THE 2007 ANNUAL GENERAL MEETING

CHINA COUNCIL FOR INTERNATIONAL COOPERATION ON ENVIRONMENT AND DEVELOPMENT

China Council for International Cooperation on Envitonment and Development

Program

NOVEMBER 28 WEDNESDAY

08:00 On-desk Registration
10:00 CCICED Bureau Meeting

Afternoon
Opening Session
Chairing: Mr. Zhou Shengxian
Minister, State Environmental Protection Administration,
CCICED Executive Vice Chairperson

15:00 Welcome Remark
Mr. Zhou Shengxian
Adoption of the Meeting Program
Adoption of the amended Terms of Reference and the Rules of Procedure

15:10 Opening Remark
Mr. Zeng Peiyan
Vice-Premier of the State Council, China, CCICED Chairperson

15:40 Welcome Remark
CCICED Vice-chairperson:
Mr. Xie Zhenhua Mr. Klaus Töpfer Mr. Børge Brende

16:00 Keynote Speech
Mr. R.K. Pachauri Chair of Intergovernmental Panel on Climate Change
IPCC: The Winner of 2007 Nobel Peace Prize

16:20 Coffee break
Session One: Environment and Development in the context of Globalization
Chairing: Mr. Klaus Töpfer, CCICED Vice Chairperson
Former UN Under Secretary General, former UNEP Executive Director

16:30 Introduction on CCICED Issues Paper 2007
Mr. Arthur Hanson, CCICED International Chief Advisor

16:50 Session Keynote Speaker

Mr. Ye Ruqiu, Professor, Counsellor, the State Council of China

17:10 Special Speaker

Mr. James Leape, Director General, WWF

17:25 General Debate and Discussion

18:00 Reception

NOVEMBER 29 THURSDAY

Morning

Session Two: Innovation Strategy for an Environment-Friendly Society

Chairing: Mr. Zhou Shengxian

09:00 Session Keynote Speaker

Mr. Feng Zhijun, Vice Chairman, Environment Protection and Resources Conservation Committee, NPC, China

09:20 Session Keynote Speaker

Mr. David Strangway, Chancellor, Quest University, Canada

09:40 Session Keynote Speaker

Mr. Hu Jianxin, Professor, Peking University, China

10:00 Special Speaker

Mr. Lars-Erik Liljelund, Director General, Swedish Environmental Protection Agency

10:15 General Debate and Discussion

11:00 Coffee Break

Session Three: Introduction on Draft Policy Recommendations to the Chinese Government

Chairing: Mr. Klaus Töpfer

11:10 Introduction on the Draft Policy Recommendations

Mr. Shen Guofang, CCICED Chinese Chief Advisor

11:20 General Debate and Discussion

12:00 Lunch

Afternoon

15:30 Courtesy Call on State Leader of the Chinese Government

(Participants: International Council Members, TF/SPS co-chairs, invited special observers and guests)

NOVEMBER 30 FRIDAY

Morning

Chairing: Mr. Børge Brende, CCICED Vice Chairperson
First Deputy Chair, Standing Committee on Energy and the Environment, Norwegian Parliament

Session Four: Energy Saving and Emission Reduction in China & Global Climate Change

09:00 Special Speech
Mr. Zhou Shengxian, Minister, SEPA
Mr. Achim Steiner, UNEP Executive Director

09:30 Session Keynote Speaker
Ms. Wang Jirong, Vice Chairwoman, China Environmental Protection Foundation

09:50 Special Speaker
Mr. Gordon Conway, Chief Scientific Advisor, DFID, UK

10:05 Special Speaker
Mr. He Jiankun, Vice President, Tsinghua University, China

10:20 General Debate and Discussion

11:00 Coffee break

Session Five: Discussion on AGM Policy Recommendations to the Chinese Government

Chairing: Mr. Klaus Töpfer

11:15 Introduction on the Revised Draft of the Policy Recommendations

11:30 General Debate and Discussion

12:00 Lunch

Afternoon

Closing Session

Chairing: Mr. Børge Brende

14:00 Adoption of the final Policy Recommendations to the Chinese Government

14:10 Introduction on CCICED Future Working Plan
Mr. Zhu Guangyao, CCICED Secretary General

14:25 General Debate and Discussion

15:00 Closing Remark by the Vice Chairpersons

15:10 Summary Remark
Mr. Zhou Shengxian

15:30 Closing of the Meeting

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Remarks of Leaders

Speech at the Opening Ceremony

Zeng Peiyan, Vice Premier of the State Council, Chairperson of CCICED

Dear Members and guests, ladies and gentlemen, friends,

Good afternoon.

First, I'd like to share a piece of good news with you. While China maintaining high economic growth rate, the energy consumption per unit GDP further dropped during the first three quarters of this year, down by 3% compared to the same period last year. The total discharge of SO_2 and COD has changed from upward to downward, down by 1.81% and 0.28% respectively than the same period of last year. This major change signifies that the environmental protection undertaking of China has entered into a new stage.

Today marks the official establishment of China Council for International Cooperation on Environment and Development Phase IV. We have both familiar old friends and a lot of new friends in the Members of this new phase of the Council. I am very glad that we can get together to discuss practical problems emerged in the environmental and development cause of China. It is of great significance that this 2007 AGM has chosen "Innovation and Environment-Friendly Society" as its theme and discuss about it. Here, on behalf of the Chinese government, I'd like to express my warmest welcome to all Members, experts and representatives presenting at today's meeting and heartfelt thanks to your long-standing care and support to the environment and development cause of china.

The world today is featured by the deepening of economic globalization, rapid scientific and technological development and faster flow of various production elements like capital, technology and talents. Against such a backdrop, the overall economic development trend across the globe is very promising, and all countries are encountering very precious development opportunity. Meanwhile, the factors that threatening world economic sustainable growth cannot be ignored with ever-mounting pressure on energy, resources and the environment. The international price of major mineral products such as oil, iron ore and copper ore are rocketing. At the 2006 AGM, the price of crude oil was around 60 US$ per barrel, attracting widespread attention of the international community. Now, the price hike of oil to around 100 US$ has drawn deeper concern of the world. Global warming, loss of biodiversity, the depletion of the ozone layer and regional eco-environmental degradation has all brought about major impacts on human life and production activities. It has already been highly valued by various national governments, enterprises and people of insights to join hands in cooperation and create a new future under this circumstance.

Since the start of the new millennium, China is experiencing accelerated industrialization and urbanization with a new round of economic growth. During the past five years, the average annual GDP growth was over 10%. The first three quarters of this year witnessed 11.5% GDP growth, and the economy maintained good momentum of relatively rapid growth, structural improvement with more profit. However, we should be sober-minded at the same time that a number of problems are still hampering the stable and sustainable development of China’s economy. Currently, we are facing the problem of excessive liquidity, great foreign trade surplus, high-investment ratio and relatively big fluctuations in commodity price. The per capita GDP of China is rather low, there is a long way to realize modernization, and the conflict between development and resource and environment in the coming years will remain outstanding. The Chinese government attaches great importance to these issues and is taking measures to address them.

The development of China not only brings welfare to the Chinese people, but also promotes global economic prosperity and eases the pressure on resources and environment of other countries. There has been a massive transfer of traditional manufacturing industry, especially heavy and chemical industries into China over the past two decades. The ever-increasing export volume of China has provided other countries with cheap and good commodities on the one hand, but increased the resource consumption and pollution emission of China on the other. It is estimated that one fifth of the energy consumption in China each year is for the manufacturing of energy-intensive products that no longer in production in developed countries. Economic globalization brings benefit to China, but at the same time increases the difficulty of China in addressing resource and environmental problems.

Ladies and gentlemen,

China has always attached great importance to addressing environmental problems. During the last five years, The Chinese government has made a series of arrangements on strengthening environmental protection and adopted a range of well-targeted policy measures from the strategic standpoint of building a well-off society in an all-round way and accelerating socialist modernization. As a result, environmental protection work has made the following positive achievements.

We have accelerated industrial restructuring. We have improved industrial policies, raised market access in terms of environmental protection, strengthened EIA of construction projects and curbed many new projects with high energy consumption and heavy pollution. We have made more efforts in the phase-out of outmoded productivity of 13 industries such as iron and steel, cement, power generation and paper-making. The target of phasing out all the small thermal power units with the capacity less than 10 million KW has been achieved ahead of schedule. The industrial restructuring has drastically reduced pollution emission from the source.

We have stepped up efforts in the development of eco-environment. We have developed and revised a great number of wastewater treatment plants and landfill facilities in urban areas and parts of rural areas, expedited the construction of desulphurization facilities of coal-fired thermal power units with the addition of total capacity of 200 million KW of power units equipped with desulphurization facilities across China this year and last year. A total of 140 million *mu* farmland have turned into forest land and 440 million *mu* of pastureland to grassland over the past five years. Large-scale environmental projects have improved the environmental quality of some regions in China.

We have enhanced environmental law enforcement and legal work. We have formulated and amended a range of environmental laws and regulations, enhanced the supervision of environmental law enforcement, investigated and eliminated hidden environmental risks across China. During the past five years, we have addressed over 1.6 million pollution cases with public concern. This move has not only effectively solved outstanding environmental problems, but also promoted the practice of “rule by the law” in environmental protection.

We have improved environmental economic policy. The Chinese government has taken such measures as increasing the investment in energy saving and environmental protection, adjusting resource taxes on mineral products, raising the price of finished oil and carried out power price policies that limit the development of energy intensive enterprises and encouraging power plant desulphurization and the development of renewable energy, improving the charging system for sewage treatment and domestic refuse disposal and establishing a market-oriented system for the operation of pollution control facilities. All these have provided a good leverage for the prevention and control of environmental pollution.

Through hard work China has scored new progress in environmental protection. With fast economic growth and some increase of pollution emission, the overall environmental quality of China basically remained stable with some improvement in the environmental quality of some river basins, cities and regions.

Ladies and gentlemen,

The last-month 17th Congress of the CPC is an important meeting held at a key stage of China's reform and development. At the meeting, the Party made thorough arrangements for further advancing reform and opening up, socialist modernization as well as for achieving the goal of building a moderately prosperous society. It was made clear that economic development should be achieved on the basis of optimized industrial structure, high efficiency, low energy consumption and good environmental protection. This fully demonstrates the development mode that takes environment as top priority. The meeting has identified conservation culture as one of our objectives for building a moderately prosperous society （*Xiaokang* society）in an all round way. This reflects our new requirements for conservation development, clean development and culturally advanced development. In the future, we will promote innovation and further strengthen environmental protection.

Firstly, make innovations on our development ideas. We will firmly follow the path of people first, balanced and sustainable development, adhere to the basic national policy of saving energy and protecting the environment, further implement the strategy of sustainable development and accelerate our efforts to build a resource efficient and environment-friendly society. We will take energy saving and consumption reduction as well as emission reduction as a major objective for development, which serves as an important means to economic restructuring and economic growth mode transformation as well as an essential component for our endeavor to improve macro economic regulation and industrial development policies. We are committed to work hard on it.

Secondly, make innovations on our development mode. We will accelerate the transformation of economic growth mode, facilitating the change from investment and export driven economy to a balanced driving forces of consumption, investment and export; from mainly relying on secondary industry to the synergy of primary, secondary and tertiary industries; and from relying on increasing resource consumption for economic growth to relying on technology advancement, improvement of workers' personal quality and innovation in management. We will continue our strict control on excessive growth of high energy consumption and heavy pollution industries and speed up the development of modern service sector, advanced manufacturing and green agriculture in order to establish a modern industrial system featuring clean energy and high efficiency. At the same time, we will make more efforts in phasing out backward productivity with high energy consumption and heavy pollution. During the 11th Five-Year Period, we are going to phase out the outdated capacity in the following sectors: 55 million tons in steel, 50 million KW in thermal power, 250 million tons in cement production and 6.5 million tons in paper-making.

Thirdly, make institutional and systematic innovations. We will improve environmental laws and regulations as well as environmental standards and strengthen punishment on environmental infringements. We will deepen our reform in pricing, public finance, taxation and banking, establish the system for compensated use of resources and eco-compensation system and improve economic policy system conducive to resource saving and emission reduction. We will improve environmental management system, perfect emission reduction target system, monitoring system and evaluation system and carry out local government responsibility system for environmental protection. We will promote emission permit system, strengthen on-line monitoring of key enterprises and establish corporate creditability system for environmental protection. We will safeguard public's right on the access to environmental information, play the role of media and social organizations for supervision, mobilize the initiatives of all social forces in taking part in environmental protection and advocate environmental and conservation culture in the society.

Fourthly, make innovations on pollution prevention and control mode. We will make more efforts in such aspects as facilitating conservation of energy and resources, fully implementation of key energy saving projects such as reform of industrial boilers, use of residual heat and pressure, and promotion of energy saving buildings; focusing on reform of key energy intensive industries and promoting conservation of water, land and other resources. We will work hard to facilitate clean production, circular economy and accelerate the transformation from end-of-pipe control to whole-process control with a view to reducing resource consumption and pollution at source. We will speed up our efforts in key environmental protection programs such as the construction of sewage treatment plants, desulphurization devices of coal-fired power plants; disposal of hazardous waste, prevention and control of water pollution in key river basins and development of eco-function zones so as to raise pollution control efficiency and improve environmental quality as soon as possible.

Ladies and gentlemen,

Under the circumstance of increasing economic globalization, the solutions to environment and development issues are more and more dependent on international cooperation in the environment field. We suggest that every country in the world help and cooperate with each other on environment issues, cherish our common home - the earth on which the mankind is relied for survival, and make more efforts in protecting biodiversity and ozone layer, especially take active responses to global climate change.

