

China's Sustainable Industrial Development: *Paradigm shifts in response to Global Climate, Energy and Food Security*

China's environmental challenges

While the West is increasingly seeing Climate Change as a looming if distant risk, it is for China a clear and present national danger.

The first danger is water, which, in one form or another, has been taxing China for millennia. China's per capita fresh water resource is only one third of the world's average. Moreover, our water resources are very unevenly distributed: 36% of the land south of the Yangtze has 80% of China's water, historically prone to flooding of devastating proportions. 64% of the land north of the Yangtze has only 20%, chronically beset by droughts. Worse still, all of China's 7 main rivers and 25 out of her 27 largest lakes have become polluted. 500 million inhabitants do not have ready access to safe drinking water. 25% of the land is threatened by desertification. Like most of the world's largest rivers, the Yellow River is running dry as a result of years of increased irrigation, urbanization, silting and climate chaos (Fred Pearce, *When the Rivers Run Dry*, Random House, 2006).

While China has achieved economically in 20 years what has taken the West 100 years, we are now facing all at once the environmental consequences equivalent to a hundred years of industrial growth.

On 26th December 2006, China released a first-ever *National Assessment Report on Climate Chaos*, a 400-page multi-departmental meticulous research. China's average temperature is expected to rise 1.3 -2.1 degrees Centigrade by 2020. Glaciers on the Qinghai-Tibet Plateau, a main freshwater source for China and neighboring countries, are shrinking by 131.4 sq km per annum. Those in Western China are melting down by 27.2% by 2050. Extreme weather conditions including floods and droughts are

likely to lead to diseases as well as water and food scarcity. The Report called for a dramatic transformation of our development model.

The clarion call was extremely timely, if not overdue. At the international press conference of the Fifth Session of the 10th National People's Congress on 16th March, 2007, Premier Wen Jiabao categorically stated that notwithstanding China's impressive growth, he remained deeply concerned about the nation's environmental risks. He feared that China's current development was becoming 'unstable, unbalanced, uncoordinated, and unsustainable'. It was no surprise that China played a highly proactive role in galvanizing an international agreement on the Bali Roadmap on Climate Change in January 2008.

China's current industrial development problems

At far back as the National People's Congress in March 2005, Premier Wen flagged up the 'Five Imbalances' in China's national development: Rural versus Urban, Human versus Environmental, Economic versus Social, National versus Local, and Inward versus Outward Investment. He also stressed the need for 'people-based governance' ('government for the people') and a 'people focus' instead of a 'growth focus' approach to development.

China's current development is largely driven by environmentally-unfriendly, energy-inefficient, low margin and over-export-dependent industrial production. The problems are only too obvious:

(a) According to a research by Fudan University, pollution costs Shanghai alone more than 8 billion yuan a year in healthcare. According to the Jamestown Review in 2005, air pollution causes China 400,000 deaths per annum. Similar research showed that economic losses caused by sulphur dioxide emissions amounted to some 510 billion yuan in 2005. Environmental costs are thought to represent as much as 12-13 % of the GDP.

(b) A large part of the problem is backward technology, local protectionism and vested interests, legitimate or otherwise. These are manifested in various mining disasters and cases of reckless environmental exploitation at the expense of water and air quality. With a relatively short history, the Environmental Protection Ministry is fighting an uphill battle against other departments or authorities more concerned with growth-related agendas.

(c) On average, each Chinese citizen consumes only about one-fifteenth of primary energy as an American, a fifth as much as a Japanese, but twice as much as an Indian. But in terms of energy input per unit of GDP produced, China is extremely inefficient: about 10 times more than Japan, 6.5 times more than the UK, 4.3 times more than the US and about 3 times more than India.

(d) China's manufactured export is largely reliant on foreign brands, external proprietary technologies and other forms of foreign intellectual property. The extent is some 50%, compared with 5% in the case of Japan and the US. Only about 3% of China's manufacturers possess own proprietary technologies. For example, only \$1 of pure profit is generated out of a \$32 DVD player after deducting \$18 royalty for the proprietary brand owner and \$13 for production costs. Likewise, only 1.65% is domestically captured of the value of an iPod made in China. Although China is the world's leading IT merchandise exporter, she accounts only for 15% of the value added, of which 60% is derived from foreign invested enterprises. It has been said that China has to produce numerous DVD players to buy a Boeing 747 or an Airbus.

