Chapter 2 China's Green Prosperity Future —Environment, Energy and Economy

Executive Summary

Of the multiple crises facing the world at present, those posing the greatest threat to environment and development include the 2008 financial meltdown and its economic consequences, climate change, and poverty. Crises breed both challenges and opportunity, a point well realized within China. Thus China is seeking to mitigate the impacts of the global economic downturn with a stimulus package that will shift emphasis towards domestic consumption and accelerated infrastructure development, while continuing to build a modern economy in both urban and rural areas. It hopes to continue its march towards 2020 goals for improving both income levels and quality of life, including becoming a more environment-friendly society. This Issues Paper, prepared for the CCICED 2009 Annual General Meeting, explores how China might achieve a Green Prosperity Future through linking its future growth to better environment, energy and economy relationships. It will be essential to do this in order to address global climate change.

The unprecedented level of international cooperation to deal with economic recovery has shifted attention to the role of the G20 group of nations including China and other emerging large economies. In the dialogue at the UN, in G8 and G20 meetings, and in many other international gatherings during this past year, concern has been expressed that economic stimulus should not be at the expense of the environment, and, indeed, that economic recovery should be based on *Green Growth*. G20 leaders and many other nations have pledged significant action to address climate change, including efforts based on energy efficiency improvement, shifts towards greater reliance on renewable energy, and on pursuit of a low carbon economy. These commitments to new approaches have to be long-term, certainly with a need to set goals to 2020, 2030 and 2050, with very substantial investment, innovation and capacity development.

China has given energy and environment high priority in its economic stimulus package, drawing on goals set for the 11th

Five-Year Plan. The overall approach to environmental protection should continue to be improved during the next few years of recovery period. Structural changes within 10 key industrial sectors are being undertaken, including environmental protection action and more efficient use of resources and energy. In cities and rural areas environmental improvements, including better planning and design of infrastructure are happening and it is critical to accelerate progress. China also hopes to gain international competitiveness through its investment in new green technologies and products for which there will be both domestic and international markets. However, the growing income levels of people will significantly raise the per capita levels of energy use and greenhouse gas emissions. Therefore, how domestic sustainable consumption issues are addressed will become a key matter for concern. Chinese citizens at present are savers rather than spenders and frugal in their consumption. But that is not a guarantee of future sustainability, especially depending on shifts in lifestyles and decisions regarding urban design, transportation and other infrastructure. Greater emphasis on energy productivity and structural shifts in the economy towards more emphasis on tertiary, service based industry is important.

This year five CCICED Task Forces will report their findings and recommendations on various aspects of energy and environment. The topics include: Sustainable Use of Coal, Urban Energy and Environment, Rural Energy and Environment, Economic Instruments for Energy and Environment, and Low Carbon Economy. These studies cover the most critical issues that China needs to address for continuing its high rate of economic growth, but gradually decoupling this growth from increases in energy use and from environmental degradation.

With more than three years of the 11th Five-Year Plan completed it is possible to examine where progress has been made, and what remains to be done. For example, of the mandatory targets related to energy and environment, it should be possible to meet the very important 10% reduction goal for SO_2 emissions a year ahead of schedule. However, to reach the goal of 20% energy reduction per unit GDP from 2005 levels will require further reduction levels of 5.89 % in 2009 and in 2010. Now that renewed levels of economic growth is definitely a strong prospect for China, the reliance on intensity indicators (tied to GDP) rather than total loading is dangerous in that absolute amounts of pollutants and energy use are still likely to be on the increase. Furthermore, many important pollutants such as NO_x , ground level ozone, mercury and other heavy metals, and POPs are not subject to targets, or even control strategies. Greenhouse gases and carbon reduction strategies were not incorporated

into the 11th Five-Year Plan.

Looking ahead, China can continue along the pathway of transformative change concerning environment and development. The opportunities associated with Low Carbon Economy in particular should provide both competitive advantages and improved quality to future growth. There are many specific topics that may be highlighted for consideration in the 12th Five-Year Plan and beyond. In addition there are a number of specific drivers that should be taken into consideration in China's national planning and action for *Green Prosperity*. Those with direct links to environment, energy and economy include the following:

(1) Energy conservation and energy efficiency needs in a variety of sectors to bring energy intensity in line with, or better than, existing international norms.

(2) Reduction in energy intensity for urban buildings, infrastructure construction and operations, and urban transportation.

(3) Continued efforts to expand as rapidly as possible the use of renewable energy sources in China, focusing particularly on wind, solar, marsh gas (methane), and small-scale hydro.

(4) Specific actions related to international arrangements on energy, environment and climate change, including carbon pricing and possible trading, CDM, bilateral and multilateral agreements on technology transfer and partnerships, IPR, and investment arrangements.

(5) Adaptation needs concerning climate change.

(6) Mandatory targets for reduction in GHG emissions and carbon intensity of development.

(7) Continued improvement in environmental quality through more stringent reductions in pollutants covered under the 11th Five-Year Plan mandatory targets, plus a broader range of pollution control (e.g., mercury from coal burning, NO_x).

(8) A system for reduction in total pollution load for some sectors and regions.

(9) Improved protection for ecological services, and eco-compen-sation.

(10) Environment and health targets designed to reduce or eliminate mortality and cases related to specific causes, and improvement in environmental safety associated with key sectors such as coal mining and various types of industrial sectors.

(11) Full achievement of the MDGs within China, including those related to environmental sus-tainability.

(12) Strengthening frameworks to improve green growth opportunities, including scientific R&D, innovation technology investment, institutional strengthening and capacity building related to advanced efforts that will provide China with new economic growth opportunities and export potential related to meeting international demand especially those related to environment and energy.

(13) Improvement to the statistical information base for both energy and for environmental performance.

Key themes where China must build new or revised policies are:

(1) Strategy for sustainable use of coal.

(2) Immediate and longer-term steps towards Low Carbon Economy and Development, including implementation in both urban and rural settings, in various industrial sectors, and shifts towards green growth for both domestic and export products.

(3) An energy productivity strategy, including a progressive, predictable approach to energy pricing and the use of an improved mix of regulatory and economic incentives.

(4) Carbon pricing, which may be based on carbon tax, cap and trade, or other arrangements.

(5) Targets for energy efficiency and energy-related environmental concerns, with some based on absolute amounts rather than intensity.

This Issues Paper has examined several global shifts of historical dimension taking place virtually simultaneously. On economic recovery and associated institutional changes there is a sense of optimism gradually emerging, in part due to the rapid action by political leaders to avert worst-case scenarios. The power sharing that is taking place in the restructuring of global institutions, and in the decision-making among the world's major economies is an outcome that would have hardly been believed possible only a year ago. China has strengthened its potential for international cooperation as a result.

The second great shift has been the depth of dialogue on the issue of climate change. Unfortunately getting a solid agreement about the best approach, with high levels of immediate action, is proving to be extremely difficult in the lead-up to Copenhagen. Whatever the immediate outcome, it is the start of a new way of thinking about our planet, and particularly about developing the Low Carbon Economies needed for the future.

The third shift is international cooperation concerning poverty reduction, and global capacity to address this serious problem. China's strides towards meeting its Millennium Development Goals present a remarkable success story, but one that is tempered by growing inequalities in wealth, and the realization that a fair part of China's population remains far too close to the poverty line. Yet China also can contribute much through expanded international cooperation throughout the developing world. The technologies that China is diffusing in its rural areas, its experience with renewable energy, and the advantages it brings in driving down the costs of production of many products are examples of unique contributions China can bring to many oth-

ers in the world. Poverty is interlocked with climate change impacts and adaptation and with better environment and development relationships.

The fourth and hopefully very enduring shift is towards societies based on innovation that can more rapidly address the changing circumstances and demands on productive forces within national economies and globally. Green growth involves new forms of both production and consumption. It should influence all sectors of economic productivity, ranging from primary and secondary industries to the commercial, tourism, telecommunications and other aspects of modern tertiary activities. It is understandable that much of the focus on green growth currently centres around energy, environment, and climate change, but ultimately it is transformation of lifestyle, infrastructure design, and the way business is carried out that will determine better outcomes—a future of Green Prosperity.

Will China be the global leader in developing this new future? China's potential is great because it has the means to address key challenges and opportunities precisely at the point in time where it is building the infrastructure to house, transport, meet energy needs, water supply of its people at a better level; and because it is prepared to invest in social improvements, especially for health and education. China also has demonstrated its tremendous capacity to succeed in the global marketplace. With the great size of its domestic markets, its export marketing skills, and its ability to be adaptive, smart and fast, China has advantages that will be put to good use in coming years.

It is well to seriously consider the meaning of Ecological Civilization, a phrase used mainly in China. If nations can prosper at low levels of ecological damage—with a deeply felt respect for nature and the ecological services provided by the global commons and by the rich resources of the planet—then we might achieve an Ecological Civilization globally. China's leadership has called for this state of harmony between people and the planet, and we must presume that it will become a central part of China's on-going development philosophy. Other countries will have much to learn, and hopefully much to contribute, during this common journey towards a prosperous future.

2.1 Introduction

The multiple crises faced by China and the world call for new paths to prosperity. These pathways must align environment, economy and development in ways never before seen in the modern world. They must be resilient enough to address economic and financial upheaval; major environment, energy and climate change concerns; declining ecosystem conditions and ecological ser-

vices; growing world demand for natural resources including water and food; unmet human development needs; and public health threats. These are among the *Common Challenges of the 21st Century.* [1]

The greatest challenge ever faced by the modern global economy occurred during this past year. It has been the most significant year for climate change negotiations. And, a very important shift in global relations is underway, with the emergence of the G20 this year as the major forum for shaping global economic decisions. In this year of New China's 60th Anniversary celebrations, and certainly in the coming decade, opportunities and expectations concerning China's participation in global economic, environmental and development matters are greater than ever before.

Our 2009 Issues Paper focuses on China's Green Prosperity Future because any future development pathway that fails to create a much improved relationship between environment and the economy ultimately will impoverish rather than enhance human well-being. This is true within China and elsewhere. Indeed, it is a fundamental point being stressed globally—at meetings of the G8, the G20 and in the United Nations General Assembly. Even in these harsh economic times, there has been a quite remarkable level of global resolve to continue efforts to address environmental protection. Much of this attention has focused on energy and environment, especially in relation to climate change. What has been most encouraging in the dialogue this past year among the world's leading economies is the recognition that between now and the mid-century there will be a revolution in how we capture and use energy to fuel our economy and meet human development needs. This, in turn, will influence the design of our communities, our food production, transportation and other key aspects of human existence, and will shape the next phase of globalization.

In meetings of the G20 and at the OECD this year, the call has been for a sustained and urgent effort for *green growth*, which is generally defined in terms of innovation and investment that will promote environmentally and socially sound economic development. Green growth is a means to an end—a prosperous, thriving society. A society of equitable distribution of wealth and opportunity, and one where the ecological support systems and services are well maintained. It is a society where people are satisfied with their way of life. In short, *Green Prosperity* is an aspirational outcome that deals with key quality of life factors, not only financial wealth and economic growth.[2] Both green growth and its outcome of green prosperity are inextricably linked to how the

[1] A phrase used by President Obama in commenting on why he is accepting the Nobel Peace Prize in order to empower all nations. October 9, 2009.

[2] Attempts to provide an index of prosperity along these lines have been started, notably the *Legatum Prosperity Index* based on *economic competitiveness* measured by 9 indicators and 12 indicators of *comparative liveability.* In the 2008 Prosperity Index, the leading nation was Australia, the USA and Germany ranked fourth and China ranked 54th. http://www.prosperity. com/ranking. aspx

world and how countries, including China, deal with their energy and environment relationship, and particularly on how countries build their pathways of *low carbon economy, low carbon development, and low carbon prosperity.* Whatever the term used, it is essential to decouple energy use from economic growth, and to minimize environmental impacts, including those of climate change.

China's leaders propose that, domestically and internationally, long-term transformative change should be towards *Ecological Civilization* [1]. This transformation must take into account China's enormous economic and social development challenges. These challenges include br-inging some 250 million Chinese citizens (mainly located in rural areas) above the World Bank poverty line standard of US$1.25 per day.[2] As well, the massive planned migration of people to cities creates enormous demand for construction of both public and private infrastructure, and for hundreds of millions of new employment opportunities. The dual goals of quadrupling China's GDP by 2020, while also seeking to build an environment-friendly society remain formidable challenges, even though progress has been made on both goals during the first three years of the 11th Five-Year Plan. Vice-Premier Li Keqiang has noted the need for new economic growth points, focusing attention on efforts to tackle climate change, developing clean energy, and strengthening environmental protection.[3]

An example of the resolve that is emerging is the "New Chinese Road towards Environmental Protection." Minister Zhou Shengxian in his thoughts about this New Road has laid out a clear set of needs:

1) a proper relationship between environment and economy with accelerated efforts for environmental protection; 2) a holistic perspective on environment fitted within a Chinese macro-strategy and conditions; 3) a precautionary system that places emphasis on pollution prevention and control; 4)cost-effective environmental measures that are efficient and practical in their application; 5) improved policies, standards and laws in order to create advanced production capacity within China;

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[1] This term was introduced in a speech by Hu Jintao at the 17th Part Congress in October 2007. A concise point of view from a 5 June 2009 speech by Minister Zhou Shengxian is that "ecological civilization is to mend the ills of industrial civilization, instill the concept and requirement of environmental protection into social and economic development and create a major line of defence that will effectively prevent environmental pollution and resource waste." For a detailed overview of the concept, see China Society for Hominology (eds.) June 2009. *Ecological Civilization, Globalization and Human Development.* Conference Proceedings. 388 pp. Sanya, China.

[2] Li Zhenmin, China Deputy Permanent Representative to UN speaking to the 5th Committee of 64th Session of the UNGA. China Daily 7 October 2009. *China Ready to Contribute More to United Nations.*

[3] China Daily 6 July 2009 *Making Chinese Officials See Green.*

and 6) a more complete environmental management system in which public participation is the major social force and government takes a leading role for environmental protection. [1]

And internationally, there are new initiatives such as the Global Green New Deal promoted by UNEP and others.[2] China is very actively engaging with others on how to address climate change, and other energy and environment concerns.[3]

Internationally, however, during this time of economic stimulus and recovery, there is a perhaps grossly unfair perception that "as China goes, so goes the world". Some expectations are simplistic and overblown, for example, that China's shift towards greater domestic consumption will support renewed economic growth for the rest of the world, that China's efforts to improve global financial institutions will lead the way to stability, and that China, either single-handedly or with one or two other nations (e.g. the USA and/or India), can make-or-break a favourable outcome of the Copenhagen climate change negotiations.