China has always paid great attention to the issue of climate change. The energy consumption per unit GDP dropped constantly during the last two decades of the 20th century, but went up at the start of the new century due to a large proportion of heavy industry in the industrial mix. However, it began to decline again in last two years because of the measures adopted. Over the past 26 years, the energy consumption per unit GDP has decreased by 64.5%. Meanwhile, an ever wider area has been reforested and more and more forests are protected, which has played an important role in controlling the emissions of greenhouse gases. Not long ago, China developed the *National Climate Change Programme* and set up a leading group in response to the climate change, which is headed by Premier Wen Jiabao. We shall do our utmost to implement the *Programme*, shoulder due international duties and obligations under the *United Nations Framework Convention on Climate Change* and its *Kyoto Protocol* and in the principle of "common but differentiated responsibilities", and try to meet the goals and fulfill the tasks of reducing energy consumption, increasing the percentage of renewable energy, improving the forest coverage, and developing low-carbon economy. The international community should intensify communications, do more to address climate change, develop appropriate means of production and modes of consumption that are in compliance with sustainable development, and promote the cooperation on technological R&D in the fields of energy saving, environmental protection, and low-carbon energy. Developed countries should face squarely their historical responsibilities and the reality of high levels of per capita GHG emissions, seriously fulfill the emissions reduction goals set out in the *Protocol*, take the lead in continuing reduction efforts after 2012, and provide more assistance to developing countries in terms of capital input, technology transfer, training and institutional improvement.

China's environment and development efforts have been deeply influenced by the economic globalization. Protecting the country's environment contributes not only to China's sustainable development, but also to the world environment and development cause. The Chinese government is duty-bound of this but also needs enhanced international cooperation. We want less sensational reactions and reproach but more understanding of and supports to the environmental problems in the development cause. We hope that the international organizations, foreign governments, business, and scientific research institutes can intensify their communications and cooperation with us, join us in environmental projects, head for making breakthroughs in environmental science and technology, deepen the cooperation on training of environmental professionals, and introduce advanced environmental equipment, technology, talents, managerial expertise and funds for environmental treatment, so as to enhance the capacity of environmental protection collectively.

Since its establishment in 1992, the Council has become one important platform that intensifies environmental cooperation between China and the international community. Over the past 16 years, the Council has conducted policy studies on important and practical problems related to environment and development, and put forward many valuable policy recommendations to the Chinese Government. The 3rd Phase of the Council has made many effective achievements. The Chinese Government highly values the Council's findings and has transformed many good recommendations into specific policy measures. The Council has been well recognized by the Government for putting forward recommendations from unique perspectives and contributing to the country's environment and development cause in its own way.

Today, the 4th Phase of the Council will start its journey. I hope whole-heartedly that all Council Members and experts will pay more attention and supports to the country's sustainable development cause, so that the Council can further play its role as bridging for international environmental cooperation. Let's explore more study areas and put forward more policy recommendations, extend the spheres of communications and practice down-to-earth cooperation in a wider scope, seek for innovative work style and strengthen environmental protection, so as to make more contributions to the development of conservation culture in China and the world.

Finally, I hope that with your in-depth discussions about the meeting's theme and in-sights as well as valuable recommendations, all Council Members and experts presented here can create a good beginning for the activities of Phase IV.

I wish a complete success of the 2007 Annual General Meeting of China Council for International Cooperation on Environment and Development. I hope all of you enjoy a pleasant stay in Beijing and good heath.

Thank you!

Special Speech on Focusing on Pollution Reduction and Rehabilitating Rivers and Lakes

Zhou Shengxian, Executive Vice Chairperson

Respected Chair, Council Members, experts and distinguished guests,

Premier Wen Jiabao met with international members of the Council yesterday afternoon, listened to the policy recommendations on China's environment and development and highly appraised the Council's work. Vice Premier, also Chairman of the Council, Zeng Peiyan attended the opening ceremony and made a speech. This fully demonstrates that the Chinese government values the Council's unique role and positive contributions to promoting China's cause of environment and development.

I would like to make a brief introduction on China's efforts to reduce pollution and control water pollution on this occasion.

This year the Chinese government has put energy saving and emission reduction on top agenda. The State Council established a leading group for energy saving and emission reduction with Premier Wen Jiabao as the leader, convened teleconference on the task and made nation-wide arrangements for it. The General Work Plan for Energy Saving and Emission Reduction issued by the State Council identified a series of measures and policies. Local governments and all quarters of the society have made more efforts on it. The strenuous efforts have begun to take hold. The first three quarters saw a reduction of SO_2 emissions by 1.81% and COD by 0.28% in the whole country as compared with that of last year, showing a decline for the first time. This marked an important turning point, which testified that pollution reduction could be accomplished while the economy sustained rapid growth. The credit goes to such measures of reduction through constructing treatment facilities, industrial restructuring and management that enabled the total discharge of two major pollutants to drop for the first time in the country.

Reduce emissions through constructing treatment facilities. We have accelerated the construction of municipal sewage treatment facilities and desulphurization devices for coal-fired plants. The newly added sewage treatment capacity last year was 11.56 million tons per day and 9 million tons more were added in the first three quarters. By far, national sewage treatment rate in cities have increased to 60%. In 2006, the newly added desulphurization capacity in coal-fired plants totaled 104 GW, more than doubled the total capacity added in the past 10 years. In the first three quarters of 2007, another 74.12 GW units were installed with desulphurization facilities, increasing the proportion of desulphurization units to 45% of total coal-fired power units. All this shows that we have stepped up efforts to control pollution in the past two years and this trend will continue in the future.

Reduce emissions through industrial restructuring. Substantial progress was scored to expand large-scale production and phase out small capacities in key sectors. In the first three quarters of this year, we have eliminated outdated production capacities in such sectors as cement, calcium carbide, mechanical coke oven, steel and iron by 25 million tons, 400,000 tons, 11 million tons, 9.69 million tons and 8.73 million tons respectively. We moved 2 months ahead of the deadline of shutting down 10 GW of small coal fired units. Phasing out backward production in paper-making and alcohol industries also registered positive results with eliminated capacity hitting 1.7 million tons and 350,000 tons respectively. We also encourage the development of large-scale projects with high technology. From January to October this year, 365 large scale industrial projects passed environmental impact assessment. When these projects put into operation, the outdated production capacity will be phased out accordingly, which are expected to reduce emissions of SO_2 and COD by 310,000 tons and 7300 tons each year.

Reduce emissions through management. We have resorted to the measure of banning projects in the whole region twice this year to cope with serious pollution and outstanding environmental infringement in some areas by rejecting EIA on industrial projects in these areas and taking actions to rectify the problems. The special campaign to combat environmental non-compliance and safeguard people’s health included 860,000 investigations on enterprises, among which 620 paper mills failed to meet environmental standard in a stable manner were halted operation for rectification and 403 paper mills were required to improve pollution control facilities within certain time limit. These control measures on paper mills are expected to cut COD by 300,000 tons. During investigations, 545 people were investigated for suspecting of violating environmental regulations and polluting enterprises suffered serious blow.

These achievements were hard earned and they also showed that the policies and measures of the Chinese government were absolutely right. So long as we make unremitting efforts to implement them, China’s capability to deal with issues on environment and development is out of question. However, we must keep sober-minded and recognize the stern situation we are now facing, particularly the situation of water environment. Large scale blue algae have occurred in the Taihu Lake, Chaohu Lake and Dianchi Lake since the beginning of this year, affecting some of the key drinking water sources subsequently. This represents a reflection of rivers and lakes that are already overloaded. Serious water pollution not only harms people's health and affects social stability, but also restrains the economy from growing sound and fast.

Facing increasingly serious water pollution, we have convened several meetings for the pollution control of the Songhua River and other lakes and rivers across the country, reviewed lessons and experience in dealing with water environment and put forward the policy of rehabilitating water system in light of past experience and laws governing natural succession. We will show humanistic care for rivers and lakes, restore the benign cycle of eco-system and lay environmental foundation for the sustainable development of the society and economy. This policy manifests the overall guidance of environmental work by laws governing social and economic development and law of nature, and is of vital significance to the promotion of scientific development and social harmony.

Water is the source of life, the root of world and civilization. Human civilization tells us the close relationship between water and national strength, social prosperity and cultural development. The tide of Nile bred brilliant culture of ancient Egypt, the vicissitudes of Euphrates determined the rise and decline of Babylon, the beautiful environment along the Mediterranean nurtured civilization of ancient Greece and the surging Yellow River and Yangtze River extended the splendid Chinese culture. The Chinese has long been honoring the tradition of respecting water, loving water and making friends with water. As the old Chinese saying goes, "The wise find pleasure in water, the virtuous find pleasure in hills" （the Analects of Confucius）, "We should behave like water, which nourishes all objects while never seeks for supremacy" （Lao Tzu）, "One should not drain the pond to catch fish, nor burn up whole forests to hunt" （Huainan Zi）and "Accept all as the sea is converged by all rivers"（couplet at Lin Zexu's Office）, the concept embracing harmony between man and water and the brilliance of the culture of water are always carried in the minds of sages. However, cases of cultural decline due to irrational use of water are also ubiquitous. Mesopotamia and Asia Minor, once abundant in water and plants, are now reduced to infertility; the world famous Phenician civilization and Sahara civilization disappeared one after the other due to loss of water sources. There is no denying that water gives birth to human beings and supports the immense progress of human civilization. Water crisis facing China and other countries in the world has posed a menace to the development of civilization. This is no exaggeration. To recover rivers and lakes means to acquire conservation culture, promote harmony between man and water, and accelerate the building of a resource-conserving and environment-friendly society.

To restore rivers and lakes is not to wait passively. It is a proactive way to make progress. Instead of being sluggish, we are gearing up for a fight. This policy will push hard on the extensive mode of economic growth that has long plagued China, guide a transformation of concept on economic development, change the mode of development and improve its quality so as to fundamentally mitigate the stress on water environment.

The success in rehabilitating rivers and lakes depends on a string of factors such as most stringent environmental measures, slash in total discharge of water pollutants, strict conditions on environmental access, prohibition against discharge of toxic and hazardous wastes into water body like heavy metals and POPs, strenuous efforts to phase out outdated production capacities, protect drinking water sources, accelerate treatment of industrial and urban wastewater, appropriate management of water use for household, production and ecological purposes, and rational development and use of water resources. All this will ensure the rejuvenation of rivers and waters.

Resolution of China's problems in environment and development is a challenging task as well as a significant undertaking for global sustainable development. Its toughness calls on our joint efforts. Despite many difficulties ahead, we are still full of confidence, a confidence driven by the correct decisions from the CPC and the government. The last month 17th Congress put environmental protection at a strategic position in our national plan and explicitly demonstrated our commitment to international cooperation in the field of environment by helping each other and synergy in order to protect the planet upon which we human being srely. Our confidence also comes from the strong support of the people. With the improvement of people's living standard, people have grown an increasingly strong awareness for environmental quality. As more and more people put themselves in the place of a watchdog, non-compliance will be driven to nowhere. Our confidence is boosted by the full participation of all social circles. The big difference that environmental problems make on the development of human civilization has brought about much attention from all quarters, and the whole society has reached the consensus to develop a conservation culture.

Ladies and gentlemen,

As human society is now confronting unprecedented challenges from environment, and climate change becomes a threat in reality, many people expect a bigger role of China in control of GHG emissions. With regard to this issue, the Chinese leadership including President Hu Jintao, Premier Wen Jiabao, Vice Premier Zeng Peiyan and others has all stated their positions on different occasions. Here I would like to stress three points:

Firstly, all countries should cooperate in the principle of openness and pragmatism. Combating the global issue of climate change is incumbent on all of us. Developed countries should face up to their historical responsibilities and the lingering reality of high level emissions per capita, set stricter objectives in the long run and continue to cut emissions. Developing countries should take active measures and contribute to global fight against climate change according to their own capabilities. Without frank and pragmatic cooperation, we won't make substantial headway in this regard.

Secondly, to transform the mode of economic development is the fundamental measure to cope with climate change. Climate change is fundamentally an issue of development. It is no good to approach it while turning a blind eye to poverty and halting development. There is an old Chinese saying that goes like this "A man is dead to shame when in poverty and hunger". If we are not able to provide people with food and clothing, how can we protect global environment? Of course, we are not for lopsided pursuit of economic growth without regard to climate change. The ultimate way out is to transform development mode, accomplish economic development and poverty elimination in a responsible manner for the society and nature and call on prudent use of resources and energy and rejection of extravagance.

Thirdly, technology development and technological cooperation play a decisive role. The international community should increase the inputs spending on environmental protection, improve information exchange and enhance technology development and innovative cooperation in energy saving, environmental protection and low-carbon energy sources, and strengthen technology extension and application in particular. In this regard, we should not only stress the role of market mechanism. To address climate change, it requires the combination of market and administrative measures. We urge developed countries to make more efforts in extension and application of technologies that are affordable and applicable for developing countries.

Ladies and gentlemen,

I would like to take this opportunity to express my gratitude to the Council for its contribution. A succession of dedicated Council Members and experts make the Council in blossom. The Council has proposed many valuable policy recommendations to the Chinese government through their study on many practical issues facing China's environment and development and related the extensive and profound changes taking place in the world to those in China through their unique perspective and work mechanism. Its positive contribution to China makes the Council a role model of international cooperation in the field of environment and development.

I am very pleased to see the new phase of the Council in this annual meeting. I sincerely hope all the Council Members and experts will make the best of this platform and work mechanism, thoroughly study polices conducive to the steady and rapid development of China, share your insights and make greater contributions to China's environmental protection and sustainable development!

Thank you!

Summary Speech at the Closing Ceremony

Zhou Shengxian, Executive Vice Chairperson

Members, experts and all guests:

CCICED 2007 AGM is going to close after 3-day intense work. During the meeting, both Chinese and International Members present their comments with heated discussion and full exchange of ideas. The comments and suggestions of each Member, in particular, those in-depth discussions on innovation and environment-friendly society is of great significance to the implementation of sustainable development strategy in China. The meeting meets its anticipated aim. Here, on behalf of the Bureau of the Council, I would like to express my heartfelt appreciations to the hard work of each Member.