(e) Gross export accounts for 40% of China's GDP, compared with only 11% of the US. In contrast to the US's reliance on internal consumption, our over-dependence on exports exposes us disproportionately to dramatic downturns in world markets. This is now painfully evident in the current global financial and economic crisis. It also implicates us in the increasingly tense global competition and rivalries for energy and resources, including oil and gas, minerals and potentially, water.

Energy Security

With NYMEX crude oil prices breaching \$147 a barrel on 11 July 2008, countries across the world have woken up to the harsh realities of an energy-hungry world. Inhabited by a fifth of mankind and industrializing at a breakneck pace, China finds herself in the thick of a global energy quest.

China is driving the largest and fastest urbanization in human history. Over the next 30 years, at a total cost of 2 trillion yuan, about 3,000 km of roads will be added each year to build a '7-9-18' network of 85,000 km national expressways, longer than the US interstate network by 10,000 km. 7 major arteries will radiate from Beijing: 9 from north to south and 18 from east to west.

This huge expanse of expressways anticipates that car ownership will jump from a low base of 16 per thousand of population in 2002 to 267 per thousand by 2030. The current car ownership is still very low by world standards but already accounts for a quarter of world demand. Likewise, China is building the world's biggest railway expansion since the 19th century. This represents an increase from 78,000 km, carrying 25% of the world freight traffic with 6% of the world's total length, to 100,000 km by 2020.

We have to continue to industrialize fairly quickly to create about 20 million new jobs a year to absorb the massive excess labour from the countryside. We have to build up and expand a consumption-oriented middle-class to achieve a more balanced and less export-dependent economy. We have to take advantage of the current period of relative internal stability to lay a solid foundation to meet the looming challenges of an ageing population emerging after a few more decades. Underpinning all this fast growth is energy security.

Relying on an abundant coal reserve for 77% of our energy, China has a relatively high level of overall energy self-sufficiency: 94% compared with the OECD average of 70%. However, coal is not a perfect substitute for crude oil for urbanization and economic development. In aggregate, China only accounts for 8% of the

world's crude oil demand compared with 25% for the US, but China already contributes one-third of the global demand growth, while both China and the US each sits on only about 3% of the world's oil reserves.

Rivalry and Partnership in Conventional Energy

Like the US, China relies heavily on import for 40% her crude oil, hoping to gradually reduce to 12–15% in the long term. This compares with Japan's almost total and India's 60 – 70% import dependence. Meanwhile, unlike previous Industrial Revolutions, half of the entire world are industrializing at the same time (Clyde Prestowitz, *Three Billion New Capitalists: The Great Shift of Wealth and Power to the East*, Basic Books, 2005). It is no surprise that global competition for oil and gas is becoming intense.

A vast proportion of fossil fuels is concentrated in relatively few, and mostly geopolitically unstable countries. Apart from supply source, much of our energy is imported by sea to our industrial east coast through the Strait of Hormuz in the Middle East, which is exposed to Iranian military influence. In addition, a great deal of this has to pass through the Malacca Strait in the Indian Ocean, which is susceptible to US military manoeuvres. These are critical transportation routes where China remains highly vulnerable to events beyond our control. It goes without saying that China's energy and economic security would be better served by developing a wider network of partnerships across the globe. Supply reliability aside, some of these partners may be able to provide alternative land transportation routes away from choke-points in geopolitically-sensitive sea-lanes.

In the **Middle East**, China is fostering closer ties with Saudi Arabia, which accounts for 17% of our oil imports. When HRH King Abdullah paid a state visit to Beijing in January 2006, on the cards was the supply of Saudi oil for China's strategic reserves. These include facilities in Zhenhai, 160 km south of Shanghai, and in Qingdao, Shangdong Province. According to Vice Premier Zeng

Peiyan, China is thinking of building a strategic reserve equivalent to 90 days consumption involving both government and business participation over the next 15 years. Separately, we have now become Iran's largest petroleum export market on the strength of a \$70 billion deal in November 2004 to develop the Yadavaran, one of the world's largest oil fields. Apart from supply, OPEC President Ahmad al-Fahd al-Sabah visited Beijing in late December 2005 to discuss oil price modalities, as China, being the world's second largest oil consumer, has become a major influence on global oil prices.

