

GREENING

China's search for a sustainable future

THE DRAGON



CHINA: THE MOST IMPORTANT STORY IN THE WORLD

What happens in China, argues **Jonathon Porritt**, happens to the rest of the planet. For good, or ill...

Back in June, the Chinese construction minister decreed that all Chinese cities had to reinstate the bike lanes that had been removed over the last few years to make way for the car. All civil servants were told that they must either cycle, or take public transport to get to work – with the minister apparently determined that China should regain its global accolade as “the Kingdom of Bicycles”.

He'll have quite a struggle on his hands with some of China's increasingly powerful city mayors, for whom the car has become a far more fitting symbol of economic and political success than the lowly bike. Every

day in Beijing, for instance, more than 1,000 new cars are rolled out on its already helplessly congested streets.

“China is building a new coal-fired power station every ten days.”

That is just one of a seemingly limitless flow of eye-watering statistics about China today. The sheer scale of the place continues to astound the rest of the world. And if your passion in life is sustainable economic development, rather than

simply the environment, then what's going on in China is quite simply the most important unfolding story anywhere in the world.

If 10% of the 60 million people who live in the UK choose to reduce their energy consumption by 1%, it hardly registers as a blip on the world scale. But when 10% of the 1.3 billion people who live in China take advantage of its surging prosperity to *increase* their own energy consumption by 1% a year (by buying a car, or eating more meat, or getting a larger flat), then the world had better take notice. Such decisions affect us here in the UK as much as our fellow world citizens in



“Living standards have soared and life expectancy doubled.”

China. In an interconnected and interdependent world, China's emissions are our emissions.

Chinese politicians talk with justifiable pride of their enormous achievement in enabling more than 250 million people to escape grinding rural poverty, and to find

“There is no point trying to downplay this: there is an ecological apocalypse unfolding in China right now.”

jobs in the country's burgeoning economy. Living standards have soared; and average life expectancy increased from just 35 years when the communists came to power in 1949, to 72 years in 2004.

These social gains have been driven primarily by the economic boom – with average growth of around 10% over the last 15 years. But that has caused environmental damage on such a scale that the entire growth model for China is now imperilled. As *Nature* reported in 2005: “The losses from pollution and ecological damage range from 7% to 20% of GDP every year in the past two decades.” The impact on human health has been particularly severe. About 300,000 deaths a year are attributed to air quality problems. Sixteen of the world's 20 most polluted cities are in China, and levels of cancer in such areas are among the worst in the world.

Things are going to get a great deal worse before they get much better. China is building a new coal-fired power station every ten days. In 2005 alone, it added about 65,000 megawatts of new power generation – roughly equivalent to the entire power capacity of the UK today. It is already the world's second largest emitter of greenhouse gases, and is one of the most inefficient energy users in the world – emissions per unit of GDP are ten times that of the average for developed countries.

There is no point trying to downplay this: there is an ecological apocalypse unfolding in China *right now*.

But few are more aware of this than the rulers of China themselves. Just a few months ago, the 11th Five Year Plan was unveiled by Premier Wen Jiabao with an exceptionally tough message that China could not follow the old path (which, he might have added, is the path set out by the West) of “grow first, clean up the environmental mess later”. It had to learn to grow *sustainably* – even if that meant growing more slowly.

The government's impressive targets for the next five years include a 10% fall in total pollutants (notably sulphur dioxide emissions and chemical oxygen demand), a 20% fall in energy consumption per unit of GDP, and a 30% reduction in water use (per unit of industrial value added). It's also developing a green accounting system that will include full environmental costs in its calculation of GDP – something that I would dearly love to see working here in the UK.

It is an extraordinary challenge. But China is capable of moving with great speed when it puts its mind to it: it phased out the use of leaded petrol in less than two years (compared to the decade or more it took us here in the UK), and has recently mandated emissions standards for all new cars that are at least the equivalent of European standards.

All of which guarantees an ongoing battle royal between those who see the glass as half empty, and those who see it as half full. The ‘half-empties’ look at the existing environmental legacy, factor that into the huge political and social pressures to keep the Chinese economy booming at almost any cost, and remain sunk in impenetrable gloom.

The ‘half-fulls’ see no reason why China shouldn't become the world's number one nation in terms of eco-efficiency and the kind of “green industrial revolution” that Western leaders love to

“China is capable of moving at great speed.”

pontificate about. But they acknowledge that achieving this will take a lot more than some ministerial decree restoring the bike to its rightful place in the hierarchy of sustainable transport systems – however welcome that may be! 🐦

Jonathon Porritt is Founder Director of Forum for the Future and Chair of the UK Sustainable Development Commission.



Beijing: capital in a hurry

“China's economic miracle will end soon because the environment can no longer keep pace. Five of the ten most polluted cities worldwide are in China; acid rain is falling on one third of our territory; half of the water in China's seven largest rivers is completely useless; a quarter of our citizens lack access to clean drinking water; a third of the urban population is breathing polluted air; less than a fifth of the rubbish in cities is treated and processed in an environmentally sustainable manner.”

– Pan Yue, Chinese deputy environment minister

“CHINA IS PART OF THE WORLD – AND WE ARE ALL EARTH CITIZENS”

Jiahua Pan sees signs of hope at the end of a frenzied boom.

Within ten years, China is likely to be the prime emitter of greenhouse gases worldwide. The fact that the most populous country in the world becomes the world's number one contributor to global warming does not in itself indicate anything wrong with China. But this scale is still serious – for China and the world. Size matters. With the turn of the century, China has entered the stage of capital-intensive industrialisation, with massive, resource-heavy investment in highways, urban infrastructure and construction. Speed also matters. Annual growth of GDP has been running at over 9% for the past two and a half decades. But these trends cannot last forever. They are almost certainly only transitional, and currently close to the peak of resource requirements.

If China is to become more sustainable, we need to lower the peak and shorten the duration of high material intensity. It's not unachievable. Thanks to advances in technology, China can be far more energy- and resource-efficient than the developed countries at their comparative stage of industrialisation.

But it's not all plain sailing. As a latecomer to the global market place, and a heavy consumer of resources, China loses out in trade terms. It has to cope with rising prices for essential imports such as iron ore, but at the same time can't yet command high prices for its exports.

But China is part of the world and we are all earth citizens. And mutual understanding and communication can pave the way for international co-operation. Control of conventional pollution and ecological degradation in China has to take priority over greenhouse gas emissions, but China and the world can work together to address both conventional environmental challenges and climate change, at one and the same time. After all, energy efficiency serves the goals of energy security, sulphur emissions reduction, and reduced greenhouse gases, simultaneously.

China has been doing a lot – and doing it well, too. Family planning has avoided some 300 million births over the past three decades. Aggressive development of hydroelectric power, large and small, has been ongoing. China is the world's leading user of solar for water heating. Other renewable energy sources are being actively promoted, as is energy efficiency. Carrots and sticks are everywhere...

But individual consumers have a big role to play, too – in China as elsewhere. We know that our planet cannot support our luxurious and wasteful way of life. Enough is enough. The way of life in the developed countries is not necessarily an indicator of a truly worthwhile quality of life. ♣

Jiahua Pan is vice president of the Chinese Society for Ecological Economists and consultant editor of Greening the Dragon.



In China, the 21st century can still arrive by bike

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SIFTING MYTHS FROM MOUNTAINS ON THE LONG GREEN MARCH

China is so huge in every respect that its environmental and social challenges can easily seem like insurmountable mountains – not just for the country itself, but the whole world. Yet it would be a mistake to accept all the well-aided myths of inevitable doom – and much more so to lay blame at China's door ahead of time for the global catastrophes that the pessimists predict. **Roger East** sifts myths from facts in this overview of China's long green march.

Transit / Still Pictures

Work out China's ecological footprint, and you'll find that, on average, it takes a frugal 1.2 hectares of land to sustain each inhabitant – that's less than a global 'equal share' of 1.7 hectares. Or look at its history in tackling massive environmental challenges – like population growth. This was, not so long ago, widely seen as a runaway train, a time bomb even. That train has slowed to a near standstill; the bomb has stopped ticking. China's population stands at around 1.3 billion, and is growing at a modest 0.59% a year. Admittedly, this means over 40 million more people than in 2000 – but demographers predict the total will peak in 2035 at around 1.5 billion. It will gradually start to decline before mid-century – by which point it is expected that India will have taken over the dubious honour of the world's most populous country.

Today, it's China's extraordinary economic growth that has woken up the world to the seriousness of the sustainable development challenge. In terms of scale, what is happening in China is comparable with compressing into a few decades all of last century's economic growth in Europe, Russia, North and South America and Japan combined.

Sandstorms and stress

China's leaders see no moral case for their people to settle forever for lower living standards than those to which the industrialised world has already helped itself. But, as Jiahua Pan points out [see p11], they recognise a common interest in avoiding catastrophic global warming. And they cannot afford to ignore the more local costs of unsustainable development either – the air filled with fumes and sand, water supplies under intolerable stress (so serious as to prompt such far-fetched notions as the

eventual abandonment of Beijing as the country's capital) and arable land disappearing under concrete and soil erosion.

Nor are they trying to. The government has declared green growth as its guiding economic policy goal. Heavily dependent on coal (for three-quarters of its power) and critically devoid of oil, it's starting to address the huge issues of improving its very poor energy efficiency, 'cleaning' its coal use, and diversifying its energy sources. Nuclear power is, controversially, part of its answer, as is the (even more controversial) development of huge hydro schemes, notably the Three Gorges Dam. But there is also a commitment to generate at least 10% of electricity using renewable energy sources by 2010 – with financial incentives being put in place to boost the use of small hydro, biomass, wind and other options.

China's buying up of scarce oil resources in aggressive international competition has

done more than almost anything else to prompt apocalyptic speculation. It's not only for oil that Chinese demand has affected global markets. It's true for steel too, for copper and for cement. And every week there are fresh headlines in the business press about Chinese companies racing round the world snapping up timber, gas, phosphates and mining companies. The anxieties aroused by this acquisitiveness extend into the diplomatic field too. An important strand in the West's engagement with China concerns the building of some common ground about standards of governance in dodgy but resource-rich regimes.

Oil, unsurprisingly, looms largest – as witness the commentaries that accompanied President Hu Jintao's recent trip to Latin America, or the takeover of Nigerian oil interests. Not to mention the shrieks that went up when CNOOC, one of four big oil companies created when China's oil industry was restructured in the late 1990s, had the temerity to bid for US firm Unocal last year – a bid that was halted only by unprecedented opposition from US lawmakers.

It's not an issue that's going to go away. China may be a newcomer as a big player on oil resources, but it's already in the top league. Its imports of 2.4 million barrels of oil per day (in 2004) make it second only to the USA. And if those were to increase, in line with current estimates, to 8.4 million barrels by 2030? In a word, unsustainable. Look to China, then, for a better answer. Oil substitution may be part of it – although hardly with biofuels, in a country which so critically lacks the land to grow its food. But don't be surprised if hopes for the hydrogen economy increasingly take on Chinese characteristics...

Really going to town

China is engaged in the world's greatest experiment in rapid urbanisation. Its population is very unevenly spread, with 94% living in the densely inhabited eastern half. Soon after 2010, it will pass the point where over half its people will be living in cities – roughly the same proportion as in the world as a whole. For a society that was overwhelmingly rural just a couple of generations ago, this is a transformation of staggering speed.

Many new migrants are simply in search of a living. There are ten times as many without stable jobs in rural areas (150 million) as in cities. But that massive urban influx in turn helps spur China's vast construction boom – a key element in its runaway economic growth. China currently accounts for 50% of world cement consumption – and Shanghai has famously built more skyscrapers in the last ten years than there are in the whole of New York. As

architect Bill McDonough graphically expressed it, if China were to do its building with brick, it would lose all its top soil and burn all of its coal.