The Chinese Government attaches great importance to the meeting. Premier Wen Jiabao met with International Members yesterday afternoon and listened to the policy recommendations of the Council. Premier Wen spoke highly of the theme of 2007 AGM. He pointed out that innovation and environment-friendly society are two major topics for the development strategy of China. We will develop an innovation country and environment-friendly society. In innovation, we not only need scientific innovation and institutional innovation, but also the innovation in thinking and ideas. To realize the “Three Transformations”, we must start from the institution. Only when we set up a mechanism or system that facilitates innovation and environmental protection can we achieve our goal. Premier Wen Jiabao introduced the development of energy saving and emissions reduction in China over the past year. He pointed out that there has been reduction in both energy consumption per unit GDP and total emission of major pollutants. This is an important turning point. Premier Wen Jiabao also paid much attention to global environmental issues including climate change, saying that low carbon cities and environmental indicators are two key issues under consideration by the Chinese Government. China will actively, in the spirit of constructive, practical and realistic, attend the upcoming international meeting on climate change that will be held in Bali, Indonesia. Premier Wen said he would be an environment premier and his cabinet cares about the environment. We will not only create a prosperous China, but also enable China maintain a good environment including blue sky, white cloud and clean water. In the end of his meeting, Premier Wen fully affirmed the work of the Council over the past year. He said that the Council is a good platform for exchanges and learning. The international communities help China （1.3 billion people）address its environmental problems, this means helping 1/5 of world population to solve environmental problems. It is a great contribution to global cause on environmental protection.

Mr. Zeng Peiyan, Vice Premier of the State Council and Chairperson of the Council attended the opening ceremony of 2007 AGM and delivered an important speech. In his speech, he expounded the striking environmental problems that the world including China are facing in the context of economic globalization, summarized the unremitting efforts of China in the cause of environmental protection and the key achievements, and introduced the strategic arrangements of China for the development of resource saving and environment-friendly society in the next stage. He hoped that, based on the existing foundation, the new phase of the Council obtain greater achievements, continue play its role as a bridge and tie for international environmental cooperation and make greater contributions to the development of conservation culture in China and even the world.

Centering on the theme “Innovation and Environment-Friendly Society”, this AGM invited Mr. Pachauri, Chairman of IPCC to give a keynote speech. In the 5 topic sessions, the meeting has also arranged topic keynote speeches and a special speech. This AGM listened to the reports of the following four Task Forces or Policy Studies, including “Policy Mechanism towards Successful Achievements of the 11^{th} Five-Year Plan Environment Targets”, “Innovation and Environment-Friendly Society”, “Strategic Transformation of Environment and Development in China: Global Experience and China’s Solutions” and “Environmentally Sound and Strategic Management of Chemicals in China”, which are very informative with rich contents. Focusing on these findings, Members and experts have carried out in-depth and fruitful discussions. With heated discussion, Members have put forward many recommendations with insights and vision to the Chinese Government. After 3-day discussions, the meeting has obtained some important achievements as follows:

First, common understanding on many issues.

A. Members have fully affirmed the huge contributions that the Chinese government has made in the field of environment and development. They all agreed that the Chinese government attaches great importance to environmental protection. Guided by the approach on scientific development and the strategic goal of building a harmonious society, the Chinese government has identified the binding targets on energy saving and emission reductions and is planning to realize the historic transformations in environmental protection. With a series of strong policy measures, it has made dramatic achievements and actively contributed to the sustainable development of China as well as the world.

B. Members have full confidence in future environmental protection cause of China. It is encouraging and inspiring that the 17th National Congress of CCCPC has made strategic arrangements for environmental protection and put it at an important position in the development and modernization strategy. Environmental protection in China has become the main field and arena in economic and social development.

C. To face the unprecedented environmental challenge, we still need more hard work. China now is at the critical stage of urbanization and industrialization with growing population and more pressure on environmental protection. And this will last for some years. No country in the world is facing so huge environmental challenge like China. With firmer determination, we must make more efforts with more effective measures to address environmental problems during the development.

D. We must strengthen innovation in environmental protection. To address environmental problems at the root, we must achieve harmonious development among the environment, economy and society in China with innovations in ideas, development mode, institutions and science & technology.

E. We must address environmental problems in the context of globalization. Addressing environmental problems requires joint efforts of all countries in the world. To study environmental problems of China, we must strengthen international exchanges and cooperation. With mutual help and joint efforts of all countries in the world, we will work together to protect our Earth on which human survival depends.

Second, we have developed high-quality policy recommendations. These policy recommendations involve the following 5 aspects:

A. To strengthen and develop new policy measures to ensure emissions reduction. It is suggested that China reform the performance examination system on energy saving and emission reduction, carry out emissions reduction in the whole production process, establish macro and joint decision-making system, raise technical supporting capacity and present new strategy for emission reduction during the "12th Five-Year Plan" period.

B. Taking the opportunity of the transformation of environment and development strategy, China should actively explore environmental protection path with Chinese characteristics. It is recommended that China should integrate institutional functions, enhance publicity and education, promote advanced technology and improve environmental economic policies.

C. To jointly address environmental challenges imposed by economic globalization. It is recommended that China should shift its trade growth mode, optimize export structure, intensify environmental management of international trade of recyclable waste, actively take part in bilateral or multilateral environmental cooperation and greatly develop low carbon economy.

D. To set up national eco-innovation system. It is recommended that, if China establishes resource saving and environment-friendly society, the Chinese government should, based on the innovations in concept, theory, technology, institution and culture, improve innovation capacity in such aspects as enforcement management, market incentives, policy promotion, awareness improvement and capacity building.

E. To mainstream environmental management of chemicals into national environmental management system. With such measures as improvement of legislation, establishment of management mechanism and enhanced public participation, China should strengthen environmental management of chemicals in each process including production, circulation and consumption. These insights reflect the wisdom and vision of relevant Members and experts of Task Forces, serving as important references to the acceleration of the historic transformations of China's environmental protection.

Third, we have developed more active study mechanism. With 16-year continuous exploration since its establishment in 1992, the Council has presented a new outlook. Firstly, The Member composition of new phase of the Council is more appropriate. There are 47 Members in Phase IV with 22 International Members and 25 Chinese Members. International Members come from both developed and developing countries. Famous experts and scholars account for near 50%, higher than that of the previous phases. Members are top-level decision-makers, leaders or experts in the field of environment and development. They have sound professional background, wide international perspective and insights. They could accurately understand the direction of development and innovation and good at putting forward key countermeasures to address major issues. Secondly, the targets of research projects are more suited to the practical situations of China. With further work of the Council and the communications and cooperation among experts, it is expected that research topics will be broader and targeted on practical issues. The experts of the four study teams of this AGM, focusing on core environmental issues such as energy saving and emission reductions as well as environment-friendly society, have carried out in-depth research and explorations and produced the findings with an important guiding role. Thirdly, the relations between the Chinese Government and the Council are closer. Members and experts feel that they are closer and closer to State leaders of China with deeper communications. They also feel that the Chinese government is eager to listen to the voices from every party. And the policy recommendations of the Council are widely applied in each field relevant to sustainable development of China.

I would like to mention here that due to time limit, I might miss the viewpoints of some Members or experts in the summary. I hope you understand this and do not mind.

Members and experts,

With further progress of sustainable development cause in China, it is expected that the Council will have more pre-eminent role and face harder tasks. When disseminating advanced ideas, enhancing international communications and putting forward policy recommendations, the Council should focus more on addressing the most striking environmental problem in China, R&D and communications of environmental technologies, education and training of environmental staff as well as the demonstration and extension of environmental policy measures. It should provide not only theoretical guidance, but also practical help. I believe that with our joint efforts, the Council will play a greater role in the field of environment and development.

At the end of the meeting, please allow me, on behalf of the Bureau, pay high tribute to the Members of past phases of the Council. We will always remember their hard work and efforts in helping the cause of China's environment and development over the past years. At the same time, we express our heartfelt thanks to the contributions of each Member and expert of the Council Phrase IV！Our thanks also go to the strong support and active participation of all relevant departments, social organizations, universities and research institutes！Finally, we also appreciate the hard work of the staff of Secretariat and interpreters.

Finally, I wish you all the best!

Speech at the Opening Ceremony

Xie Zhenhua, Vice Chairperson

Respected Vice Premier Zeng, Vice chairs, Members and experts,

Good Afternoon!

I am very happy to attend 2007 AGM of China Council for International Cooperation on Environment and Development Phase IV to discuss with many Chinese and international friends, old and new, about relevant environment and development issues in China. This year is the 16th year of the Council. As one of the founders and a Member for the past three phases of the Council, I witness the development of the Council. It is a great honor for me to continue the participation in the Council activities under the leadership of Vice Premier Zeng Peiyan, also Chairman of the Council and I am willing to make new contributions.

The Council has constantly put forward recommendations for sustainable and scientific development of China and played an important role over the past years. This fully demonstrates that the Chinese Government is willing to listen to the insights of both Chinese and international experts in the implementation of sustainable development strategy and learn the experience and lessons of foreign countries. At the same time, it also reflects the fact that China has always adhered to the reform and open up policy. A moment ago, Vice Premier Zeng Peiyan made an import speech. He expounded major strategic arrangements for the building of a socialist society with Chinese characteristics set forth by the 17th Congress of CCCPC, introduced the scientific outlook on development and the policies China is taken with some development. He also put forward requirements for the future work of the Council. We must carefully implement his instructions in the activities of the Council Phase IV.

Taking this opportunity, I would like to briefly introduce to each Member and experts here about energy saving and emission reduction in China. The Outline of the 11th Five-Year Plan of China for National Economic and Social Development clearly requires: "we take resources conservation as a basic national policy; we will develop circular economy, protect eco environment and accelerate the development of a resource saving and environment-friendly society". It also identifies the binding targets during the 11th Five-Year plan period, i.e. 20% reduction of energy consumption per unit GDP and 10% reduction of total emission of major pollutants as compared with that of 2005.

Both the central and local governments have taken energy saving and emission reduction as an important measure for adjusting economic structure, shifting development mode, protecting eco-environment and addressing climate change over the past few years with more efforts in this field. Early this year, the State Council convened a national teleconference on energy saving and emission reduction. Premier Wen Jiabao made arrangements for the work of energy saving and emission reduction. The Central government has set up a National Leading Group on Climate Change and Energy Saving & Emission Reduction with Premier Wen as group leader and Vice Premier Zeng Peiyan and State Councilor Tang Jiaxuan as vice group leaders. It has approved the comprehensive work program for energy saving and emission reduction with 45 countermeasures in 10 areas, which fragment energy saving and emission reduction targets down to local governments and key enterprises who have signed target responsibility documents with the central authority. China has established the statistics, monitoring and examination system for energy saving and emission reduction, taken the achievement of energy saving and emission reduction as an important component for the examination of the performance of the heads of local governments and state-owned enterprises and accountability system being in place. Each province and relevant departments have made their corresponding energy saving and emission reduction work program or implementation suggestions.

In order to achieve energy saving target, we are taking the following measures:

1）Make more efforts in restructuring to curb excessive growth of the industries with high energy consumption and emissions. China focuses more on the development of primary and tertiary industries to raise the proportions of service industry and high-tech industries in national economy. China is adjusting the energy mix, actively develop renewable energy sources with wide application of clean coal. During the "11th Five-Year Plan" period, it is expected that the proportion of the added value of service industry to GDP will go up by 3 percentage and that of high-tech industry against total industry by 5 percentage. The percentage of renewable energy in energy mix will go up from 7.5% to 10% so as to raise the quality and benefits of development.

China will accelerate the phasing out of lag-behind productivity of 13 industries including power, iron and steel, building materials, electrolytic aluminum and coal according to law. It is expected that during the "11th Five-Year Plan" period, lag-behind productivity in the following sectors will be closed down or phased out: 50 million KW from small thermal power plants, 100 million tons of iron and 55 million tons of steel, 250 million tons of cement and 6.5 million tons of paper-making. The *Regulations on the Rewarding Funds of the Central Budget for the Promotion of Phasing Out of Lag-Behind Productivity* will be formulated and the establishment of incentive mechanism for the phasing out of lag-behind productivity will be speeded up.

2）Enhance the implementation of key energy saving projects. China will continue the implementation of 10 key energy saving projects, including reform of coal furled boilers, co-generation, petroleum conservation and alternatives, green lighting and energy saving buildings. Incentive mechanism will be carried out for corporate technical reform for energy saving in line with *Interim Regulations on the Rewarding Funds of the Central Budget for the Energy Saving Technical Reform*.

3）Strengthen energy saving in key areas. China is going to mobilize 1000 key enterprises with large consumption of energy to carry out energy saving activities, energy audit and develop energy saving plan. It will make public the energy audit and utilization report of the 1000 enterprises and urge them to meet energy efficiency target. China will promulgate and carry out Technical Specifications for the Inspection and Acceptance of the Quality of Building Energy Saving Projects and intensify the supervision on the enforcement of compulsory energy saving standard by new buildings.

4）Greatly develop circular economy. According to the principle of “Reduce, reuse and recycle”, China will make more efforts in carrying out the trial work of circular economy and develop a number of advanced models in circular economy. It will strive for the development of circular economy systems at enterprise level, industrial park level, waste recycling and whole society level. Yesterday, China approved the second group of 92 organizations for the trial of circular economy, which indicates the official commencement of such trial.