In **Central Asia**, a 1,200 km pipeline from Kazakhstan to North Xinjiang has been completed, bringing into China 10 million barrels of crude oil a year. Xinjiang remains our biggest provincial supplier of crude oil and gas, linked by massive pipelines to our industrial east coast.

China's influence in Central Asia has grown since the founding of the Shanghai Cooperation Organization (SCO) in June 2001, which was originally formed to combat international terrorism. Together with Russia, the SCO's other members comprise Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. It has vastly expanded its scope and influence by welcoming, as Observers, India, Pakistan, Iran, Afghanistan and Turkey. Afghan President Hamid Karzai was in Beijing on 19 June 2006 following a summit meeting of the SCO in Shanghai. While the scope of mutual cooperation amongst members is fairly broad, all members are strategic energy players in one way or another.

Similarly, China is building up a network of energy suppliers and goodwill in **Africa**, which has now become our second biggest continental supplier, accounting for one-third of our oil import.

In **South America**, we have likewise become a leading purchaser of energy and other resources from a host of countries, especially Venezuela and Brazil.

In an increasingly energy-hungry world, China's energy quest is meeting with fierce competition, often fraught with geopolitical

overtone. China suffered a major setback when, following prolonged negotiations, **Russia** eventually decided to build its massive eastward pipeline within Russian territory albeit at much greater cost, bypassing northern China to go to ports near Japan and the rest of the north Pacific. Only a southward link from eastern Siberia to Xinjiang has been provided as a concession. Nevertheless, an increasingly energy-confident and assertive Russia is intent on good rapport with China as a means to achieve greater global balance. As Russia is a main energy supplier of the world, there remains a vast potential for closer Sino-Russian energy cooperation.

Our energy and mineral relations with **Australia** have witnessed a quantum leap in recent years. Even there, we recently lost to Japan's Osaka Gas, which has secured an annual supply of 1.5 million tonnes of liquefied natural gas (LNG) for 25 years from the huge Gorgon field off the NW coast of Australia. The field is operated jointly by Chevron, Royal Dutch Shell and ExxonMobil. 2.5 million tonnes of the fuel will be supplied separately to the West Coast of the US annually for 20 years. LNG, of course, is cheaper and cleaner than oil and is expected to displace oil in primary consumption by 2050.

Perhaps nowhere else is energy competition or rivalry more sharply focused than in the East China Sea, complicated by territorial disputes over certain islets with **Japan** and other neighboring countries. Tiny though some of these islets are (some may even be compared to rock protrusions), they involve disputed rights over estimated potential reserves of 7 trillion cubic feet of natural gas and 100 billion barrels of oil. After China-Japan relations had become embroiled by former Prime Minister Koizumi's recalcitrance on history, President Hu lost no time in making a 'Warm Spring' visit to Japan in early May 2008 to mend fences. As a result, relations have since greatly improved with more common grounds for cooperation.

Geopolitical and geo-economic drivers of Energy Security

Until a viable alternative energy source is found on a global scale, there will be increasing concerns about energy security, scrambles for fossil resources and shifts in the world's economic and geopolitical landscape, set against the background of Climate Change.

There are five drivers at work.

First, rapidly rising energy prices have dramatically boosted the confidence and international influence of countries rich in fossil energy. Some of these countries, such as Russia, Iran and Venezuela, are flexing their energy muscles to gain geopolitical space. Others, especially the petrodollar countries, are making their financial muscle felt across the globe. For example, the Abu Dhabi Investment Authority acquired 7.5% of Carlyle Group for US\$1.35 billion and 5% of Citigroup for US\$7.5 billion. This was outdone by the Kuwait Investment Authority, which bought a US\$14.5 billion stake in Citigroup, along with Saudi Prince Alwaleed bin Talal and Singapore's Temasek. On 23 March this year, Abu Dhabi-backed Aabar invested \$2.7 billion in Daimler making her Daimler's largest shareholder. Saudi Arabia, a *gigantis inter paris* amongst the Gulf Cooperation Council (GCC) states, has a domestic investment fund of US\$600 billion with projects in the pipeline over 20 years. There are talks of a GCC Monetary Union for 2010. The attitude of OPEC countries on what currencies in which to keep their oil wealth would have a profound impact on the US dollar and global financial stability.

