Trina Solar (US\$0.72bn), Solarfun (US\$0.71bn). Figures taken from Google Finance on 21st July 2008, <http://finance.google.com>
- 34 – National Bureau of Statistics of China, *China Statistical Yearbook 2007*, 2007
- 35 – Renewable Energy Policy Network for the 21st Century, http://www.ren21.net/pdf/RE2007_Slides.pdf
- 36 – China Economics Net (in Chinese), http://www.ce.cn/xwzx/gnsz/gdxw/200804/22/t20080422_15234331.shtml
- 37 – Xinhua News Agency, *Renewable Energy May Account for 30% of Energy Supply*, 19 September 2007, http://www.chinadaily.com.cn/bizchina/2007-09/19/content_6118929.htm
- 38 – Renewable Energy World, *Powering China's development: The role of renewable energy*, March 20, 2008, <http://www.renewableenergyworld.com/rea/news/reworld/story?id=51586>
- 39 – Earth Policy Institute, *Solar Cell Production Jumps 50 Percent in 2007*
- 40 – China's Medium- and Long-term Program for Renewable Energy Development, 2007
- 41 – Global Wind Energy Council, *Global Wind 2007 Report*, 2007, <http://www.gwec.net/index.php?id=90>
- 42 – Xinhua News Agency, *Renewable Energy May Account for 30% of Energy Supply*, 19 September 2007, http://www.chinadaily.com.cn/bizchina/2007-09/19/content_6118929.htm
- 43 – Zhuang, Guiyang, *How Will China Move Towards A Low Carbon Economy*, China Meteorological Association Press, 2007 (in Chinese)
- 44 – Martinot and Junfeng, *Powering China's Development: The Role of Renewable Energy*
- 45 – Experts referred to are from China Strategies LLC. Story from: Hudson, Gavin, *Energy experts say China's wind energy could grow 1667% by 2020*, July 3rd, 2008, <http://ecoworldly.com/2008/07/03/energy-experts-say-chinas-wind-energy-could-grow-1667-by-2020/>
- 46 – Junfeng, Li and Ma Lingjuan, *In focus: China's wind industry*, Refocus, Volume 8, Issue 5, September-October 2007, pp. 46-48
- 47 – Chinese National Development and Reform Commission, *Requirements of Wind Power Project Construction and Management*, July 2005, http://www.sdpc.gov.cn/njyt/nyzywx/t20050810_41378.htm
- 48 – Goldman Sachs Global Markets Institute, *Alternative Energy: A Global Survey*, 2007
- 49 – The China Renewable Energy Law, 2006
- 50 – Energy Institute of China, *Official Renewable Energy Plan of the National Development and Reform Commission* (in Chinese) September 2007, <http://www.eri.org.cn/manage/editor/UploadFile/200791710347695.doc>
- 51 – Measures on the Cost and Pricing of Power Generation from Renewable Energy (Trail), 2007
- 52 – Medium- and Long-term Program for Renewable Energy Development, 2007 (2005 data)
- 53 – Personal communication with Nickolas Themelis, Waste-to-Energy Research and Technology Council, to China, October 18-November 3, 2007 (by Liliana and Nickolas Themelis), <http://www.seas.columbia.edu/earth/wtrt/sofos/Themelis%20China%20Visit%20Report.pdf>
- 54 – National Bureau of Statistics of China, *China Statistical Yearbook 2007*
- 55 – China's Medium- and Long-term Program for Nuclear Power Development (2005-2020), 2007; and China Climate Change Info, *China to double nuclear power capacity by 2020*, November 16 2007, <http://www.ccchina.gov.cn/en/NewsInfo.asp?NewsId=9823>
- 56 – Medium- and Long-term Program for Nuclear Power Development (2005-2020)
- 57 – Houser, Trevor, *China's Energy Consumption and Opportunities for U.S.-China Cooperation to Address the Effects of China's Energy Use* presented to the U.S.-China Economic and Security Review Commission, June 14, 2007, http://www.cpi.cam.ac.uk/pdf/Houser_Statement.pdf
- 58 – Chinese National Development and Reform Commission (in Chinese), http://www.sdpc.gov.cn/xwfb/t20071230_182913.htm
- 59 – For more information see <http://www.nzec.info/en/what-is-nzec/>