5）Gradually improve policy mechanism conducive to energy saving and emission reduction. For industrial policies, China has revised the Guiding Catalogue on the Adjustment of Industrial Structure and adjusted the Guiding Catalogue for the Industries with Foreign Investment. It will strictly control the projects with high energy consumption and emissions. China will implement more stringent standards in energy and water consumption, environment, safety, comprehensive use of resources and quality as well as technology for the construction of projects, focusing on energy consumption assessment and EIA approval. In pricing policy, China will gradually adjust fuel price, cut down the on-grid price of the electricity from small thermal power plants, carry out the power pricing policy that encourages the construction of desulphurization facilities and development of renewable energy sources and make more efforts in the implementation of differentiated power price. In financial and taxation policy, China will adjust the base of resource tax of some mineral resources and raise the consumption taxes of such products as gasoline and diesel, big emission vehicles, throw-away wooden chopsticks and solid wood floorboard. China will remove or reduce the export tax refund for the products with high energy consumption and high emissions and impose export tariff on some goods. China will adjust and issue government procurement list for energy saving and environment-labelling products and carry out compulsory procurement of some energy saving products. China will promulgate and carry out the newly revised *Regulations on the Identification of Comprehensive Use of Resources Encouraged by the State*. The Chinese government will continue the improvement and vigorously promote new mechanisms such as power saving dispatch, contract energy management, energy efficiency label and authentication of energy saving products.

6）Strengthen legal development. China will accelerate the development of relevant laws, regulations and standards. Energy Conservation Law（Revised Draft）has been reviewed and passed. It is expected that Circular Economy Law will be promulgated in the near future after review and approval. Next year, it is expected that a number of supporting regulations and standards will be promulgated.

7）Continue publicity. The authority will organize and carry out large scale topic publicity activities including National Energy Saving Publicity Week, “June 5 World Environment Day” and “Nationwide Campaign on Energy Saving and Emission Reduction” as well as science popularization activities with the topic of energy saving and emission reduction. With these activities, it is expected that the social environment for energy saving and emission reduction with actions from now on and beginning from doing minor things will be formed and lasted for ever, mobilizing the initiatives of the whole society.

We are willing to listen to policy recommendations of each Member and expert on energy saving and emission reduction, higher efficiency and climate change in China during this AGM.

As an international high-profile policy consultation institution, the Council has unique expert resources and advantages. The experience over the past years shows that many important policy recommendations of the Council have played an active role in helping the Chinese government to develop and adjust relevant national policies. As a Chinese Vice Chairman of the Council, I am willing to work with you to promote new progress of the Council so that it will make more contributions.

Thank you.

Speech at the Opening Ceremony

Klaus Töpfer, Vice Chairperson

Vice Premier Zeng, Minister Zhou, dear friend Minister Xie, colleagues, friends, ladies & gentlemen, Members of the Council,

First and foremost, I would like to preface my remarks by expressing my admiration, my admiration for the leadership and vision of Vice Premier and Minister Zhou. Thank you very much! I want to express specifically also in the name of our good friend, Vice Chairman Greenhill, who apologized not to be here today, so at this moment, you are sitting as a deputy here and delivering a speech, thank you very much for this as well.

Ladies and gentlemen, we are starting a new five-year. The first meeting is always the meeting for agenda setting. It's a meeting to touch face of new Members. It is chance to express our expectations for this new five-year term. But what time is that, it's a time only several weeks after the 17th Congress of Communist Party of China. Mr. Vice Premier, I have a chance exactly only some days after this speech（by Hu Jintao）to be in Shanghai, at Tongji University. You know, I am a professor there. After retiring, it's good to be a professor again! And I can inform you that I go on in what UNEP is partnering with Tongji University. You can't imagine, what the interests all the young people and students expressed in this speech of the President Hu Jintao. You see those sentences. They ask what they expound. What to do to realize this for a good future in China? You know a good future is important for the people living in this country and this great nation. We know that your work has important impacts to environmental protection and emission reductions in China and is important for the world of economic repercussions and also for the ecological repercussion as well. They ask the question as the President singles out the new requirements for attaining the goal of building a moderately prosperous society in all respects, the harmonious society. They ask the question how to promote the conservation culture by basically forming an energy and resource efficient and environment-friendly structure of industries, and the mode of consumption. It is at the center of all our interests to propel these three transitions, which the Vice Premier refers to as well. The transition also go beyond the heavy industry and chemicals, knowing that they ask us to contribute also to the solution of those industries in the situation we are live in, and Mr. Chairman and Vice Premier, I am very happy to be at the table of very outstanding reporter of chemicals. That is important. It gives me a chance to express our thanks to the Secretariat. The Secretariat prepared this meeting very very seriously. I am an old hands. Vice Premier was told that I am a veteran here. So others are ladies who saw they are never veterans, they are always young. But as a man, I am a veteran. And therefore I can give some judgments on the papers. And that is not to criticize the past, but to underline this is extremely good, it's world class. It was added by two speeches we learned, your speech, Vice Premier, giving us the signal of where to go and what is the status. What is the status in the transition from heavily relying on increased consumption of materials and resources to rely mainly on advances in science and technology? Science and technology, we know, not only in this country, nearly all the world that, nature capital is more and more important for the future, for overcoming poverty and give all the people a good prospective in the globalized world.

It is linked with transformation and innovation. Yes we all know from our table those paper "Innovation and Environment-friendly Society". What kind of innovation in institutions? We underline in the last meeting of CCICED in the last phase the need for the development of the institutional setting, having in mind that environment and sustainable development has a new dimension for the future. We really believe that it is necessary to stick on those for the future innovation with regard to policies, innovation with regard to technologies. We are meeting in a time when the Premier himself was responsible for the Working Group on Climate Change Action Plan. I believe this gives us a very clear signal how important this topic is. Yes we are extremely happy and honored that our good friend Pachauri is with us. Congratulations, Mr. Pachauri for the Nobel Peace Prize, for IPCC!

I think it also gives us a signal that if you cannot overcome the burden of environment in this case of the climate change, we cannot have a peaceful world in the future. It is a very clear signal. And the Premier accounts himself take the responsibility for this topic give us hope that there must be a transition to a much more energy efficient as developed country as we learned in this speech before. It is also the time for the 11th Five-Year Plan. Congratulations to the Vice Premier for the information that the GDP in China this year will increase at 11.5%! What a figure! What a perspective! What a signal for the realization of the Millennium Development Goals to overcome poverty.

Without the success in this country, we would not be able to reach the 50% reduction target in 2015 without any doubt. And then to link this with environment targets: with 20% increase of energy efficiency and 10% less pollutants. That is the signal we need to award, and I am very sure that you will do your utmost to give advice and to give backing for the inter-linkages of environment and development, knowing that only balanced approach is a stable approach. Mr. Vice Premier, I will never forget your wonderful speech delivered on the 23 Session of Governing Council of UNEP in Nairobi in February of 2005. It was really the start of this new dimension and the headline of this speech was “Strengthen Environmental Protection and Achieve Sustainable Development”. All these are integrated: life-cycle economy, producer responsibility, changing consumption and production pattern. Exactly, this is the chance. Mr. Chairman, Mr. Vice Premier, I can inform you that there are 22 International Members in this Council, quite a number of new, quite number of old faces, but all joined in one common target. Let’s join our hands, let’s cooperate with our friends in China those experts from scientific community, with politicians and with those directly linked with civil society. I mention to my students in Tongji University. I want to do my uppermost also to give this explanation today. Therefore, thank you very much for giving me this chance as a Vice Chairman to link this expectations of society and to underline and to prove that 22 International Members are really dedicated to do their uppermost in the new phase of China Council.

Thank you very much!

Speech at the Opening Ceremony

Børge Brende, Vice Chairperson

Mr. Vice Premier, ladies and gentlemen,

China Council is really a unique advisory mechanism. I feel and I think all the International Members feel very privileged to be invited to work together with our very qualified Chinese friends. I think this body is unique. I can think a lot of governments who wouldn't have invited international guests to, in an open way, come with advices based on scientific data in the environmental field. So I think this shows the dedication of the Chinese Government. That also verified by the 17th Congress of CCCPC that I think makes important decisions in enhancing and mainstreaming of the environment in the whole Chinese society. New statistics now shows that China is meeting the overall targets in the Millennium Development Goals. China is on the track when it comes to eradicating poverty. And this has been not possible without sustainable growth in economy. But the big question in the years to come like the Vice Premier also said is that economic growth is the prerequisite, but we ought to decouple growth in economy and growth in emissions and environmental problems.

So if we together here can find good pathways into the future to make a more sustainable growth that is truly essential. And I have to say that I am impressed by the papers that are presented last year by the Chinese Government, the first China's National Assessment Report on Climate Change released a year ago. And in June it came a report from NDRC on China's National Climate Change Program. It's also a staggering report showing willingness to decouple.

The Council now is entering into a new phase. I think many of the Members are new and highly motivated to work in the Council. For this new phase, the Council is also eager to address emerging issues. The first and foremost emerging issue is energy, environment and climate change. We have a kind of startup of this spring a seminar organized by the Secretariat on the Pathway to a Low Carbon Economy. The seminar was very successful. The Council will for the coming years establish new Task Forces. The Task Forces are also the basis for the discussions in the Council. I have to say that I am pleased when on our table there are proposals for the setting up of Task Forces like Low Carbon Economy, Use of Market-based Instruments for Energy Efficiency, Sustainable Use of Coal, Energy Efficiency in Transportation and Buildings.

Let's have a clear vision. China has been very successful in alleviating poverty and building a much stronger economy. Let us see and let us hopefully be successful globally in decoupling economic growth and the growth of emissions.

Thank you!

Meeting Documents

POLICY RECOMMENDATIONS TO THE GOVERNMENT OF CHINA

OVERVIEW

The First Session of the China Council for International Cooperation on Environment and Development （CCICED）Phase IV was held in Beijing from Nov. 28 to 30, 2007. The theme of the meeting is “Innovation for an Environment-Friendly Society.”

CCICED members highly appreciate the full set of innovative strategic ideas and policies on environment and development put forward in the recent 17th National Congress of the Communist Party of China（CPC）. Encouraged by this, by the “Three Transformations” set out in 2006, and by efforts during the first two years of the 11th Five Year Plan, CCICED views that China is now entering a period of strategic transformation for environment and development.

This transformation towards a “resource conserving and environmentally friendly society” will be a long-term undertaking, but with a clear need to meet important milestones such as the environmental targets in the 11th Five Year Plan. The Council believes that it will be extremely difficult to achieve these targets with the current framework for environmental management, levels of investment, and pollution-intensive mode of economic growth. The higher than expected rate of economic growth, fuelled by a range of incentives at the local level, intensifies these pressures. Reconciling China’s environment and development policies is likely to be even more difficult during the 12th and 13th Five Year Plans since the problems will become even more complex, including a growing “ecological deficit.”

Also, while China is focusing its main efforts on primary environmental problems caused by industrial and municipal pollution, a range of secondary, often non-point source pollution problems, mostly from the use of various chemicals, are threatening its environmental security and public health. The Chinese government has begun to pay great attention to the problem. The members of CCICED also have expressed deep concerns about how to address these problems. They involve a wide range of pollutants, including those produced by the burgeoning chemical industry sector.

It is against the backdrop of globalization that China's industrialization and urbanization revolution is taking place, including the building of a knowledge-based society, and a socialist market economy. China's environment and development process has become integrated with that of the world. While China is faced with new environmental challenges brought about by globalization, it is also creating impacts on global and regional environments. China's ecological footprint, a measure of human demand on the planet's biologically productive land and water, is still low by comparison to many other nations, if measured on a *per capita* basis. Yet it already exceeds China's own biocapacity and it is growing. It should become a matter of concern in policy decisions such as those affecting international trade, climate change and other international cooperation.

The future of China's environmental quality hinges on tackling the issues mentioned above, and others, through changes that involve fundamental reforms and mechanisms for involvement of the whole society in their outcome. This is the key message arising from successful transformative approaches to environment and development in other countries such as Germany and South Korea. Incremental change is not enough.

China's commitment to becoming "an innovative society" is an essential step in the right direction. Innovation is the opportunity side for environment and sustainable development. The key to its success lies in taking a comprehensive innovation approach to institutional change, policies and technologies.

Supported by various Task Forces and other research efforts,[①] the 2007 CCICED AGM has focused on policy innovations, particularly on the following two aspects:（1） innovation of strategic thinking, including the transformation of environment and development strategies, as well as the challenges brought by globalization; and（2） innovation of specific policies and mechanisms, particularly on emissions reduction for the 11th Five Year Plan and beyond, and for chemicals management.

This examination of "Innovation for an Environment-Friendly Society" is intended to set the stage for future work of CCICED, including Task Forces on Innovation for Sustainable Development, Environment and Health, and on Energy and Environment. It marks a shift in CCICED's attention towards collaborative work to identify early warning of key problems, and towards creative solutions that will rely much more on technology and

① The studies reported at the 2007 AGM included: CCICED Task Force on Policy Mechanisms towards Successful Achievement of the 11th Five Year Plan Environmental Targets, CCICED Special Policy Study on Strategic Transformation of Environment and Development in China, CCICED Special Policy Study on Environmentally Sound and Strategic Management of Chemicals in China, and interim reports from the CCICED Task Force on Innovation for China's Environmentally-Friendly Society, and from a CCICED-WWF preliminary analysis of China's Ecological Footprint.

policy innovation worked out in China. The business sector, long recognized as both the origin and centre of innovation, will play a key role in developing and implementing solutions for an environmentally friendly society. Business engagement is key since business makes the operational decisions that most affect environmental outcomes. However, enterprises cannot do so if unclear about their obligations, which need to be clearly defined and legally enforceable.

Recommendations

The following major recommendations to the Government of China are based on the deliberations and agreement at the CCICED AGM. In addition, more detailed recommendations from the individual CCICED task forces and special study reports will be forwarded for consideration.

1. Strengthen and add new policies and mechanisms to achieve emission reduction targets.

Achieving the 11^{th} Five-Year Plan emissions reduction targets is a major challenge for the Chinese government. Despite the significant efforts to date, the challenge is made more difficult by the pace and composition of economic growth. The emission reduction objective was calculated on the basis of the emission volume at the end of the 10^{th} Five-Year Plan period. But the Chinese economy is growing much faster than the original estimate of 7.5%. This fast growth rate, and the even faster growth of high energy-consuming, high pollution-emitting industries, will result in a need for a much higher level of emissions reduction than predicted. Structural changes in the economy are essential, as well as policies that provide incentives for process change rather than end of pipe solutions, but this may not occur quickly enough for 2010 targets to be reached. Very demanding targets for pollution reduction will be needed for the foreseeable future, at least to 2020.