Second, new energy geopolitics and geo-economics are re-defining relationships in Central Asia, as in the case of the Shanghai Cooperation Organization mentioned above. Australia is fast emerging as a major provider of much sought-after mineral resources, including uranium for the world's resurging nuclear energy programs. Resource-rich countries in South America, such as Venezuela and Brazil, are becoming more internationally prominent. For example, Brazil is now the world's leading exporter of ethanol, produced from her abundance of sugar cane. With 65% of her cars already using bio-fuels, Brazil is a living

laboratory for some of the world's business-savvy auto giants on cue to revolutionize the world's car industry with green-energy vehicles.

Third, insatiable global energy demand has given Africa a new-found dynamism, putting her in the spotlight of global geopolitical attention. At the last EU/Africa Summit in Lisbon, the cool reaction to the EU's bilateral economic partnership overtures is a sign of rising African pride, nationalism, and solidarity. This display of African strength reflects an awareness that an energy and resource-hungry world is competing in a new courtship of this resource-rich though strife-ridden continent. China's pervasive and ideology-free investment in Africa is a prime example. The EU is stepping up her efforts to engage Africa while the US is said to contemplate relocation of her African strategic command from Frankfurt to Africa.

Fourth, energy security has come up on top of many countries' political agendas. In his last State of the Union Address, President Bush re-emphasized the reduction of gasoline usage by 20% over the next 10 years in order to achieve the target of reducing reliance on Middle East oil by 75%. He set great store on renewable energies and bio-fuels as well as technologies for plug-in and hybrid vehicles. Such imperatives were also flagged up by President Obama in his inaugural speech, as he recognized 'that the ways we use energy strengthen our adversaries and threaten our planet'. Similar calculations of energy security also inform the EU's energy policy, ever conscious of the long arm of Russia's energy reach. China is well aware of her own conundrum. Internally, we have to take the pollution together with the world's outsourced energy-intensive manufacturing. Externally, we have to contend with the world's energy geopolitics. That's why the 11th Five Year Plan (2006-10) mandated sustainable development with emission and energy input reduction by 10% and 20% respectively.

Last but not least, a recent study by Trausti Valsson shows how the momentum of global warming may change the balance of the world's economic gravity dramatically towards the Arctic (*How the*

world will change with Global Warming, University of Iceland Press, 2006). We are already witnessing a flurry of active interests (especially Russia) in staking territorial claims on the Arctic's cornucopia of oil, gas and mineral deposits. Over the next few decades, the melting of Arctic ice is set to open up much shorter shipping lanes connecting the North Atlantic with the North Pacific. The Canadian archipelago, the Bering Straits, the Davis Strait, the Denmark Strait, the passage between Iceland and Norway, and the so-called GIUK (Greenland, Iceland and UK) sea lanes are likely to gain commercial and geopolitical importance. The same would apply to Alaska, the Kamchatka Peninsula, the Sea of Okhotsk, and the Aleutian Islands. In an extreme scenario, if global warming persists at its current pace past 2100, the centre of the world's economic gravity is projected to shift towards the Northern Hemisphere near the Arctic, thought to be virtually ice-free by then. At the same time, the world's current temperate zones may become overheated and the Southern Hemisphere relatively marginalized. Even if this extreme scenario does not materialize, the on-going geopolitical and geo-economic implications for countries with existing Arctic territorial claims such as Russia, Canada, the Nordic countries and the US would demand serious attention. Those countries such as China and India without direct and ready Arctic access are likely to have to sit up and think.

Needless to say, these implications are over and above the threats of rising sea-levels, disrupted Gulf Stream flows, methane release from melting permafrost in the Siberian tundra, and other looming ecosystem dislocations. Before the Bali Roadmap has a chance to stabilize the world's climatic order, the global geopolitical and geo-economic landscape is poised to change almost beyond recognition in the 21st century.