International cooperation depends up-on complex alignments in which China is rapidly becoming a more important player, but one primarily still concerned with getting its own development directions right. As Liu Zhenmin noted to the UN in discussions concerning Chinese financial contributions: "in 2008, China's per capita GDP stood at US$3 000, ranked about 100th in the world and still far from the average per capita gross national income (GNI) of $7,119."[4]

China's growing prominence in the world, however, is not built so much around per capita measures, as around its overall performance. China currently leads the world in its rapid return during the past year to high economic growth rates (8% target). It is projected to become the leading exporting nation in the world, outpacing Germany. And China is now believed to be the leading contributor to global greenhouse gas emissions in large part due to its reliance on coal-burning. But China also is now a leader on production of solar panels and on installation of wind turbines. It leads on the production of batteries needed for electrical vehicles and for storage of renewably-generated electricity.

China is at a critical crossroads in its development pathway. If the transformative

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[1] See speech by Minister Zhou Shengxian, Minister of MEP. 5 June 2009. Actively Exploring a New Path to Environmental Protection with Chinese Characteristics under the Guidance of Ecological Civilization. Beijing, World Environment Day Forum.

[2] http://www.unep.org/greeneconomy/docs/ggnd_Final% 20Report.pdf

[3] Examples include the China-USA Energy and Environment Agreement, the dialogue underway via The Major Economies Forum on Energy and Climate, and the UN preparatory meetings on climate change since the Bali Action Plan was signed in 2007.

[4] China Daily 7 October, 2009. *China Ready to Contribute More to United Nations.*

path towards green growth and prosperity is followed to its fullest extent, the country should be able to meet its economic and social objectives and greatly improve its own environment and development—while con-tributing to improvement of the global env-ironment and to development opportunities for other countries.

This Issues Paper focuses on concepts and efforts within China and internationally for Green Prosperity, and how these efforts relate to environment, energy and renewed economic growth. The Paper examines: 1) economic stimulus and environmental performance; 2) some key issues for energy, environment and climate change, especially those such as low carbon economy addressed through CCICED task forces; 3) green growth and prosperity; and 4) the 11th Five-Year Plan performance to date, and some potential areas for CCICED recommendations concerning the 12th Five-Year Plan. The paper draws upon valuable conclusions and recommendations drawn from the CCICED Round Table held in April 2009.[1]

2.2 Stimulus and Environmental Performance[2]

2.2.1 G20 Leadership in Economic Recovery

The financial meltdown and global economic recovery effort has perhaps forever changed the landscape of international power sharing. This was acknowledged at the G20 Pittsburgh Summit—that from now on it will be the G20 rather than the G8 providing key directions for coordinated global economic action. Following the 2008 financial meltdown, most G20 nations rushed to put in place economic stimulus packages that would avoid disastrous financial ruin, and would stimulate renewed growth. From the start of this effort there were serious concerns about the environmental effects of short-term stimulus packages and also on the longer influence of deficit spending on a remarkable scale. As well, much has been written about the potential effects of the global financial crisis on development progress within poorer countries, and on the potential of the crisis to derail the global climate change negotiations.

At the London meeting of the G20 in

[1] CCICED 2009 Roundtable Meeting Proceedings. *Green Development: Opportunities for China in Times of Economic Challenge.* 79pp. 16-17 April, 2009.

[2] This section has been prepared in part from a background paper prepared for this Issues paper by Dr. Zhou Guomei and Dr. Yu Hai.

April 2009, leaders[1] noted that:

We agreed to make the best possible use of investment funded by fiscal stimulus programmes towards the goal of building a resilient, sustainable, and green recovery. We will make the transition towards clean, innovative, resource efficient, low carbon technologies and infrastructure…We will identify and work together on further measures to build sustainable economies…

This mantra was repeated during the latest G20 meeting in Pittsburgh, but with the addition of a proposal to develop a Framework for Strong, Sustainable and Balanced Growth. This Framework is intended to …move towards greener, more sustainable growth, [and] to phase out and rationalize over the medium term inefficient fossil fuel subsidies while providing targeted support for the poorest. The G20 Pittsburgh commitment provides the str-ongest support yet for green recovery including the pledges noted in Box 1. China is a signatory to these pledges.

That the efforts towards economic recovery have had a positive short-term effect on turning around a potentially devastating destabilization of the world economy appears certain. But there are still strong warnings concerning the fragility of today's situation, plus the additional concern that deficit spending in the years ahead will foreclose options for the coming generation. While it is encouraging that political leaders of the world's major economies agree on the need for a green recovery, for an end to destabilizing booms and busts, and for structural reforms, the path ahead may be fraught with practical macroeconomic and other difficulties too numerous to discuss here. What is clear is that China's position in the recovery is one of relative strength, and of significance to the rest of the world's recovery.

In fact, both China and the USA have been front and centre since September 2008, but for somewhat different reasons. China has demonstrated a more rapid recovery, and greater stability in its banking and financial system. The USA has plunged itself into a high level of indebtedness, even though it has undertaken major steps to avoid a repeat of what is now regarded as senseless folly on the part of its financial sector. It has supported huge recovery packages that place much of the funding into the hands of foundering industries such as the domestic auto sector. But the USA, along with Western Europe also has taken major steps towards an integrated recovery process that places major faith on innovation, especially towards green growth and transformation of energy-economy relationships.

[1] G20 Leaders Statement, 2 April 2009.

Box 2-1 Excerpts from the Statement by G20 Leaders at the Pittsburgh Summit, 25 September 2009

As leaders of the world's major economies, we are working for a resilient, sustainable, and green recovery.

Increasing clean and renewable energy supplies, improving energy efficiency, and promoting conservation are critical steps to protect our environment, promote sustainable growth and address the threat of climate change Accelerated adoption of economically sound clean and renewable energy technology and energy efficiency measures diversifies our energy supplies and strengthens our energy security. We commit to:

Stimulate investment in clean energy, renewables, and energy efficiency and provide financial and technical support for such projects in developing countries.

We, the Leaders of the countries gathered for the Pittsburgh Summit, recognize that concerted action is needed to help our economies get back to stable ground and prosper tomorrow. We commit to taking responsible actions to ensure that every stakeholder– consumers, workers, investors, entrepreneurs – can participate in a balanced, equitable, and inclusive global economy.

We share the overarching goal to promote a broader prosperity for our people through balanced growth within and across nations; through coherent economic, social, and environmental strategies; and through robust financial systems and effective international collaboration.

We have a responsibility to secure our future through sustainable consumption, production and use of resources that conserve our environment and address the challenge of climate change.

We have a responsibility to invest in people by providing education, job training, decent work conditions, health care and social safety net support, and to fight poverty, discrimination, and all forms of social exclusion.

We have a responsibility to recognize that all economies, rich and poor, are partners in building a sustainable and balanced global economy in which the benefits of economic growth are broadly and equitably shared. We also have a responsibility to achieve the internationally agreed development goals.

2.2.2 Environmental Spending in Stimulus Packages

Monitoring of environmental spending in stimulus packages has been relatively difficult to do since categorization of expenditures is somewhat arbitrary and commitments have shifted as plans were implemented. Lord Nicholas Stern suggested that at least 20% of recovery packages should be devoted to environment, especially for addressing climate change. Joseph Stiglitz proposed that at least 1% of stimulus packages should be directed to meeting the needs of poorer developing nations. And, of course stimulus packages

have ranged from a relatively moderate commitment in relation to GDP to massive packages such as those of the USA and China.

The first major assessment of "eco-friendly" stimulus expenditure was carried out by HSBC in January 2009. This assessment noted that the leader was South Korea with almost the entire package focused on green growth. China's commitment was also noted as one of the highest at more than 35%, and USD 200 billion (4.8% of the 2008 GDP), figures that likely erred on the high side. It was higher than the USA which was USD 94 billion, about 12% of the package.[1] Green stimulus funding appears to be spent primarily on four areas of concern: *green infrastructure* including buildings, transportation; renewable energy; electrical grid; water & sewers; *environmental restoration* in rural areas, cities & industrial areas; *protection of ecosystem services* for sustainable land, water and air use; and *sustainability technologies from the R&D stage to commercialization* for new approaches for clean coal, advanced biofuel, solar, and many other energy-related technologies.

That stimulus packages can have positive and negative impacts on environment is a concern. A study by E3G and WWF[2] suggested that, of 5 countries surveyed, plus the EU stimulus efforts. Italy was the only country with a net negative impact due to its major focus on road-building. All 5 countries had some negative as well as positive environmental contributions. The EU contribution was considered exclusively positive, with a focus on renewables, electrical grid infrastructure and carbon capture and storage (CCS). This study did not include analysis of China's situation.

2.2.3 Environment and Development in China's Crisis Recovery

The key question for CCICED is what are the immediate impacts of economic stimulus on China's environmental protection? And, more generally, what longer-term consequences will there be for environment and development as a consequence of China's recovery strategy and actions.

2.2.3.1 *Economic Stimulus Efforts*

Without a doubt, China has launched a major environmental effort through its two-year stimulus plan. The overall plan gives priority to welfare projects, infrastructure construction, ecological protection, and post-quake reconstruction in Western China. The focus is to generate more income for citizens, particular poor groups so

[1] These figures are from 3 April 2009 issue of The Economist, based on the HSBC study by N. Robins. February 2009. A *Climate for Recovery. The Colour of Stimulus Goes Green. See also naturenews 30 March 2009, based on Edenhofer & Stern Towards a Global Green Recovery.*

[2] E3G & WWF. April 2009. Economic/climate recovery scorecards.

as to ensure sound and fast economic development. Some funding will come from central government (29.5%); the rest (70.5%) will come from local governments, bank lending and the private sector. There are many initiatives specifically labeled as environmental contributions, and other elements that should have positive environmental effects. But early on there were concerns expressed that some projects might be undertaken without adequate environmental safeguards or environmental assessments. These problems have emerged at a significant level. Initiatives specifically earmarked as environmental (emissions reduction and ecological protection) amount to RMB 210 billion, about 5.25% of total stimulus spending (see Table 2-1.)[1] If all the other environment-related investment for structural reform, post-quake reconstruction and infrastructure construction, the total investment for environment protection in this package could be as high as 10%.

The environmental efforts undertaken via the stimulus effort in China are linked to the 11th Five-Year Plan, including the mandatory energy intensity (20% reduction per unit GDP) and pollution intensity (10% reduction per unit GDP) targets, the promotion of Circular Economy, the 2007 Climate Change Action Plan, and an improved economic incentives approach for environmental protection including greater attention to policies such as environmental taxation, green credit, green insurance, green securities, emissions trading, ecological compensation, as well as green trade.[2] The attention given to green credit is particularly important given that there has been a massive increase in the number of large loans during 2009.

Over the next three years from various sources China will raise a total of 1 trillion RMB for environmental protection, including the stimulus funds. As for current progress, the Central Government allocated RMB 12 billion from the newly-added RMB 100 billion investment budget in the fourth quarter of 2008 for emission reduction and ecological protection. In addition, the Central Government also arranged RMB 2.5 billion investment in ten large energy saving projects, circular economy projects, and industrial pollution control programs in key river basin areas.

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[1] The major projects for environment protection include the following: to build 290 million mu forests; to expand water treatment capacity by 2.83 million t/d and increase garbage treatment capacity by 3 155 t/d; to build new pipeline network (water and sewage) 2 458 km; to cut COD by 65 thousand tons; to dispose chromium residue 320 thousand tons; to save energy by 6.16 million tons of standard coal; to save water by 120 million tons; and to recycle 2.7 million tons of waste.

[2] These aspects of China's efforts are reviewed in more detail in the background paper by Dr. Zhou and Dr. Yu.

Table 2-1 Elements of the 4-trillion RMB Economic Stimulus Package to the End of 2010.

Investment Theme	Investment Amount/ billion RMB	Proportion/ %
Total	4,000	100
Welfare housing projects for poor people	400	10
Infrastructure construction in rural areas	370	9.25
Key infrastructure like airports, railways and express ways, and grid facilities in urban areas	1,500	37.5
Social undertakings like medical care, education, and culture projects	150	3.75
Emission reduction and ecological protection	210	5.25
Innovation and industrial restructuring	370	9.25
Post-earthquake reconstruction	1,000	25

Source: National Development and Reform Commission.

All is not rosy, however. The huge economic stimulus could revive the energy-intensive, heavy-polluting sectors and result in overcapacity in low-end industries. Even though the environmental and ecological sectors will receive investment from the package, the proportion is merely 5.25%. And in terms of this year's central fiscal budget, the proportion of expenditure in 2009 for environmental protection has dropped from the previous 2.86% to 2.82%. If we consider the boom in fixed-asset investment, environment protection investment is only a small part, and its proportion to the overall investment generally has been on a downward trend from 2001-2005, a demonstration that investment in environment protection still lags behind economic growth.

Importantly, due to the current circumstances where economic growth stimulus is the predominant goal, many investment projects, even if they have passed environmental assessments, will likely pose some level of environment risk and threat in the longer term as they are so large-scale and concentrated. In February 2009, MEP investigated 71 project applications from 2008, which were either waiting for approval or had been refused. According to preliminary findings, 8 of these projects started the construction without approval and 3 projects even started operations without approval. So 15% of the projects violated the rules. In addition, the MEP conducted a sampled investigation into 118 project applications at the provincial and municipal level, and found that the rule-breaking rate was as high as 24%.

2.2.3.2 *Revitalization Plans for 10 Key Industries*

To address the bottlenecks in industrial operation and development, to secure future economic growth and job creation,

as well as to promote industrial upgrading and structural adjustment, in early 2009, the State Council unveiled a total of ten industrial sector revitalization plans, covering steel, auto manufacturing, shipbuilding, petrochemical, textiles, light industry, non-ferrous metal industry, equipment manufacturing, electronic information industry as well as the logistics industry. These plans will be translated into reality from 2009 to 2011.

These ten industrial sectors are significant pillars for China's economy as they are major source of industrial output and fiscal revenue. They create huge numbers of job opportunities and play a key role in driving China's GDP growth. The aggregate number of employees in these ten industrial sectors amount to 100 million, and the livelihood of about 300 million rural people is related to these industries. The nine industries (excluding the logistic sector) contribute 80% of the total industrial added-value in China, accounting for roughly one third of the GDP. In addition, large enterprises in these industries pay around 40% of the total tax revenue to the government.

Reviewing the revitalization plans for 10 key industries reveals that most give full consideration to factors including structural adjustment, technical upgrading, environment protection, emission reduction, and cutting low-end manufacturing capacities, etc. The plans take into account the environmental effects in the process, and map out corresponding strategies and measures to prevent and try to address potential environmental problems and risks. In some plans, there are specific chapters and indicators for emission reduction.

For instance, the auto industry plan proposes that China should follow a structural reform approach, seek breakthroughs in developing environment-friendly new cars, increase the research capacity for such cars, encourage the innovation, technological renovation, and mass production of electric-powered cars, and launch a new energy-efficient car strategy. In addition, that plan also contains a number of "green policies" including new green tax revenue, green government expenditures and green standards, all intended to make environmental protection less burdensome.