The program for achieving the target of reducing SO_2 emissions by 10% compared to the 2005 baseline is heavily dependent on installing FDG（Flue Gas Desulphurisation） equipment at coal-burning electricity stations. This strategy is impeded by the poor performance of FDG equipment and operation, and higher than expected levels of sulphur in coal. Cost effective approaches such as coal washing have not been given sufficient attention. These concerns need to be addressed urgently. Achieving the target of reducing energy intensity（energy consumption per unit of GDP）is a necessary but not sufficient condition for achieving the SO_2 target. Further efforts will be needed to reduce SO_2 emissions from the non-power sector.

COD （chemical oxygen demand in water）is an even more difficult problem. It is doubtful that the very ambitious program for constructing urban sewage treatment pipes can be completed as planned. More attention should be paid to sludge treatment and to discharges from the industrial sector and non-point sources. The pricing and financing policies applied in this sector need to be re-examined.

There are serious problems in terms of quality control and performance. Monitoring is inadequate, and is impeded by three sets of data that EPBs （Environmental Protection Bureaus）work with that are not compatible. Local EPB often lack the authority and means to fulfill their responsibilities, and some local governments undermine their efforts. In short, management and institutional weaknesses are holding back progress. Inadequate financial investment is also a major constraint in reducing pollutant emissions. Using international definitions such as those of OECD and Eurostat, environmental expenditures amount to about 0.6% of GDP, about half of the official estimates, and low for countries at this stage of development.

End-of-pipe pollution control approach is necessary but not sufficient to deal with the growing volume of pollution in China. What is needed is an effective total emissions control （TEC）approach that controls both the volume and concentration of pollution. More emphasis should be put on cost-effective approaches such as washing coal, structural adjustment in the energy and industrial sectors, and on removing incentives such as favourable financial conditions that foster excessive investment in polluting industries such as coke and steel. Greater use of market instruments is needed to provide continuous incentives to find cost-effective approaches to pollution prevention and control, including through innovation. This can include CAP & trade market-based systems. Energy conservation and new processes that eliminate pollution production can help. Other economic instruments and strict enforcement of regulations are needed so that it is no longer cheaper to pollute than to clean-up.

It is vital that environmental management systems within government be made much more functional, with clearly understood responsibilities and accountability at each level. The performance assessment of local political leaders should place greater emphasis on their environmental performance. Failure to do so results in economic considerations over-riding environmental policy objectives.

Therefore, we recommend:

1）Strengthening environmental management capacity at the national level through a larger, full cabinet-level Ministry of Environment.

2）Adopting a new “Five Shifts” approach and examining how it could be implemented not only in the 11th, but also the 12th and 13th 5 Year Plans: （1）Move to a focus on reducing total emissions and specific improvements in environmental quality; （2）Move from an over-reliance on reducing pollution from selected industries to reducing pollution from all industries; （3）Move from total control of single pollutants to the coordinated control of many pollutants; （4）Move from increasing the number of pollution reduction projects to increasing their quality; and （5）Move from reliance on administrative mechanisms to greater use of market-based instruments.

3）Under the leadership of the State Council, establishing a technological analysis platform for economy-energy-pollutant emission reduction and a joint policy making system between the relevant government departments to carry out dynamic tracking, early warning and response in regard to pollutant emission reduction; and with a strategic focus on understanding the benefits and costs of changing the economic development mode.

4）Constructing a total emission reduction system composed of reduction of resource-energy inputs, much greater efficiency improvement in production processes, and end-treatment of pollutant emissions.

5）Reforming the performance assessment system for local government officials to take account of their responsibility for achieving environmental targets and related policy objectives; creating a simple evaluation system for government officials based on a locally-appropriate energy and emission reduction index as well as the degree of compliance by enterprises with current environmental laws and regulations in their jurisdiction.

6）Improving the technical support capacity of both the central and local governments, including the development of a more integrated environmental information system, a scientific indicator system of pollutant emission reduction, an accurate emission reduction surveillance system, and a rigid emission reduction examination and evaluation system;

7）Improving the operability of COD reduction programs focusing on the key polluting industries and non-point source pollution especially from agricultural sources; on funding and faster construction of urban sewage pipes networks and sewage treatment infrastructure. Optimize SO_2 reduction programs through integrated programs that broaden the focus from scrubbers and other stack controls including quality of coal, and the proportion being washed, more effective supervision of the quality of FDG equipment, and developing a program to reduce pollution from coal-fired boilers in the non-power sector.

8）Beginning now to study trends in pollutant emissions, and how they could be reduced most cost-effectively in the 12th Five-Year Plan period, paying attention to all the points mentioned above, but emphasizing greater use of public-private sector approaches to necessary investments; establishing long-term emission reduction mechanisms using market-based instruments including environmental taxes; resource pricing; emissions trading; the establishment of appropriate environmental finance mechanisms; and continuing efforts to build a high-performing administration and management system, particularly at the local level, with necessary upgrading of laws and regulations.

2. Integrate chemical management strategy into China's overall national environmental and health management systems.

Currently, China is producing and marketing 47,000 or so kinds of chemical products, with about 100 new chemicals in line for registration annually. In the course of production, storage, selling, transportation, utilization and waste disposal, chemicals can create vital impacts on human health and environmental security owing to misuses, abuses, emergencies, and maltreatment of wastes. Many hazardous chemicals that are widely controlled internationally, are still produced and used without restriction in China. In addition, accidents involving hazardous chemicals happen frequently. The international community is vigorously promoting SAICM – Strategic Approach to International Chemicals Management, with a proposed target of 2020 for production and use of chemicals in ways that minimize environmental and human health harm.

The rapid development of China's chemical industry sector makes formulation of a robust chemical management system an urgent matter. China's existing chemical administration is mainly limited to the professional safety administration of the flammable, explosive, and acute toxicity chemicals. The methods of chemical environmental administration are limited to end-treatment of toxic chemical pollutants and the registration of toxic chemicals upon importation and exportation. The currently used classification system for hazardous chemicals in China does not fully reflect various potential environmental and health hazards and risks of chemicals. China is yet to exert systematic and institutional environmental administration on the chemicals that have potential and long-term harms on human health and environment.

Therefore, we recommend:

1）Establishing China's Environmentally Sound and Strategic Management of Chemicals System, with environment protection departments as the major responsible institution but coordinated with other relevant departments; and strengthening capacity building to carry out effective testing, evaluation, monitoring and management of chemicals from an environmental perspective.

2）Formulating China's chemical environmental administration strategy, with "prevention as the key measure, combining prevention and rectification of problems, strengthening surveillance and regulation" as the guidelines. A long term action plan for risk assessment should be developed. Chemicals with high risks to health and environment should be given earliest attention for possible replacement, and their manufacture and management should follow clean production and green chemistry concepts. The strategy should be WTO compliant.

3）Formulating a special law or administrative regulations on chemical environment administration. This should establish a basic institutional system on chemical environmental administration, including classification and labeling, notification of new chemical substances（currently established only by a ministerial rule）, risk assessment and management of new and existing substances, national criteria for prioritization of chemicals of very high concern, appropriate environmental monitoring systems, a right-to-know system for release of toxic chemicals, and environmental accident prevention and emergency response systems coordinated with existing mechanisms.

4）Establishing a system of release recording on toxic pollutants and a publication system for toxic chemical pollutants so that the Chinese public is informed and can participate in the government decision-making on chemicals management.

5）Promoting and supporting voluntary measures on the part of chemical enterprises, including Responsible Care and product stewardship initiatives that have been successful in other countries or internationally, and clarify the legal status of voluntary agreements between government and industry and actions taken under China's "Cleaner Production Promotion Law".

3. Seize the opportunity provided by China's strategic transformation of its environment and development mode.

CCICED notes the substantial progress since 2003 towards creating a coherent approach to environment and development policies. It is encouraging for the future, despite the magnitude of challenges today. China is setting in place necessary conditions to optimize the potential of future innovations for sustainable development. The current transformation of environment and development strategy in China is a necessary step for China's social advancement. According to international experience, China should strive for strategic transformation of its environment and development path for the coming 15-20 years, leading to significant improvement of its ecological environment as well as its economic development.

The 17th National Congress of the CPC, especially, marked a turning point for China's new strategic system to guide sustainable social-economic development—using Scientific Development Theory as an overarching framework for building a harmonious socialist society.

Signals for a strategic transformation of Chinese government policy relevant to environment include: a new industrialization pathway with five criteria, as well as a peaceful development path internationally; and elevating environment protection to the level of an "ecological civilization", where the objective is building a resource-conserving and environment-friendly society. The guiding idea has shifted from "rapid and sound development" to "sound and rapid development." China is demonstrating its immediate commitment through the difficult pollutant emission reduction objectives in the 11th Five-Year Plan.

Other countries such as Germany and Japan in their period of transformative change for environmental improvement, have found four key factors. One is public participation and involvement of the whole society in decisions on environment and development. Second is that in most cases it is problems of environment and health that have galvanized action, whether Minamata Disease caused by mercury pollution in Japan, or by the effects of smog in Los Angeles. Third is the need for a progression of changes, some immediate and others longer-term, towards fundamental technological and institutional changes over periods generally of 5 to 10 years. Fourth is the need to take into account international aspects of the transformation as well, including impacts of the transformation on other nations. The results include substantial new economic opportunities and positive influences on environmental standard-setting and practices influencing all sectors in society.

CCICED believes that China is now in the most significant period for strategic transformation when it will be possible to accelerate the turn-around in the relationship between environment and development. To take full advantage of this key period, the Chinese Government must solve three outstanding problems. First, the strategic transformation is taking a top-down approach and lacks the full involvement and support from all stakeholders and levels of government. Second, detailed and effective policies, capacities and action plans are still missing to carry out the strategies and principles set up by the central government. And third, it is essential to continue searching for better value from existing levels of investment, and at the same time, increasing the flow and level of funds in support of environmental protection.

Therefore, we recommend:

1）Building public awareness and participation so that the whole society plays a role in the strategic transformation, including household and workplace consumption and environmental health, monitoring of local development, and direct participation in environmental improvements. Encouraging the participation of environmental NGOs as a way to draw upon perspectives from across the range of societal views. Also, providing special training and education to the policy makers, administrators and managers, especially of local governments at various levels, and enterprises. This capacity building is necessary to sharpen their consciousness of the importance and urgency of the coordinated environmental-social-economic development, and to enhance abilities to deal with practical implementation.

2）Accelerating improvement of China’s existing environmental protection institutional system to take maximum advantage of environmental legal frameworks, management techniques and technology. This should include upgrading the institutional status of SEPA and local environmental protection departments; rewriting of key laws such as the 1989 Environmental Protection Law; appropriately stringent standards and the means to enforce their observance; allocating more human, capital, and technical and equipment resources to the environmental protection departments so they are well-equipped to be the mainstay for promoting the strategic environment-development transformation. Clearly the greatest need is to build a high-performing system that will drastically reduce the extent of illegal environmental behaviors, reform the penalty system to ensure that financially effective penalties are in place, create enabling situations where enterprises, cities and towns, and projects of all types have the means to address environmentally sustainable development; and improve the environmental judicial system to secure both public and private environmental welfare and exercise environmental justice

3）Making full use of market-based policies to promote the environment-development strategic transformation, including environment taxation, resource-energy taxation, green credits, environment insurance, ecological compensation, and emission trading, etc. This market-based approach, with carefully constructed incentives, is essential to fully realize the benefits of innovation, including development and commercialization of environmental and sustainable development technologies.

4）Reviewing current levels of environmental investment in the environmental sector to determine the amounts actually being spent in support of high priority activities, and where necessary re-direct or increase the funds required for these priorities. In addition, place greater attention on how to encourage private investment for the substantial expenditures required to carry out ecological/conservation innovations in the industrial sector and to establish innovative resource-conserving and environment-friendly production and consumption models, including those that support a Circular Economy.

4. Address in a more timely and effective way the challenges brought by economic and environmental globalization.

China is facing new environmental pressures through its participation in economic globalization. As the “world’s factory”, China is host for the relocation of many high energy-consuming and high pollution-emitting industries. The introduction of carbon constraints in developed countries will spread the displacement of these industries to China and increase the risk of technology lock-in for high energy, high-polluting sectors. While China enjoys a “trade surplus” in economic terms, it is also building a domestic “ecological deficit”, generated by the export-oriented economy that consumes a large quantity of energy and resources and produces a large volume of pollutants and greenhouse gases. In addition, China is also facing severe local impacts from illegal trade of hazardous waste.

China also needs to pay greater attention to addressing environmental effects its market supply chains may have on other nations. But at the same time, China should give full recognition to the positive contribution that a global competitive marketplace could have on China domestic environmental advancement. These are rather new effects that will grow in significance over coming years as Chinese multinational businesses become more active, and as China’s resource needs and economic activities continue to increase. China may find itself increasingly vulnerable to various forms of environmental protectionism and other retaliatory action, perhaps involving third parties.

CCICED is encouraged by the new “coordinate and cooperate to protect our only earth” international environmental cooperation principle that was put forward by the Party’s 17th Congress. China’s effort in protecting global environmental conditions, such as ODS（Ozone Depleting Substances）reduction, carbon sequestration through afforestation, and its 2007 Climate Change Program are notable. China’s own strategic environment and development transformation is linked to success of the international community’s in realizing progress on ambitious agreements to control global and regional environmental concerns, such as climate change.

China must be able to address global environmental concerns from its own perspectives and self-interests. But increasingly its influence on the world’s economy and ecology places China in a position of great responsibility to the community of nations. Indeed the world’s economic and environmental security is increasingly being perceived to be in China’s hands. Over the coming five years this perception is likely to be reinforced as China’s rapid economic growth continues. China needs to determine where it should place its major efforts to address global environment and development issues.