Chapter Two

- 60 – Design Standard for Energy Conservation in Civil Building; and McKinsey Global Institute, *Preparing for China's Urban Billion*, March 2008
- 61 – Worldwatch Institute, *China to Push Use of Solar Water Heaters, 8th May 2007*, <http://www.worldwatch.org/node/5060>
- 62 – Fridley et al., *Impacts of China's current Appliance Standards and Labeling Program to 2020*, Lawrence Berkeley National Laboratory, 2007, <http://repositories.cdlib.org/cgi/viewcontent.cgi?article=5840&context=lbnl>
- 63 – McKinsey Global Institute, *Preparing for China's Urban Billion*, March 2008

64 – Tyndall Center for Climate Change Research, *Who Owns China's Carbon Emissions?*, October 2007

65 – Peoples Daily, *Discussions on Energy Efficiency with Government Office* (in Chinese), January 2007. <http://politics.people.com.cn/GB/1026/5302960.html>

66 – Worldwatch Institute, *China Pushing for Energy-Efficient Buildings*, January 2007

67 – Chinese National Bureau of Statistics, *China Statistical Yearbook 2007*

68 – As set out in the “11th Five Year Plan” approved by National People's Congress of China

69 – Announcement by the Ministry of Finance of China, March 2008, http://www.mof.gov.cn/news/20080310_2119_32009.htm

70 – Fridley et al., *Impacts of China's current Appliance Standards and Labeling Program to 2020*, Lawrence Berkeley National Laboratory, 2007, <http://repositories.cdlib.org/cgi/viewcontent.cgi?article=5840&context=ibnl>

71 – McKinsey Global Institute, *Preparing for China's Urban Billion*, March 2008

72 – Ibid

73 – China Economic Information Network, *China mandates energy efficiency standard in urban construction*, February 27 2006, <http://www1.cei.gov.cn/ce/doc/cenn/200602270785.htm>

74 – Xinhua News Agency (in Chinese), http://news3.xinhuanet.com/politics/2007-06/03/content_6191869.htm

75 – Li, Ling, *China Pushing for Energy-Efficient Buildings*, Worldwatch Institute, January 2007

76 – Asia Times, *Beijing's Bright Idea for Saving Energy*, January 30 2007, http://www.atimes.com/atimes/China_Business/IA30Cb04.html

77 – Worldwatch Institute, *China to Push Use of Solar Water Heaters*, 8 May 2007, <http://www.worldwatch.org/node/5060>

78 – Martinot, Eric, *Renewable Energy Information on Markets, Policy, Investment and Future Pathways*, <http://www.martinot.info/china.htm>

79 – Institute for Electrical and Electronic Engineers (IEEE), *China's Cyclists Take Charge*, June 2005

Chapter Three

80 – Chinese National Bureau of Statistics, *China Statistical Yearbook 2007*; China Auto News, *Overall Profitability Improves, Rapid Growth in China Auto Market in 2007* (in Chinese), January 2008, <http://www.qiche.com.cn/files/200801/16016.shtml>

81 – New China News Agency, *China Raises Taxes on Gas Guzzlers*, March 23 2006, http://www.chinadaily.com.cn/opinion/2006-03/23/content_550431.htm

82 – China State Forestry Administration, *Fuel from forests is new clean energy goal*, February 2007, http://english.gov.cn/2007-02/08/content_521544.htm

83 – Department of Information Technology, Ministry of Commerce, People's Republic of China, *Global Automakers Report Soaring Q1 China Sales*, Xinhua News Agency, April 10 2008, <http://english.mofcom.gov.cn/aarticle/newsrelease/commonnews/200804/20080405471568.html>

84 – Mang, Heinz-Peter, *Perspective of Bioenergy and Jatropha in China*, International Consultation on pro-Poor Jatropha Development, Rome, Italy, April 10-11 2008, www.ifad.org/events/jatropha/country/HP_Mang.ppt