By comparison with the industrial revitalization in developed countries, China's revitalization plans remain focused on traditional industries to a considerable degree. This is closely related with China's situation as the plans have to accommodate specific constraints in economic development and industrial structure, and also have to address the major social issues like job creation. Therefore, some industries included in the 10 plans still belong to energy-intensive, high-polluting and resource-dependent industries, such as iron steel and petrochemical. These industries have experienced over-expansion and

over-capacity during recent years. Most are manufacturing low-end products that consume huge amounts of energy and resources, with heavy pollution. As they are relying on overseas markets, they have been heavily hit by the financial crisis. In terms of their total capacity, structure and geographical distribution, revitalization of these sectors will likely exert heavy pressure on environment, with uncertainties that may trigger significant environment risks in the future.

Table 2-2 Energy Saving and Environmental Content in 10 Key Industry Revitalization

	Targets, tasks and measures for energy-saving and environment protection			
10 key industries	Structural reform	Technical up-grading	Emission reduction	Cutting low-end manufac-turing capacity
Auto	√	√	√	√
Iron steel	√	√	√	√
Electronic information		√		
Logistics				
Textile	√	√	√	√
Manufacturing	√	√	√	√
Non-ferrous metal	√	√	√	√
Light industry	√	√	√	√
Petrochemical	√	√	√	√
Shipbuilding				

(Information for Logistics and Shipbuilding is not available)

2.2.3.3 *Deepening Structural Economic Reform*

On May 19, 2009, the State Council distributed the *Opinion on Deepening Structural Economic Reform* (hereinafter 'the Opinion'), which was drafted by the NDRC. The Opinion is the overarching document to guide in-depth structural economic reform. It is aimed at overcoming obstacles, seizing opportunities, and addressing the most difficult issues in economic reform. The Opinion requires that China should identify opportunities in the crisis, move ahead with reform in key areas and address critical links with the purpose of expanding domestic demand, securing economic growth and benefiting ordinary households. This shift towards stimulating consumption on the part of citizens and domestic businesses is a complex matter from a sustainability perspective, as will be discussed later in this Issues Paper.

In effect the Opinion proposes institutional arrangements for meeting scientific development and social harmony objectives. Key areas for reform are shown in Box 2-2.

Box 2-2 Deepening Structural Economic Reform in China (May 2009 State Council)

- *Changing the government's role in managing the economy to tap vitality in market-based investment;*
- *Deepening the reform in monopoly industries to expand the investment scope and areas for private funds;*
- *Promoting reform in price mechanism for resource products and environment protection to shift the development pattern;*
- *Focusing on optimizing industrial structure and ownership structure to boost service sector and private sector development;*
- *Accelerating reform in welfare projects to increase people's consumption capacity and will;*
- *Deepening the reform in technological, educational, cultural and health care sectors to encourage the growth of social undertakings;*
- *Deepening the rural sector reform to establish sound mechanism for coordinated urban-rural development;*
- *Accelerating taxation reform to make the taxation regime more suitable for scientific development;*
- *Deepening the financial sector reform to build a modern financial system;*
- *Deepening the external-related economic sector to build an open economy; and*
- *Promoting the pilot programs for comprehensive reform to set examples for other areas to study and follow.*

The Opinion is important as a means to recognize the current difficulties and environmental risks, deepen reform in environment protection areas, and overcome long-term entrenched obstacles. Implementation should bolster environmental protection efforts and highlight various institutional and structural needs as noted below:

(1) Improving legal and regulatory framework to set up long-term mechanism for environment protection, such as amending the Law of Environment Protection.

(2) Participating in the reform of public utility sectors to increase investment in environmental and other infrastructure construction in these sectors.

(3) Improving the performance assessment indicators for emission and pollution reduction, and circular economy programs to create innovative approach for environment protection in the 12th Five-Year Plan.

(4) Deepening economic policy for environment protection, and integrating en-

vironment protection into economic development.

(5) Accelerating reform in the administrative arrangement for environment protection in rural areas, and

(6) Implementing relevant environment policies in environment-friendly and resource-conservation pilot program areas, to gain and distribute experience across the country.

2.2.3.4 ***Additional Challenges and Opportunities***

In the short term, the financial crisis has reduced the break-neck speed of growth that has created negative environmental impacts. This is particularly true for some emissions, therefore helping to achieve pollution reduction targets. In highly industrialized areas such as the Yangtze River Delta and Pearl River Delta, many firms have shut down. In Qinghai Province the local energy-intensive sectors relying on Qinghai's power advantage were seriously affected. As the commodity prices plunged in the global market, production of many energy-intensive products was greatly reduced or suspended—as of mid-November 2008 the suspension rate on the production of iron alloy, silicon carbide, calcium carbide, and electrolytic aluminium in Qinghai was 71%, 46%, 83% and 15.5% respectively.

The demand and price for raw materials such as iron and steel have declined. Electric power consumption dropped for the first time in years, although consumption started to increase again by mid-2009. Central and local government agencies have increased investment in environment protection including infrastructure construction on water treatment plants and so on. All these factors have contributed to eased pressure on emission reduction.

In the medium term, the financial crisis could have certain negative impacts on China's environment protection. If the macro-economy remains sluggish and corporate sector profits stay thin, businesses may choose to sacrifice their environment protection efforts first. Maintaining their profits and jobs will be very high priority. Some firms that already have installed environment protection facilities may stop using them. This will in turn result in more pollution, possibly worsening future environmental crises.

With the need to stimulate employment, some measures taken earlier to change incentives towards improved energy and environment efficiencies may suffer. An example is the reinstatement of tax rebates on some energy intensive export products. China also could face non-tariff trade barriers on some exported products—protectionism masquerading as environmental safeguards by developed countries.

As in the case of other countries, actions taken by China in support of stimulating domestic consumption may be in-

consistent with sustainable development strategies. Incentives for private automobile purchase are an important example.

The stimulus package has spurred new investment, much of it located in central and western China. These regions are becoming the new economic growth centres of China. Will they behave similarly to many eastern coastal areas in earlier days, placing growth ahead of environmental protection?

China has taken advantage of the decline in stock prices to purchase companies abroad, especially in various resources sectors. This is fully understandable, not only to take advantage of bargain prices, but, most importantly, to guarantee long-term supply access. But China is still at an early stage of setting out regulations to ensure these overseas investments are managed well from environmental and other considerations. It is a welcome development that Chinese banks that may provide funding are putting in place environmental considerations, and that new regulations are being prepared to regulate environmental aspects of overseas investment by Chinese firms. Corporate social responsibility requirements are needed on the part of Chinese firms wherever they operate.

China has affirmed that it will continue to be involved in African development efforts, no matter what the economic crisis may bring in the year ahead. China is in the fortunate position to do so not only for Africa but for other poor regions of the world, including some parts of Asia. The environment will need to be taken into account in these international cooperation efforts. Ultimately such a commitment could accelerate the transfer of green technology, experience in addressing climate change adaptation, and many other aspects of environment and development.

2.2.3.5 *Some Conclusions*

Firstly, China's environment protection is facing very daunting challenges to address the multiple crises of the recent past. To offset negative impacts, China has worked out one of the world's largest economic stimulus packages and comprehensive industrial revitalization plans. On one hand, this has brought opportunities for better environment protection, but on the other hand, it has created potential environment risks. In some cases, the risk may be even greater than the benefit of environmental improvements.

Secondly, at present, China's overall plans in response to financial crisis could be described as pro-growth, pro-con-sumption and pro-restructuring. An important aspect of these plans should be to pursue growth based on conditions of improving quality, optimizing structure, increasing efficiency, cutting energy use, and ensuring environment protection. This is, of course a huge and long-term challenge.

Thirdly, the multiple crises have

brought about historic opportunities for green innovation in both China and other major economies. Well established industries can become more eco-friendly; growth of new clean technology and industries will mushroom; and developing clean energy is a high priority of many governments. Most industrial countries would like to tap the opportunities provided by the multiple crises, promoting a new-round of economic restructuring with green economy and green policy initiatives. They will gain globally competitive advantages and at the same time help to secure their sustainable development. It is safe to say that developing a green economy has become an irreversible trend for key decision-makers in China, and is a direction that is essential for China's contribution to achieving global environment and development goals.

Fourthly, China is well placed to take advantage of these green growth opportunities, as this new concept requires economic restructuring of the type China proposes, along with continued social growth. The key point is that green growth can help China to achieve its strategic goal in environment protection while building a more diverse and efficient economy. There are important sub-themes to green growth, especially Cleaner Production, Energy Productivity and Efficiency, Circular Economy and Low Carbon Economy.

If we look at the issue of economic growth from a long-term perspective, and presume that the Central Government's policy package will deliver some sound reforms, with full implementation of various environmental protection measures, then China's economic restructuring could create a great longer-term success out of the crisis. In this case, the economic pattern in China will have impressive changes with significant shifts in economic structure, industrial structure and products mix. With a variety of environment-centred policy incentives, an array of technological advances, and a comprehensive process of environment management, China should be in a position to strengthen its efforts towards becoming a resource-conserving and environment-friendly society. The key is to identify the new and sustaining driving forces for economic growth, which could both help propel economic development and promote environment improvement and sustainable development.

2.3 Sustainable Consumption and Green Growth

2.3.1 Sustainable Consumption

The shifting emphasis in China from export-driven growth to a greater balance with domestic consumption presents an opportunity—even a necessity—to ensure that the new patterns of economic growth reflect a sustainable consumption pattern. This is not a simple undertaking by any

means. The trap facing China is that of over-consumption, especially in the richer cities. Sustainable consumption is defined in various ways, for example, by Canada's Office of Consumer Affairs as *the use of goods and services required to meet basic needs and improve quality of life without placing at risk the needs of future generations*.

2.3.1.1 ***Avoiding Over-consumption***

OECD notes that: It is resource use and environmental pollution that have to be brought to sustainable levels, not the consumption of products and services as such.[1] Yet, while energy and materials have been used more efficiently in recent times, the level of over-consumption in both goods, including houses and autos, and high energy consumption service industries such as those related to recreational travel has shot up.[2] The global economic downturn may have a significant influence on future levels, but the warning signals are clear—the ecological footprint of consumers in rich countries is already far too large and it is still growing.

The OECD has suggested that five general conditions are needed in a general framework for sustainable consumption:[3]

(1) A price structure for consumer goods and services that internalize environmental costs and benefits.

(2) A policy and regulatory framework that makes clear the priorities and direction of change.

(3) Availability of a range of environment-friendly goods and services.

(4) Technology and infrastructure that includes environmental quality criteria in the design and running of transportation networks, housing, waste management, etc.

(5) An educational, learning and information-rich environment that motivates and enables consumer action.

A combination of instruments could then be applied, along with life cycle analysis to determine points of intervention, with appropriate sustainable consumption indicators.

2.3.1.2 ***China and Sustainable Consumption***

With its huge population and rapidly growing wealth, China will have a significant impact on global consumption, certainly driving up the total level in coming decades. But can this consumption be done in a fashion that is different than the OECD nations? This is a very difficult question to answer. It requires an examination of the

[1] OECD. July 2002. *Towards Sustainable Household Consumption? Trends and Policies in OECD Countries.* Policy Brief, OECD Observer.

[2] For example, vehicle stock in OECD countries totals 550 million, of which 75% are private autos. This total number is projected to grow by more than 32% to 2020, and with a 40% increase in kilometres driven. Municipal waste in OECD countries is projected to grow by 43% from 1995 to 2020. (OECD Policy Brief, 2002).

[3] http://www.oecd.org/document/52/0,3343,en_2649_34331_ 35145204_1_1_1_1,00.html.

characteristics of Chinese consumers today, including structural issues in the economy that influence current behavior, and various policies or actions that might change consumer spending habits in the future. It also requires a look at the external influences on China. These influences include: global media and advertising; the limited level of access to the most highly advanced energy and material efficient durable products, and the positive influence of other nations that have made some progress in addressing sustainable consumption—Norway, Swe-den and the Netherlands, for example.[1] It is helpful that China has enunciated a philosophy of *Xiaokang*[2], where wealth and consumption should be modest and distributive.

China currently has the lowest domestic consumption level of any major economy, about 36% of GDP. This is a level half that of the USA and about 2/3 that of Japan or EU nations. In fact, consumption in China has dropped about 15% relative to GDP since 1990. Commonly it is believed that Chinese dedication to saving is the result of limited or inadequate social benefits such as pensions, health and education. Thus addressing these problems via new policies would help to stimulate a higher level of consumption by households. In addition, short-term measures such as those within China's stimulus package might hasten the transition, or at least signal the government's intent to place more emphasis on the growth of domestic consumption.

The McKinsey Global Institute recently published an interesting, in-depth study of the future of Chinese consumerism development which points out key barriers to increasing the level perhaps to as much as 50% of an expanded GDP, by 2025.[3] Whether this goal is reasonable from a sustainable consumption perspective is debatable，a key hypothesis of the McKinsey study is that if this expanded consumption goal were to be achieved, the actual pressure on the environment and natural resource use could be reduced since the intensity of water, land and fossil fuel use would be lessened as a consequence of a smaller burden from the export economy and other reasons. And, while China's overall share of world consumption would

[1] See Cohen, M. J. 2004. Sustainable Consumption and Global Citizenship: An Empirical Analysis.Paper presented at the annual meeting of the American Sociological Association.

[2] Wikipedia notes that: "The vision of a *Xiaokang* society is one in which most people are moderately well off and middle class, and in which economic prosperity is sufficient to move most of the population in mainland China into comfortable means, but in which economic advancement is not the sole focus of society. Explicitly incorporated into the concept of a *Xiaokang* society is the idea that economic growth needs to be balanced with sometimes conflicting goals of social equality and environmental protection."

[3] McKinsey Global Institute. 2009. If You've Got It, Spend It: Unleashing the Chinese Consumer. Also, McKinsey Quarterly. August 2009. A Consumer Paradigm for China.

rise to between 11% and 13%, it would still be well below China's portion of world population.

The McKinsey study highlights structural change in the economy as the key element to accelerate change in domestic consumption. This is important and recognized by Chinese economists and leaders, even though it is a difficult matter to address. China is investing a large portion of its wealth in developing basic infrastructure for the nation, including transportation, water treatment, and other basics of cities and countryside areas, energy networks, etc. Much of this is public sector spending, and therefore opens to influence through green procurement policies. But investment in large-scale industrial development has a very large share of GDP. In fact it is believed that overinvestment has taken place in some sectors such as iron and steel. This part of the economy, especially in the case of state owned enterprises does not contribute as much to employment growth as does the growth of SMEs and the service sector. And therefore consumers do not have as much money for consumption. Furthermore, in poorer rural areas, household income in excess of meeting basic needs will be quite limited for years to come by comparison to urban areas.

The study suggests that without structural change towards a more balanced economy, China's domestic consumption will remain at a very low level, possible around 39% to perhaps 42% of GDP. Furthermore, some steps already taken, such as the current efforts to make home appliances available in rural areas at subsidized prices, are unlikely to make much of a long-term difference in consumption patterns.