Therefore, we recommend:

1）Gradually changing the current growth mode of trade in order to adjust the relationship between trade, resources and environment. Make full use of China’s trade surplus to import products and technology with high embodied energy and resource content, and reduce export of some goods（especially commodities）with high embodied energy and resources. Find and expand substitutes for goods that require high energy consumption in their production, or sometimes, import them. Speed up transformation of the current foreign trade growth mode, moving from the traditional growth mode relying mainly on price competition, quantity expansion and seeking very high growth rates, to a mode relying on improvement of quality, increase of value-added, and optimization of structure. Expand the export of services, and strengthen their international competitiveness.

2）Optimizing regional structure for manufacturing goods for export, including strict environmental upgrading of all industrial processing in eastern areas, while making full use of the local abundant human resources in the middle and west of China, and introducing environment-friendly processing for trade to these areas. Levy an environmental pollution tax on products and industrial sectors with high energy consumption and high pollution, and assign costs for environmental damage to the responsible enterprises. Introduce appropriate advanced foreign technology and equipment, and promote energy saving and emission reduction activities to improve domestic environmental quality.

3）Strengthening environmental aspects of trade for recyclable and waste goods; and conduct regional planning within China for environmental management of trade for recyclable and waste materials. Carry out life cycle analysis for imported recyclables and wastes being re-processed as raw materials, and enforce strict environmental entry standards into China of such materials. Restrict those processing enterprises in China that import recyclables and wastes from exporting the resulting raw materials in order to ensure that such raw materials are used for meeting domestic needs, or for producing higher value export products—and not merely for getting foreign exchange, while leaving behind pollution byproducts. Work with other nations to ensure the honoring of international agreements and international monitoring in order to curb illegal trade in toxic wastes.

4）Developing appropriate regulations for and carrying out comprehensive environmental impact assessments on key market supply chains for raw products entering China, including agricultural products such as soybeans, edible oils, fish and cotton, wood products, biofuels, and minerals, and take steps to prevent negative influences on the environment in the countries of origin. Take additional steps to eliminate illegal timber trading and other such problems, including activities banned under the Convention on International Trade in Endangered Species of Flora and Fauna （CITES）.

5）Strengthening environmental management of Chinese companies that invest or operate overseas, and improve the Corporate Social Responsibility awareness of these enterprises. Encourage Chinese enterprises to obtain international advanced environmental managerial experiences and environment-friendly technologies through their investment overseas or establishment of joint ventures in other countries. Such investment in environmentally-friendly efforts will strengthen the long term competitiveness of Chinese companies.

6）Constructive participation of China in bilateral or multilateral environmental cooperation. Promote the implementation of international environmental conventions within China by setting up complete domestic implementation mechanisms, management systems and framework of policies and regulations. And, participate more actively in the construction of the global environmental regime, while adhering to the principle of common but differentiated responsibilities; maintaining the right for development of all developing countries including China; building an international image of China as an environmentally-responsible nation through its actions. Shoulder international obligations within China's capabilities, explore technological cooperation opportunities through South-North cooperation, and strengthen environmental cooperation activities between China and other developing countries in Asia, Latin America and Africa.

7）Combining the endeavors of energy conservation and pollutant emission reduction in China with that of CO_2 emission reduction so as to develop an energy and industrial system with a relatively low CO_2 emission. In other words, begin moving towards a pathway in China consistent with global efforts to achieve a low-carbon economy in the future.

5. Construct an "conservation culture" through innovation.

It is time for China to build greater domestic capabilities for "Made in China" advanced solutions to environmental and sustainable development technologies, along with the associated institutional strengthening and systems to ensure that good ideas turn into commercially viable, widely used products. China's Medium- term S&T Plan calls for a major emphasis on environment in future R&D. Yet there are many challenges and barriers that have to be addressed in the National Innovation System（NIS）before it can achieve full potential. Furthermore, sustainable development in China and many other countries has tended to be implemented without much connection to the NIS.

There are significant problems with reliance on importing the new environmental technologies that would allow China to leapfrog in reduction on emissions in the same way as it has in other sectors such as telecommunications. The problems include limited willingness to share advanced technologies（auto emissions）, technologies not suited to Chinese conditions, and the high costs of accessing some advanced technologies and intellectual property rights（IPR）such as for advanced electrical power generation systems. As well, some transformative technologies such as hydrogen-powered fuel cells require much additional development effort and time.

On the other hand, China has clear advantages that are not being sufficiently tapped for environmental innovation. Lower labour costs coupled with a potentially large domestic market could make Chinese environment and sustainable development products and services very attractive to the global marketplace. An example is solar photovoltaic panels.

The right enabling conditions for eco-innovation are not yet fully in place within China. These conditions include unleashing creativity within China's vast research system, including academies, universities and the private sector, but with the recognition that short-term failure of some efforts should be tolerated. The financial investment systems for environmental innovation are still weakly developed and it is important that more venture capital be attracted at various developmental points so that environmental technology markets are strengthened. Regulatory frameworks favoring innovation are needed, especially market-based approaches that provide the necessary incentives for industry to move towards environmentally-friendly processing without pollutants and "green chemistry."

Instruments such as green public procurement and green investments have the potential to stimulate market penetration of existing environment-friendly products and services, and to increase their competitiveness. In this way government gives a very positive signal by its own actions. The concept of green investments offers great potential for public-private partnership and a mechanism to accelerate the pace of new environmental technology adoption.

The decision to "make or buy" advanced environmental technologies is never simple, and must be decided on the basis of specific situations. International joint scientific and development initiatives are already in place, especially for energy efficiency and some pollution reduction efforts. These will need to be expanded, and more will be needed, especially in light of the urgency for solutions to sustainable use of coal, greenhouse gas reduction and other important environmental problems.

Therefore we recommend:

1）Mobilizing both national and local-level interest and willingness to implement environmental and sustainable development innovation strategies. The approach needed goes beyond environmental compliance, which is perceived to be cost-driven and inconsistent with economic growth. This need is even more urgent than investment in R&D for new technologies, since many technologies are already available but not effectively used by enterprises, or promoted as solutions by local government. A combination of enforcement, incentives, improved planning, awareness-raising, and capacity development is required to address this type of system failure. Development of regional “innovation clusters” appropriate for the environmental and economic conditions is needed to build local-level understanding and access to suitable innovation products and approaches, for example to address development in fragile ecosystems such as the Qinghai-Tibet Plateau, and the upper watersheds of major river basins, and in major coal-producing regions.

2）Strengthening and popularizing the field of environmental technology R&D and removing obstacles to commercialization. Numerous technological breakthroughs already exist in China and others are likely in the future. However they must move more quickly from trial stages to commercialization, and be seen as attractive opportunities for investment at all stages. Present incentives do not promote long-term innovation for environmental technologies. This problem can be addressed through a combination of government commitment and involvement in the earlier stages of scientific research and development, and the private sector and investors in the later stages. The problem should be tackled as a central issue via the NIS.

3）Taking action to overcome market failure that hinders environmental technology introduction. Private enterprises should become the main players for the development and implementation of technologies for an environment-friendly society. However this is not happening to the extent that it should. The limited markets for such technologies, reliance on command and control regulation, inadequate resource and other pricing policies, and the limited sanctions for non-compliance all need to be addressed as components of market failure. Better green procurement policies operating at both national and local levels of government are needed. Preferential loans for initiatives making use of environmental technologies and/or denial of loans for initiatives that shun their use needs to be implemented on a much broader basis than existing trial efforts.

4）With the growing focus on new products from biotechnology, nanotechnology and energy technologies, their potential for environmental improvement and sustainable development should be assessed, including their potential negative impacts. These types of assessment are different from project-oriented evaluations, and proper regulations and guidelines are needed. For some advanced technologies, the best method would be to make full use of international experience of foreign investment and international enterprises, but with strict regulations and guidelines.

5）Raising the public quality of environmental science and technology. China's economic and environmental future depends on making the world's most populous nation scientifically-literate and able to create the social environment for technology innovation of many types. The commitment to a "conservation culture" depends on improvements to the educational system, dissemination of basic technology knowledge to China's people, and on demonstration of real environmental value arising from eco-innovation.

6. Develop a road-map of pathways towards a Low-Carbon Economy for China.

China and all countries will need to understand the impacts, mitigation and adaptation steps related to climate change. These are pressing concerns that will have major effects on structure of the future economy, and on both local and national opportunities for future development. In turn, this will lead to new pressures, but also opportunities concerning international trade, investment and global environmental improvement.

Addressing China's future economy in terms different than the past requires an understanding of how changing prices and taxes on energy, dynamics of carbon sources and sinks, international and domestic carbon trading, and a host of other factors will influence the relationship of energy, environment and climate change. Broadly, these can be addressed in the context of a low carbon economy. China needs to start now to build a comprehensive understanding of these new relationships, so that the implications of key policy choices are understood. As a start, there is a need for careful development of a road-map identifying major topics, approaches and potential impacts over the coming years and decades, if China reduces its reliance on growth in fossil fuel use as its economic development continues to rise.

Work Report of CCICED 2007

Zhu Guangyao, Secretary General of CCICED

The year 2007 is an important transitional year for the CCICED. With strong support from the Chinese Government, and joint efforts and cooperation of many partners and donors at home and abroad, the establishment of CCICED Phase IV has been successful with work on new policy studies continuing during the period. CCICED operational funds for the next five years are basically in place, reflecting considerable progress in the development of new partnerships between Chinese and international organizations, which reflects in turn the continuous expansion of CCICED's influence. The new Phase of the Council has started its work on time, and the work performed in 2007 has provided a good start to the future work of the Council.

The major activities and outputs of the Council in 2007 are summarized below.

I. Further Enhancement of Chinese and International Support to CCICED

When meeting with International Members during the 2006 CCICED AGM , Premier Wen Jiabao said that he would like to see the CCICED continue in existence for a long time until the international community was satisfied with the steps China was taking on environmental protection. He asked that CCICED pay closer attention to the impact of China's economic structure and growth mode on sustainable development, and carry out assessments to examine results.

CCICED's Chairman, Vice Premier Zeng Peiyan, asked CCICED to carry out in-depth studies on environment and development policies; to further enhance its role as a multilateral advisory mechanism; and to organize Chinese and international experts for further study of key issues concerning sustainable development, while taking into consideration a wide range of international experience and incorporating a scientific perspective of development to build a harmonious society. He also asked the CCICED to submit forward-looking, strategic, and workable policy recommendations to the Chinese Government.

As the host agency of CCICED, SEPA has further strengthened its leadership of and support to the CCICED's Secretariat. Other ministries and government departments such as the Ministry of Foreign Affairs, NDRC, Ministry of Finance, and Ministry of Commerce have attached great importance to the work of CCICED and provided stronger support. The Chinese government has increased its financial support to the new phase of the Council by a relatively large margin.

As the primary donor country, Canada has continued its support to CCICED Phase IV through a bilateral cooperation mechanism. Other donors, such as Norway, Sweden, Germany, Japan, Italy, the Netherlands, Environmental Defense, and the Shell Company have also strengthened their financial support to the Council. Furthermore, Australia, France, Denmark, UNDP and the Rockefeller Brothers Fund have become new donors to the Council, and Great Britain, EU, UNEP, WWF, and others have made commitments to continue their support of CCICED activities. Thus, CCICED is now supported by a wider network of partners, reflecting growing support from and influence with the international community.

II. Establishment of new Council

(I) Chinese and International Membership of CCICED

One important activity in establishing the new phase of CCICED was the nomination of Chinese and International Council Members. In the first half of 2007, the Chinese side invited relevant departments of the Chinese government to nominate Chinese Members, and the nomination of International Members was accomplished after consultation with major donor countries. According to CCICED procedures, Chinese and International Council Members were officially invited by the Chinese government. The Membership of CCICED Phase IV was approved by the State Council in June of 2007.

There are 47 Members in the new phase of CCICED. Many members are veterans who have been involved with the Council for many years. Others are new members. Members come from different government departments, international organizations, research institutions and universities, and from different countries, all with broad experience in environment and development.

(II) Amendment on CCICED Terms of Reference and Rules of Procedure

CCICED Terms of Reference is the basic guiding document that defines the objective and procedures of the work of the Council. Terms of Reference and Rules of Procedure of CCICED have been amended based on the proposals of Chinese and International Members and the experience of past years. After intensive consultations among stakeholders, they are submitted to the 2007 Annual General Meeting for consideration and approval.

The amended Terms of Reference and Rules of Procedure reflect important improvements, with a sharper focus on work objectives, decision making mechanisms for the Bureau, enhancement of the functions of the Secretary General, Secretariat and Chief Advisors, identification and implementation of policy studies, Annual General Meeting, other meeting mechanisms including Roundtables, as well as the dissemination of CCICED achievements. The improvements will make the operation of the Council more efficient and transparent in the future, and will be useful in promoting the Council work at home and abroad.

III. Policy Studies in 2007

The execution of CCICED Policy studies faced a number of challenges and difficulties in 2007, and placed pressure on the Secretariat and the Chief Advisors, as a result of the transition between Phases III and IV. The Secretariat and its International Support Office at Simon Fraser University in Vancouver, Canada, worked together closely with the Chief Advisors and task force experts, both Chinese and international, to ensure that new Task Forces and Special Policy Study teams were established in a timely fashion and that their work ran smoothly. The cooperation of donors ensured that all of these studies received sufficient funding.

The Task Forces/Special Policy Studies that were established in 2007 and that will report to the 2007 AGM include the followings:

- Task Force: Policy mechanism towards successful achievement of the 11th Five-Year Plan environment target
- Special Policy Study: Strategic transformation on environment and development: Global experience and China's Solution
- Special Policy Study: Environmentally sound and strategic management of chemicals in China

Task Forces established in 2007 that will report their findings to the 2008 AGM include the following: Task Force on Innovation and Environment-friendly Society, and Task Force on Environment and Health. The Task Force on Innovation and Environment-friendly Society will submit a Background Report to the 2007 AGM.