85 – KPMG, *Momentum: Driving Forces in China's Car Market*, 2007, http://www.kpmg.com/hk/en/virtual_library/Industrial_markets/Momentum_Driving_Forces.pdf

86 – Rosen, Daniel H. and Trevor Houser, *China Energy: A Guide for the Perplexed*, May 2007, <http://www.iese.com/publications/papers/rosen0507.pdf>

87 – Asian Development Bank *Energy Efficiency and Climate Change Considerations for On-Road Transport in Asia*, 2006, <http://www.adb.org/Documents/Reports/Energy-Efficiency-Transport/energy-efficiency.pdf>

88 – China Daily *China Oil Consumption to Hit 563M Tons in 2020*, April 8 2008, http://www.chinadaily.com.cn/china/2008-04/08/content_6599920.htm

89 – National Development and Reform Commission (in Chinese), http://www.ndrc.gov.cn/zfd/jggg/you/t20080620_222277.htm

90 – Xinhua News Agency (in Chinese), http://news.xinhuanet.com/fortune/2008-03/20/content_7823778.htm

91 – International Council on Clean Transportation (ICCT), *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, 2007

92 – International Council on Clean Transportation (ICCT), *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, 2007; Bloomberg Worldwide, *Congress Agrees to Increase Fuel Standard to 35mpg*, December 2007; *Energy Foundation, China Emerging As New Leader In Clean Energy Policies, Energy Foundation – China Sustainable Energy Program*, March 2008

93 – Defined as cars with engine displacements below 1.3 litres

94 – China Auto News, *Overall Profitability Improves, Rapid Growth in China Auto Market in 2007* (in Chinese), January 2008, <http://www.qiche.com.cn/files/200801/16016.shtml>

95 – Forbes, *China's Drivers have a Green Future*, March 7 2008, http://www.forbes.com/2008/03/06/solutions-green-car-china-oped-cx_cob_0307china.html

96 – China Daily, *They Will Drive You Green Without Envy*, February 22 2008, <http://www.china.org.cn/english/environment/243568.htm>

97 – Business Week, *China's Plucky Plug-in Hybrid*, January 2008, http://www.businessweek.com/magazine/content/08_03/b4067064367712.htm

98 – Financial Post, *China Market Powers Growth for Electric Bike Manufacturer*, March 2008; China Electric Bicycle Business Info Net (in Chinese), www.ddc.net.cn

99 – UC Davis, *The Transition to Electric Bikes in China: History and Key Reasons for Rapid Growth*, Institute for Transportation Studies, 2006

100 – Yingling, Lui, *China Moving Away from Grain for Ethanol Production*, Worldwatch Institute, April 27, 2006, <http://www.worldwatch.org/node/3919>

101 – China Daily, *Bio-industry Outlook Bright*, June 27, 2007, <http://english.hanban.edu.cn/english/BAT/215279.htm>

102 – Chinese National Bureau of Statistics, *China Statistical Yearbook*

2007. Green Energy News, *Jatropha Curcas: Promising Biofuel Feedstock or Invasive Species?* August 14, 2007 – Vol.12 No. 21, <http://www.green-energy-news.com/arch/nrgs2007/20070100.html>

Chapter Four

103 – Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2007 Global Status Report*, 2008

104 – World Bank, *State and Trends of the Carbon Market 2008*, 2008, <http://siteresources.worldbank.org/NEWS/Resources/State&Trendsformatted06May10pm.pdf>

105 – Announcement from the Chinese Ministry of Finance, March 2008 (in Chinese), http://www.mof.gov.cn/news/20080310_2119_32009.htm

106 – New Energy Finance, *Interesting Times 2.0 – Second Focus Report on Clean Energy Investment Opportunities in China*, January 2008, <http://www.newenergyfinance.com/?n=19>

107 – World Bank, *World Bank, GEF-Backed Energy Efficiency Program Expands in China*, January 14 2008, <http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/EXTSDNETWORK/0,,contentMDK:21610830-menuPK:3981802-pagePK:64159605-piPK:64157667-theSitePK:3167628,00.html>

108 – Data for 2004-6 taken from United Nations Environment Program and New Energy Finance, *Global Trends in Sustainable Energy Investment 2007*