Food Security

In March, 2007, a joint governmental report warned that with unchecked Climate Change, our production of wheat, rice and corn will decrease by 37% by the latter half of the 21st century with the

result that China will suffer a food shortage of 5-10% within the next 20 years.

Moreover, as more and more countries are industrializing on a large scale and as the world population continues to grow, there is increasing demand for food crops and grain-intensive meat. This demand has been accentuated by the world's sudden embrace of bio-fuels following concerns about Climate and Energy Security. Unfortunately, bio-fuel production in some places is achieved at the expense of agricultural land usable for food crops. So there is a real possibility of a long term rise in global food prices.

China is agriculturally disadvantaged as we are endowed with only 9% of the world's arable land but 20% of the world's population. Additionally, after WTO entry, we are open to highly-subsidized agricultural imports from the West. This has already caused more than 20 million of her farmers to abandon their land to seek alternative livelihood. We are now the largest purchaser of US cotton and soybean, whose production is supported by modern scale-mechanization and heavy government subsidy. Compared with a 50% subsidy in the US, 60% in the EU and 76.7% in Japan, our agricultural subsidy stands at only 1.23% of gross production. Many other developing countries, including India, face a similar challenge. This is one of the reasons for the recent collapse of the Doha Round of international trade negotiations.

In the 11th Five Year Plan (2006-10), China has redoubled her ongoing efforts to address the 'Three Agrarian Issues': Farmers, Agriculture and Rural Development. Taxation on farmers has now been abolished. Free and compulsory nine-year education has been made available for rural children. Better access to basic healthcare is being provided for. A better supported and better-off farming sector is promised under the banner of 'A New Socialist Countryside'. Concern with the farming sector has gained impetus in the wake of rising food costs following a series of adverse weather conditions and natural disasters, such as the snow-storm at the beginning of the year and the Sichuan earthquake a few months later. China's food prices leaped by 25% in the first quarter of

2008. They have since come down significantly as the Consumer Price Index eased from a peak of 8.7% in February to 1.2%% in December, 2008. This is a result of earlier price controls, tightening monetary policies, and the recent economic downturn. Nevertheless, because of its potential threat to social stability, Food Security is assuming much greater importance on the national agenda. The Three Agrarian Issues are thus likely to receive even higher priority in coming years.

Indeed, Food Security is increasingly grabbing the attention of many other countries dependant on food imports. A number of Middle East and North Africa (MENA) energy-rich but food-scarce nations are already exploring agricultural investments overseas as a strategic option. For example, Libya has talked to Ukraine about growing wheat in the former Soviet republic. Saudi Arabia has signaled investment in agricultural and livestock projects overseas. China's Ministry of Agriculture was exploring the possibility of acquiring land in Brazil for soybean production (*Financial Times*, 8 May 2008).

China's Action Program for Sustainable Development in the early 21st Century

Following the United Nations Conference on Environment and Development in 1992, China formulated '*Agenda 21 – A White Paper on Population, Environment and Development in the 21st Century*'. This embodied the principle of 'common but differentiated responsibilities' for mitigation and adaptation measures adopted at the United Nations Framework Convention on Climate Change (UNFCCC).

According to the International Energy Agency (IEA), China's *per capita* CO₂ emissions from fossil fuel combustion improved to 3.65 tons in 2004, equivalent to 87% of the world average and 33% of the level in OECD countries. Our emission intensity also fell from 5.47KgCO₂/US\$ in 1990 to 2.76KgCO₂/US\$ in 2004 in constant prices. This was a reduction of 49.5% compared with the world average reduction of 12.6% and OECD's average of 16.1%

for the same period. Nevertheless, balanced and sustainable development remains a long-term uphill battle. The 11th Five Year Plan (2006-2010) mandated targets of energy saving of 4% p.a. and emission reduction of 2% p.a. per unit GDP. Initial performance, however, has left a lot to be desired. Local recalcitrance still remains strong. These targets are now reached in the year 2008.

In June 2007, following detailed research, the National Development and Reform Commission published a *National Climate Change Program* on China's responses in the coming decades up to 2050. Nevertheless, well before its publication, China has in fact been undergoing a quiet Green Revolution.