But China's emerging megacities can be immensely innovative, bursting with vitality, magnets for inward investment and – nowhere more so than Shanghai – a showcase for high technology solutions to rival anywhere in the world. And, with a characteristic Chinese emphasis on learning through example, ten 'model environmental cities' have been designated to showcase a more sustainable path. These are not new projects built from scratch, such as Dongtan (or the three others like it, all of which are being designed by Arup – see p12). Rather they are existing cities, like Suzhou with its 2.2 million inhabitants.

A Special Economic Zone as well as an 'environment protection model' city, Suzhou is to spend \$13 billion on its light rail/subway scheme. Its taxis are switching to compressed natural gas; recycling programmes are aggressively promoted, and polluting industries are shifted out of the city centre. This is sustainability at a price, however; whole villages have been moved to make way for relocated factories.

Beijing, too, has set itself stringent clean air targets – although it's a measure of just how polluted the capital's become that 'stringent' means aiming for 227 days in the year without serious fog or pollution. It's allocating almost a fifth of the whole budget for the 2008 Olympic Games to improving air and water quality. And it's using sticks as well as carrots: it threatened businesses which don't meet pollution reduction deadlines with a three-year ban on raising stock market capital. Already, many US-made cars can't be sold in China because they don't meet stiff new efficiency standards.

All in the plan?

For all the pressures resulting from development at China's speed, it is clear that sustained growth remains very much part of the plan. The Five Year Plan, that is, by which China's economy is still so heavily shaped. The latest Plan – covering 2006-2010 – includes targets for annual GDP growth of 7.5%, and a continuing shift of population from the countryside to the cities at a net rate of 10.5 million per year.

Crucially, however, its growth targets are to be achieved by "optimising structure, improving efficiency and decreasing energy consumption". That's what the official communiqué in *China Daily* said when the Plan was unveiled at last October's party plenum. And beneath those bland words lies an important acknowledgment that many things have been going wrong in China. At a rhetorical level, at least, its leaders accept that the country's headlong growth has caused a vast array of problems.

It's not just China's environment that's taken the toll. The health of its people, too, has reached a crisis point. The revolution brought massive improvements, famously doubling life expectancy – but the health 'system' is now creaking towards collapse. Millions struggle to afford basic care. Government spending on health has been declining dramatically over the last 20 years (down by 50%); most hospitals in cities now get just 10% of their funds from the state. TB is on the rise, and HIV/AIDS is rapidly taking hold: a million people infected now, ten million by the end of the decade.

A countryside in crisis

Among the newly rich, private spending on health care is soaring. But prosperity brings its own health crisis. In the boomtown of Shanghai, a shocking 80% of three- to six-year-olds could already be classified as obese – compared with fewer than 5% of adults in China as a whole.

But it's in the countryside where some of the greatest challenges lie. Neglected by government in the rush for modernisation, under pressure from massive urban expansion, and suffering from decades of uncontrolled soil erosion and forest loss, China's countryside is in crisis.

Three years after taking office, President Hu is aiming to redress the balance. He talks of "building a new socialist countryside" under the overall motto of creating a "harmonious society", which is China's near synonym for sustainable development. The Plan envisages higher spending on rural education and health, reductions in the tax burden on the rural population, more price support for agricultural products – and greater attention to environmental concerns.

AT THE DOUBLE

Since 1980, China has consistently been the world's fastest growing economy. Between 1980 and 2000, its GDP more than quadrupled.

Its growth rates over the last 13 years average 9.9%.

Absolute poverty (defined as an income of less than 625 Yuan – £42 – per year) has shrunk from 49% in 1981, to less than 7% today.

In 2000 the government set a target to quadruple GDP again, to \$4 trillion by 2020.

Since then, GDP has more than doubled, to \$2.25 trillion in 2005.



Tea change: in little more than a generation, China has gone from being overwhelmingly rural to urbanised – and globalised. The social impacts are as dramatic as the environmental ones...

It's a move precipitated by another novel phenomenon in Chinese society – open protest. A cocktail of pollution, water shortages, land loss and degradation have combined to spark growing unrest in the countryside. The government itself admits to about 90,000 protests last year – and environmental organisations are playing an increasingly vocal part. Five years ago, the number of NGOs addressing environmental concerns in China was negligible. Now there are well over 2,000.

Consuming passion

Meanwhile, the surge of consumerism breaking across China remains the most visible emblem of its economic success – and its environmental crisis. Already, there are estimated to be 100-250 million 'middle class' Chinese consumers, the kind who go to Ikea on a Sunday. (Quite literally; the Swedish-based retail giant now has several stores in China and is expanding fast.) That's rivalling, if not exceeding, the total of their American equivalents.

In the traffic-crammed cities, the rapid rise of private car ownership, and the passion for prestige models, is one of the most striking examples of this new consumerism. And growing per capita income (which is expected to treble to \$3,000 by 2020) means surging demand for every kind of product and service – especially energy-intensive home comforts, from air conditioners to consumer electronics. TVs and fridges, once rarities, are now commonplace for all but the poorest. And China is already the world's largest mobile phone market, with 390 million users.

Proportion of Chinese with use of:

	Fridge	Television
1985	7%	17%
2005	75%	86%

Diets too are changing: rice remains a staple, but China is fast discovering a taste for meat. It now out-consumes the US in the meat stakes (64 million tonnes versus 38 million). Not only is this widening

waistbands – it's increasing the pressure on everything from available land to energy resources: in each case, meat needs more.

If China as a whole took up this US lifestyle across the board, its ecological footprint would swell from 1.2 hectares each to a massive 8.4 hectares. The Chinese would need one whole earth for themselves.

But China is taking the first tentative steps to reining in consumption via green taxes.

Taxes on bicycles have been dropped, and fuel taxes introduced, penalising the worst gas-guzzling cars and 4x4s. And even the re-usable plastic chopstick might become an icon of green progress, courtesy of a tax on the disposable wooden version. It sounds trivial, but 25 million trees are used up each year to make the 45 billion pairs that bite the dust. Now each wooden set will cost 5% more than the reusable equivalents. Well, every long march consists of many small steps... 🐣

Roger East is editor of Green Futures.

ENERGY *IN THE*

China's roaring economy is being fuelled by a dangerous cocktail of coal, oil and nuclear power. But as **Clifford Coonan** reports, there's also a fast-growing renewables sector – and a rising sense of urgency around efficiency improvements, too.

It's hard to overstate the importance of the 2008 Olympics in Beijing. It's a symbol of national pride, and a motor for change. And one of its high profile ambitions – to deliver a “green Olympics” – is being translated into a whole raft of projects to clean up China's notoriously polluted capital in time for the Games.

Inescapably, renewable energy is a key feature of this drive – with the city providing direct investment or interest-free loans to key projects. Tian Maijiu, deputy director of the standing committee of the Beijing municipal people's congress, ran through some of the 2008 targets for renewables at a recent seminar:

- ★ 90% of the city's street lamps running off solar;
- ★ solar heating for 90% of water used for bathing;
- ★ wind power generating 20% of the electricity for Olympic venues, many of which will also feature large solar photovoltaic (PV) panels;
- ★ ground source heat pumps providing central heating and air conditioning for an area of 400,000 square metres.

It's not wholly new ground for Beijing. A pilot project already up and running in Xuanwu Park is using solar PV panels to provide power for electric lighting, plus solar heating and refrigeration. And among the more innovative ideas is a recent proposal to build a ‘solar street’, where not only the lights, but whole buildings, will run entirely on energy from the sun.

The city's prestigious Tsinghua University is heavily involved in both research on practical clean energy technologies, and advice on its use to the top economic planning body, the National Development and Reform Commission (NDRC). According to Jiang Ning, director of the Tsinghua-BP Clean Energy Research and Education Centre (launched three years

ago by Tony Blair): “Our goal is to save up to 20% of current energy use by 2008. As the Olympics is approaching, we're also looking at making the urban energy system more sustainable as a whole.”

But energy savings and renewables on this scale can only be a small part of the solution. The lion's share of the Tsinghua-BP Centre's work is focused on coal. Which is as it should be. Coal provides some 70% of China's energy needs.

The Worldwatch Institute's *State of the World 2006* report puts this staggering growth in a global context. “The biggest energy questions facing China and India,” it says, “are how much higher their coal use will go, and what other energy sources they will use to power their futures. The answers will have a big impact on the quality of life in [these countries], but since they will almost certainly be the world's two biggest markets for new energy technologies, their decisions will help set the 21st-century energy course for the world as a whole.”

Cleaner coal

Within China, at least, there's a growing awareness that coal's environmental costs are unsustainable – and that, as a minimum, three things need to be achieved:

- ★ a step change in energy efficiency, as a key goal of investment in modernisation;
- ★ a radical cleanup of the way coal is burned, drastically cutting sulphur dioxide pollution and sequestering carbon emissions;
- ★ a determined pursuit of alternatives, to cut the overall share of coal in the energy mix to something more like 40% by 2030.

Targets for improving energy efficiency feature strongly in the latest five-year plan, and that's not surprising, since the need for action on this front could hardly be more acute. For every dollar of GDP, China

currently expends three times the world average of energy, and ten times the Japanese level. Hence the NDRC's goal of saving the equivalent of 240 million tonnes of coal during the next five years, cutting overall energy intensity by 20%.

Cleaning up coal use is equally crucial. The NDRC vice-minister Zhang Guobao told the China Power 2005 conference that the country's coal-fired plants emitted more than 13 million tonnes of sulphur dioxide (SO₂) in 2004, and were headed for 16 million tonnes in 2005. A key constituent in urban smog and acid rain, SO₂ remains one of the greatest pollution challenges for China.

The Tsinghua-BP centre's polygeneration programme is out to change this. It uses ‘gasification’ techniques to convert coal to gas, which is then used in gas turbines within the same plant to generate electricity. Sulphur is removed as an integral part of gasification. The process also produces valuable liquid fuels – methanol which can be used for vehicle fuel, and dimethyl ether for cooking and heating in the home. Jiang Ning says the centre's tests in the city of Zaozhuang – which faces the typical problem of fuelling rapid expansion while still reliant on high-sulphur coal – show that polygeneration could fulfil more than a quarter of its electricity needs by 2020, while drastically cutting sulphur emissions.

But it is coal's high carbon dioxide emissions, rather than its sulphur pollution, that are the focus of a new EU-China project: the ‘near Zero Emissions Coal’ (nZEC) scheme. The UK is leading the first phase, a three-year feasibility study (with £3.5 million funding from Defra and DTI) to assess different ways of capturing the carbon emitted during generation, and then storing it underground in China. It's part of a wider initiative, aimed at delivering a practical demonstration of coal-fired

HOTHOUSE



Overshadowed by coal: China's dependence on dirty power casts a pall on its booming economy

generation with complete carbon capture and storage, in both China and Europe, by 2020. For a coal-rich country like China, such a development could be priceless.

Meanwhile, with its hothouse economy showing few signs of cooling, China's power needs are surging. Its total capacity is expected to double – to almost 1,000 gigawatts (GW) – by 2020. China reckons

it needs all the energy sources it can get. In the long view, this encompasses hydrogen fuel cells and nuclear fusion, two areas where Chinese scientists – at Tsinghua and elsewhere – are keenly engaged in research and in international collaboration. More immediately, and less sustainably, it is projecting a continuing rise in oil use (implying increasingly sharp competition

for oil purchases on the world market – see p5), and planning much greater exploitation of its natural gas reserves.