If it is the creation of wealth through the creativity of small businesses and a flourishing service sector that is most needed, then attention will need to be given to mechanisms to make credit more freely accessible to both individuals (including families seeking to have their children enroll in expensive post-secondary education) and smaller enterprises. There are many ways to do so, but at the moment progress is slow, and access to money is still much easier for larger, state-owned businesses. According to the McKinsey analysis this transition will be key:

A more consumer-centric economy would allocate capital and resources more efficiently, generate more jobs, spread the benefits of growth more equitably—and grow more rapidly—than China will if it remains on its present course. The narrowing of the trade surplus and the Chinese consumer's larger contribution to global growth would make foreign ties more harmonious.

But a consumer-centric society is not necessarily a society of sustainable consumers. How can progressively wealthier Chinese citizens avoid becoming over-consumers in coming decades? There

is ample evidence that some fraction of urban residents already fall into this category. North American, Japanese and European luxury auto makers certainly see Asian markets and especially China as a major market for their large vehicles, even if there are punitive taxes on such vehicles.[1] And whose rules should apply? Governments can only do so much to channel consumer behavior in desired directions.

Much has been written about whether Chinese cultural characteristics might or might not predispose people towards a conserver type of society. The current tendency towards frugality could well be reversed quite dramatically if some constraints are removed, as suggested by the McKinsey study. It must be presumed that if household income share of the national income increases significantly (currently it is 56%; by comparison US households get more than 70%), and if credit is easier to obtain, then people will enlarge their debt loads perhaps setting off buying binges. The auto industry in China has seen this development in the previous few years prior to the world financial and economic crisis, and most recently in August 2009, when 2,000 new vehicles per day entered the streets of Beijing, aided by the government stimulus efforts.

There are several urgent tasks for making the transition to an environmentally ultra-responsible consumer society in China a possibility.

The first task is to accelerate the pace of implementing green growth initiatives so that consumers will have a wider range of "green" products to choose from, at competitive prices; and in general, that any products purchased will have lower embedded energy, carbon and pollution costs related to production processes and material content. Governments at all levels within China can also assist through green procurement policies that are even more robust than today's.

The second task is to ramp-up public education and information campaigns that explicitly reveal the true cost of unsustainable actions, expose non-compliant businesses and poor performance on the part of administrators and others entrusted with protecting public goods, and that provide sufficient knowledge about what constitutes sustainable consumption. Some programs already are well established for green labeling but a broader range of efforts is needed, for example, related to major purchases such as apartments.

The third task is to continue developing and promoting green standards for all the main purchases that people are likely to make. As much as possible this should be done on a public participatory basis, and for both urban and rural settings.

[1] http://www.chinaluxculturebiz.wordpress.com/tag/porsche/.

The fourth task is to make China even more of a leader in the application of Circular Economy. Already China has made great inroads within the country and in transforming pathways for recycling globally. But the next generation of autos, in which China has a huge stake, should be super-easy to recycle completely. Building materials should be of a type and quality that minimizes embedded energy and can be reused or recycled with minimum cost and difficulty.

The fifth task is certainly to use design more effectively to promote sustainable development. This has still not been done to a desired level in the design of Chinese cities and there will be significant opportunities in development of the New Socialist Countryside. Utility infrastructure is one of the most important elements, for example, "smart electrical grids" and "smart metering."[1] Part of the need is engineering and architecture, but it is also in the design of management systems, institutional arrangements and incentive systems.

China's leaders have been promoting many aspects of sustainable consumption in recent years, and backing up rhetoric with action. Their efforts are quite impressive although sometimes inconsistent, but the task is very difficult, and likely to have major surprises in the years ahead. It should not be presumed that even with all the right economic moves and incentives that the desired move to sustainable consumption will occur smoothly. Therefore the processes to bring about this move must be as adaptive as possible and should maximize the involvement and commitment of both large and small scale enterprises, the financial sector, and community groups.

2.3.2 Green Growth

2.3.2.1 *International Perspectives*

The UN ESCAP defines *green growth as environmentally sustainable economic progress to foster low carbon, socially inclusive development*. ESCAP suggests five pathways for policy intervention: sustainable production and consumption, greening business and markets, sustainable infrastructure, green tax and budget reform, and eco-efficiency indicators.[2] Green growth in the Asia Pacific region and in other parts of the developing world needs to be pro-poor, with a major emphasis on sustainable livelihoods.

In a Financial Times article,[3] Mr. Ban Ki-Moon (with Al Gore) wrote that:

A successful [climate change] deal in

[1] The Economist. 8 October 2009. *Wiser Wires.*

[2] http://www.greengrowth.org/.

[3] Financial Times (London). 17 February 2009. *Green growth is essential to any stimulus.* http://www.huwu.org/sg/articleFull.asp?TID =92&Type=Op-Ed.

Copenhagen offers the most potent global stimulus package possible. With a new climate framework in hand, business and governments will finally have the carbon price signal businesses have been clamoring for, one that can unleash a wave of innovation and investment in clean energy. Copenhagen will provide the green light for green growth. This is the basis for a truly sustainable economic recovery that will benefit us and our children's children for decades to come.

This linkage of innovation, investment and green growth is essential not only for addressing climate change, but for most other pressing environment and development issues.

In June 2009 the OECD countries, plus several others, committed to development of national efforts and international cooperation on a green growth strategy. The OECD Council's Ministerial Declaration included several points noted in Box 1-3.[1] This is a significant statement that will lead to a reshaping of OECD perspectives on growth, since this new approach will be brought forward for further development during 2010-2011.

The remarkable rise of green growth as a major hope and objective for new economic growth and development among the richer countries is here to stay, and by no means is it restricted to Europe and North America. China has embraced the concept and in following sections, we will explore issues of implementation, with special attention to energy, environment and climate change.

2.3.3 Conclusions about Sustainable Consumption and Green Growth

Consumers with access to sizeable disposable income levels generally seek high energy and high resource and environmental-consumptive life styles. The additional burden on the planet is not generally within the power of the individual to fully address, except through life style choices and a conservation philosophy. In fact, with the constant influence of media and other communications there is a strong

Box 2-3 OECD Council Ministerial Declaration on Green Growth, June 2009

STRENGTHEN our efforts to pursue green growth strategies as part of our response to the current crisis and beyond, acknowledging that "green" and "growth" can go hand-in-hand.

ENCOURAGE green investment and sustainable management of natural resources…We will consider expanding incentives for green investment, in particular in areas where pricing carbon is unlikely to be enough to foster such private sector responses...Approaches to recognise the value of biodiversity should be encouraged through appropriate instruments and consistent with relevant international obligations. We are

resolved to share information on green investment flows and policies, and best practices.

[1] http://www.olis.oecd.org/olis/2009doc.nsf/LinkTo/NT 00004886/$FILE/JT03267277.PDF.

ENCOURAGE domestic policy reform, with the aim of avoiding or removing environmentally harmful policies that might thwart green growth, such as subsidies: to fossil fuel consumption or production that increase greenhouse gas emissions; that promote the unsustainable use of other scarce natural resources; or which contribute to negative environmental outcomes. We also work towards establishing appropriate regulations and policies to ensure clear and long-term price signals encouraging efficient environmental outcomes. We call on other major economies to follow the OECD countries' lead.

ENSURE close co-ordination of green growth measures with labour market and human capital formation policies. We note that these can support the development of green jobs and the skills needed for them…

STRENGTHEN international co-operation. In this respect:

We recognise that special efforts need to be made at the international level for co-operation on developing clean technology, including by reinforcing green ICT activities, fostering market mechanisms, and augmenting, streamlining and accelerating financing and other support to developing countries in their fight against climate change and the loss of biodiversity, and support in their water management. We also recognise the need to ensure that each country pursues green growth policies, including to tackle climate change, in accordance with existing international agreements and based on the principles of free trade and investment.

We are resolved to make every effort to reach an ambitious, effective, efficient, comprehensive and fair international post-2012 climate agreement at COP15 in Copenhagen in December 2009… by which all countries will take measurable, reportable and verifiable nationally appropriate mitigation commitments or actions as well as adaptation actions, reflecting the principle of common but differentiated responsibilities and respective capabilities.

We recognise the importance of the liberalisation of trade in environmental goods and services in fostering green growth. We are resolved to ensure that measures taken to combat climate change are consistent with our international trade obligations.

We underline the special need to co-ordinate international development cooperation activities in order to help developing countries promote green growth.

compulsion towards consumption. Chinese consumers, with their exceptional behaviour towards saving rather than spending, and their relatively small share of the national GDP, perhaps stand a better chance than people elsewhere of avoiding the endless cycle of over-consumption that plagues western society. But this is by no means a certainty over the longer-term.

The great challenge is to build enabling mechanisms that help consumers to create and enjoy sustainable lifestyles with a relatively low material consumption but high satisfaction levels. This is a challenge that has failed in most western countries over the past few decades, and continues to fail at the present time. The greatest challenge lies ahead—with climate change as a

driver. It is certainly too much to expect of China or many other developing countries that they should be the leaders, when industrialized countries are still consuming such a large portion of the earth's environmental resources. But the reality is that both should converge towards intermediate levels of consumption, largely decouples from harmful emissions and wasteful production techniques.

The hope, of course, lies with green growth. That is why the growing resolve towards this topic on the part of countries throughout the world and on the part of their leaders is so important at this transformative time for globalization and search for sustainable growth.

2.4 Energy, Environment and Climate Change

2.4.1 Crossroads for International Cooperation

The relationship between energy, environment and economy is at a crossroads that will test cooperation between rich nations and poor, will shape trade and consumption, and will determine whether and how well global society and individual nations address the pressing issue of climate change. Nations cannot claim to be sustainable without ensuring that their economic growth is eventually decoupled from energy consumption levels, especially from fossil fuel sources.

Those nations that have high existing per capita uses of energy must reduce these levels as quickly as possible, and seek sources and patterns of use that have a drastically lower level of Greenhouse Gas (GHG) emissions. Countries such as China, India and Brazil, already in a stage of rapid development and high economic growth, need the opportunities to become as eco-efficient as possible in energy use, but also to have access to energy sources and a share of GHG "space" sufficient to meet their expanding needs. No single nation, single region or grouping of countries can fully address the issues created by energy, environment and economy on their own. It is a vast concern demanding unprecedented levels of international cooperation.

In fact, the unprecedented level of global cooperation on tackling the financial and economic crisis has had the co-benefit of setting the stage for: 1) reaffirming the importance of addressing climate change, including innovations needed to hasten progress as well seeking agreement at forthcoming meetings, and 2) linking the outcomes more concretely to economic recovery based on green growth.

Global agreement on action for climate change is only part of the larger puzzle to be solved on energy and environment. But it is front and centre at the moment in part due to the urgency of seeking a robust accord to replace the Kyoto Protocol of the

UN Framework Convention on Climate Change (UNFCC). The December 2007 Bali Plan of Action laid out the groundwork. This Plan of Action noted that:

All Parties should cooperate to build a low-carbon global economy that ensures continued growth and sustainable development, increases global supplies of secure, and affordable clean energy, and stren-gthens the capacity of all Parties to adapt to the adverse effects of climate change. All Parties shall support long-term cooperative action to achieve an aggregate reduction in global greenhouse gas emissions of at least 50% by 2050.

In December 2009 at Copenhagen, the hope is that a workable and effective follow-up agreement will be set in place for the next phase of implementation of the UNFCC. As Lord Nicholas Stern has said, the world can act now, pay less—or wait, and pay many times more, with greater damage arising from climate change. While the UNFCC Meeting of the Parties in Copenhagen will be an important event, it only marks the beginning of what will be a long journey. Fortunately it should be a path filled with new opportunity as human creativity, markets and innovations make their contributions. The situation might develop along the time frame shown in Box 2-4.

Another very useful way of looking at how to tackle energy and environment, and of the various options for addressing climate change, is the McKinsey Cost Abatement Curves.[1] These demonstrate that many of the energy efficiency actions needed are profitable (for example improved insulation of buildings and some transportation options). The curves also show the relative costs of most other proposed solutions including biofuels, CCS and reforestation. Some options would be very costly. The value of these curves, which have been prepared globally and for individual countries such as China, the USA and Germany, is that they point out many excellent opportunities that can be taken now, without the need to resort to international agreements, etc. For it is vital that nations and businesses have the flexibility and means to take action as swiftly and efficiently as possible.

This section of the Issues Paper highlights both challenges and opportunities that China, and really the world, face now and for the foreseeable future on making energy use compatible with sustainable development. While this part of the Issues Paper started with the globally urgent matter of addressing climate change, it is certainly but one of the key focal points on energy and environment. From China's perspective at present, perhaps the most significant question is how to ensure that relationships among energy, environment

[1] http://www.mckinsey.com/clientservice/ccsi/costcurves.asp.

and economy become mutually supportive in ways that permit human development to occur in a satisfactory fashion.

Box 2-4 Time Frame of Future Action on Environment, Energy and Climate Change

2010–2012 Fine-tuning Copenhagen Outcomes*. Global, regional & sectoral; ratification & national strategies.*

2010–2015 Emphasis on efficiency, cost effective solutions with increased tech transfer between rich & poor countries. *Maximum impact of economic recovery stimulus.*

2010–2020 S&T Energy and Environment investments lead to new, often disruptive technology options*. Useful to rich & poor nations.*

2013–2020 International agreements focus on major credibility & equity concerns*. Greater attention given to actual impact of accords on mitigation and adaptation success.*

2010–2030 Behavioral changes towards Low Carbon Economy. *A focus on new economic opportunities, and with greater integration among economic, social and environmental international accords.*

2030-2050 50% to 80% reduction in GHG emissions from the 1992 baseline achieved.

2.4.2 Energy and Environment in China

CCICED has examined energy and environment relationships in the past, especially through its Energy Working Group during earlier phases of CCICED.[1] The attention being given to the subject of energy and environment within the 11th Five-Year Plan, China's rapid overall increase in energy use, and the potential to gain competitive advantage in the low carbon economy of the future have led this year's CCICED AGM to focus on energy and environment. This effort has involved five task forces and a cooperative project within Ningxia Province.

Until the Beijing Olympics, relatively few people outside of China fully recognized the rapidity of change in China's energy and environment relationship, or of the many actions that are shaping it, hopefully towards a sustainable future. Yet over the past half decade, a large number of international cooperation initiatives have started in addition to the very substantial efforts China has undertaken entirely on its own. An example is the rapidly evolving

[1] *Energy for Sustainable Development*, Vol. V. No. 4, published a Special Issue covering findings of the CCICED Working Group on Energy Strategies and Technologies, December 2001.

relationship between China and the USA on environment and energy cooperation.[1]

China will face: the possibility of future energy shortages, on-going and perhaps additional environmental and human health concerns related to energy use; energy efficiency and design concerns as it faces large scale construction of cities, transportation and utility networks; and high energy demands from the continued modernization and expansion of its industrial base and development in rural areas. There is a need, already well recognized by China's national leaders, to create a broad societal understanding that as China continues its economic growth, energy use cannot follow the profligate ways of industrialized countries. The Chinese people and businesses must have access to better energy alternatives, and that is where government, communities and enterprises need to provide the right mechanisms, incentives and goods and services to make sustainable choices possible.