The Chinese and international experts on these Task Force/Special Policy Study worked well and in close cooperation. They held 22 Task Force meetings, 4 international workshops, and conducted numerous domestic investigations. Each Task Force/Special Policy Study team completed their tasks, working with under tight schedules.

In addition, an overall plan for CCICED policy studies on energy and the environment has been developed, based on a proposal submitted by the Chief Advisors. Recommendations to establish new Task Forces on energy and environment during 2008-2010 have been submitted for approval by the Council Bureau.

IV. Work of CCICED Chief Advisor

During the transitional period, improvements were made in procedures for securing scientific advice for the Council. Working mechanisms were formulated for the Chinese and International Advisors and their supporting team. The Council's Chief Advisors are responsible, *inter alia*, for presenting scientific recommendations with respect policy studies. Under the leadership of both the Chinese Chief Advisor and International Chief Advisor, this working mechanism has operated smoothly over the past year and has played a key role in ensuring the implementation of the Council's policy research.

Four joint meetings Secretariat and Chief Advisors have been held to date at which participants discussed and assisted in the establishment of policy study projects; put forward suggestions on Chinese and international members for each Task Force /Special Policy Study team; provided guidance for policy studies and developed general plans for the Council's policy study activities..

The Chinese Chief Advisor and International Chief Advisor have taken the initiative to participate in research activities of relevant policy studies and provided direct assistant and support. The Chief Advisors and their support team are also responsible for preparing draft Policy Recommendations and the Issues Report for the AGM. Based on the comprehensive findings of each research project, they have finished the preparation of these basic documents for this AGM.

V. Work of the Secretariat

With the stronger support of SEPA, the CCICED Secretariat has overcome many challenges in fulfilling its duties during the transition period in 2007. Working closely with the Chief Advisors and donors and partners, and with the support of International Support

Office, the improved and strengthened Secretariat has laid a sound foundation for implementation of the new phase of CCICED. The principal elements of the work carried out by the Secretariat in 2007 were, but were not limited to, the following.

- The Secretariat completed the preparation and establishment of CCICED Phase IV. In close consultation with Chinese and international stakeholders, and in particular main donors, a new membership of the Council was established and the CCICED's Terms of Reference and Rules of Procedure were amended.
- The Secretariat strengthened working relations with relevant ministries and departments of the Chinese government. It promoted CCICED activities and its growing influence, and developed close partnerships with relevant Chinese institutions.
- The Secretariat made significant progress in fund-raising for the Council. More countries and international institutions are willing to providing support to the Council. With strong support from all stakeholders, CCICED operational funds have been put in place, and the amount of matching funds from the Chinese Government has also been increased.
- The Secretariat worked closely with the Chief Advisors, provided necessary support and worked hard at coordinating the various policy studies. It has maintained regular communications with each policy study project as well as with their Chinese and international experts, and provided assistance to them, and been instrumental in helping them complete their work.
- The Secretariat has greatly strengthened the partnership with each donor, and improved the transparency of the Council's operation.
- Focusing on the long-term development of the Council, the Secretariat has developed a phased work plan and strategy with the assistance of its International Support Office. In doing so, it has made the Council's activities and implementations more effective.
- The Secretariat has maintained close communications with Chinese and International members to ensure the effective sharing of information and to provide services to Council Members.
- The Secretariat has organized the Annual General Meeting, learning from past experience and applying international standards. The Council's AGM has now become one of the most influential forums on environment and development in China.

VI. Promoting the Influence of CCICED

One of the most important aspects of the Council's work is to gradually promote and enhance the influence of the Council both in China and internationally. In 2007, the Secretariat initiated and organized a series of activities with the support of relevant donors and partners.

1. The seminar on low carbon economy

In April 2007, the Council held a Seminar on Low Carbon Economy and China's Energy and Environment Policy. A large number of high-level Chinese and international delegates were invited for a dialogue on energy, environment and climate change. It was very successful. Among the participants were representatives from Norway, Great Britain, Sweden, the United States, Japan, Germany, Canada, India, EU, ADB, WB, IPCC, UNDP and WWF, as well as high-level officials from relevant Chinese government departments and experts. The key issues discussed at the meeting and the policy recommendations formulated by the participants were submitted to the leaders of the Chinese government and relevant departments for reference.

2. Strengthening exchanges and developing partnerships

Through various workshops and other events, the Council has established close working relations with and promoted its influence to relevant ministries and departments of the Chinese Government. By maintaining closer communications and consultation with donors, a new cooperative partnership has been developed. The Secretariat paid higher attention to developing wide contacts with other international institutions in order to enhance its partnerships and broaden cooperation.

3. Disseminations of the Council's policy outputs

Over the past year, the Secretariat has invested greater effort in disseminating the Council's policy recommendations and related information among stakeholders at home and abroad.

- The policy recommendations and findings flowing from the Council's policy studies were reported to State leaders in a timely fashion and forwarded to relevant government departments and local governments. The Council's outputs have served as reference for government policy makers at many different levels.
- The Secretariat's electronic publication of the CCICED Update in both Chinese and English enabled both Chinese and international readers to gain a better understanding of the progress of the Council's activities.
- Council publications have been improved. The CCICED's Annual Policy Report

(2006) in Chinese was published and circulated to the public in order to disseminate information on the Council achievements to a wider audience.

VI. Summary of CCICED Phase III Funding

CCICED Phase III completed its work in 2007. The Chinese Government and a large number of other donor countries and institutions made sizeable financial contributions to the Council over Phase III's five years (2002-2007). These contributions laid a sound foundation for the operation of CCICED. Annex provides a brief summary on funding over the past five years.

Annex

China Council for International Cooperation on Environment and Development Report on Phase III funding

Introduction

During the third phase of CCICED (August 2002-December 2006), the Council's operations and activities were supported financially by the Government of China and a wide range of international donors. Funds were administered by the Secretariat in China (in Phase IV referred to as SERI) or by the Secretariat Canadian Office at Simon Fraser University (in Phase IV known as the Secretariat International Support Office, or SISO), working in close cooperation. Funding was of two types: core financing and dedicated financing. Canadian funds remained available until October 2007, and Norwegian and Swedish funds until September 2007, to fund Phase III activities during the transition period to Phase IV.

Core funding and dedicated funding

Core financing supported the Council's core operations: its Annual General Meeting, Task Forces, Lead Experts, and Secretariat. It could be deployed flexibly and was not tied to any specific purpose, and thus helped ensure that the Council had sufficient funds with which to plan its activities. Dedicated financing referred to funds that were provided to the Council for a specific purpose, for example, to support a specific task force. For example, in Phase III, all Canadian funds, contributed through the Canadian International Development Agency (CIDA), were core funds and could be used to support any Council activity, whether or not there was Canadian involvement in it.

Contributions

The following contributions were pledged to CCICED Phase III:

- Chinese contribution: 10,000,000 RMB in cash over the five year period for core funding, plus the provision of staff, facilities and local costs representing and in-kind contribution of an estimated 22,000,000RMB.

- CIDA (Canada): 8,000,000 CAD over 5 years, all for core funding.
- Norwegian government: 10,000,000 NOK core funds over 5 years (with 77% for Task Forces).
- Swedish SIDA: 15,900,000 SEK core funds (with 84% for Task Forces).
- British DFID: 630,000 GBP over 3 years for the Environmental and Natural Resources Pricing and Taxation TF.
- German GTZ: 2,000,000 EUR over 5 years with average of 19% for core activities such as annual meetings and other activities.
- Japanese Ministry of Environment: 30,000,000 JPY over 2 years to Eco-Compensation TF. 30,000,000 JPY over 2 years to Financing Mechanism TF. OECC contributed 7,500,000 JPY to the Secretariat. GISPRI contributed 19,900,000 JPY for TF on Cleaner Production.
- Switzerland SECO: 992,000 USD for TF on WTO and Environment.
- WWF: 400,000 USD for TF on River Basin Management.
- The Netherlands: 600,000 EUR over 5 years for the TF on Enterprises and Environment, and the TF on Economic Growth and Environment.
- Italy: 200,000 EUR for core fund.
- US Environmental Defense: 200,000 USD over 2 years to Environmental Governance TF.
- Shell (China) Limited: 600,000 RMB over 5 years.

Over the past five years, the exchange rate between USD and CAD has fluctuated and is now approximately at par. For convenience in this report, the rate of CAD1=USD1 is used.

The financial support from all sources is of great importance to CCICED and much appreciated, as are the many in-kind contributions made, not only by China, but also by Council members, and many institutions and individual experts.

Expenditures.

Table 1 lists the allocation of funds.

Table 1

Work Plan for CCICED 2008

（Approved by the Bureau Meeting）

The Council 2007 Annual General Meeting marks the official inauguration of the work the new Fourth Phase of the Council. It is therefore important that the activities for 2008, the first year of Phase IV, be well planned and implemented. With the support of the Chief Advisors of the Council and of the Secretariat and its International Support Office, the Secretary General herewith puts forward the following recommendations with respect to the core activities of the work plan of the Council for 2008 for review and approval by the Bureau Meeting.

I. Policy studies' work in 2008

1. WORK OF ESTABLISHED TASK FORCES

Two Task Forces were established and commenced their studies in 2007 after approved by the Bureau in November 2006. They are:

（1）Task Force on Innovation for Environmentally Friendly Society

（present an interim reports to the 2007 AGM.）

（2）Task Force on Environment and Health

The Secretary General suggests that the Bureau Meeting recognize the progress made by these two Task Force teams over the past year and encourage them to proceed with their research work in 2008 so that they can present their final reports to the 2008 AGM.

2. INITIATING POLICY STUDIES ON ENERGY AND ENVIRONMENT RELATED TOPICS

In view of the great significance of the energy issue to the long-term development of China and its direct impact on the environment, it is proposed, based on the recommendations of the Chinese and International Advisors, that several Task Forces be established targeting the topic of energy and the environment. These Task Forces will focus on such topics as energy efficiency and the environment, sustainable use of coal, and low carbon economy. Through those policy studies, the Council will be in a position to formulate a series of findings and outputs concerning energy and environment issues. The work of the Task Forces will interlink with each other and will follow an overall schedule and plan with the objective of reporting their findings and submitting policy recommendations to the 2008 and 2009 AGM respectively. The proposed Task Force topics are the followings.

（1）Task Force on “Market-based Instruments for Energy and Resource Efficiency”. Based on current environmental and economic policies of China and international experience, this Task Force will study market instruments and policies that will raise the efficiency of resources and energy, put forward policy recommendations, and assist the Chinese government in improving policy regulation tools in this field.

This Task Force will commence its work before the end of 2007 with a duration of 12-month and report its findings to the 2008 AGM.

（2）Task Force on “Improving Energy Efficiency in Building and Transportation Sectors in Urban Development”. With accelerated urbanization, energy consumption of urban buildings and transportation in China has increased rapidly and represents an increasing proportion of total energy consumption. Therefore, there is considerable potential for increasing energy efficiency in the field of urban building and transportation, which is of great importance for the control of emissions of greenhouse gases. Targeting energy efficiency in the field of urban buildings and transportation in China, this Task Force will carry out systematic study and put forward policy recommendations.

This Task Force will be established and commence operation in the first half of 2008 and work for 18 months, and will submit an Interim Report to the 2008 AGM and its Final Report to the 2009 AGM.

（3）Task Force on “Road Map for a Low Carbon Economy in China”. This Task Force will promote the low carbon economy development approach in accordance with the requirements of the Chinese Government for building a resource saving and environment-friendly society. It will play an important role in helping China to raise energy efficiency, protect the environment, and mitigate climate change. Based on in-depth study of international progress and experience in this field and actual conditions of China, it will present a possible approach and roadmap for low carbon economy and put forward policy recommendations to the Chinese government on adjusting the long-term economic growth path.

This Task Force will be established and begin its operation in 2008 and work for 20 months, with a view to submitting its Report to the 2009 AGM.

（4）Task Force on "Sustainable Rural Development and Energy, Environment and Climate Change". With economic development, the living standards in rural China will be gradually improved. As a result, energy consumption will grow in the rural areas and environmental problems will emerge. Studying the impact of energy consumption, environmental pollution, and response to climate change in rural China in a comprehensive way is a difficult task. The Task Force will carry out a study on this topic and provide recommendations to the Chinese government that will assist in the development and adjustment of relevant policies.

This Task Force will be established and begin its operation in 2008 with 18-month study period duration, and submit its final Report to the 2009 AGM.

（5）Task Force on "Sustainable Use of Coal". Coal will be the most important energy source in China in future years. How to design sustainable coal use in the next 20-30 years or even longer involves a series of major issues such as energy structure, pollution control, and reduction of greenhouse gases in China. This Task Force will organize Chinese and international experts to study the issue and present a comprehensive study report on sustainable coal use. In view of the complexity of the work of this proposed Task Force, it is recommended that a Task force on Sustainable Use of Coal be established by mid-2008, but only after a Scoping Meeting is held in order to determine the most valuable contribution that might be made by the Council. This meeting should take into account the extensive international cooperation efforts with China on coal use, and also the range of R&D expertise within China concerning coal.

It is expected that this Task Force will be established and begin its operation in the second half of 2008 and last for 18-22 months and finish its research in 2009 or, if necessary, 2010.

3. DEVELOPMENT OF A POLICY PILOT PROJECT

In the new Phase, the Council should consider the establishment of a policy pilot project to provide practical support to policy research outputs. It is recommended that, based on the studies related to energy and the environment, the Council select a city of an appropriate scale to carry out comprehensive policy demonstrations on low carbon economy, energy efficiency, and improving environmental quality. These activities would provide opportunities to explore the potential of medium-sized cities to be leaders in energy and environment innovation.