China's quiet Green Revolution

Naturally, our energy challenge -- largely dependent on coal and fossil fuels -- is by no means confined to scarcity, competition and geopolitics. The world, China included, is becoming increasingly aware of the risks of emission-induced pollution and environmental sustainability. In any event, it is not beyond imagination that we may need more than one planet if China, with a fifth of mankind, and India, set to overtake China as the world's largest population in several decades, were to replicate the American Dream in terms of energy consumption per head.

The World Energy Council, headquartered in London, points out that China, with the highest energy intensity level in 1980, registered the strongest improvement in energy productivity - around 7.5% p.a. between 1990 and 2000, although this trend has since drastically declined to only 1% p.a. China's energy intensity is now only slightly above the world average level, whereas it was 80% higher in 1990.

China is committed to building 2 new **nuclear power** plants annually for 15 years. By 2008, China's nuclear power generation capacity has increased to 8.85 million KW. Although nuclear energy is seen to have greater security, safety and disposal

problems, over-reliance on external fossil energy supply would be liable to potential risks of overt or covert blackmail, using energy as an asymmetric ‘weapon of mass disruption’.

Our **water** imperative has launched a gigantic ‘South to North Water Diversion’ project at a cost in excess of \$60 billion. The project comprises three huge canals connecting the flooding Yangtze to the much drier Yellow River. In addition, the Three Gorges Dam, the largest dam in human history, is designed to increase China’s hydroelectric power from 108 GW to 290 GW by 2020. With a generating capacity of 163 million KW in 2008, China’s hydroelectric power potential is estimated at 400 GW.

Wind power, much of it in Inner Mongolia, is expected to grow from 1 GW to 30 GW, to power some 13-30 million households by 2020.

According to the Worldwatch Institute in Washington DC, China already has 30 million **solar** households, or 60% of the world’s current solar capacity, with photovoltaic (PV) energy accounting for 65 MW. China expects to increase solar panels to 300 million sq metres providing 2 GW of power by 2020, displacing 40 million tonnes of coal annually. Concurrently, plans are being drawn up for a new generation of energy efficient buildings, incorporating solar power where appropriate, for possible application nationwide.

Our solar manufacturers already accounted for 10% of the world’s PV market in 2006, ranking third after Japan and Europe. China is slated to become one of the largest solar cell manufacturers in the world by 2010, with annual production capacity of 1 GW (*China Renewable Energy Development Overview 2008*). The NYSE-listed Chinese solar energy corporation Suntech has made its founder China's 4th richest man with a wealth of \$1.4 billion.

To make the use of our abundant coal resources more environmentally-friendly, we would hugely benefit from cleaner (and safer) **coal** extraction and liquefaction technologies. Small energy-inefficient and highly-polluting coal power plants are already being closed. The closure of those with less than 10m kW

capacity has been completed by 2007. The next closure will be those with a capacity of less than 50m kW. In addition, China has entered into a deal with South Africa's SASOL to build a Coal to Liquid (CTL) plant in each of the inner provinces of Ningxia and Shaanxi at a total cost of \$10 billion. The production target is 10 million tonnes of crude oil by 2010, and 30 million tonnes by 2020, equivalent to about 16% of China's overall crude oil output. In addition, the International Finance Corp, the World Bank's private sector lender, has signed an equity-and-loan deal with the Xinao Group to convert coal into dimethyl ether, a cleaner gas used for cooking and heating or as a substitute for diesel fuel.

As for **bio-fuels and mixed fuels**, China is the world's third largest ethanol producer, generating 1 billion gallons annually in Heilongjiang, Jilin, Liaoning, Anhui, and Henan, where the use of gasohol, a mixture of petrol and ethanol, has been made mandatory. Since December 2007, economic incentives are provided to encourage bio-fuel production by making use of non-food agricultural products such as forest biomass, sweet sorghum and cassava. Increasing use has been made of human and animal waste to produce energy so that by the end of 2007, 26 million households have switched to methane gas generated in this way.