There are three key pillars for improving energy and environment relationships in China. The first is sustainable use of coal, since this is such a key element in China's energy mix. The second is energy efficiency, for which there are co-benefits with the economy, health, and environment. There is a great deal of room for improvement, for example, China uses up to 3 times as much energy per unit of output as the USA and up to 9 times as much as Japan. The third is the longer-term transition towards a low carbon economy, which will drive green growth as well as assist in climate change mitigation. These three pillars need to be considered in both rural and urban areas and in relation to industrial and service sectors.

The transitions toward greater efficiency, developing new sources of energy and better ways of dealing with existing energy use, and toward a low carbon economy need to start now in China and in other major economies. There are five considerations that may help in this process, and to some considerable extent, China has made progress on each.[2]

A bottom-up approach, eventually moving towards a globally-homogenous system for energy and environmental action. It is not realistic for every country to adopt identical approaches towards environment and energy. Instead, coordination of varied autonomous efforts should be encouraged to achieve the best possible result. Diversity should be recognized and pro-

[1] An agreement for a 10 year cooperation effort on energy and environment was signed in 2008, and in July 2009 a further agreement on energy, environment and climate change was signed.
http://www.brookings.edu/papers/2009/09_us_china_energy_cooperation_lieberthal.aspx.

[2] This discussion is drawn from a paper prepared for the CCICED Chief Advisors Group and the CCICED Secretariat in the early planning stages for the work of the current task forces on various energy and environment topics. Zhang Jianyu and A. Hanson. 2007. *Framework on Energy and Environment Policy Studies.* Discussion Paper. 15pp.

moted. This is the basis for the principle of common but differentiated responsibility, but also of recognition that countries need to take into their specialized needs for energy security, available sources of energy, and socio-economic development requirements. It is also a means to maximize the value of the mosaic of local initiatives and creativity that will be unleashed in the years ahead through green growth and innovation strategies.

Institutional and management Innovation. Policy integration is an important need. Sectoral policies still drive most decisions in China, often with limited coordination and understanding of cross-sectoral impacts. Along with policy integration is the need for timely goal-setting so that appropriate staging of development can be achieved. Getting the right mix of regulation and enforcement, incentives and voluntary action is important, especially in an era when there are new mechanisms such as cap and trade, payment for carbon credits, and the possibility of new energy taxes and subsidies. Institutional and management innovation should be an important driver for new technology applications and acceptance, and be designed to take into account policy integration.

Promoting national efforts. China has set out major legislation and action plans related to renewable energy use, energy conservation, promotion of circular economy, and climate action over the past several years. At some point there will be carbon intensity reduction goals. As a follow-up to the 11th Five-Year Plan energy efficiency and renewable energy targets, there will be new goals in the next Five-Year Plan. All of these efforts will require careful monitoring and commitment to more rapid improvements. Most will help to satisfy energy security, efficiency, environmental, climate change efforts simultaneously.

Technical innovation. The bottom line for the various energy and environment technology introductions and improvements needed in China is that they should be good for the environment but also be more efficient and sometimes much more financially viable than what they replace. As well, they need to be socially acceptable and beneficial. Government's role in stimulating and guiding research and development is essential, and so is the development of an enabling framework, including appropriate laws and enforcement policies, standards, pricing and incentives. The private sector will become increasingly important as a means for rapid implementation. Fostering Chinese entrepreneurship in environment and energy technologies is a key role to be shared by both government and the private sector.

Improved international cooperation. The international enthusiasm for green growth based on energy, environment and climate change now must be turned into

more productive cooperation. This is especially true for such major topics as developing clean and innovative use of coal, carbon capture and storage (CCS) of GHGs, smart electrical grids, and next generation biofuels, implementation of more robust energy and environment technology transfer arrangements, and carbon trading mechanisms. There is also a growing need for China to share the technology it is developing, for example, in rural biogas, with other developing nations.

Over a relatively short period (mainly 2006-2009) China has developed considerable analytical capacity on energy and environment issues, and coordinating mechanisms such as the Leading Group on Climate Change, chaired by Premier Wen Jiabao. The focus on mandatory targets in the 11th Five-Year Plan for energy efficiency and pollution control, on standards for industrial operations, buildings, auto fuel efficiency and emissions, and changes in energy pricing are all examples of where progress is being made on developing a new relationship between energy and environment.

Despite these efforts, the path ahead is still uncertain, especially as economic growth rates accelerate, and as domestic consumption increases. There is little doubt about China's will at the senior level of central government to take the issues of energy, environment and climate change very seriously. But what is needed is a high level of performance across a wide range of decision-makers at all levels of government, and within China's state owned enterprises and private sector interests. As well, at the community level and within universities, academies and the growing number of non-governmental organizations, these issues need to be given priority as action items.

In the remaining parts of this section of the Issues Paper we present a brief overview of China's energy use, some of the key issues associated with each of the five CCICED energy and environment task forces, and some general conclusions.

2.4.3 China's Energy Use

The energy use pattern of China is summarized in Figure 1. This flow diagram reveals the pervasive influence of coal, and also the degree to which industrial use of energy prevails. A comparison of this diagram with a similar one for the USA reveals a much more even spread of energy supply for the American case, and with coal use mainly restricted to power generation, while a large portion of petroleum use is for transportation. In China, residential and commercial energy uses take a smaller portion of the whole by comparison to the USA.

Even with the great amount of energy devoted to the production of goods for export, China's per capita energy use is still small by comparison to Europe, the USA and Japan. However, to a considerable ex-

tent, this low per capita energy use masks a number of important trends and differences within China. First, the difference between per capita energy use of urban dwellers and rural people are substantial. And even within cities there are major differences between relatively rich and poorer people. Second, within industrial sectors there also are substantial differences, particularly between small, older operations and new ones. The figures are striking in the case of steel mills, for example. Third, with the expansion of transportation networks and the emphasis on private car ownership, gasoline and diesel fuel use will increase substantially, with attendant supply and environmental issues. Fourth, China's dependence on coal is a key concern. While there are many decades, or even hundreds of years of supply, the environmental and health concerns of coal burning are very substantial. And, fifth, the efficiency with which energy is transformed and transported is an important consideration that requires much attention, including development of "smart grids" for electricity transmission, and building of ultra-efficient power generating facilities.

China has substantially reduced its energy intensity in relation to GDP over the past 15 years and particularly during the 11th Five-Year Plan. It will have to continue to do so for the foreseeable future. With efforts to quadruple GDP over the first two decades of the 21st Century, even with very dedicated efforts to decouple energy growth it is very likely that substantial energy use increases will take place. High, medium and low estimates by the International Energy Agency are noted in Table 2-3.

One key issue for CCICED is to suggest policy mechanisms through which China can make much greater progress on reducing the environmental impacts of this incremental energy use, including the impacts associated with energy sourcing, generation, emissions and waste disposal. These require policy innovation, innovations through the use of markets, and structural change in the economy.

Table 2-3 Estimation of China's Primary Energy Consumption (2005-2030)

(Oil equivalent: Mt)

	2005	2015			2030			Average Growth Rate 2005-2030		
		High Growth	Reference	Alternative Policy	High Growth	Reference	Alternative Policy	High Growth	Reference	Alternative Policy
Coal	1,094	2,037	1,869	1,743	2,910	2,399	1,842	4.0%	3.2%	2.1%
Oil	327	626	543	518	1 048	808	653	4.8%	3.7%	2.8%
Natural gas	42	125	109	126	276	199	225	7.8%	6.4%	6.9%

	2005	2015			2030			Average Growth Rate 2005-2030		
		High Growth	Refer-ence	Alter-native Policy	High Growth	Refer-ence	Alter-native Policy	High Growth	Ref-erence	Alter-native Policy
Nuclear energy	14	34	32	44	82	67	120	7.4%	6.5%	9.0%
Hydropower	34	63	62	75	100	86	109	4.4%	3.8%	4.8%
Bio-energy and waste	227	235	225	223	231	227	255	0.1%	0.0%	0.5%
Other renewable en-ergy	3	13	12	14	43	33	52	11.1%	9.9%	11.9%
Total	1,742	3,135	2,851	2,743	4,691	3,819	3,256	3.2%	3.2%	2.5%

Source: IEA World Energy Outlook 2007, reproduced in the CCICED Low Carbon Economy Task Force Report.

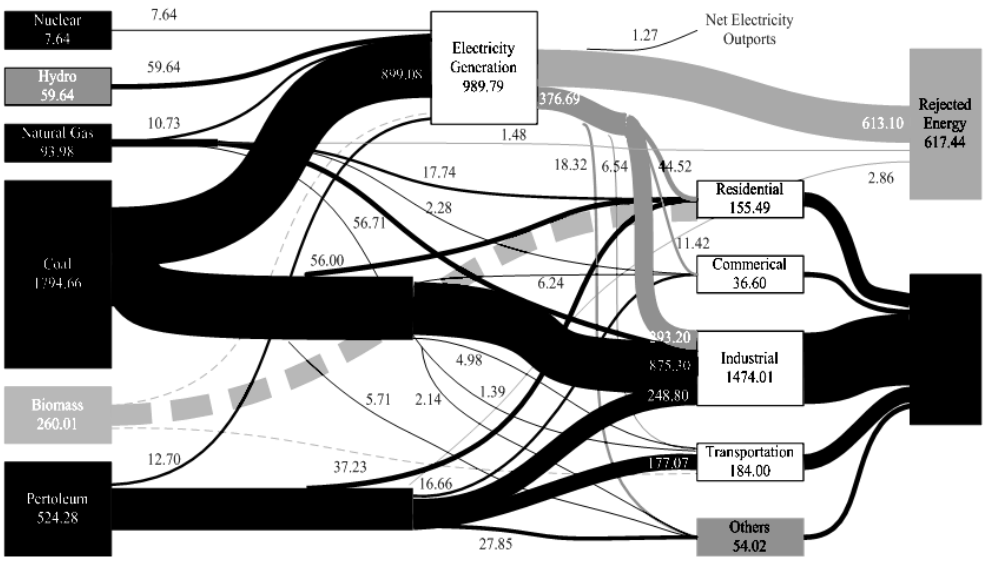

Figure 2-1 China Energy Flow Chart 2007

(-2 535 Mt of coal equivalent)

(This diagram was prepared by the China Energy Research Institute at the request of the CCICED Chief Advisors Group. A similar diagram for the USA is available from the Lawrence Livermore National Laboratory.)

The second issue is to identify policies for practical pathways for eliminating harmful emissions altogether, which is the promise of wind and solar energy generation, and for energy conservation practices that substantially reduce demand. This introduces design, information technology and many other S&T innovations that are being supported through China's Mid-term S&T Plan and other means.

The third set of issues are those associated with policies for management innovation, including the energy saving and environmental improvements possible thr-ough more efficient operations, and for car-eful attention to industrial performance and institutional reform.

The fourth set of concerns relate to the need for international cooperation, especially regarding technology transfer and financing, a point that China has repeatedly made in its international interventions on climate change. China's success with the Clean Development Mechanism (CDM) demonstrates the strong capacity that has been developed to utilize international initiatives designed for addressing energy and environment. There has been much less interest on the part of China towards international cap and trade schemes related to GHG reductions.

2.4.4 Five Topics Examined by CCICED Task Forces

2.4.4.1 *Sustainable Use of Coal in China*

China is the number one coal using country in the world. As the IEA and many others have noted, there must be drastic improvements in coal use everywhere in the world, if it is to become a more environmentally acceptable energy source.[1] While a theoretical case can be put forward that China could drastically reduce its dependence on coal over the coming 30 to 50 years, the more likely scenarios suggest continued dependence and possibly a major increase in the total amount of coal used over the coming two or three decades. Over that time span, it is presumed that renewable sources of energy and various innovations to reduce energy intensity will eventually reduce China's coal demands. As well, coal will have to become a much cleaner energy source, stripped of harmful emissions and with its GHG emissions sequestered or utilized. But China is far from having this vision of coal use become reality. Indeed, it is doubtful if China or any other country on its own accord could succeed. While the USA for cost reasons pulled back from its massive FutureGen coal combustion project, China is pursuing a similar effort labeled GreenGen.[2]

Investment in China's efforts towards sustainable use of coal should be in the best interests of other countries in order to create the most environmentally benign and efficient technical and policy approaches. Everyone will benefit. Recognition of this

[1] See, for example, IEA. 2009. *Cleaner Coal in China*. IEA, Paris. 320pp.

[2] According to the company's owners, which include leading power companies and coal companies, *GreenGen*'s *business goals include: coal gasification, oxygen production, hydrogen production, syngas purification, hydrogen turbine and fuel cells generation, carbon dioxide capture and sequestration; and also research on advanced materials, instrumentation and control technology, related technologies of applications development; advisory services, technology transfer, power plant construction, operation and management.* GreenGen's objective is to design, build and operate the first IGCC power plant in China in 2009 and a coal-based, near-zero-emission GreenGen power plant in China with independent intellectual property rights. http://www.greengen.com.cn/en/aboutus_02.htm.

point is spreading, with increasing levels of technical cooperation and joint ventures involving coal. There is a growing capacity within China not only for necessary S&T but also for the investments and the enabling conditions for full scale deployment and commercialization of very advanced coal production, power generation, and chemical utilization facilities. Pilot efforts on carbon capture and storage (CCS), advanced underground coal combustion, and other innovations now underway likely will be mainstreamed over the coming 10 to 15 years.

The most immediate challenges are to make sure that available technology and improved management practises lead to safer, more efficient and cleaner coal production and use throughout the value chain. There is evidence of this happening, including a substantial decline in coal mining deaths, reduction in SO_2 emissions from power plants and boilers, and modernization of many mining, transportation and electrical generation facilities. But there is still a danger of technology lock-in, particularly if there is resurgence in power demand, and if there is any breakdown in the effort to make local officials responsible for meeting environmental quality, safety and other standards. Furthermore, some important pollutants related to coal use, for example heavy metals like mercury are still inadequately controlled.

What would a longer-term vision of sustainable coal use in China look like? The starting point is definitional. Two key conditions must be met for sustainability[1]: the energy system must have good pro-spects of enduring indefinitely in provision of high quality and sufficient levels of energy services; and must not impose unacceptable environmental, health or social impacts and risks. A nonrenewable energy source like coal where, if it is very abundant, could be considered as a sustainable source if its use helps to build conditions that will eventually permit use of alternative energy sources. For example, if coal use helps to support district heating that could also utilize heat from sewage water, or if wellhead coal burning helps to build a more efficient national power grid that can utilize solar, wind or local hydro energy.