Then there's its highly controversial programme of massive dams for hydro-electricity. Construction of the biggest of these to date, the Three Gorges, was completed in May. It should have a capacity of 22GW when it is fully operational in

Eckel/Still Pictures

SHANGHAI CATCHES THE SUN

Solar water heating comes cheap and cheerful in China's biggest city. Many Shanghai residents have rigged up simple systems on the roofs of their apartments to provide hot water for their daily showers. And the city government is now embracing solar power to help resolve its energy crunch. It plans to invest 100 million yuan in 2006-7 in solar water heating, rooftop photovoltaic (PV) panels and street lamps. By 2010, 100,000 of Shanghai's six million roofs should boast a PV panel.

Now there's a fresh component in the mix – the city's first clean energy research centre. It opened this May, with a brief to "gather together the city's research forces to speed up clean energy research", as Shou Ziqi, deputy director of the Shanghai Science and Technology Commission, puts it. Researchers at the centre are working on technology to boost PV's efficiency, and are already talking of a potential tenfold increase...

Industry leaders all over the world are watching China's development closely, aware that the scale at which renewable energy technologies can be applied here makes a huge difference to their viability. Anything that works in a country of 1.3 billion people becomes a mass-market option, rather than remaining a niche solution.

2009. The dam has drawn a storm of criticism from environmentalists and human rights activists. Millions will be displaced, historic sites destroyed, and, it's alleged, lasting damage caused to the whole Yangtze ecosystem, all by a technology whose long-term efficacy is questionable, they say.

For its part, the Chinese government insists the plant will bring huge benefits in the form of low-carbon energy, regional development and flood control. Overall hydro capacity is set to rise from 108GW in 2004 to 246GW by 2020 – contributing about a quarter of total Chinese electricity.

Nuclear ambition

Equally controversial is the government's plan for a massive fivefold expansion in nuclear power capacity from the current 6.2GW to 32GW by 2020, using the latest (substantially 'home-grown') pebble bed reactor technology. This allows for smaller units which can, in theory, be brought on line more rapidly. China's nuclear ambitions have caused concern on both environmental and security grounds – and its expansion will place increasing pressure on world supplies of uranium, already a potential trigger for conflict. But faced with a looming energy deficit and growing concerns over climate change, the government argues that nuclear has a vital role to play.

The real excitement comes over China's newfound enthusiasm for renewables. Indeed, they feature more prominently in the country's energy plans than nuclear: China's new renewable energy law sets a goal of generating 15% of its electricity from renewables by 2020.

Eric Martinot, a senior research fellow with the Worldwatch Institute and senior visiting scholar at Tsinghua University, believes that China's huge spending in renewables shows it is taking the target seriously. Excluding large hydropower, it invested £3.3 billion in renewable energy last year. That, says Martinot, makes it one of the biggest investors in renewables in the world.

"I'm very optimistic here," he says. "In China, introducing renewables is a good industrial development strategy." And it's not climate change that's driving it – it's local air pollution. "Ordinary people just don't accept this kind of pollution."

The renewables law is central to progress here. Li Junfeng, secretary general of the Chinese Renewable Energy Industries Association (CREIA), describes it as "the basis of all our work". He stresses that different regions lend themselves to different types of renewables. Wind power, for example, is especially suitable for the remote, economically underdeveloped north and west. So CREIA launched major wind farms in Inner Mongolia and Jilin – while promoting solar and biomass in provinces such as Hebei and Jiangsu.

The most wind in the world

China still has some 70 million households without any electricity at all, which opens up opportunities for small-scale solar in particular. The northwestern city of Xi'an, for example, is the base for a new company in which BP Solar and China Xinjiang SunOasis will pool their capabilities to supply 25 megawatts (MW) of sustainable power to remote rural areas.

But it's wind power that holds out the best hope of generation on a really substantial scale. Capacity increased by two-thirds in 2005 alone (to 1.27GW), and is now set to soar: to 4GW by 2010, 10GW by 2020. And this could just be the start. A new wind power assessment centre calculates that onshore turbines could provide as much as 250GW of electricity (over ten times that from the Three Gorges Dam). And even that's dwarfed by the potential from the winds that blow across China's coastal waters. The centre estimates that offshore wind farms could produce around 750GW. It's fairly speculative stuff – but if met, it means wind could meet virtually all China's electricity needs. This is wind power on a scale unimagined anywhere else in the world.

In the short term, Jiangsu province in the Yangtze delta has been singled out as having particularly good wind resources, and is aiming to build one fifth of China's total installed capacity of wind power by 2010 – including a wind farm at Rudong which aspires to be the largest in Asia. According to its engineer, Zhao Shengxiao, its 430 turbines will each produce 2MW.

Chinese law currently demands that wind power projects must contain parts that are at least 70% locally made. So major western manufacturers are rushing to expand local capacity. GE in particular has big plans here, and recently opened its first turbine assembly plant in the country in Shenyang, in the northeastern province of Liaoning. Spanish turbine maker Acciona has set up a plant at Nantong, in the eastern province of Jiangsu, which will turn out 900 turbines a year, while Denmark's Vestas Wind Systems, which had a 15% market share in China last year, is planning a new generator factory in the eastern coastal city of Tianjin. The dominance of western companies is a contentious point, says Martinot, but while Chinese companies have a good record in small-scale hydro and solar, they are lagging behind on wind.

Investment in renewable generation only happens, of course, if the incentives are there – and the Chinese government took a vital step in February this year by setting minimum 'green electricity' quotas for power companies. Zhang Guobao told a press briefing in Beijing that any such companies with an installed capacity of over 5GW will have to ensure that 5% of their output is powered by renewables (specifically not including large hydro) by 2010. This figure will rise to 10% by 2020. The 15 or so companies that meet this criterion account for more than half the country's total generating capacity. To sweeten the pill, they will be allowed to charge higher tariffs for supplies sourced renewably, and given tax breaks and subsidies to offset investment costs.

Zhang struck an optimistic note. "It will be a new business attraction, with huge market potential and lucrative returns." And, significantly, the country's top power companies, including Huaneng, Datang and China Power Investment, have already included renewable energy development in their long-term business growth strategy.

So far, their portfolios may be tiny; Datang, for example, currently relies on coal for more than 99% of its electricity generation. But it plans to cut that to 75% by 2014 and, according to its spokesman Zhang Shaopeng, is "looking at a slew of wind farm projects across the nation".

Clifford Coonan is China correspondent for The Independent.

CLIMATE *OF* CONCERN

China's runaway economic growth means it could soon be the world's largest single contributor of greenhouse gases. But with climate change threatening the country's new found prosperity, there are signs it's waking up to the challenge, says **Jiahua Pan**.

China's overall carbon dioxide emissions account for just over one seventh of the global total. That's way below the global average, when you consider it in terms of emissions per head of population. But it's bigger than any other country except the United States. And China's energy consumption, the major source of its emissions, will continue to soar over the coming decades. Researchers at the US-based Pew Center on Global Climate Change predict that China is likely to be the number one emitter within 20 years.

Yet as a developing nation, China is not legally bound to limit its emissions under the Kyoto Protocol – and it's inconceivable that it will agree to do so at the expense of its development. But that does not mean that the issue is a matter of indifference to China. Far from it. It has recently shifted from having an energy surplus to being an oil importer – a symptom of its rapid industrialisation. And that's been accompanied by growing evidence of just how seriously it is already suffering the effects of climate change.

Climate change diplomacy

When climate change first reared its head in the 80s, China treated it as a scientific issue, giving the China Meteorological Administration the responsibility of advising on policy options. After Kyoto, this passed to the more powerful State Development and Planning Commission (now the National Development and Reform Commission). It was an important shift in perspective. For China, climate change had become predominantly a development issue.

From the outset, the government approached international negotiations on climate change as an integral part of its foreign policy. It argued that the industrialised countries should take the lead in reducing emissions, while the developing world needed scope to increase emissions so as to meet the needs of development. Developed countries should help them contain these increases, ran the argument, by transferring technology and funds.

At the time of Kyoto, China officially stated that it would not consider limiting

its emissions until it reached a “medium level of development”. It implied that this meant an annual income of about US\$5,000 per person, which would be reached around the middle of the 21st century. Nine years on, the government remains unlikely to make any commitments to limit its emissions. It has, however, been more flexible when it comes to international efforts to mitigate climate change. These include co-operating on the technological development of renewable energies, as well as on carbon capture and storage. And it has played an active role in the Clean Development Mechanism (which helps developing countries run projects to reduce greenhouse gas emissions using investments from developed nations).

Meanwhile at home, China has been striving to diversify its energy sources and increase energy efficiency. This is not primarily because it wants to comply with global climate change policy – although it may have the same desired results. Instead the reasons are economic and social. China is concerned about having sufficient secure energy supplies to sustain its booming economy and meet the consumption demands of its rapidly urbanising population. But it must also do these

things while bringing the country's acute pollution problems under better control. The fact that it generates most of its electricity by burning coal is a real issue – and the worst contributor to its rapidly climbing greenhouse gas emissions [see pp8-9].

Although China labels itself a developing country, the image it wishes to cultivate — of a large and responsible power — will probably make it more flexible in international negotiations in the future. There has certainly been no mention recently of the idea that it would do nothing to limit emissions until it has reached ‘medium level development’. Many feel that it will have to consider committing to some kind of emissions ceiling in the post-2012 phase of the Kyoto process, because of the unprecedented speed and scale of its industrialisation and urbanisation. After all, it is in China's interest to help mitigate the effects of climate change, both internationally and domestically.

But it's more likely to do so through an active engagement with global initiatives on energy efficiency, renewables and carbon capture, than a new found enthusiasm for curbing its own emissions.

FEELING THE HEAT

In 2005, when a comprehensive assessment entitled *Climate and Environmental Change in China* was published in Beijing, it confirmed that the country is experiencing a pattern of climate disruption similar to the rest of the world. Global warming will hit China hard, making it more vulnerable to damage caused by extreme weather events, rising sea levels, drought, flooding, tropical cyclones, sandstorms and heat waves. Although a warmer climate could increase the amount of land available for farming, extreme weather may reduce agricultural yield by 10%. There is already clear evidence of this happening. In 2004 alone, drought and floods damaged more than 37 million hectares of arable crops, leaving over four million of them barren.

REGIONS AT RISK

NORTHWEST: Largely arid and semi-arid, a fragile environment highly vulnerable to climate change.

NORTHEAST: A warmer climate might increase agricultural production, but also bring growing risk of catastrophic damage from storms and flooding.

CENTRAL / EAST: Winters are very cold, and summers bakingly hot: climate change could exacerbate these extremes, threatening both economic activity and quality of life.

COASTAL AREAS: The densely populated southern and eastern shorelines are highly vulnerable to storms and sea level rise, particularly in the economically dynamic and prosperous Zhejiang region and Yangtze delta.

A TALE OF TWO CITIES



Weng Peijun

China's sprawling cityscapes are starting to sprout some eco-alternatives. **April Streeter** reports from Shanghai.

Zoom in on the cities of China, via the wonderful software that is Google Earth, and they look clean and even moderately green, ringed with agricultural plots and forested fringes. But the impression of blue skies and sunny weather on the static satellite imagery is a misleading one.

Here on the real Earth, Shanghai and Beijing are more likely to be covered in a brown haze of dust and pollution. It's largely the product of China's frenzied economic growth – a growth which is also precipitating a housing shortage of boggling proportions. Legions of rural residents are migrating to cities such as Shanghai, squatting in shantytowns for a while, hoping eventually to afford apartments in skinny cement high-rise blocks. Painfully aware of the problem, the Chinese government estimates that it must build new housing for 300 million in the next decade.

Their task, they know, is practically Sisyphean – to create dozens, even hundreds, of new cities, while at the same time holding environmental catastrophe in check. To their credit, Chinese officials increasingly embrace the language of sustainability. But radical experiments speak louder than soothing phrases – and none more so than the concept of designing a more ecological city.