Forests are powerful absorbers of carbon emissions. China has started as early as 1978 to build an **afforestation** belt of 4,480 km, sometimes referred to as the *Green Great Wall*. This has now become the world's largest single ecological project. Its coverage is planned to expand to 18.21% of the nation by 2010. It is absorbing 500m tons of CO₂ per annum or 8% of China's greenhouse gas emissions. The absorption rate is expected to increase to 1 billion tons or 20% of emissions by 2010. This would be a much welcome counterweight against the on-going encroachment of 2.6 m sq km desertification threatening the livelihood of some 400m people in China.

The adoption of hydro, nuclear, coal-seam gas, biomass, wind, solar, terrestrial heat, wave and other renewable energies is being actively encouraged across the provinces, embracing a variety of

sectors and innovations. What is more, both local and international environmental NGOs are being actively engaged in pushing the country's green agenda. Greenpeace, for example, was invited by the Chinese government to contribute suggestions to the development of China's Renewable Energy Law, which was enacted on 1 January, 2006. It has also been delivering its climate change project in China for the past four years.

Electric Cars capable of a reach of 120 miles at 80 mph are being manufactured in Tianjin for commercial launch in 2009. Indeed, under the aegis of a '*Project 863*' launched in March 1986, China has been quietly working on the development of a variety of alternative vehicles, including electric, hybrid, compressed natural gas (CNG), and hydrogen fuel-cell electric cars. GM has also invested more than \$1 billion in hydrogen-fuel-cell-electric cars as part of a strategy to revive its global leadership in the car industry. It has signed a collaboration agreement with Shanghai to develop a prototype and supporting urban infrastructure. Coupled with the development of advanced micro-power, energy-storage and distribution grids, these green innovative technologies are set to spawn a whole new generation of Cars of the Future. They are poised to dramatically revolutionize the world's car industries as well as to help extricate the world from over-dependence on Oil. (Iain Carson & Vijay V Vaitheeswaran, *Zoom: The Global Race to Fuel the Car of the Future*, Twelve, Hachette Book Group, USA, 2007).

Another example of China's green innovation is the proposal to build the world's first sizeable **Eco-City** at Dongtan on Chongming Island, 15 km north of Shanghai, with the help of UK's Ove Arup and Partners. With a planned population of half a million, the city is designed so that inhabitants will live close to their work. Only green transportation such as fuel-cell electric buses will be used. The city is to be equipped with photovoltaic, biomass, and wind energies with facilities to capture and use rainwater, along with other environmentally-friendly measures and installations. It was originally intended to open by 2010, to coincide with the World Expo, although the project has recently hit

the rocks. However, more of such eco-cities, towns and villages, or at least the eco-planning concepts, are on the drawing board as many brand-new second or third-tier urban and rural communities will be springing up from scratch in China in mankind's largest and fastest urbanization drive in the coming decades.

Green Investments

The IEA estimates that China will be investing \$2.3 trillion in energy development during the period 2001-30. Of this, \$200 billion is earmarked for renewable energy development within the next 15 years. This is expected to grow from 7% to 10% annually by 2010 and 20% annually by 2020. This is also borne out in a Deutsche Bank study of 2006. In 2008, renewable energy accounts for 8.5% of China's primary energy utilization. The target is to increase this to 15% by 2020.

China's green energy portfolio forms part of a surge in green investments worldwide. The latter totaled \$63 billion in 2006, up from \$49 billion in 2005 and \$30 billion in 2004. The growth has been 20-30% per annum and is set to provide the biggest job and wealth creation opportunity in the 21st Century (*Economist*, 18 November 2006). In bio-fuels, such investments have come from some of the world's top visionary business leaders, for example, Microsoft co-founders Bill Gates and Paul Allen, and Sun Microsystems founder Vinod Khosla. In advanced all-electric cars, they have come from such names as Larry Page and Sergey Brin, co-founders of Google, and Elon Musk of PayPal fame. China is very much in the game: it is no coincidence that the United Nations has set up a world carbon trading exchange in Beijing (*Financial Times*, 5 Feb, 2007).

In his *New York Times* column, Thomas Friedman (author of *The World is Flat*) recently highlighted the growing impetus to the quest for green energies: an emerging alliance between rising environmentalism and growing concerns about Energy Security. In this connection, the Pentagon has helped fund a major study on how greater fuel efficiency, lightweight car materials, advanced

bio-fuels, and other technological breakthroughs could help achieve *Winning the Oil Endgame* (Amory Lovins et al, Rocky Mountain Institute, 2004).