A question of interest to China's coal industry and many others is what level of coal might be used sustainably? The 2.8 billion tons of coal production in 2008 is only a small fraction of the available resource, even though it places a tremendous demand on China's transportation capacity. But China's coal use currently does not fully meet environmental, health or safety criteria at any stage along the value chain, although improvements are being made and

[1] These conditions have been suggested by the CCICED Task Force on Sustainable Use of Coal in China.

some facilities are exemplary. If coal production levels reach projected levels of 3.5 billion tons in 2020 and more than 4 billion tons by 2030, the challenges will become much greater. Once GHG emissions associated with coal are factored in, the task of achieving sustainable use become monumental since there are no fully proven, economically-viable large scale solutions for CCS available at present.

There are several key policy needs that must be addressed in order for coal production and use to be placed on a sustainable path: modernization and consolidation of coal-dependent enterprises; policies that encourage deployment of best available technologies and avoid technology lock-in to outmoded types; mechanisms for rapid development and commercialization of advanced coal technology, including advanced environmental technology such as CCS; policy changes to pricing and subsidies that work against efficient market mechanisms; and enforcement policies; and possibly new policies for cap and trade emissions systems and/or carbon taxes.

If China is able to bring about substantial use of its vast coal resources, it will contribute to its own energy and environment security as well as improving regional air and water quality, and helping to meet global climate change objectives. It is a remarkable challenge but the rewards to China will be of great economic value, since China will have access to a wide range of technologies and intellectual properties related to coal and other advanced energy uses, great improvement in management capacity of these energy systems, and marketable products and services for the international marketplace. Therefore, the coal sector in China will be one of the key demand areas for a strategy of green growth.

2.4.4.2 *Urban Energy and Environment*

Action at the level of cities and towns in China will make a crucial difference to China's energy saving and transformation to an environment-friendly society. Urban settings are the source of great innovation potential and the powerhouses that will help to fuel green growth in industry and commerce. Urban households likely will hold the key to sustainable consumerism in China. The massive migration of Chinese from countryside to city over the coming decades will create one of history's greatest construction efforts, including remarkable investments in environmental infrastructure, transportation networks and buildings.[1] The embedded energy in this construction is immense, but what is most important are the implications of urban design, and of the behavior of China's urban citizens. Will

[1] McKinsey & Company. February 2009. *Preparing for China*'s *Urban Billion.* 540pp. http://www.mckinsey.com/mgi/ publications/china_urban_billion/ and China Academy of Social Sciences. 200. City Blue Report Competitiveness.

communities, businesses and urban residents continue or develop patterns of conservative energy use, or will they become more profligate as happens in most industrial countries? Will Chinese cities become not just energy efficient, but exemplary models of energy saving and innovation? What factors are the most important in determining these behavioural outcomes?

CCICED's Urban Energy Use Task Force has examined energy consumption in various Chinese cities, and compared these levels to cities abroad. Building energy use is of particular interest. The hypothesis is that Chinese behaviour is to minimize energy consumption from air conditioning and lighting, for example. Thus some older office buildings tend to have lower consumption than modern western-style office buildings, even though the latter have more advanced design characteristics. Yet in cities like Beijing and Shanghai it is the western styled buildings that now fill the horizon. Similarly, cities incorporating massive road networks into their structure are locking communities into high energy use for generations to come. So-called eco-cities are showcased within China but in reality these are not yet making serious inroads into overall energy conservation nationally.

The most critical areas of concern for energy and environment urbanization policy include the layout and design of new communities; the relationship between urban centres and surrounding suburban communities; regional design of transportation and public utility infrastructure and energy efficient buildings, including construction techniques and materials; and design of communities that promote low energy activities such as neighborhoods that provide for most shopping, recreational and other needs without driving. Provision of green space and urban forest areas such as much of the Beijing Olympic Park provide energy and environment benefits. Policies that reward such efforts need to be instituted throughout China.

China already is investing heavily in public transportation within and between urban areas, with some of the most advanced technology in the world being built, but it is failing to keep up with demand. Furthermore, purchase of automobiles is being encouraged as part of the overall plan for stimulating economic growth and specifically encouraging domestic consumption. While this plan is being shaped to include an emphasis on energy efficient and low emission vehicles, the overall energy consumption and the environmental impacts of private vehicles has continued to rise. Creation of an automobile culture in China is one of the most significant policy decisions taken anywhere in the world. It is hard to see how this decision has promoted sustainable development, especially since it is in part stimulated by incentives such as tax cuts. China already has surpassed the USA as the world's largest auto market.

Although small vehicles are the norm and encouraged through some policies such as a progressive consumption tax on higher emission vehicles, China has become the largest market in Asia for luxury vehicles—larger than the market for Korea, Australia and Japan combined. J.D. Power Asia-Pacific has estimated that this market for vehicles above 400,000 RMB (USD 57,000) in price will reach almost 600,000 vehicles by 2015.[1] And it is a Chinese enterprise (Sichuan Tengzhong Heavy Industrial Machinery Company) that has offered to purchase the iconically-unsustainable Hummer brand from General Motors.

Urban energy and environment management systems in China, as elsewhere, will increase in extent and level of sophistication in the coming years. Examples include computerized traffic flow management that reduce traffic jams and unnecessary waiting at stop signals, smart electrical grids and interactive metering and management of electricity use, energy and methane capture from solid waste and from urban wastewater, LED lighting, mandated limits on cooling and heating of buildings, etc. Many of these innovations are in practice today within some Chinese cities, especially in support of both energy efficiency goals and air pollution reduction. Yet the policies regarding urban management are still not optimal, and they are not always enforceable across the many hundreds of cities within China.

Furthermore, creating the urban advances that will be required to address GHG challenges is a daunting task. Many cities elsewhere in the world, especially in some OECD countries, have been in the vanguard of climate change action. ICLEI-Local Governments for Sustainability, for example, notes that some 700 communities participate in its worldwide Cities for Climate Protection™ campaign. The ICLEI approach is to establish five milestones focused on practical policies that can be implemented largely through improvements in public infrastructure and buildings.[2] China does not appear to have a comprehensive urban climate change policy of this type in place covering all cities.

Urban and suburban areas are home to China's major technology innovation clusters, on themes such as wind and solar power, and also have invested heavily in green industrial parks where many of the sunrise industries powering green growth will be located. These parks themselves can be exemplars of energy efficiency and advanced pollution control. For instance,

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[1] T. Dunne. 2009. *China*'s *Luxury Vehicle Market: A Bright Future Ahead.* J.D. Power and Associates. www.jdpower.com accessed 23 August 2009.

[2] ICLEI's Five Milestones for addressing climate change: 1. Conduct a baseline emissions inventory and forecast. 2. Adopt an emissions reduction target for the forecast year. 3. Develop a Local Action Plan. 4. Implement Policies and Measures. 5. Monitor and verify results. www.iclei.org.

funded through China's economic stimulus is an industrial park in the City of Hengyang, Henan Province, for the production of "environment-friendly" lead batteries. This technology has been developed by China Ritar Power Corp., a Shenzhen-based, NASDAQ-listed company that specializes in sale of such batteries in China and abroad, with a special interest in deep cycle batteries for wind and solar power and batteries for light electrically-powered vehicles.

The transformation of China from 46% to 70% urban population over the next two decades is perhaps also its greatest energy and environment challenge, especially since it will be accompanied by a rise in urban wealth that may or may not be accompanied by patterns of sustainable consumption. With over 200 cities expected to have populations of over a million by 2030, some 40 billion m^2 of building construction and perhaps 50,000 new skyscrapers, there will be enormous scope for innovation. The 2010 World Expo in Shanghai with its theme of "Better City, Better Life" will provide the perfect venue for both China and the World to take stock of progress on urban energy and environment and future opportunities for appropriate the 21st Century urban development.

2.4.4.3 ***Rural Energy and Environment***

Building the 'New Socialist Countryside' offers the potential of improved energy availability, and economic development related to energy production and use. Most of China's poor and those who only marginally escape poverty live in rural areas. They are among the most vulnerable to climate change effects, and therefore their needs should figure prominently in both mitigation and climate change adaptation strategies. Rural areas are of course where many energy sources serving the country are located including coal mines, hydropower dams, energy biomass sources, and the new wind and solar energy farms. Therefore rural areas are vital to the solutions for many of China's energy and environment problems. Yet the rural regions for the most part are not fully equipped for the tasks—not having the education and scientific skills, or full access to the full range of technologies and enterprises that promise a new road ahead.

Rural people are still well behind urban dwellers in terms of their household income levels, and therefore cannot be expected to take full advantage of the current drive to create greater domestic consumption. Very likely, as their incomes rise, they may have different priorities on such expenditures. How their rising wealth, anticipated in coming years, will influence sustainable consumption in China is hard to predict. But at present rural dwellers help considerably with maintaining low per capita national energy use statistics low.

Rural residents have special energy needs, notably inexpensive, clean and

healthy sources of energy for heating and cooking. Traditional use of coal and biomass fuel presents respiratory problems, especially for women and young children who spend longer periods indoors. Biogas is an ideal solution in some situations. Rural buildings generally are not being build to high enough energy efficiency standards. Another special need is off-grid electrical power, especially in remote western areas. The emphasis on solar and wind energy, and small scale hydro is therefore a good solution with the co-benefit of reducing coal burning. Rural populations benefit from dams that provide irrigation water and which also may guarantee access to reliable sources of electricity not only for household use but also for operating modern farm machinery, agricultural processing plants and cold storage. China has moved quite dramatically to meet these rural needs and therefore help meet its national Millennium Development Goals (MDGs).

The modernized rural countryside is intended to have more livelihood opportunities, including local industries appropriate to the regions, and to have greater, more efficient and productive agriculture. Also, given China's commitment to reforestation and grassland protection, more attention will be given to eco-compensation for ecological services. Some of the new occupations are related to biofuel production, to intensified agriculture, which requires more energy for fertilizer applications and other inputs, and to agribusinesses involving more specialized crops such as fruits, animal production, etc. The net result is higher energy use, sometimes accompanied by serious environmental impacts. Turning materials such as manure from a waste to a useful product such as biogas; plant stalks and other wastes into cellulosic ethanol; and reducing energy use associated with cultivation by low-till agriculture are examples of how energy and environment can be addressed in the context of modernizing China's countryside.

The issues of energy and environment in rural areas therefore fall very much within the purview of extension workers, local community leaders and county level officials. At this level there is much work to be done in order to build the necessary resolve and understanding of appropriate policies and to improve practical implementation.

The concerns of climate change may be even more important to address at this level. As noted recently by China's Ambassador for Climate Change Yu Qingtai[1]: *Around 150 million Chinese citizens are mired in poverty, based on a UN benchmark of those living on less than USD 2 per day…lifting tens of millions out of poverty must remain* [China's] *primary goal*. The

[1] Reuters Wed. 5 August 2009, interview with Yu Qingtai in Beijing.

real issue is how to ensure that poverty reduction becomes part and parcel of China's climate change effort, with good progress on both topics.

Rural populations are vulnerable to the greater intensity of severe weather events such as typhoons, floods and droughts. It is farmers and herders who are most directly affected by the melting of glaciers and other effects in western China. Human, animal and plant diseases and pests may spread, and ecological effects including changes in vegetation zones, crop ripening and biodiversity, all need to be taken into account via a combination of adaptation and mitigation of effects. Rural climate adaptation strategies are therefore an essential need for all areas of rural China. Part of this need will be adequate mechanisms to compensate losses suffered by these residents and producers. Some of this compensation could be through international funds linked to REDD[1] or other mechanisms based on agricultural or forestry practices that lead to carbon sequestration. Climate adaptation is still at an early stage in China and elsewhere and the necessary policies still need to be developed.

2.4.4.4 ***Economic Instruments for Energy and Environment***

CCICED has pressed for improved incentive-based regulation concerning energy and environment for many years. Recommendations on pricing, reduction and elimination of environmentally-perverse subsidies, and greater use of taxes have been proposed. China is gradually moving towards a greater use of these instruments, and bringing resource prices into line with those of international markets. But the job is far from done. Indeed to some extent what has so far emerged is a patchwork quilt. The quilt has a variety of patterns, a number of holes, and is quite ragged. In other words, incentive policies are characterized by inconsistencies in their application, offer easy ways to be circumvented, and lack enforcement.

In the coming years development of a system of market-based incentives and mechanisms will be required to address energy and environment problems that are, at their core, economic and financial issues. What is of crucial importance is to increase energy productivity—ability to squeeze more value from a given amount of energy use. Stronger incentives are needed to make this happen. A growing part of the effort will need to be directed towards climate change. We are seeing the emergence of a variety of proposals for cap and trade systems and for pricing and taxing carbon, for example. The incentives for taking action on specific environment and energy matters

[1] REDD is the UN Program for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries. A special fund has been established for this purpose and REDD is under discussion for future international agreement.

often are not yet large enough to be attractive within China, or elsewhere. But sometimes larger incentives may only reinforce what people are already prepared to do (e.g., subsidies for taking older high polluting gas-guzzling autos off the road in the USA and Europe), or do little to actually tackle the problem they are intended to address (e.g., first generation, highly-subsidized biofuels from grain or corn).

Policy failure involving energy and environment economics has been high throughout the world. There are a number of reasons why: politics trumps economic rationality, fierce lobby pressures, inadequate scientific knowledge or use of existing knowledge, and long histories of subsidizing hydrocarbon energy sources and uses. The recent announcement at the Philadelphia G20 Summit of a commitment to eliminate environmentally harmful hydrocarbon subsidies will be an extremely important test case.

A problem of reforming entrenched pricing and other financial support systems involving energy and environment is that there never seems to be a right time to do so. Otherwise, we might have expected much more support for emerging renewable energies over the past decades and public transportation, and less for fossil fuels, automobiles, etc. This has certainly been the case in North America and Europe, where artificially low energy prices held back energy technology development. The combined energy, financial and climate change crises is increasing the pressure for positive change of incentives, but certainly the signals are mixed, especially given the massive bailout of the automobile sector.

In the case of China, it is certainly true that there have been many more good suggestions made about market-based mechanisms than fully satisfactory action to date. One reason for limited action is that there are complex agendas, for example, the concern for stimulating domestic consumption while at the same time seeking sustainable development. Another is for maintaining social stability, which is threatened when prices rise suddenly. A third is to create fiscal mechanisms that avoid negative impacts on the poor, or on particular regions within China. Fourth, there has been a tendency in environmental programs everywhere in the world to resort to command and control first.

But what about the future? If it is reasonable to argue that without full application of market-based mechanisms the problems of environment, energy and climate change will remain intractable, then the question is not whether, but how a comprehensive system of incentives can be put into place. China cannot expect to undertake green fiscal reform totally on its own, since it must maintain competitive advantage in global trade, and it also must have access to the necessary technology solutions, etc., at fair prices. Furthermore,

highly-volatile commodity prices internationally make green fiscal reform more difficult. And carbon pricing is a necessary part of GHG emissions reduction strategy nationally and, ultimately, globally.