In fact, it is more than a concept – it is the inspiration for two pilot projects, on vastly different scales. The first is tiny Huangbaiyu in Liaoning province, where architect Bill McDonough is drawing up a blueprint for a more sustainable urban future. A future in which cities function like superior living organisms: self-sufficient in energy creation and use, with their 'biological nutrient' waste put back in the ground while 'technical nutrients' are recycled endlessly.

Twelve hundred kilometres to the south, UK design and engineering giant Arup won a big urban planning contract late last year. Its client is the Shanghai Industrial Investment Corporation, and its raw material an 86-square-km tract of undeveloped wetland, on the island of Chongming, just outside the city. Its brief is to create a new city on a huge scale: Dongtan – a carbon-neutral metropolis for, initially, 25,000 inhabitants, rising eventually to half a million.

A city of birds

McDonough's starting point was, literally, a model of blue-sky thinking. He imagined a bird looking down upon a landscape and speculated what that bird might like to see. He studied how rainwater enters aquifers, how local animals migrate, where the plants grow, how the sun shines and where the wind blows.

The resulting plans are groundbreaking. For a future city in Liuzhou, in Zhejiang province, for example, he advocates moving the soil on to the roofs of buildings, and connecting them by sky bridges, so that tractors can be driven between rooftop farms and orchards. Other commerce and industry are relegated to the ground floor levels. In between are the living spaces for the inhabitants.

Working with the China-US Center for Sustainable Development, and with funding and technical help from more than a dozen multinational companies including Intel, HP and BASF, McDonough's team has already designed the first 42 homes in Huangbaiyu. The new houses combine pressed-earth construction with underfloor heating and solar panels. A gasification factory also under construction will turn waste into methane for cooking meals.

Dongtan's demonstration

By contrast, Dongtan's audacity lies in its sheer scale. According to Alejandro Gutierrez, Arup's project design leader, its buildings will eventually use only one-third as much energy per inhabitant as say, a high-rise in nearby Shanghai, and, crucially, the power will be sourced mainly from biomass, solar and wind.

Dongtan's layout, says Gutierrez, is designed to preserve the system of canals already in the area. Its buildings – none higher than eight stories – will be angled to capture sunlight as well as natural ventilation; its no-through-streets will be better suited to bikes and pedestrians than cars, allowing people to “move around without the need to move a vehicle”. A network of parks will ensure at least 30 square metres of green space per person – similar to Berlin and Copenhagen.

The nearby wetlands of Chongming Island are the breeding ground for wild cranes, swans and mandarin ducks. The successful preservation of this natural jewel, separated from the new development by a buffer zone just 2km wide, will be a barometer of just how sustainable a city Dongtan can claim to be.

While Dongtan is still a project inside the minds of its planners, Huangbaiyu is a work in progress – and one that has not always fulfilled expectations.

In addition to resettling rural dwellers to more urban settings, China is keen to augment wherever possible the amount of arable land available for agriculture. In Huangbaiyu, this was to be accomplished by ‘centralising’ dwellings into a smaller, walkable area, and razing far-flung residences to increase arable hectares.

Thus far, however, none of Huangbaiyu's inhabitants have signed up to move in to the new houses in the ‘centralised’ zone. The reasons, according to anthropologist Shannon May, are not to do with desirability, but affordability. May was sponsored by Intel to live at Huangbaiyu during construction, and to record her observations about the villagers. Farmers here, she explains, depend not only on the crops they grow, but also on supplementing their earnings from livestock housed in backyards, and aquaculture in the nearby stream. But plans for the ‘new’ Huangbaiyu failed to take into account that they would lose these secondary sources of income if they moved. “The residents of Huangbaiyu are the ‘have nots’ of China,” she explains. “No one doubts the new homes will be warmer and more convenient, but at what cost?”

McDonough intended to keep the cost of Huangbaiyu housing as affordable as possible, and the idea was that residents would be able to pay in part for new houses by being reimbursed for the value of their old homesteads. But they will also face monthly fees for such services as running water, waste management and gas, which will be difficult to afford without an increase in household income.

What's more, May cites local developer Dai Xiaolong as estimating that cost overruns have doubled prices. He has also made ‘adjustments’ to the original McDonough prototypes, even deviating so far as to incorporate garages and, as he explained recently to a visiting BBC reporter, cutting down on things like solar panels “for financial reasons”.

McDonough himself, who is often cited as an eternal optimist, has said that in some ways his designs are anticipatory, and the actual implementations must wait for technology, such as widespread and cheap solar collectors, to catch up.

Sustainable urban planner Richard Register, of Berkeley-based Ecocity Builders, makes the point succinctly. “Developers have to actually build something someone wants or they stop being developers [pretty quickly].”

Roads less travelled?

In Dongtan, Arup's engineers face different hurdles, although they could potentially be just as disruptive. The site itself for instance, is susceptible to periodic flooding, located as it is in alluvial terrain, flat and muddy, at the mouth of the Yangtze river.

Then there's transport. “So far in China,” says Register, “experimental cities are too much compromised with cars – supposedly better ones – and don't use the fuller palate of ecological features, nor imaginatively designed higher density.” Arup's plans will indeed call for ‘better’ cars, stipulating electric and hydrogen fuel cell vehicles for both public and private transport, in order to achieve their goals of zero emissions and low noise pollution. But, however imaginatively Dongtan itself might be designed, it could still be compromised by the way its surrounding region is developed.

Both Gutierrez and Roger Wood, Arup's associate director for urban planning, admit to serious worries about the potential impact of an expressway planned by the national government to connect Chongming Island to Shanghai. “By providing that access, the expressway makes Dongtan attractive and accessible to people in Shanghai,” Wood says. “On the other hand it becomes a double-edged sword if it is encouraging development.”

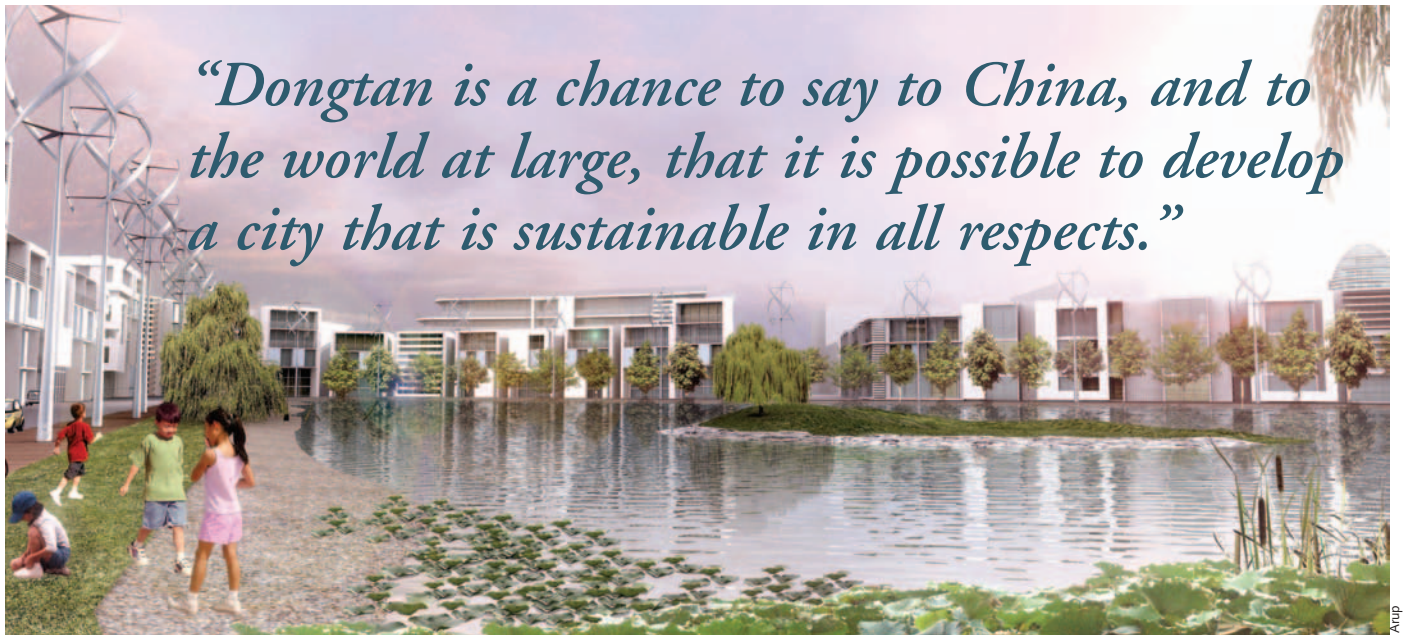
Non-ecological development, he means – for Arup has control only of development design of the southeast corner of Chongming; it cannot constrain what may be situated on other parts of the island. A San Francisco firm, Skidmore Owings Merrill, has developed a master plan for the entire island, dividing it into eight zones, one of which will concentrate on industry, with another slotted to receive an entertainment ‘theme park’. However holistic the eco-city concept may be for Dongtan itself, its ultimate reality check will be how well it functions in its wider context, not just within Chongming Island, but as part of the hinterland of the mega-city of Shanghai. 🍀

Sunrise city: Dongtan's waterfront homes will be powered by a mix of biomass, solar and wind



ARUP

April Streeter is a freelance environmental journalist, formerly based in Beijing.



“Dongtan is a chance to say to China, and to the world at large, that it is possible to develop a city that is sustainable in all respects.”

Roger East talks to Arup's **Peter Head**, who, as head of urban planning, is at the helm of the Dongtan project, and **David Singleton**, chairman of its global infrastructure business.

Green Futures: Just how challenging a project is Dongtan?

Singleton: It involves meeting some real stretch goals, to create a self-contained city of that size with a relatively small footprint on a sensitive site.

Head: It's all based on the ecological footprinting concept, with the objective that each Dongtan resident should take up less than the 'global earthshare' – the amount of resources available to each person on earth for 'one planet living'. [Most cities have a per capita footprint of several earthshares.]

It's a methodology to drive right down the supply chain, informing the development spec for the build-out, and longer-term issues of how the city works in practice. [We've got a host of] indicators, including availability of jobs for everyone in the city, reducing health care costs, and zero-emissions transport. We've been talking to motor manufacturers about making it a hydrogen showcase, and building that into the infrastructure from the outset, as well as making walking and cycling easy, and providing for really good public transport to minimise the need for cars.

We are determined to have Dongtan running entirely on renewable energy, including its transport – which is unprecedented in the world. It's a good site for onshore wind, open and near the

sea, but biomass will probably be the largest single power source, alongside energy from waste (via anaerobic digestion), and solar photovoltaics as prices come down.

Green Futures: But is one Dongtan going to make a real difference to the whole of China?

Head: It's a demonstrator project. A lot of what we are doing is applicable in existing cities. Dongtan sets them a level of ambition, even if it takes them 20, 50 or 100 years to achieve. Having something tangible helps with the 'hearts and minds' aspect, showing people that there are solutions, that you can have a modern lifestyle – you can 'do Dongtan' elsewhere.

Singleton: It's a huge challenge for the world as a whole over the next ten years to house and service the populations of developing megacities with populations heading over the 20 million mark. Dongtan is at a higher standard than these can be, but the challenges of large-scale master planning are the same – including issues such as the location of housing relative to work. Even if there is a 'socio-economic mismatch' between the populations that Dongtan is designed for, and the hundreds of millions of Chinese engaged in mass migration to urban areas, the 'top-enders' can go into the Dongtans, allowing others to move into their former houses...

Green Futures: But isn't the integrity of the project threatened by the proximity to Shanghai – and the proposed expressway linking the two?

Head: Not necessarily. Certainly our brief is not to plan a desirable commuter suburb for Shanghai, but a self-contained sustainable city. We are confident about the development of the master plans: then we face the big challenge of helping our client [the Shanghai Industrial Investment Corporation] to deliver it on the ground.