109 – New Energy Finance, *Interesting Times 2.0 – Second Focus Report on Clean Energy Investment Opportunities in China*, January 2008, <http://www.newenergyfinance.com/?n=19>

110 – United Nations Environment Program and New Energy Finance, *Global Trends in Sustainable Energy Investment 2007*

111 – CleanTech Group LLC, *China Cleantech Venture Capital Investment Report, 2006-Q1 2007*, <http://cleantechnetwork.com/Whitepapers/ChinaCleantechVCIReportQ12007.pdf>

112 – Google Finance

113 – Xinhua News Agency, *China Focus: China Takes Responsible Attitude to Climate Change and Environmental Protection*, April 2008

114 – New Energy (in Chinese), <http://www.newenergy.org.cn/html/0085/5300817806.html>

115 – United Nations Framework Convention on Climate Change (UNFCCC) *Global Warming Potentials*

116 – Chandler and Gwin, *Financing Energy Efficiency in China*, Published by Carnegie Endowment for International Peace, 2008

Executive Summary charts

1 – Calculated from data in the BP Statistical Energy Review, 2007; required value taken from Nicholas Stern, Key Elements of a Global Climate Deal, 2008

Chapter One charts

1 – Junfeng Li, Renewable Energy in China, 2007

2 – China Renewable Energy Law; Jungeng Li, Renewable Energy in China, 2007

3 – China Renewable Energy Law (NB fossil fuel installed power base estimated from 2007 figure from the National Bureau of Statistics with 5% growth rate to 2020)

4 – Earth Policy Institute; Solarbuzz; Worldwatch Institute

5 – Production Capacity Targets for Top Solar PV Companies in China

6 – Worldwatch institute

7 – Global Wind Energy Council

8 – Goldman Sachs, Global Markets Institute

9 – World Energy Council; Huaneng Power International

Chapter Two charts

1 – The National Bureau of Statistics of China

2 – The National Bureau of Statistics of China

3 – The China New Energy Net (www.newenergy.com.cn)

4 – REN21

Chapter Three charts

1 – The Innovation Center for Energy and Transportation

2 – International Council on Clean Transportation (ICCT)

3 – Chinese Ministry of Finance

4 – National Bureau of Statistics of China

Chapter Four charts

1 – UN SEFI for 2004-6, REN21 for 2007

2 – New Energy Finance. Note: Does not include large hydro

3 – UN SEFI

4 – Google Finance

5 – World Bank

6 – World Bank

7 – The National Coordinating Committee on Climate Change of China

Acknowledgements



For specific support of this publication The °Climate Group would like to thank HSBC and Thor Björgólfsson.

In 2007 The °Climate Group joined EarthWatch Institute, The Smithsonian Tropical Research Institute and WWF to form the HSBC Climate Partnership – a five-year programme on climate change launched in May 2007. The Partnership aims to inspire action by individuals, businesses and governments worldwide to combat the impacts of climate change, with a focus on selected world cities and major rivers. The °Climate Group's work as part of the HSBC Climate Partnership will promote low carbon solutions and practices in five world cities – Hong Kong, London, Mumbai, New York and Shanghai. Our programme will support leadership by influential businesses and governments (city, state and national) based in these cities. In addition, it will seek to engage and enable consumers through the Together campaign, which convenes a range of consumer brands and public-facing organisations to deliver climate solutions to the general public. As part of the efforts to help address climate change, HSBC has taken the lead. In 2005 it became the first major bank – and FTSE100 company – to go carbon neutral, and was later awarded the “Sustainable Bank of the Year 2006” by the Financial Times.

The report was also supported by Thor Bjorg Ifsson, international investor, entrepreneur and CEO of Novator. Novator's investment portfolio is focused around four main sectors: Telecommunications, Pharmaceuticals, Financial Services and Real Estate. In addition, Novator operates a Private Equity Fund and a Credit Opportunities Fund.