The entire financial sector can participate in market-based approaches to environment and energy. Banks in China are beginning to add environmental conditions to their loans, and there are efforts to create environmental liability and compensation mechanisms within the insurance industry. Green securities measures are beginning to appear in China's stock markets. Industries from sectors with a history of heavy pollution must undergo an environmental inspection before making an IPO, and there are regulations demanding greater public disclosure of possible environmental effects of operations.[1] These are definitely works in progress, with a considerable potential for major improvements on their impact in the years ahead.

Better balancing is needed among co-mmand and control regulation, use of economic instruments for environmental cost internalization, and voluntary measures. This balancing demands fundamental rethinking of environmental laws and regulations, new standards, and strong monitoring and enforcement. These are challenges that need to be addressed quite urgently, for China's framework has been designed in an era when administrative measures and command and control were the predominant elements. However, it must be emphasized that this does not mean a new era of less regulation. In fact, it should be a time for more efficiently applied and enforced regulation, sometimes called *smart regulation*.

2.4.4.5 *Low Carbon Economy (LCE)*

CCICED has been exploring the potential value of Low Carbon Economy to China since April 2007, when it convened an exploratory workshop that attracted considerable Chinese and international interest. Since that time, LCE has become a topic of considerable interest in many OECD countries, and within China. Statements by Chinese leaders have demonstrated support. At the 15th APEC Economic Leaders Meeting held in Australia in September 2007, President Hu Jintao indicated to APEC members that:

We should improve energy mix, upgrade industries, promote low-carbon eco-nomy, build an energy-conserving and environment-friendly society and thus address the root cause of climate change…We should step up research and development as well as the application of energy efficient technologies, environmental protection technologies and low carbon energy technologies, increase capital investment in these areas, and boost technological coop-

[1] http://www.climateintel.com/2008/03/04/china%E2%80%99s-green-securities-policy/.

eration and transfer of technologies.

Since that time, this subject has rapidly gained ascendancy with senior policy makers.

Recently, the topic has been discussed at a cabinet meeting of the State Council in mid-August 2009 where it was noted that several key tasks would have to be undertaken to cope with climate change, including: developing a green economy by cultivating new economic growth with low-carbon emissions and speeding up the construction of low-carbon industrial architecture and transportation systems.[1] Furthermore, the meeting noted that governments at all levels would have to incorporate climate change measures into their development plans. This has been interpreted as a signal for incorporating LCE into future Five-Year Development Plans. On August 27, 2009 the Standing Committee of the 11th National People's Congress (NPC) passed a resolution on climate change that states: China should make carbon reduction a new source of economic growth, and change its economic development model to maximize efficiency, lower energy consumption and minimize carbon discharges.

At the UN Climate Change Summit on 22 September 2009, President Hu made the following commitment for action on energy, environment and low carbon economy[2]:

In the years ahead, China will further integrate actions on climate change into its economic and social development plan and take the following measures: First, we will intensify effort to conserve energy and improve energy efficiency. We will endeavor to cut carbon dioxide emissions per unit of GDP by a notable margin by 2020 from the 2005 level. Second, we will vigorously develop renewable energy and nuclear energy. We will endeavor to increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020. Third, we will energetically increase forest carbon sink. We will endeavor to increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels. Fourth, we will step up effort to develop green economy, low-carbon economy and circular economy, and enhance research, development and dissemination of climate-friendly technologies.

LCE is rapidly moving from being a theoretical concept debated by academics and others in China towards becoming a principal driver of future green growth in China. It is therefore an immensely important topic that requires careful study for its economic, social and environmental implications. Of particular concern is the macroeconomic impact of such a major shift, and also just how quickly it should

[1] http://www.china.org.cn *China Underscores Climate Change Strategy*. 13 August 2009. Quoted from MEP website media service.
[2] http://www.china-un.org/eng/zt/hu2009summit/ t606111.htm.

initiated? Some would argue that the shift is well underway with China's growing commitment to renewable energy and to the energy efficiency goals of the 11th Five-Year Plan and other initiatives including energy technology commitments in the economic stimulus package. But these are only starting points for what will be a long-term effort that must involve not only China but also strategies implemented by many other countries.

The American Progress Institute, for example, suggested 10 policy steps to move the USA towards a LCE[1]:

(1) Create an economy-wide, greenhouse-gas-emissions cap-and-tra-de program;

(2) Eliminate Federal tax breaks and subsidies for oil and gas;

(3) Increase vehicle fuel economy;

(4) Increase production and availability of alternative low-carbon fuels;

(5) Invest in low-carbon transportation infrastructure;

(6) Improve efficiency in energy generation, transmission and consumption;

(7) Increase the production of renewable electricity;

(8) Use carbon capture-and-storage systems to capture and bury the carbon emissions from burning coal;

(9) Create a White House National Energy Council and make the Federal government a low-carbon leader;

(10) Lead efforts to advance international global warming policies.

Great Britain has introduced legislation, strategies and transition plans that would lead towards a Low Carbon Economy. Other European countries and the EU are at various stages of the same.

Based on these and other efforts, the common elements of a LCE approach are to: 1) articulate a definition appropriate for the country that decouples economic growth from carbon content; 2) link the effort clearly to climate change mitigation but also to competitive advantage in the form of green growth; 3) create a strategic roadmap of key intervention points and potential outcomes; 4) focus on sectoral shifts including an industrial plan, an energy and environment plan, etc.; 5) estimate costs and revenue sources over a defined time frame of 20 to 30 years at least; 6) define necessary science and technology needs; 7) set out a LCE transition plan; and

8) build public and private sector understanding, support and participation for LCE initiatives.

Policies, legislation and regulations, incentives and institutional arrangements to support LCE are still more or less at an early stage, although certainly rapid progress will be needed. Most importantly,

[1] J. Podesta, T. Stern and K. Batten. November 2007. *Capturing the Energy Opportunity Creating a Low-Carbon Economy* American Progress Institute. 88pp. http://www.americanprogress.org.

LCE ultimately must be tied to pricing of carbon and then to workable mechanisms such as carbon taxes, cap and trade or other means to reduce GHG emissions.

Some issues about applying LCE within China include the following questions:

(1) Is it more appropriate to focus on Low Carbon Development rather than LCE?

(2) How can the transition to LCE improve development that favours poorer people and regions, and avoids negative impacts on them?

(3) Is use of coal as a main energy source compatible with LCE, especially if economically-viable solutions to carbon capture and storage from coal uses can be developed?

(4) Is it necessary for China to develop cap and trade or other limiting targets as part of a national or global LCE?

(5) What are the best means for China to finance LCE?

(6) How can access to needed LCE technologies be improved, including both domestic and international sources?

(7) What would provincial and municipal LCE strategies look like?

There is a need to provide some assurance to decision makers that deciding to move towards a LCE will have manageable economic impacts, and, hopefully, rising economic benefits. This requires substantial on-going scenario development using credible macroeconomic models. As well, employment costs and benefits, impacts on poorer people within society, and regional or sectoral impacts need to be carefully considered. Fortunately there are co-benefits such as pollution reduction that can be gained through LCE investments and these need to be carefully identified and calculated. Thus China, and many other countries will need to undertake on-going socio-economic analysis, and assessment of environmental and other benefits, especially during the early stages of constructing and implementing LCE strategies.

On the basis of these assessments and analyses it will be possible to undertake corrective and adaptive measures. The important point is to start small but soon on creating a Low Carbon Economy. Pilot projects and other experimental efforts will be valuable in the immediate future, but certain essentials are also needed soon. These essentials include a national strategy for LCE that can be readily understood by the public, enterprises, and people at all levels of government; mechanisms for pricing of carbon and setting of carbon reduction intensity targets, a roadmap with strategic points for initial intervention, and an incentives-based system to promote rapid change of technologies, institutions and management systems towards new approaches.

2.5 Looking Ahead

This AGM comes at a time when inputs into the 12th Five-Year Plan are desirable, and also in the aftermath of the difficult first year of the financial crisis. Therefore it is a good point in time to consider mid-term assessment of what has been accomplished on the mandatory environment and energy goals in the 11th Five-Year Plan, progress on other environmentally-related objectives, and on sustainable development progress. This performance should set the stage for defining objectives of the 12th Five-Year Plan. A variety of task force recommendations have come forward over the period of CCICED's Phase 4 that may be relevant to the 12th Five-Year Plan. In the final part of this section of the Issues Paper we lay out a number of suggestions, mainly as a summary for discussion during the AGM.

Some of the important questions: Can China meet or surpass relevant environment and energy goals? Which ones are most likely to be in trouble and why? If the goals are met across the board, are the results credible, given the problems of statistical data, and the pressure on lower administrative jurisdictions to be judged favourably? What are the most significant outcomes that appear to be emerging from the 11th Five-Year Plan and who/what will they benefit most? Are there significant social groups that have not benefited? What can be changed at this midpoint in order to strengthen eventual outcomes? Has the experience of the 11th Five-Year Plan been transformative? How can the 11th Five-Year Plan experience be useful for setting goals and approach of the 12th Five-Year Plan? We will not try to answer all these questions here. But they should be kept in mind as potential issues, not only for the current Five-Year Plan, but also future ones.

2.5.1 11th Five-Year Plan

2.5.1.1 *Meeting China's 11th Five-Year Plan Mandatory Environment and Energy Goals*[1]

In 2007 a CCICED Task Force[2] noted that meeting energy and environment targets[3] would be difficult due to the very high economic growth rates and the relatively slow progress made during the first two years of the 11th Five-Year Plan, even though there also were expressions of hope that vigorous action would lead to success. Of course much has changed since that time: lower economic growth rates in 2008/09; lower imports and exports since

[1] This section draws upon a background paper prepared for this Issues Paper by Chen Gang and Wang Xiaowen. *Mid-term Assessment of Obligatory Indicators for Energy Conservation and Emission Reductions in 11th Five-year Plan Implementation.*

[2] CCICED Task Force on China's the 11th Five Year Plan Environment and Development Performance.

[3] The Chinese Government has required that the energy consumption per unit of GDP should be cut by 20% from 2005 to 2010, and the total pollution discharge should be reduced by 10%. These two targets are binding ones on all levels of governments.

September 2008; lower FDI; shift to domestic consumption; efforts to shift from low-value, high embedded carbon exports; and improvements to rural social spending and economy. Government leaders have vigorously pressed all provinces and levels of government to achieve the 11th Five-Year Plan targets established for particular regions and sectors. The effort appears to be having some good results and there now is the possibility that even the most difficult targets might be reached.

According to official statistics, by the end of 2008, the total energy consumption per unit GDP had been reduced by 10.1%. And the total discharge of SO_2 and COD were reduced by 8.95% and 6.61% respectively. In the first half of 2009, there were further reductions of 5.46% and 2.46% for SO_2 and COD, and 3.35% for energy intensity. While these results are very encouraging, there are still significant worries about overall energy and environmental performance. MEP indicates that the average SO_2 atmospheric concentration in key cities went down by 15.8 percentage points compared with that of 2005. And the accumulated energy saving is 290 Mt of coal equivalent over the past 3 years, equivalent to the reduction of 660 Mt of CO_2. However, as recently described in a speech by Minister Zhou Shengxian, environment conditions remain *very serious* within China and form a *grave situation* globally.[1] China believes that by continuously improving its own environment, it also will be improving the global situation.

Two years remain to accomplish the obligatory environmental and energy indicators. Assuming emissions are reduced at a fixed rate over the two years and the obligatory indicators are realized as due by 2010, the fixed rate can be calculated.[2]

For COD, a year-on-year reduction of 1.83% should be made in 2009 and 2010 in order to achieve the indicator goal, annual COD reduction should be 8.32% and 10% in 2009 and 2010 respectively in relation to the baseline year of 2005. The somewhat unfavorable situation for COD reduction is due to several factors: first, new industrial emissions continue to increase rapidly, where pulp & paper, brewery and textile industries, which contribute over 60% of COD emissions, remain on a fast track of growth; secondly, the engineering of emissions reduction is lagging—the construction of water projects with a daily treatment capacity of 6.8 Mt at urban sewage treatment facilities required by the 11th Five-Year Plan is running far behind schedule; and thirdly, the progress in structural emissions reduction is less than

[1] http://www.english.mep.gov.cn/Ministers/Activities/200909/t20090929_161949.htm.

[2] Calculations are from the background paper by Chen Gang and Wang Xiaowen.

ideal, where essential advances have not been made in closing down backward production capacities for pulp & paper, brewery, MSG and citric acid.

For SO_2, a year-on-year reduction of 0.58% is needed in 2009 and 2010. The annual reduction should be 9.5% and 10% in 2009 and 2010 respectively in relation to the baseline year of 2005. It is believed that the SO_2 goal could be met a year ahead of schedule. There are several reasons for this optimistic outlook. First, the pressure from newly added emissions sources has somewhat eased. Power generation, steel production and non-ferrous metal production, which contribute over 70% of industrial SO_2 emissions, have for the first time dropped or stayed even. Secondly, engineering emissions reduction has been progressing steadily with 82 desulphurization systems newly installed at coal thermal power plants—an installed capacity of 3.6 million kW, which is 72% of the annual plan. Thirdly, major advances have been made in structural emissions reduction, where 3,382 small thermal power generation units with an installed capacity of 19.89 million kW were shut down over the first 6 months—some 54.07 million kW accumulatively, a planned shutdown that was accomplished one and a half years ahead of schedule. And fourthly, the effects of emissions reduction supervision have started to show.

For each unit of GDP, the energy consumption should be reduced by 5.89% in 2009 and 2010 year on year, and the annual reduction should be 15% and 20% in 2009 and 2010 respectively in relation to the baseline year. These are very difficult goals to achieve.

2.5.1.2 *Progress towards Sustainable Development*

The 11th Five-Year Plan addressed many aspects of sustainable development, which is, of course, a more complex topic than environmental protection on its own. An independent review of the 11th Five-Year Plan progress was released by The World Bank in mid-December 2008.[1] It concluded that:

(1) Economic growth has far exceeded expectations;

(2) Considerable progress has been made toward the 11th Five-Year Plan's most important social objective: Improving basic public services in social protection, education, health, and conditions in rural areas, even though income disparities between rural and urban areas continue to widen; and

(3) Progress on the environmental objectives has been mixed: insufficient progress had been made in energy conservation, but improvements were seen in reducing air and water pollution, treating industrial solid waste, increasing the effi-

[1] World Bank China Office. 18 December, 2008. *Mid-term Evaluation of China's 11th Five-Year Plan*. Report No. 46355-CN.

ciency of water use, and expanding forest coverage.

Furthermore, the Bank concluded that the economic structure had shifted further towards dominance of the industrial sector, and, within the industrial sector, the energy intensive heavy and chemical industry had gained further dominance. The lack of rebalancing the overall economy had offset in part the gains at the micro level. The efficiency improvements gained through mandated efficiency standards and closure of inefficient capacities would become harder to tap in the future. Without making more fundamental changes in the economic and industrial structure, it was viewed as unlikely by the Bank that the 11th Five-Year Plan's 20% reduction target in energy conservation could be achieved.