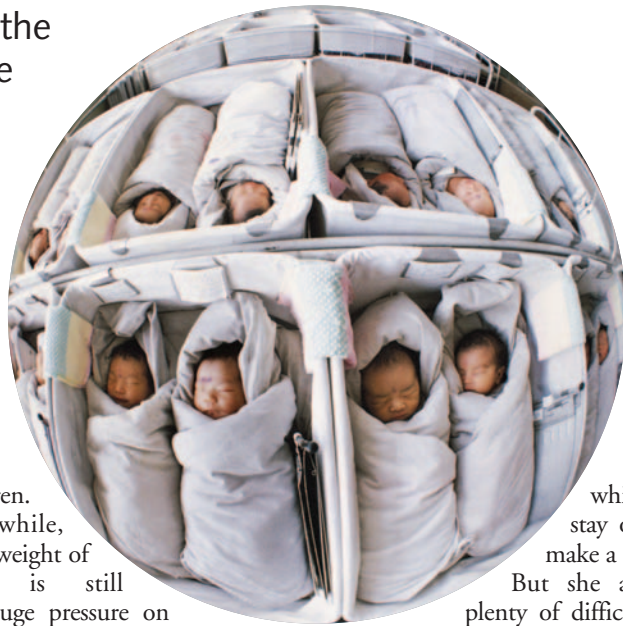
Singleton: China now has a huge appetite for the opportunity to learn and import ideas, techniques and solutions. We need to be out there, contributing to the debate on how these things can be done. As with the new towns in the UK, you need a real command and control approach to planning and land use.

Green Futures: So where does it go from here?

Head: The planning application for phase one needs approval by the Shanghai authorities, then comes the build-out, for completion by 2010. Decision-making can be very fast when a project develops momentum. Here [on Dongtan] there is a total alignment of high-level and regional government and other stakeholders. And Arup has been contracted to do the master planning for three more eco-demonstrator cities on sites of similar sizes.

Will China get old before it gets rich?

On the surface, population control is a Chinese success story. But as **Zhao Baige**, the country's leading expert on the issue admits, the challenge now is very different...



The notorious 'single child' policy, enforced by stringent family planning regulations (now somewhat less draconian), has had the intended effect. The government reckons that since it was introduced, China has prevented over 400 million births. There is now an average birth rate of 1.8 children per couple, compared to six when it was introduced.

But while that has been brought under control, it has left other demographic problems in its wake. One is the gender imbalance – a ratio of 106.3 males for every 100 females. More serious still is the growing weight of the elderly in the population pyramid. This is an issue more usually associated with the global North – but it sees China facing the distressing possibility of being the first country ever to get old before it gets rich. Already more than one Chinese person in ten is over 60. By 2040 it could be as high as one in four – by which point the working age population could be just half the overall total, working to support equal numbers of elderly people

and children.

Meanwhile, the sheer weight of numbers is still putting huge pressure on the environment, says Zhao Baige, vice-minister of the National Population and Family Planning Commission, and one of the country's leading experts on population issues. "The basic fact is we have over 1.3 billion people in China, which accounts for 22% of the world's population, while we have only 7% of the world's arable land."

Migration into cities is an inevitable consequence, but this in itself puts growing strain on China's ecosystem, she says. So rather than merely controlling numbers and growth rate, the challenge now is to shift policy so that it tackles wider issues. Three singled out by Zhao include improving the literacy rate, eliminating gender discrimination, and addressing the issue of an ageing population. And that means moving from stick to carrot in terms of making change happen.

"We are introducing a system in the countryside to encourage people to obey the family policy plan, granting economic rewards rather than punishing people who break the rules," she said. It combines free contraception services for rural women, with more sensitive local economic assistance, such as micro loans for communities in the remote countryside,

which can help them stay on their land and make a living from it.

But she admits there are plenty of difficulties ahead. "For example, how should we promote proper contraception without offending women's rights? That will be a great challenge to our work," says Zhao, whose background is as a specialist in reproductive health. And, she adds, China's complex bureaucracy can make the transition from policy to implementation fraught with problems.

Zhao, who also has a doctorate from Cambridge, said China was keen to learn from the West. "By learning from the experience of Western countries during their industrialisation, we may suffer a lot less and not have to start from the very beginning. Just as we've seen in many Western countries, the rise in social standards and education should help reduce the fertility rate."

"Ultimately," says Zhao, "the solution to China's environmental problem is closely linked to its population situation. We realise that China's population and environmental concerns are the world's concerns, and we are willing to take the responsibility and share our experience of solving the problems with the rest of the world." 🐼

Interview with Zhao Baige by Clifford Coonan in Beijing. Additional material by Roger East.

SUCCESS STORY?

Total: 1.3 billion

Aged 0-14: 21% and falling

Aged over 60: 11% and rising

Overall growth rate: 0.59%

Projected peak: 1.5 billion in 2035

(end-2005 figures)





A CITY WITH NO END IN SIGHT

China's urban population has soared from 72 million in 1952 to over half a billion today. By 2020, it's estimated that up to a billion Chinese will live in cities such as Shanghai, above. The almost bewildering speed and scale of this transformation is a recurring theme in the work of Chinese artist and photographer, Weng Peijun, as featured here.

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LOESS LEADER

One of the world's most extraordinary exercises in ecological restoration is taking shape in central China – and it's happening on a massive scale. **John Liu** reports from the Loess Plateau.

High on a hillside in Shaanxi province, an old man stood alone with a shovel, digging a hole to plant a tree. It looked the most vain exercise imaginable. For all around him, acre upon bare acre, stretched empty slopes without trees, grass or soil. This is the Loess Plateau, the most eroded place on earth. Decades of overcultivation and overgrazing, compounded with uncontrolled logging, have stripped the soil from the hills – and the hope from the farming communities who depend on it.

That such a disaster has happened here is deeply ironic, for this land was once famed for its fertility – rich enough to make it the cradle of China's first civilisation.

But I write in the past tense. This was in 1995. As a film-maker, I was charting the early days of a remarkable restoration scheme: one which holds out the hope of ending rural poverty across vast swathes of the country, and leaving future generations with the priceless gift of an intact ecosystem.

Ten years later, I returned to the same hillside – and could not recognise the place. All around me were flourishing young trees, and in the valleys, crops and orchards. The old man hadn't been fighting a lost cause; he'd been an ecological pioneer.

This is the fruit of the Loess Plateau Watershed Rehabilitation project – a massive undertaking which has mobilised millions of local people to restore their environment, in what is surely the biggest

ecological reforestation effort ever undertaken.

The plateau, named for its fine powdery loess soil, stretches across parts of seven northwestern Chinese provinces; in all it covers 640,000 square kilometres, approximately the size of France. Until recently, the 90 million people who live there were locked in a cycle of poverty and ecological destruction.

As all too often, the first blow was tree cutting. Without the forests, the people tried planting crops on the slopes. When that failed, they allowed goats and sheep to graze freely until all the vegetation was gone. It took with it soil stability, fertility, biodiversity, the natural infiltration and retention of water, and the ability to sequester carbon: all were lost. The plateau is soaked with between 250 and 800mm of rainfall per year, but without vegetation and stable soils, as much as 95% of that simply runs off as soon as it lands. So the land became little more than a moonscape.

Over the last decade, it's undergone a dramatic transformation. Teams of local people, together with planners, government officials and external consultants, worked for more than three years to plan systematic restoration works, under the government's World Bank-backed rehabilitation project. Local and external experts collaborated to analyse the watershed, soil composition, biology, agricultural practices, economics and culture.

As a result, the land was divided into two main zones: one, usually in the valleys

LESSONS FROM THE LOESS

The Loess project is a special case – but it need not be unique. Strong visible evidence is emerging that by involving local people in carefully integrated programmes, it is possible to restore large-scale damaged ecosystems. Employing the rural poor as agents of conservation can help to reduce the disparity between those living in wealth and privilege, and those who for generations have lived as subsistence farmers.

Designating ecological land, protected from human impact and encouraged to return to near pristine state, has the potential to restore soil stability. This in turn means reduced erosion, increased natural fertility, greater diversity of plants and animals, and a balanced water cycle where rain infiltrates and circulates through the natural systems. It even sequesters large amounts of carbon, helping to mitigate emissions elsewhere and their adverse effects on global climate change.

While specific local conditions must always be considered, the concept of employing marginalised local people in large-scale ecological restoration is an idea with real potential elsewhere in the world.

or on shallow slopes, where careful farming could still continue; the other set aside and painstakingly reforested.

Early in the project, small dams were built that can hold water for use locally throughout the year. Simultaneously, the local people were employed in massive terracing campaigns that created viable agricultural fields, while replacing the destructive practice of planting directly on the steep hillsides. New, less damaging farming methods were introduced and encouraged. Orchards, vineyards, and greenhouses gave local people new high-income crops. Growing fodder for livestock replaced the destructive free ranging of goats and sheep. Backyard pigsties provided a new source of income – and, for some, a new source of cooking fuel, too, in the form of biogas from the methane captured from the pig waste. This not only saves the householder money; it spares trees that would otherwise be cut for fuel wood. [For more details of this remarkable project, see the *Green Futures* Special Supplement on small-scale energy generation, *A hundred thousand points of light*.]

Strong new policies were instrumental in the transformation. Tree cutting, growing crops on slopes, and unrestricted grazing were banned. Vast tracts were planted with grasses, bushes and trees, usually by local people themselves. In areas where the desert was encroaching, dunes were carefully stabilised through planting belts of hardy grasses.

Transforming the landscape meant transforming the lives of local communities, too – often radically. Farmers had to become foresters, or develop the skills needed to undertake a completely different type of farming from the one they grew up with. But while some welcomed the new opportunities this brought, others were suspicious. As one old man complained to me: “They want us to stop planting crops, and start planting trees, even on the good land. What are the younger generation going to do? They can’t eat trees!” In some villages, husbands left to seek better-paid work in towns, leaving their wives to manage their land alone for weeks or months on end.

Gradually, though, the scheme has won hearts and minds. In part this is because of a sustained public education programme; in part because local people are being paid for

their work; but more positively, because the results are starting to show. Fields have become more productive and the bare slopes are slowly greening. Bit by bit, the benefits are becoming apparent. Support is bolstered, too, by awarding long-term land use contracts to local people, so securing for them the benefits of the restoration happening on their doorstep.

In areas where the restoration is most advanced, the benefits have been dramatic. Local people’s income has quadrupled, according to World Bank figures. Young people now expect an education and a future. And a sense of hopelessness has been replaced by cautious optimism. In the words of one villager, Guo Hai Wang: “Everything was a desert here. All we wanted was a brick house and enough to eat... but now with all these changes, it’s as if our imagination just couldn’t keep up!”

John Liu is a film-maker and director of the Environmental Education Media Project (www.eempc.org). His film is currently in production (www.earthshope.org). Additional reporting from Shaanxi by Martin Wright.

John Lui



It used to be brown, not green: the world’s largest tree-planting project has brought colour – and soil – back to the hills of Shaanxi

THIRSTY

With nearly a quarter of the world's population, but just 8% of its freshwater, China is the thirstiest nation on earth. Some of its rivers no longer reach the sea, and half the country is in danger of drying out completely. But as **Roger East** reports, the crisis has unleashed a wave of fresh thinking, whose ripples are running well beyond water.

Last November's chemical pollution disaster on the Songhua river in northern China propelled the country's water problems into the news around the world. By no means the first of its kind, it caught the attention because of its scale – depriving millions of people in and around Harbin of drinkable water for several days – and its extent, threatening to spread toxic contamination downstream into Russia. Even more alarmingly for the Chinese authorities, it also provoked the kind of public anxiety that the country's stability-conscious leaders know they cannot afford to ignore.