The °Climate Group recognises and thanks our supporters: Baker & McKenzie Limited, Barclays Bank, Thor Björgólfsson, Bullitt Foundation, W. Carey Crane III, Clean Power Foundation, Stephen Dawson, The Department for Environment, Food and Rural Affairs, Catherine Drury, Stichting DOEN, Michael Edge, Esmée Fairbairn Foundation, Garfield Weston Foundation, Goldman Sachs & Co., HDR, HSBC Holdings plc, JP Morgan Chase Foundation, Man Group plc, MSST Foundation, MWH, Nationale Postcode Loterij, Oak Foundation, Paul Pheby – Lotus Asset Management, Richard and Rhoda Goldman Fund, Rockefeller Family Fund, Gary Ross and Allison Thomas, Shell International Ltd, State of Victoria, Schroder Foundation, Swiss Reinsurance Company, The Carbon Trust, The Energy Foundation, The John D. and Catherine T. MacArthur Foundation, The Nand and Jeet Khemka Foundation, The Robertson Foundation, UK Foreign and Commonwealth Office, United Nations Foundation, Universal City Studios, Webex, World Resource Institute, Zennström Philanthropies and other individual and anonymous donors.

We are also grateful for the ongoing commitment of our members; Arup, Austin Energy, Baker & McKenzie, Barclays, Bloomberg, BP, British Columbia, British Sky Broadcasting Ltd, British Telecom (BT), Cadbury plc, California, Catalyst, CBRE, Chicago, Coke, Dell, Deutsche Bank, Dow Chemical Inc, Duke Energy, Florida Power and Light, Google, HDR, HSBC, IBM, Interface, IWC, Johnson & Johnson, JPMorgan Chase, Lenovo, London, Los Angeles, Man Group plc, Manitoba, Marks & Spencer, Miami, Munich Re, MWH, News Corp, New York City, New York State, Nike, Ontario, Pepsi, Pratt Industries, Quebec, South Australia, Starbucks, Swire (Cathay Pacific), Swiss Re, Tesco, Timberland, State of Victoria, Virgi.

About THE °CLIMATE GROUP

The °Climate Group is the world's first international NGO focused exclusively on the solutions to climate change. The °Climate Group's mission is to accelerate the low carbon economy by building close partnerships with the world's leading businesses and governments, by engaging and convening the world's most influential individuals on the carbon intensity of the world economy, and by launching and incubating a number of strategic initiatives with our members and partners. The °Climate Group focuses on the links between reduced greenhouse gas emissions and improved financial and economic performance. The °Climate Group is the hub for a network of corporate and policy leaders who can identify, implement, and support effective strategies and policies. In just four years The °Climate Group has grown from a three-person office in southwest London to an 80-person organisation in six countries/regions (UK, US, Greater China, India and Australia), working with more than 50 significant member companies and governments.

The °Climate Group is a registered independent not-for-profit organisation funded predominantly through philanthropy with registered charitable status in the UK, US, Australia and Hong Kong.

Production

This brochure has been printed by St Ives Westerham Press Ltd, who are FSC certified, ISO 14001:2004 credited and are a CarbonNeutral® company.

Designed by Browns/London
www.brownsdesign.com

Photography

Adrian Cooper/EASI-Images
Chris Fairclough/EASI-Images
Tony Binns/EASI-Images
Chris Fairclough/EASI-Images



THE CLIMATE GROUP

Head Office:

The Tower Building
3rd Floor
11 York Road
London SE1 7NX
United Kingdom

T: +44 (0)20 7960 2970
F: +44 (0)20 7960 2971

Greater China – Beijing

Suite 1502 Golden Tower
1 Xibahe South Road, Chaoyang District
Beijing
China
100028

T: +86 (10) 6440 3639

USA – New York

444 Park Avenue South
Second Floor
New York
NY 10016
USA

T: +1 (646) 233 0550
F: +1 (646) 861 4606

Australia

Level 39 Rialto, 525 Collins Street
Melbourne
VIC 3000
Australia

T: +61 (3) 9617 4329
F: +61 (3) 9614 2103

WWW.THECLIMATEGROUP.ORG

FEEDBACK AND REQUESTS FOR INFORMATION
SHOULD BE SENT TO INFO@THECLIMATEGROUP.ORG