The Mid-term Report on the 11th Five-Year Plan Implementation reported to the NPC by NDRC points out that the overall progress has been good. In terms of fulfillment of the main socioeconomic development indicators, expected progress had been achieved for most of the 22 main indicators. 10 of the 14 indicators reflective of economic growth and livelihood improvement had been as expected or better, while progress was less than expected for 3 of the 4 economic structure indicators besides the rate of urbanization. Progress greater than required has been achieved for 5 of the 8 obligatory indicators, while forest coverage failed to be accurately assessed due to inadequate annual data, and advances in the 2 indicators for energy conservation and emission reductions were lagging.

There are a number of other environmentally-related goals where good progress has been achieved according to the NDRC assessment. For example, water consumption per 10,000 RMB industrial production growth was reduced by 16% by 2007, accomplishing 53% of the goal, and the effective utilization coefficient was increased by 0.02 for agricultural irrigation, reaching the 11th Five-Year Plan requirement. Goals for comprehensive utilization of industrial solid wastes were achieved ahead of schedule.

2.5.1.3 *Regulated Projects and Activities*

Over 1,100 paper factories causing severe pollution, 16.69 million kW of small thermal units, 14 Mt capacity of obsolete iron factories and 6 Mt capacity of backward steel factories were shut down through regulatory action in 2008. Meanwhile, some of the backward production facilities in non-ferrous metal, cement, coke, chemical engineering and dye printing were closed down. Factories generating excessive pollution and backward productivities in pulp & paper, leather making, dye printing and brewery were shut down around Lakes Taihu , Chaohu and Dianchi as well as along the key water systems.

The MEP reviewed and responded to 365 projects between December 2008 and May 2009, accounting for a total invest-

ment of 1 442.8 billion RMB. It suspended or did not respond to 29 chemical, oil, steel or thermal power generation projects worth 146.7 billion RMB to prevent launching of 2H1R (Heavy energy consumption, heavy pollution and resource-related), duplicated or access productivity projects. There is the worry that if such 2H1R projects are launched or go into operation thanks to economic interests or local protectionism, they will cause severe damage to the public, environment and health.

2.5.1.4 ***Innovation Technologies***

China's commitment to green growth has shown some solid results over the years of the 11th Five-Year Plan. This is partly the result of the large S&T investment, but also from the realization that opportunities can be quickly realized with the right combination of technology. This subject has been discussed in considerable detail by the CCICED Sustainable Development Innovation Task Force which reported to the 2008 AGM.

2.5.1.5 ***Conclusions***

The 11th Five-Year Plan will set a new baseline for action on environment and energy within China. Clearly the process has not been easy, and to some considerable extent success has been dictated by external factors, especially the economic turn-down of the past year. But it is also clear that momentum is building, and that the use of mandatory targets on environment has been a positive feature in this process. There are concerns about how accurately current statistics represent reality across the vast reaches of China. But it is highly encouraging news that substantial progress is being made on both energy and environment indicators.

With renewed economic growth definitely a strong prospect, the reliance on intensity indicators (tied to GDP) rather than total loading is dangerous in that absolute amounts of pollutants and energy use are still likely to be on the increase. Furthermore, many important pollutants such as NO_x , ground level ozone, mercury and other heavy metals, and POPs are not subject to targets, or even control strategies. Furthermore, GHG and carbon reduction strategies were not incorporated into the 11th Five-Year Plan.

The social and economic impacts of the environmental results so far of the 11th Five-Year Plan do not appear to be systemically tracked. Thus it is difficult to know the extent of impacts on either rural or urban areas in the different regions of China. Also, while in general it might seem to be a safe assumption that environmental improvement in China is good for the whole planet, this is still an untested hypothesis in the minds of many people abroad. The reason for this is in part the credibility issue that China actually can make such quick progress on environmental clean-up. Therefore it would be useful for China to devote greater effort to scientifically meas-

ure how its domestic improvements directly affect the global environment.

2.5.2 Environment and Development Highlights for the 12th Five-Year Plan

Broad guidelines for the next Five-Year Plan are already under consideration, with various research efforts underway. The MEP and others have set out some initial guidelines for research on national environmental protection, shown in abridged form in Box 2-5. There are other topics relevant to the theme of this Issues Paper that are not included on the list in Box 2-5, including various aspects on environment, energy and climate change. And certainly, it might be expected that green economic growth would be an important component for consideration.

The *Five Changes* pollutant emissions reduction recommendation from the CCICED 11th Five-Year Plan Task Force has not been fully implemented and remains highly relevant for the 2011-2015 period. The Five Changes are: 1) change from sole emphasis on reduction of total amount of emissions to a combination of total emissions reduction and environment quality improvement; 2) change from priority of key industries to comprehensive reduction; 3) change from control over total emissions of single pollutants to synergic control over multiple pollutants; 4) change from emphasis on capacity to implement reduction programs to emphasis on the quality and actual effects of the programs; and 5) change from reliance on administrative methods to market-based economic instruments.

There are a number of key needs for improvement and updating of environmental laws and regulations in order to address the more complex environmental protection situation that exists within China today, and to address the greater use of economic incentives. To complement an enhanced regulatory framework, there is a need to build and to enforce an indicator system that emphasizes both total emissions control and environment quality improvement. There are many specific needs to be met in relation to expanding the range of pollutants to be controlled and to o enhance local implementation of total emissions control. Examples include: boiler emissions reduction for coal-burning industries and to transform approaches to SO_2 emissions reduction; steps to carry out total emissions control of nitrogen oxides for the thermal power generation industry; choose key river systems and lakes for ammonia nitrogen control; choose some sensitive lake reservoirs for pilot total nitrogen and phosphorus control; provide pilot total non-point source pollution control in some areas. There is a need to create active prevention and control of such newly emerging environment problems as POPs, mercury pollution and VOCs; and to develop and implement pilot programs such as restoration of

pollution sites, polluted soil and neutralization of electronic wastes.

Box 2-5 Tendering Guidelines for Initial Research Projects on National Environmental Protection for the 12th Five-Year Plan

(Issued in 2009 by the Department of Planning and Financing, National Environmental Protection Ministry and the China Environment Planning Institute)

(1) The national environmental protection objectives of the 12th Five-Year Plan are to be regarded as phase requirements for realizing an all-round welfare society by 2020, featuring fundamental improvements in environment quality.

(2) Methods to control the total amount of pollutant emissions are to be improved and optimized, issues such as control of total N, P, nitrogen oxide and other new pollutants to be studied, and practices for total amount control to be furthered.

(3) Control of water pollution is to be furthered by applying systematic management of pollution in key waters such as changing from target total amount control to volume total amount control.

(4) Total amount control of air pollutants, especially prevention and control of nitric oxides and regional joint prevention and management of air pollution, is to be the leading direction.

(5) Eco-environmental protection and soil pollution prevention and management is to be one of the key tasks for the 12th Five-Year Plan.

(6) Integrated utilization of solid wastes such as domestic, hazardous, medical and industrial wastes and the relevant key projects are to become important work during the 12th Five-Year Plan, requiring innovative technologies and techniques, improved support policies and laws, and strengthened social administration.

(7) Support from public financing for environmental protection is to continue to grow as the Chinese economy keeps growing rapidly, and a designated financial funding assurance mechanism, which is stable, well-oriented and specifically targeted in spending, is to be built up.

Five very important items on energy and environment include:

(1) Strategy for sustainable use of coal.

(2) Immediate and longer-term steps towards Low Carbon Economy and Development, including implementation in both urban and rural settings, in various industrial sectors, and shifts towards green growth for both domestic and export products.

(3) An energy productivity strategy, including a progressive, predictable approach to energy pricing and the use of an improved mix of regulatory and economic incentives.

(4) Carbon pricing, which may be based on carbon tax, cap and trade, or other arrangements.

(5) Targets for energy efficiency and energy-related environmental con-cerns, with some based on absolute amounts rather than intensity.

In summary, there are many specific drivers that should be taken into consideration in the design of the 12th Five-Year Plan goals for energy and environment. Among them are the followings:

(1) Energy conservation and energy efficiency needs in a variety of sectors to bring energy intensity in line with or better than existing international norms.

(2) Reduction in energy intensity for urban buildings, infrastructure construction and operations, and urban transportation.

(3) Continued efforts to expand as rapidly as possible the use of renewable energy sources in China, focusing particularly on wind, solar, marsh gas (methane), and small-scale hydro.

(4) Specific actions related to international arrangements on energy, environment and climate change, including carbon pricing and possible trading, CDM, bilateral and multilateral agreements on technology transfer and partnerships, IPR, and investment arrangements.

(5) Adaptation needs concerning climate change.

(6) Mandatory targets for reduction in GHG emissions and carbon intensity of development.

(7) Continued improvement in environmental quality through more stringent reductions in pollutants covered under the 11th Five-Year Plan mandatory targets, plus a broader range of pollution control (e.g. mercury from coal burning, NO_x).

(8) A system for reduction in total pollution load for some sectors and regions.

(9) Improved protection for ecological services, and ecocompen-sa-tion.

(10) Environment and health targets designed to reduce or eliminate mortality and cases related to specific causes, and improvement in environmental safety associated with key sectors such as coal mining and various types of industrial sectors.

(11) Full achievement of the MDGs within China, including those related to environmental sustain-ability.

(12) Strengthening frameworks to improve green growth opportunities, including scientific R&D, innovation technology investment, institutional strengthening and capacity building related to advanced efforts that will provide China with new economic growth opportunities and export potential related to meeting international demand especially those related to environment and energy.

(13) Improvement to the statistical information base for both energy and for environmental performance.

According to some views, the Low Carbon Economy could characterize a new

approach to implementation of scientific development and harmonious society for the 12th Five-Year Plan, since it represents not only such a major turning point in sustainable development, but also because it will open great new opportunities for China's future economic growth and development.

2.6 Conclusion—Prospects for a Green Prosperity Future

This Issues Paper has taken on an almost impossible task of trying to examine the implications of several major global shifts of historical dimension taking place virtually simultaneously. A year ago it appeared that they were on a track of imminent collision, perhaps even leading to global collapse. The issue of financial meltdown and economic recession has been turned into a series of hopefully manageable problems—mainly for the major economies of the world to resolve. China has been vaulted into a role of greater international responsibility and consequences due to its favourable path of economic recovery. Certainly the problems with the global economy China and others will face in the coming five years are massive: restructuring the world's financial system, including the problems of moving away from high levels of deficit spending in some countries; ensuring adequate safeguards on trade and investment; and other issues highlighted during the recent G20 Leaders Summit in Pittsburgh. Yet there is a sense of optimism gradually emerging, in part due to the rapid action by political leaders to avert worst-case scenarios. It also is clear that without a credible and stable global financial system in place, sustainable development goals will be very difficult or impossible to achieve globally and therefore within countries as well.

The second great shift has been the depth of dialogue on the issue of climate change in this year of lead-up to the Copenhagen climate change meeting that will take place in December 2009. There is now a reasonably well-entrenched view that climate change—along with poverty elimination—are defining problems for our common future and security during this century. Unless they are addressed well and soon, the costs will be perhaps unbearably high. Unfortunately getting a solid agreement about the best approach, with high levels of immediate action, is proving to be extremely difficult in the lead-up to Copenhagen. This problem has implications for green growth, for development of international markets for new technologies, and, very importantly for domestic consumption patterns in both industrialized and rapidly developing countries in particular. The Copenhagen climate change meeting is of historic significance to be sure—a beacon that will send its beam far into the future. But whatever the outcome, it is the

start of a new way of thinking about our planet, and particularly about developing the Low Carbon Economies needed for the future.

The third shift is international cooperation concerning poverty reduction, and global capacity to address this serious problem. China's strides towards meeting its Millennium Development Goals present a remarkable success story, but one that is tempered by growing inequalities in wealth, and the realization that a fair part of China's population remains far too close to the poverty line. Yet China also can contribute much through expanded international cooperation throughout the developing world. The technologies that China is diffusing in its rural areas, its experience with renewable energy, and the advantages it brings in driving down the costs of production of many products are examples of unique contributions China can bring to many others in the world. The multiple crises that have emerged in recent times, including high prices for natural resource and energy commodities, the high price and scarcity of food, threat of pandemics and, in many parts of the world, natural disasters of increasing intensity and frequency. These problems will need to be dealt with in more systemic ways and with fresh visions and solutions. Poverty is interlocked with climate change impacts and adaptation, especially for water issues, and with improving environment and development relationships.

The fourth and hopefully very enduring shift is towards societies based on innovation that can more rapidly address the changing circumstances and demands on productive forces within national economies and globally. Green growth involves new forms of both production and consumption. It should influence all sectors of economic productivity, ranging from primary and secondary industries to the commercial, tourism, telecommunications and other aspects of modern tertiary activities. It is understandable that much of the focus on green growth currently centres around energy, environment, and climate change, but ultimately it is transformation of lifestyle, infrastructure design, and the way business is carried out that will determine better outcomes— a future of Green Prosperity.

Will China be the global leader in developing this new future? It is difficult to answer this question because it depends upon China's own willingness to take on this role as part of its rise in the world. And in part it depends upon the wealthier countries undertaking their own transformations. China's potential is great because: 1) it has the means to address key challenges and opportunities precisely at the point in time when it is building the infrastructure to house, transport, meet energy and water supply needs of its people at a better level; and 2) it is prepared to invest in social im-

provements, especially for health and education. China also has demonstrated its tremendous capacity to succeed in the global marketplace. Whether it is LED lighting, wind turbines, advanced coal plants, or a myriad of other advanced green technologies, perhaps including electrical vehicles, through the great size of its domestic markets, its export marketing skills, and its ability to be adaptive, smart and fast, China has advantages that will be put to good use in coming years.

Green Prosperity also depends upon expanded international cooperation. This will involve a greater degree of sharing, and not only of wealth, knowledge and experience. The power sharing that is taking place in the restructuring of global institutions, and in the decision-making among the world's major economies is an outcome that would have hardly been believed possible only a year ago. China has strengthened its potential for international cooperation as a result. This is seen in the case of environment and energy where there has been a rush of many countries to engage with China on matters of energy, environment and climate change. This new engagement is often on the basis of solving problems of mutual interests. Ultimately many of the results will be helpful not only to China but to the other countries involved. This is a pattern that should be encouraged.

It is well to seriously consider the meaning of Ecological Civilization, a phrase used mainly in China. If nations can prosper at low levels of ecological damage—with a deeply felt respect for nature and the ecological services provided by the global commons and by the rich resources of the planet—then we might achieve an Ecological Civilization globally. China's leadership has called for this state of harmony between people and the planet, and we must presume that it will become a central part of China's on-going development philosophy. Other countries will have much to learn, and hopefully much to contribute, during this common journey towards a prosperous future.