In the wake of this disaster, the head of the State Environmental Protection Agency (SEPA) was replaced. His successor, Zhou Shengxian, was swift to offer reassurance, promising safety inspections and stricter monitoring of the 21,000 chemical factories located along the country's rivers and coastline. "The Chinese government," he told a press conference in January, "has made a very timely and determined decision to stop the conventional approach of development, which could be characterised as 'pollution and destruction first, treatment later'."

Five months later, SEPA's latest report on its activities and priorities gave pride of place to controlling water pollution as China's most important environmental task, with a particular focus on providing drinking-water security. And just a month after that, in July 2006, action on water pollution was top of the government's list of environmental spending priorities. In particular, He Bingguang of the National Development and Reform Commission (NDRC) promised sewage treatment work on an unprecedented scale, within an overall environmental investment programme amounting to 1,400 billion yuan – or some 1.5% of China's GDP for the next five years.

But such improvements, vital as they are, can only tackle part of the problem. The bottom line is that China has just 8% of the world's fresh water to meet the needs of 22% of the planet's population – and, in the words of the Worldwatch Institute, "virtually the entire northern half of the country is drying out".

Clearly, China can't afford to go on wasting this scarce resource by polluting its rivers and groundwater as it has done. Facing up to the true cost of water must be part of any more sustainable equation. Historically, it has been kept so cheap at the point of use that there was little incentive to treat it as a scarce resource. But that's starting to change. Take Beijing, one of the cities that suffers the most acute water stress, with only one eighth of the national average volume of water per person. In the last 15 years, it's raised its residential water prices more than twentyfold. Industry is facing the prospect of more realistic charges too. And this April, new rules came in governing water use in agriculture, which still accounts for almost two-thirds of total consumption. Farmers can still take freely from their own ponds for personal consumption, but permits and charges are being more rigorously applied for abstraction from rivers, lakes and underground supplies.

WATER WARTS

Water shortages cause China direct economic losses averaging 280 billion yuan a year (about US\$35 billion).

Damage done by water shortages is 2.5 times more costly than damage caused by floods.

Over 130 cities face severe water shortages.

Significant groundwater pollution affects half of China's 660 cities.



NATION

A wet appetite: China's drive for food self-sufficiency is soaking up its water reserves

Annelies Van Brink/Still Pictures

Progress is under way too, in the form of more efficient irrigation methods to replace the notoriously wasteful flood irrigation which is still so widely used.

Cleaning up in Chongqing

The city of Chongqing has grown accustomed to dumping four tonnes of untreated waste into the Yangtze every minute, and letting it all be flushed away by the flow of the river. But the completion of the dam at Three Gorges, 350km downstream, threatens to turn Chongqing's enormous flushing toilet into a slow-moving cesspool. Hence the city's need to invest heavily in sewage and garbage systems. Cao Guanghui, director of the local Environmental Protection Bureau, reckons the infrastructure will run to over 100 treatment plants, at a cost of some \$5 billion – cutting the proportion of waste water that the city releases untreated from 80% to 30%. Replicated around the country, this cleanup is set to be one of the big opportunities for foreign investment and technology in China over the next few years.

It is typical of the Chinese leadership that it sees large-scale engineering as part of the answer. Its huge and controversial hydro-electric dam projects, epitomised by the Three Gorges, aim to contribute to

THE RIVER THAT RAN SHORT OF THE SEA

The once mighty Yellow River (or Huang He) has become an emblem of China's water problems. It is now so sluggish and silted up along its 5,500km journey from the Tibetan plateau that for much of the year it no longer reaches the sea at all. By a cruel irony, it remains highly susceptible to disastrous flooding in the wetter months. Unpredictable at best, it has now raised its riverbed so much by depositing silt, that it runs several metres above the surrounding land. This so-called 'hanging river' phenomenon means it needs a constantly reinforced system of dykes to keep it in its channel. The Ministry of Water Resources is now proposing a massive programme to build 'warping dams' to reduce sedimentation, as well as steps to cut irrigation demand and reduce the discharge of effluents.

The Yellow River's mythic importance for the Chinese, as the cradle of their ancient civilisation, makes its parlous current condition especially poignant. All the more crucial, then, is the health of the country's other great waterway, the Yangtze. A holistic approach to preserving and restoring its 'web of life', in the face of all the pressures of land reclamation, urbanisation and runaway economic growth, lies at the heart of WWF-China's Yangtze Programme (which is supported financially by global banking organisation HSBC).

This June, the organisation celebrated the successful re-linking to the river of eight cut-off lakes in the Anqing region. The opening of the sluice gates brought a surge of optimism about the eventual large-scale reconnection of the central and lower Yangtze, with the hope of healing degraded wetland systems – to the benefit both of the wildlife and the people who depend on the river's resources. As WWF-China's Zhu Jiang says: "The lakes will once again be able to act as natural sponges, absorbing water during the flood seasons, releasing it during the dry season, and purifying it all year around."

WWF-China's initiative had already seen the reconnection of four lakes the previous year. And its principles have been formally incorporated in national policy, which now emphasises the value of re-stocking lakes with fish in tandem with the restoration of their links with river systems.

A HARVEST FULL OF RAIN

Gansu is one of China's driest provinces, so it's not surprising that it has led the way on rainwater harvesting. Since the mid-90s, local authorities have given subsidies to help rural households set up water collection systems on roofs and courtyards, linked to underground storage tanks. Families quickly found they were saving some 70 days' worth of water-carrying time per year, and had enough water to grow cash crops in greenhouses and orchards. The Gansu model has spread fast across the country, and tens of millions of households now harvest the rain, Gansu-style. The system has even been exported abroad, thanks to training programmes run by the Gansu Research Institute for Water Conservancy, which carried out the initial pilot projects back in the early 1990s.

There's growing interest, too, in Beijing, where rainwater harvesting could add 230 million cubic metres a year to the capital's chronically inadequate water supplies, according to

the local water authority. That could not only all but wipe out the need for excessive use of the city's dwindling groundwater supplies – it could also alleviate flooding and pollution from rainwater runoff. Various pilot schemes are now in place, using rainwater collected from rooftops and roads to flush toilets and wash cars. It's presently too expensive for retrofitting on existing streets and housing, but it's starting to catch on for 'waterscaping' in new developments.

Snow cellars

Meanwhile, when it comes to meeting local demand, few solutions could be simpler than the ancient practice of storing quantities of snow. Now it's being revived on the fringes of the Gobi desert, where people are encouraged to build large concrete cellars in or near their houses, packing in the winter snow which will melt back to water in the hot, dry summer.

water supply management as well as meeting power needs. But even these are put in the shade by the size and ambition of the recently launched South-North Water Diversion Project. This massive undertaking is intended for completion by 2050 at an expected cost of almost 500 billion yuan. The idea is to tap into the relatively plentiful water of the Yangtze river system to bring relief – to the tune of 45 billion cubic metres of water a year – to the parched north.

Many environmentalists doubt that the Yangtze system can afford to be deprived of this much flow. Others worry, too, that water losses en route will be punitively high. But no-one could dispute that the north sorely needs the water. Problems of inadequate supplies there have been exacerbated by environmental degradation and a five-fold increase in the use of river water for irrigation.

The South-North water diversion project may involve massive expense and engineering skill, but that has not saved it from being likened to "a cup of water to put out a bonfire – not enough to quench the thirst". Those are the words of Ma Jun, whose book, *China's Water Crisis*, made him one of the country's best known and most influential environmentalists. Ma sees water shortage as such a potent time bomb that some cities around Beijing and Tianjin will have no water left in just five to seven years.

Hence the importance of some of the innovative solutions that are emerging around the country. Meeting its water challenge will require all the ingenuity, traditional wisdom and technological expertise that can be mustered, both from China's own experience, and from international co-operation.

TRICKLE DOWN EFFECT: YANAN CITY

In *Red Star Over China*, Edgar Snow's account of his travels on Mao's Long March in the 1930s, he wrote of the mighty surge of the Yanhe river as it cascaded through Yanan, the cradle of the revolution. Now a modern road bridge crosses an expanse of sand; the

surge reduced to a trickle under a single span – and this in April, when snowmelt and spring rain might be expected to fill the bed to the brim. The hazy skies are caused by China's all too familiar cocktail of dust storms and pollution. – *Martin Wright*



WET POLITICS



Dam and be damned? The Three Gorges scheme is unprecedented in scale – and controversy.

China's water crisis is crying out for better policy and politics, argues **Seungho Lee**.

Will China succeed in shifting its water policies on to a more sustainable basis? That really depends on its ability to make decisions on socio-economic and environmental grounds. By contrast, the Three Gorges Dam, and the South-North water transfer project, are examples of political considerations taking priority over the needs of water users and the environment.

The biggest debates on the South-North scheme have been about its huge expense. It is true that the central government has cleverly devised the financing structure so as to lay more of the burden on those local governments that benefit from the project. But doubts about its economic feasibility encourage the suspicion that it is being shaped by political factors.

Part of the problem is the involvement of too many players, at the national and local level. Within the national government, Water Resources is the principal ministry, but there is a real need to bring all the various bodies together and gain consensus – including the National Development and Reform Commission, State Environmental Protection Agency (SEPA) and other

relevant ministries such as construction, agriculture and forestry. At present, there's a pretty diverse range of views. The water resources ministry, whose main goal is the management and development of those resources, sees Three Gorges as a big achievement, whereas SEPA has always been sceptical on environmental grounds.

As things stand, policymaking and implementation are often incoherent, and

Another key WWF-China initiative has been the concept of Integrated River Basin Management (IRBM), which it has promoted strongly in China since 2002. One concrete result was the Yangtze Forum, held in Wuha, Hubei province, in April 2005, which brought together government ministries, provincial governments, Yangtze river basin management authorities and national research bodies to discuss a non-traditional management approach to the Yangtze – China's 'mother river'. As a result, IRBM has been now been recognised as the overarching management principle for the Yangtze. – WWF-China

there are overlaps in investment. And, although China does have a framework of laws on water management, they are not always properly enforced. This not only puts water assets in serious danger – it also raises questions about the state's capacity to tackle the huge challenges it faces.

In the end, China's allocation of so much scarce water to low-productivity agriculture is not sustainable. If it's to tackle the grave dangers of water vulnerability, the leadership will have to abandon the myth of self-sufficiency in essential foods. 🐦

Dr Seungho Lee is a specialist in water policy at the Institute of Contemporary Chinese Studies, University of Nottingham.

**Agriculture accounted for 97% of China's total water use in 1949. By 2000 this had fallen to 74%, while industrial use rose to almost 21% and urban (mainly domestic) use to over 5%. These trends are set to continue, with industrial growth and urban dwellers not just becoming more numerous, but also greatly increasing their water consumption (already up from 113 litres a day each in 1980 to 230 litres a day in 1997).*

THE NEXT SCIENCE SUPERPOWER?

In the new geography of science, it's at the centre of the world. **James Wilsdon** reports how Chinese research is shifting from imitation to innovation – and finds out how this could help drive a sustainable future.

Ya Cai grins as he explains why he is bullish about the prospects for Chinese science. “Our researchers are as good as anywhere in the world. They are dedicated, motivated, eager to achieve. If I come in to the lab on a Sunday, I find many of them still here. I tell them to go home to their families, but they say, no, we want to work.”

So much for work-life balance...

Dr Cai is director of Unilever Research in China. Born and educated in China, he spent several years in the UK doing a PhD, before taking a research job with Unilever. And when the company needed someone to head up its R&D operations in Shanghai, he leapt at the opportunity. “When you look at the economic growth, the sheer dynamism in China right now, it's hard not to feel enthusiastic.”

Ballooning budgets

Unilever has been doing research in China since 1996, when it established a joint venture with the Shanghai Institute of Organic Chemistry. Initially, the focus was on adapting existing products for the Chinese market. But in 2002 they opened two new labs and started doing basic

research, not just for the Chinese market, but for their global businesses too.