International cooperation and investment in the field of Energy, Food and Climate Security require ready and long-term capital. With the global credit crunch, there is no other source of capital better placed than Sovereign Wealth Funds (SWFs). Derived from saved oil or trade surpluses, such funds have rapidly risen in the Middle East and Asia, including China. According to a study by Morgan Stanley, SWFs have accumulated US\$2.8 trillion in assets and have been looking for further overseas acquisitions. Merrill Lynch expected SWF investments to quadruple to US\$7.9 trillion by 2011 and to reach US\$12 trillion by 2015. These numbers have now become over-optimistic due to the world's banking turmoil. But when the global economy is back on its feet, they are likely to redouble their international investment footprints.

Investments by these funds in Energy, Food and Climate Security will open up vast areas of cooperation with countries possessing leading green technologies and expertise. These countries include the US, the EU, Japan, South Korea and India. Such investments could also usher in opportunities for joint projects between China's and the Middle East. This cooperation would not only cement the growing energy ties between China and the Middle East but would also serve to enhance their respective international image as responsible global stakeholders. For example, these investments could provide potent chemistry in mitigating the socio-economic tensions of Globalization as outlined by Joseph Stiglitz (*Globalisation and Its Discontents*, and *Making Globalisation Work*, W.W. Norton & Company, New York and London, 2002 and 2006). I have advanced the same arguments in my article 'China and the Middle East: An Eastern Alchemy for Global Harmony' dated 17 February, 2007 at http://www.andrewleunginternationalconsultants.com/publications/2007/02/china_and_the_m.html)

A blue-print for China's Sustainable Industrial Development

The above pointers for a more sustainable industrial development model are captured in a two-part document issued by the State Council in October 2008, detailing key action targets for 2006-2010 in the 11th Five Year Plan. The following components are noteworthy:

- To transform the pattern of economic and societal development through ‘less input, less consumption, less emission and high efficiency’, including energy optimization, energy conservation and eco-preservation
- To promote advances in science and technology and international cooperation to cope with climate change and to protect the world environment along the principle of ‘common but differentiated responsibilities’
- To raise the proportion of renewable energy in the primary energy supply by up to 10% and the extraction of coal-bed gas up to 10 billion cubic meters
- To make concrete progress in building a water-conserving society, to complete installation of anti-flood systems in large rivers; and to raise the drought resistance standard of farmlands
- To accelerate the development of the service sector by increasing its value-added contribution to the GDP by 3%
- To raise the value-added proportion of hi-tech industries to total industrial production by 5%, capitalizing on the progress made in such high-tech industries as information technology, bio-engineering, aeronautics, space aviation, new energy, new materials, and marine industries
- To promote energy efficiency, conservation, and emission reduction in production processes, projects and buildings,

including clean coal and clean power-generating technologies such as poly-generation and carbon dioxide sequestration; and to restrict energy-and-emission intensive industries (the proportion of coal in primary energy consumption having dropped from 72.2 % in 1980 to 69.4% in 2007)

- To push ahead the development and utilization of renewable energies including biomass, marsh gas, solid and liquid bio-fuels, and to capitalize on progress made by 2007 in hydropower (leading the world both in installed capacity of 145 million KW and in 482.9 billion kWh power generation), in solar power (110 million square meters of solar panels, by far the world leader), in wind power (seven-fold increase to over 6 million KW, fifth in the world), and in nuclear power (installed capacity 9.06 million KW, an increase of 30.5% over 2006)
- To develop a Recycling Economy. China has enacted a ‘Circular Economy Promotion Law’ on 29 August 2008, governing all stages of the utilization, consumption and reuse of resources in the society and in industries, including water and building and production materials

The world’s climate is changing. The environment is under strain. The sands of geopolitics and geo-economics are shifting. The risks are high as the opportunities are rewarding, for this generation and our future generations. Like it or not, China, along with all countries on this planet, is caught up in this high-stake game of human survival and development. In an increasingly interconnected and interdependent world, it is a game that cannot be won by any country alone, but only by the joining of hands, hearts and minds across the Global Village.

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