China and India are emerging as important centres in their own right, with 70 chemists now in Shanghai alone. This partly reflects a desire to move research much closer to emerging markets. “We expect China to become our second largest market,” says Dr Cai, “and the best way to ensure this happens is to make sure we are innovating to meet the needs of Chinese consumers.” But there are also benefits to the bottom line: a researcher in Unilever's Shanghai lab costs roughly one-third of their equivalent in Europe. The company's far from alone in seeing China as a preferred location for ‘offshore innovation’. Microsoft, Intel, ABB, Ericsson and AstraZeneca are all making substantial investments in research.

It's all part of a shift which is seeing China move ‘from imitation to innovation’. “Our core strengths,” says Dr Cai, “are in synthetic chemistry, nanotechnology and natural products derived from Chinese traditional medicine.” It's this combination of tradition and cutting edge which plays to China's strengths – and holds out the promise that the country could become

one of the leaders in sustainable science.

Science funding bodies in China are seeing their budgets balloon. For example, the National Natural Science Foundation (equivalent to the UK's Research Councils) has enjoyed a 26% budget increase this year. There has also been a sustained effort over the past five years to attract top Chinese scientists back from posts overseas. Of the 700,000 Chinese students who went to study abroad between 1978 and 2003, around 170,000 are now estimated to have returned. Four-fifths of the members of the Chinese Academy of Sciences are returnees, or ‘sea-turtles’, from overseas.

Knowledge is mobile

This is part of a wider shift in the geography of science. We used to know where new scientific ideas would come from: the top universities and research laboratories of large companies based in Europe and the US. While production was dispersed among global networks of suppliers, it was assumed that more knowledge-intensive tasks would stay at home. All that is changing fast. As globalisation moves up a gear, ideas are emerging in unexpected places and



flowing around the world as easily as money and commodities, carried by a mobile diaspora of knowledge workers.

This is not to say that everything in the garden is rosy. There are areas of persistent weakness in China's science and innovation system. Plagiarism is rife among students and researchers, even in some top universities. Research data may also be falsified, and there have been a number of low-level academic scandals in the past year.

But to get a sense of where things may be heading, the best place to start is the new Medium and Long-Term Plan for Science and Technology Development, which the Chinese government published in January. This is a significant document, which will act as a blueprint for the next 15 years. In a keynote speech to mark its launch, President Hu called on China to become an "innovation-oriented society", and emphasised the role of business in commercialising new ideas.

So what might all this mean for sustainability? How far will the Chinese government direct its scientific and technological priorities towards environmental and social goals? The new plan reads like a fairly conventional list of

scientific and technological priorities, but contained within it are some encouraging signs.

Given the heightened concern in Beijing about power supplies and climate change, the plan unsurprisingly places a big emphasis on energy research. And it is intriguing to consider what contribution China might make to low-carbon energy, if it manages to combine its growing technological capabilities with its capacity for large-scale, low-cost manufacturing.

Sunrise sector

The rapid emergence of China as a key player in solar photovoltaics (PV) shows just what might be possible. In 2005, China's solar industry grew by just under 300%, to take an 11% share of the global market. Most of this growth is being driven by one company – Suntech – but there are a clutch of smaller businesses now vying for a stake in the market, which are attracting interest from venture capitalists and multinationals like BP Solar. As China's PV capacity expands, and its companies continue to innovate, some analysts predict global prices will fall by 30-40%, making PV a far more attractive financial option.

In energy, as in other areas of sustainable innovation, international collaboration is likely to play a crucial role. Some politicians in Europe and the US view China's growing scientific strengths with alarm, fearing it will mean the loss of highly skilled jobs. But a more sensible approach is to acknowledge that science is not a zero sum game: more in China doesn't mean less in Europe or the US. To pretend otherwise is to misunderstand the nature of innovation; the way in which the work of one team builds on the successes and failures of others.

In the new geography of science, it is those who are good at sharing, rather than protecting knowledge, who will flourish. When faced with the global challenges of sustainability, mobilising the best scientific brains in China to work with their counterparts in Europe and the US may be the best hope we have. ♡

James Wilsdon is head of science and innovation at the think tank Demos, and co-ordinator of The Atlas of Ideas project, which is exploring China and India's role in the 'new geography of science' (www.demos.co.uk/atlasofideas).

YORKSHIRE, JUST WEST OF ZHEJIANG...

On the surface (and the map), the old industrial lands of northeast England are a world away from the thrusting new boomtowns of the Chinese coast. But it's clear they can each learn a lot from each other.

If you want to get something made in China, try going to Hull. Go to the Seabright China Products Centre, and ask sales director Catherine Zheng about a customised supply deal. As wholesale suppliers, her Humberside-based but Chinese-owned company knows the value of close links with its customers. Zheng speaks cheerfully of having learned the hard way – by making mistakes at the outset. For anyone unfamiliar with the UK market, it's all too easy to get products ever so slightly wrong: either to fall foul of scepticism about the quality of Chinese goods; get caught out on import procedures; or be left out of sync with seasonal demand. All too easy to end up stuck with a container-load of shoes, clothes or gifts that can't be shifted for love nor money.

Now that she has been up and running at Seabright for a full year, Zheng is keen to give other Chinese companies the benefit of her experience, encouraging them to invest in the UK too. Especially – but not exclusively – if they take her advice about doing it in Hull rather than London.

They don't even have to come from Zhejiang province – although Zheng

herself does – but there are strong links between that part of eastern China and the Yorkshire and Humber region. Regional development agency Yorkshire Forward set up an office two years ago in the provincial capital, Hangzhou, and YF's international operations manager Jeremy Coupland is hard at work getting it to deliver in terms of inward investment.

Inward investment? Hang on a minute – doesn't that mean UK companies investing in the booming Chinese economy, rather than the Chinese setting up businesses over here?

China on the Humber

Yes and no. China certainly devours more foreign direct investment than any other country in the world, at a rate of more than \$1 billion a week. The Brits are among the largest foreign investors there, involved in over 4,800 projects at the end of 2005. And, at the regional level, YF's Hangzhou office does a lot of work with the China-Britain Business Council, promoting goods and services from Yorkshire companies, helping them make commercial links and identifying outlets for Yorkshire know-how.

But it's not quite all one-way traffic.

Around 350 Chinese firms have set up in the UK, attracted by the liberalised business structure. So far 17 (mainly in light to medium manufacturing) have come to Yorkshire and Humber, creating about 100 new jobs locally. That's a useful scattering, but still pretty small beer (less than one-thirtieth of all jobs secured by inward investment). And Coupland admits that none so far are "real quality, highly skilled" ones – though he does detect a growing emphasis on knowledge-driven work, such as specialist ICT.

Interestingly, Catherine Zheng, for all her modern business savvy, makes no explicit reference to the environment; her pitch is all about the price competitiveness and flexibility of getting the manufacturing done in China, plus a promise of smooth order fulfilment, thanks to her grasp of how such things work in the UK.

But this is early days, responds Mike Smith, YF's head of sustainable development. In time, he's confident that this growing web of mutual investment can be leveraged to raise employment standards, improve environmental criteria and generally shift its participants – in



Ullstein - Eckel/Still Pictures

Red flags mean business

China and Yorkshire alike – on to a more sustainable path, as each learns from the other.

So what form would those lessons take? Jeremy Coupland argues that Yorkshire's urban regeneration experience has particular relevance for Zhejiang. He points to "rapid large-scale house building in Hangzhou which has backfired, and could need replacement". He cites examples of universities at Leeds, Sheffield, York, Hull and Bradford working with their Zhejiang counterparts on problem issues like water treatment. And, says Coupland, there are also plenty of positive lessons from Hangzhou's achievements in cleaning up its beautiful lake, taking heavy traffic under it by tunnel and promoting its parks to tourists.

Golden hills, green valleys

That mutual learning is set to intensify, thanks to growing contacts between Yorkshire Forward and Zhejiang, whose vice-governor, Zhang Mengjin, is particularly keen on fostering the links. Smith admits it has taken a while to overcome old prejudices and build trust. "For a long time, the Chinese assumed we were telling them *not* to do things, because

it would have an adverse impact on the world. They were suspicious of us and our motives – and not without reason. There are centuries of history of the Brits selling the Chinese down the river. So we had to establish a relationship where it was clear we were friendly advisors – not 'tellers'."

"We sat down with [Zhang's team], and worked out what we had to offer them in the way of expertise. It came down to environmental and energy technologies, plus financial and legal skills." But it works both ways. "We're obviously interested in inward investment," says Smith, "particularly in the power, chemicals and retail areas" – all of which play to Zhejiang's strengths.

Meanwhile, the province's energy needs are soaring. One estimate suggests it will need to build around 30 new coal-fired power stations to meet demand – hardly an appealing prospect for a government increasingly keen on a more sustainable approach. So it's no surprise that Zhang is particularly interested in learning from Yorkshire and Humber's explorations in shifting to a low-carbon economy, based around cleaner coal and, eventually hydrogen.

He's also keen to introduce corporate

environmental and social reporting to Zhejiang – another area in which Yorkshire Forward is able to offer expertise. Adam Pritchard, head of YF's business investment, admits that "from a business development point of view, it is not a target to get European-style working practices adopted in China, because they're expensive". But there is a reputational issue, as well as a moral one: for Chinese companies working in an increasingly global marketplace, says Pritchard, there's "a competitive advantage in being able to bring Western executives into their office working conditions". Encouragingly, he sees this leading to a general levelling up – not the nightmare "race to the bottom" scenario touted by the diehard opponents of globalisation.

It's a sentiment echoed by Zhang Mengjin, who told Smith: "We've spent the last three years trying to reverse the [negative] impacts of our economic development model. We thought it would give us golden hills, but we'd still somehow keep our green valleys. Now we know that the green valleys are our most important asset." 🍀

Roger East and Martin Wright.

FIRE IN THE GRASS ROOTS

Tensions between central and local government might appear a threat to China's hopes for sustainability. But as **Martin Wright** discovers, the stirrings in the grass roots are firing change, too.

China's rampant urban expansion has thrown into sharp relief some of the growing pains of its booming economy. In particular, it's brought to the surface tensions between a central government committed, in theory, to good governance, and local authorities accused of putting their own interests ahead of the community. Often such tensions and protests, some verging on violence, crystallise around environmental issues, as local communities see their lands and livelihoods under threat from unchecked industrial or urban growth. In some cases, rural people on the margins of China's mushrooming cities are losing the land they've worked on for generations, and receiving little or nothing in return.

Professor Yongnian Zheng, head of research at the China Policy Institute, has observed this process closely over the last few years: "Central government has a new policy package for environment-friendly growth – but local government is often a lot more interested in mere GDP. It's not surprising, because for years the centre emphasised GDP growth above everything else. So if local officials wanted promotion – or even just approval – they had to deliver. It's going to take a while for the new message to get through."

A slice of the action

But it isn't just a communications challenge. In some cases, a 'get rich quick' atmosphere has encouraged unscrupulous local officials to profit personally through

land or business deals which are dubious, if not downright illegal. Such moves have triggered some of the fiercest protests. "China has a huge, oversized bureaucracy," explains Professor Zheng, "especially at the local level. And when some local officials who've been bureaucrats all their life suddenly see people in the private sector getting rich beyond their wildest dreams, they decide they too want a slice of the action..."

It's exacerbated by the paradox that, while China's governance remains highly centralised, the Beijing authorities are in some respects finding it increasingly hard to enforce their rule at a local level. "There's relatively little local participation in framing national laws," says Zheng, "and so local officials sometimes feel free

THE SHAANXI MOTHERS OF INVENTION

Typical of the new breed of Chinese NGO are the Shaanxi Mothers for Environmental Protection Volunteers. The 'Mothers' were founded in Xi'an in the mid-1990s by Wang Mingying and her friends – middle-aged Chinese women increasingly exasperated by the rapid degradation of the environment around their homes. In particular, they were dismayed at runaway deforestation and the persistent fogs of pollution which, then as now, smother the air, screening out the sun even on clear days. "When I was young," Wang says acidly, "the sky was blue."

They started raising money for tree planting schemes by collecting and selling recyclable rubbish, and had to overcome initial scepticism along the way. "Even my husband used to ask me, 'Why have you turned into the garbage lady all of a sudden?'," she recalls. "If you must do this tree planting, at least let me pay for it – don't spend all your life picking up old cans!"

But Wang Mingying, a diminutive, determined dynamo of a woman, and her friends persisted. "In the early days," she remembers, "I would sit outside government officials' offices,

refusing to leave 'til I was seen." Ten years on, the association runs a wide range of environmental projects, from biogas schemes and educational initiatives to huge tree planting campaigns, many involving children and young people. One million each year take part in the 'Hand in Hand' planting project run jointly by the Mothers and the provincial Women's Federation, which receives media coverage on a national scale.

As with many Chinese NGOs, it's hard to define just how much political 'space' the Shaanxi Mothers have in which to operate. They're not a government or party organisation, and not everyone in the association is a party member. Their success is heavily dependent on being able to work successfully with the authorities. As such, part of their achievement lies in winning friends and allies in the right places. The vice-president of environmental protection for Shaanxi province, for example, is himself an honorary 'Mother'.

And when you witness Wang Mingying badgering local officials over environmental shortcomings, you can't help but feel you're also witnessing the first stirrings of a new phase in Chinese politics. – *Martin Wright*



The city is coming: Haikou's fields fall under concrete

Weng Peijun

to 'interpret' their implementation according to 'local conditions.'

So, has the introduction of village-level democracy made a difference? "Things are changing, but very slowly," says Zheng, adding that, where there's tension between elected representatives and party officials, the party usually wins out. But, he adds,

"some village committees are starting to become more assertive, and more powerful."

And there's an added element in the form of the rise of local NGOs – many of them with a strong environmental focus.

While these can be seen as posing a threat to traditional authority structures,

says Zheng, their rise is often quietly welcomed by a government keen to stop the dead hand of local bureaucracy from stymieing its plans for change. Local groups of committed volunteers can bring about change on the ground in a way which the central government, for all its theoretical authority, cannot.

FIRING UP THE YOUTH

In China, things change in generations. At the top, it's the "fourth generation" leadership ushered in with President Hu Jintao that coming to grips with the challenges of making economic growth sustainable. Meanwhile, in the classrooms of half a million schools across the country, a new generation of pupils is grappling with ESD.

That's Education for Sustainable Development – a nationwide programme which originated a decade ago in the Environmental Educators Initiative, set up by the Ministry of Education and WWF-China, with the backing of energy giant BP. The company has funded the scheme to the tune of \$2 million over the ten-year period, ending in 2007. Not that BP China is now backing off from this kind of engagement. Rather the reverse; it has insisted all along that long-term success can only be measured by the scheme's integration into the state education system – and the signs are that the trained teachers, resources and advisors will indeed be in place by October next year.

The guiding principle has been integrating environmental education into the curriculum – whether that's teaching water pollution measurement in chemistry lessons, exploring traffic

noise abatement techniques in physics, or bringing recent history to life by re-enacting public hearings on urban renewal schemes. WWF-China has even built in the concept of encouraging student-led research on local issues – a kind of active involvement relatively unknown in China, which can only help with the gradual strengthening of civil society.

For something that started as an NGO programme, the sheer scale of the initiative is remarkable. Working with teachers in 16 pilot schools, WWF-China helped set up a network of 21 centres within key teacher training institutes across the country. They've trained a 3,000-strong squad of specialist teacher advisers, and fed into the development of the new National Environmental Education Guidelines. As from 2004, it's being gradually rolled out to all of the country's 200 million schoolchildren – and their teachers. And ESD courses begin for university students this year too.

Investment in education has been one of the defining characteristics of China's astonishing economic achievements. ESD, if it's taken seriously, could lay the groundwork for an equally remarkable response to the challenges of sustainability.
– Roger East.

Far beyond the dry handshakes of ministerial meetings, the Sustainable Development Dialogues are helping weave a vibrant web of connections between experts and activists in China and the UK.



Weng Peijun

A GREEN BRIDGE...

This is Asia's century. After the domination of Europe in the 19th century, and the US in the second half of the 20th, power and focus are heading east. The emergence of China and India as huge middle-income powers has massive implications for geo-political alliances, competition for jobs and resources, and planetary health.

Sustainable development cannot happen in the UK unless it happens in Asia too. "We need to dispel the idea that there's a divide between 'domestic interests' and 'foreign interests'. That's completely outdated. This is an interdependent world: domestic policy is foreign policy and vice-versa."

Those are the words of Malini Mehra, who was responsible for establishing the UK's Sustainable Development Dialogues – themselves a response to this new reality. Led by Defra, but involving numerous other departments, notably DFID, the Dialogues provide a much-needed framework for engagement with key emerging markets – including Brazil, Mexico and South Africa, along with the 'Asian Two'.

In each case, the Dialogues have been signed and sealed by ministers, but as Malini explains: "We're trying to get beyond the idea that dialogue between nations starts and ends with ministerial meetings." So as well as government-to-government contacts, they've brought

together NGOs, companies, universities and journalists, collaborating on everything from forestry and chemicals policy to new initiatives on corporate social responsibility, sustainable consumption and production, and governance issues.

It's not about making the traditional channels redundant, but rather giving them a context – and an energy – that they would otherwise lack. "It's completely transformed from the structure originally envisioned by the bureaucrats", says a smiling Malini. Instead, she says, the Dialogues "are creating a new form of relationship between and within countries. In the case of Asia in particular, they're an excellent way of engaging those Chinese and Indians living or working in the UK in sustainable development."

They also help widen traditional perspectives. "This isn't just about how China might be a threat – or an opportunity – for British business. It's also about Chinese inward investment into the UK's science and technology sector." China can learn from the UK's experience, too, notably its long history of suffering from, and slowly tackling, the massive environmental problems which accompanied its industrial revolution. "Whether it's child labour or smog in cities," says Malini, "Britain's been there."

China cannot only learn – it can leapfrog, too. "With all its technical and

innovation skills, it's in a commanding position to create massive markets for renewables, for example." Then there's innovation in social institutions – in areas such as labour rights, consultations with civic society and overall transparency. The UK has some experience here, too, which China can draw on as it evolves its own 21st-century governance structures, beyond the rigidly traditional government and party lines.

The Dialogues have also helped bring together people from different Chinese departments around a common issue. So, for example, officials from the family planning, pensions and health departments have come together with members of the State Environmental Protection Agency (SEPA) and the National Development and Reform Commission on questions around urban migration and women's rights.

As for the UK, "you can really see the lights starting to go on in government" as a result of the Dialogues, says Malini. "They realise that this is a whole new way of working together – and that the UK has something really powerful which it can offer China. And suddenly, people see sustainable development as something to get excited about!" – *Martin Wright*

For more information on the Dialogues, visit www.sustainable-development.gov.uk/international/dialogues

WORDS INTO ACTION

The Sustainable Development Dialogues are home to a wide range of different initiatives – including this publication – all aimed at sparking fresh action on sustainability. Here are a few examples of projects under way.

From Nottingham to Ningbo

The University of Nottingham is setting up an Institute of Sustainable Development on its new £24 million campus in Ningbo, near Shanghai. It will be housed in a state-of-the-art eco-building designed by award-winning Italian architect (and special professor at Nottingham) Mario Cucinella, who specialises in environmental building design.

It will sit alongside a new Centre for Sustainable Energy Technologies, headed by Professor Saffa Riffat, who is well known in China for his research into innovative technologies for sustainable building, and a Centre for Environmental Management will follow. Both will partner Nottingham's own Centre for the Environment, to develop a variety of teaching and research programmes.

The Ningbo campus is closely involved with Nottingham's China Policy Institute (CPI) and its partners at the Sustainable Development Research Centre in the influential Chinese Academy of Social Sciences. The CPI is recruiting now for a research fellowship programme in Chinese sustainable development, with an initial focus on the potential for corporate social responsibility programmes in China to help deliver the goals in the 11th Five Year Plan. "One of China's key sustainability challenges is to develop effective, but also enforceable, policies," says CPI director Richard Pascoe. "It needs to harness its corporate sector – both Chinese and foreign-owned – to play a much bigger role."

Nottingham's China campus is in Zhejiang province, which has a more developed private sector than most other regions and is one of China's wealthiest provinces. It has therefore been chosen as one of seven Chinese provinces piloting an "eco-province" approach. The new Institute of Sustainable Development will work closely with the provincial government and its environmental protection agency, conducting policy-oriented research to bring such an approach to life. – *Martin Wright*

Screen to screen contact

How can you have a direct, lively debate between Chinese and Western thinkers, neither of whom know each other's language, and never even meet? That's the question answered by Chinadialogue.net.

Its founder, Isabel Hilton, explains: "The germ of the idea came last year, when I read an interview with China's deputy environment minister, Pan Yue, in which he famously warned that the country's 'economic miracle' was at risk from environmental degradation [see p3].

"So how can China address an environmental crisis that is growing as fast as the galloping economy? It seemed to me that we needed to open a dialogue with Chinese policy makers, environmentalists, activists and concerned citizens, to exchange ideas, news and experience. The internet was the obvious platform; the obvious obstacle was language. Our answer is a fully bilingual website on which we can publish articles from

inside and outside China and, for the first time in the world, offer the possibility of direct dialogue through fully translated user comments.

"It was a technical and cultural challenge, but after several months of hard work in London and Beijing, the site went live in early July at www.chinadialogue.net. It is now possible for English and Chinese speakers to debate environmental issues on the internet without needing to know each others' language; to discover each others' points of view; and to share ideas, argue and explore solutions together.

"In the first week, we had visits to the site that spanned the globe, from the middle of the Pacific Ocean, to the US, Europe, India and, of course, China. Come and visit – and join the debate!"

Isabel Hilton is a writer and broadcaster, and editor of Chinadialogue.net

A school for sustainability

China's astonishing economic growth, combined with its environmental crisis, poses a major challenge to the thinking of some of its traditional political institutions. Specifically, there is a real lack of practical training in environmental policy making which can combine an understanding of green technology, sustainable business modelling and political reform. In an effort to remedy this, the Chinese Communist Party School is collaborating with the Global Environmental Institute on a new curriculum in "market-based approaches to sustainable environmental development". Drawing on case studies from China and overseas, it will cover four key areas:

- ★ Tools for environmental protection, notably incentives and regulatory instruments
- ★ Urban smart growth principles and practices
- ★ Rural sustainable development models
- ★ Market mechanisms for sustainable energy development.

A chemistry between them...

Nearly half of China's chemical plants – most of which lie along rivers or in densely populated areas – pose a significant risk to the environment, according to SEPA. If the country is to avoid more disastrous accidents like those which have happened recently, its chemicals industry needs to hit the fast track to sustainability.

As part of the Dialogues, Defra is supporting plans for a range of seminars, study tours, scholarships, secondments and training for the Chinese chemicals industry, involving everyone from young professionals to CEOs. Alongside this, it is developing a pilot project on the 'circular economy' – helping Chinese companies, including SMEs, learn from some of the best UK practice in resource efficiency and waste minimisation. This will draw on a number of successful schemes such as EnvWorks, Envirowise and the National Industrial Symbiosis Programme, all of which have helped industry reduce both their costs and their environmental impact.

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We'd love your feedback on *Greening the Dragon*. Please email our editorial team at post@greenfutures.org.uk

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