Arrangements for and initiation of the pilot project should take place during 2008-2009.

II. 2008 Roundtable Meeting

The Roundtable Meeting is a new mechanism of the Council and is designed to promote the dissemination of policy study outputs and findings of the Council to a wider audience. A Roundtable Meeting would be held once between two consecutive Annual General Meetings; participants would include Council Members, policy makers at the central and local government level, representatives of the Chinese and foreign private sectors and enterprises as well as experts and scholars.

It is recommended that the first Roundtable Meeting be held at an appropriate time in the second Quarter of 2008. The Secretariat will take charge of the preparations and organization of the Meeting.

III. 2008 AGM

It is recommended that the CCICED 2008 AGM will be held on November 12-14, 2008 in Beijing. The proposed Theme is “Harmonious Development through Innovation”. This AGM will receive the reports of the findings of Task Forces on:

- Innovation for an Environmentally Friendly Society
- Environment and Health
- Market-based Instruments for Energy and Resource Efficiency
- Improving Energy Efficiency in Building and Transportation Sectors in Urban Development （Interim Report）

IV. Continuously promoting of the Influence of the Council

The Secretariat will carry out the following functions in 2008 to further enhance the influence of the Council and expand its partnerships in cooperation.

- Continuously strengthen exchanges with relevant ministries and departments of the State Council; develop a thorough understanding of the foci and priorities of the policy needs of the Chinese government.
- Broaden communications with Chinese and international institutes and private sectors with a view to the further development of cooperative partnerships.
- Make effective use of the Council publications and its website to disseminate the achievements of the Council.

Meeting Record

Great Wall Sheraton Hotel, Beijing
November 28 – 30, 2007

ITEM 1 SUMMARY RECORD

I. INTRODUCTION

1. The China Council for International Cooperation on Environment and Development（"the Council" or CCICED）was established in 1992 by the State Council of the Government of China （GOC）to support cooperation between China and the international community in the fields of environment and development.

2. The Council is a high-level advisory body that puts forth policy recommendations for the Chinese Government’s consideration on the integration of environment and development. It has so far held five annual meetings in each of the First, Second and Third Phase in the past 15 years. The 2007 Annual General Meeting was the first one in the Fourth Phase of the Council, which will go through 2007-2011.

3. The Council supports the development of an integrated, coherent approach to environment and development and encourages close cooperation between China and other countries.

The Council is a non-profit body with strong government involvement and support. At present the Council is composed of 25 Chinese Members and 22 International Members, all chosen for their experience and their expertise.

4. The Council is chaired by Mr. Zeng Peiyan, the Vice-Premier of China’s State Council. The Members of the Council attended the 2007 Annual General Meeting （AGM）at the invitation of the Chinese Government.

5. The host institution of the Council is the State Environmental Protection Administration（SEPA）. SEPA has been made responsible for inter-ministerial coordination

and for supporting the activities of the Council. It has established a Secretariat（SERI）to maintain and develop international and domestic contacts. The Secretariat also ensures follow-up within China to the recommendations made by the Council, and deals with the routine work of the Council when not in session. The Secretariat is assisted by the Secretariat International Support Office（SISO）. The CCICED Secretariat International Support Office is located at Simon Fraser University in Burnaby, Canada, and is funded by the Canadian International Development Agency（CIDA）.

6.This Summary Record of the 2007 AGM of the Council was prepared for SISO by Ms Lucie McNeill on the basis of detailed notes recorded during the AGM. The Summary Record represents SISO's interpretation of the discussions and not necessarily the views of all participants. To facilitate frank and direct exchanges it has been agreed that the Summary Record of the Meeting should present an overview of the discussions without attribution to individual speakers.

II. AGENDA ITEMS

ITEM 1. ADOPTION OF THE AGENDA AND AMENDED TERMS OF REFERENCE AND RULES OF PROCEDURE

7. Vice-Chair Zhou Shengxian, the Minister of SEPA, declared the 2007 AGM of the CCICED in session. He introduced Council Chair and Vice Premier of the State Council of China, Mr Zeng Peiyan. He also introduced CCICED Fourth Phase Vice Chairs Mr Xie Zhenhua, Klaus Töpfer and Børge Brende. He welcomed guests, Council members and observers to the meeting. He regretted the absence of Executive Vice-Chair and President of CIDA, Mr Robert Greenhill.

8. The agenda was presented; Vice-Chair Zhou stated the theme of the meeting was Innovation Strategy for an Environment-Friendly Society. The agenda was adopted as circulated.

9. Mr. Zhou highlighted the need for Council to adopt amended Terms of Reference（TOR）and Rules of Procedure so the CCICED can fulfil the mandate of its Fourth Phase. He indicated the changes were based on work done during the end of the Third Phase, and included input from members and other stakeholders. The amended TOR and Rules of Procedure were approved as circulated.

ITEM 2　OPENING CEREMONY

10. Vice-Chair Zhou Shengxian asked Council Chair and Vice-Premier Zeng Peiyan to

address the Council. Chair Zeng then invited the following participants to address the AGM:

1）Vice-Chair Xie Zhenhua, Vice-Chair of the National Development and Reform Commission （NDRC）;

2）Vice-Chair Klaus Töpfer, former Executive Director of the United Nations Environment Programme （UNEP）;

3）Vice-Chair Børge Brende, Member of Norway's Parliament and former Minister of the Environment.

11. During the course of his opening remarks, Vice-Premier Zeng made the following statements:

1）During the first three quarters of 2007, China has maintained a high rate of growth in Gross Domestic Product（GDP）, but has now managed to start reducing its consumption of energy, when calculating per unit of GDP; this is now down 3%. Sulphur dioxide （SO_2） and Chemical Oxygen Demand （COD） emissions, per unit of GDP, are also starting to come down – respectively by 1.81% and 0.28%. This indicates that China has started to turn the corner on emissions control.

2）Globalization is proceeding apace, with increasing flows of capital, goods, technologies and people. This represents good development opportunities for China, but it also presents a threat to sustainable use of resources, as fluctuating prices for copper, oil and other resources have shown. Climate change, holes in the ozone layer and assaults on biodiversity and ecosystems will have significant impacts on people and their quality of life. We need to join hands in working towards a better future.

3）China's annual GDP growth rate over the past five years has been over 10%; it reached 11.5% during the first three quarters of this year. A sober-minded assessment reveals that sustainable development is threatened by excess liquidity, rising trade surplus, excessive investment and increased commodity prices. With low productivity and incomes, China must continue to modernize. The coming years will bring challenges in terms of insistent demand for rising incomes and standards of living on one hand, and environmental protection and wise resource use on the other. China's growth is also promoting world economic prosperity by taking on much of the heavy and chemical industries, and by producing high quality goods at low prices. But China is also bearing the environmental costs of this production.

4）China has taken action to protect its environment in the context of its broader strategies of promoting a moderately well-off society（*xiaokang*）, and of pursuing socialist modernization. China is continuing to restructure industry, to strengthen environmental governance, to use financial and fiscal levers to protect the environment, and to clamp down on energy and resource intensive projects. It has invested heavily in sewage treatment facilities, coal desulphurization equipment, and has restored grasslands and replanted forests.

5）The 17th Congress of the Communist Party of China （CPC）held in October 2007 stated unequivocally that China must have optimal economic development – one that is at the same time sound and rapid; it must be energy efficient and it must not harm the environment. Ecological civilization has been decreed to be a key component of *xiaokang*. Innovation is to be emphasized, in thinking, technologies, institutions and production.

6）As globalization continues to accelerate, it becomes increasingly important to reduce the imbalance between environment and development. International cooperation is essential and China is doing its part to mitigate climate change. The GOC has a national plan to tackle the issue and Premier Wen Jiabao is heading the leading group responsible for this plan. The developed countries（DCs）need to help developing countries in the areas of technical transfer and capacity building. China's development is intimately tied to global development; protecting China's environment contributes to saving the global environment. The CCICED is an excellent platform for this kind of international cooperation.

12. During the 2007 AGM Opening Ceremony, Council Vice Chairs Xie Zhenhua, Klaus Töpfer and Børge Brende highlighted the following issues:

1）Important targets for emissions reduction were set out in the 11th Five Year Plan （FYP）; these were important in terms of climate change globally, and in helping to establish an ecological civilization in China. The State Council held an important conference on energy this past year; Premier Wen and Vice Premier Zeng are heading the leading group on climate change. An integrated plan for the reduction of emission comprising ten key measures was approved. An improved monitoring and evaluation system for the environment is in place and environment indicators are now included in the performance assessment of local officials. Industrial restructuring, the promotion of energy efficiency in industry and in construction, and the promotion of alternative energies are among the measures included in the plan.

2）Such a meeting is key for agenda setting and laying out the goals of the current five-year program. It is timely that this AGM should follow the 17th CPC Congress where key phrases included *xiaokang*, harmonious society and Conservation culture. It is in all our interests to promote energy and resource efficient environment-friendly industry, patterns of growth and modes of consumption.

3）This year the Council will hear a very important report on chemicals, which offers new avenues for industry, and on innovation for an environment-friendly society. China's great success in reducing poverty is largely responsible for the global achievement of the Millennium Development Goals（MDGs）. China's contributions on the environment could have a similar impact.

4）An important decision was made at the 17th CPC Congress to mainstream environment in all aspects of governmental decision-making. But it is essential to have sustained economic growth. In this new Phase of the CCICED, new members are eager to tackle emergent issues for China, particularly energy and climate change. The proposed Task Force （TF）on the low carbon economy represents a good fit with this work focus. It is hoped China can be as successful in decoupling economic growth from the growth of emissions as it has been in its fight against poverty.

ITEM 3. KEYNOTE SPEECH

13. Vice-chair Zhou Shengxian introduced the keynote speaker of the 2007 CCICED AGM, Dr R. K. Pachauri, CCICED member and Director General of the Energy and Resources Institute of India. Dr Pachauri is also Chair of the Inter-governmental Panel on Climate Change （IPCC）and Nobel Peace Prize laureate of 2007. In his remarks, Dr Pachauri put forward the following key points.

14. The Nobel Peace Prize awarded to the IPCC recognizes the hard work of international scientists and governments that support its work, notably Chinese experts. The IPCC assessment report was approved in Valencia, Spain, earlier in November. It presents unequivocal evidence of climate change. Global average temperatures are increasing, the sea level is rising and there is a marked decrease in northern hemisphere snow cover. The impacts of these changes are already seen and will worsen, namely extreme weather events such as flooding, droughts and heat waves. Different scenarios have been studied, from the most optimistic temperature rise of 1.8 degrees Celsius, to the catastrophic 4 degree Celsius rise by the end of this century. Emissions have to start decreasing by 2015 if we want to stabilize our climate; still, this would imply sea level rises of up to 1.4 meters.

15. The poorest regions of the world will bear the brunt of the climate change effects. Poverty, low access to funds, ecosystem degradation, political conflicts and governments' failure to take action all add to the vulnerability of the poor to climate change. Coastal

settlements in the great deltas of Asia are particularly at risk.

16. Biodiversity is threatened. It is estimated that 20% to 30% of all species are at risk of extinction if there is a 1.5 to 2.5 degree Celsius rise in temperature. The most vulnerable ecosystems are the coral reefs, the marine molluscs, the tundra and the boreal forest systems.

17. Impacts have also been seen in China, more particularly in the increased frequency of heat waves, increased intensity of cyclones and a seven-fold increase in floods since the 1950s. There has been a 22% to 33% increase in rainfall in northwest China, while an additional 6.7 million hectares of land are in areas severely affected by droughts. Agricultural productivity is at risk, due to high temperatures, droughts, floods and soil degradation. A 2-degree increase in temperatures could reduce rice yields by 12% in China. The melting glaciers of the Tibetan Plateau and other ranges will affect the water supplies for one billion people.

18. China is facing a difficult challenge. Primary energy demand is to double by 2030, with oil imports rising by 50% to 80% and with coal remaining the main fuel. Renewable sources of energy will contribute up to 15% of the total by 2020 and to 30% by 2050. China overtook the US as the world's largest emitter of carbon dioxide （CO_2） in 2007. These projections would indicate there will be further climate change and unsustainable development. China will need to minimise GHG emissions while achieving economic growth. Rapid economic growth can help China adapt to climate change.

19. Mitigation is not an expensive proposition. To limit global warming to 2.4 degrees Celsius, it would cost less than 3% of GDP. This means postponing the level of economic achievement we might have reached in 2030 by only one year; we only need a yearly reduction of 0.12% GDP to prevent very serious impacts. With access to important new technologies, the costs could be even less. An important area of intervention is transportation, as is construction of new buildings. China needs incentives to develop new technologies; this could be the imposition of an effective carbon price.

20. It is hoped that the Bali negotiations will take us in this direction. Energy investments need a long planning horizon. National policies need to be linked and coordinated with policies supporting mitigation, poverty reduction and employment creation. LDCs will need to adopt a new development path; changes are needed in the areas of economic structure, technologies, geographic distribution of activities, consumption patterns, urban design, transport infrastructure, demography, institutional arrangements and trade patterns. China could seize the global moral high ground if it took the right path.

ITEM 4. SESSION ONE: ENVIRONMENT AND DEVELOPMENT IN THE CONTEXT OF GLOBALIZATION

21. With Vice-Chair Klaus Töpfer presiding, Council International Chief Advisor Arthur Hanson presented to Council the 2007 Issues Paper on Innovation Strategy for an Environment-friendly Society. During his talk Mr Hanson made the following points.

22. The Issues Paper is intended to highlight the key points that are to be discussed during the AGM. China at the 17th Congress of the CPC resolved to adopt a transformative approach to environment and development. This will not happen without innovation in the areas of technology, policy and institutions. China needs to take significant steps in the right direction during this 11th FYP. Nobody disputes the need for China's economy to grow – but the current model is unsustainable; China is building an environmental deficit as it is building a current accounts surplus.

23. It has been stated that China has turned the corner on GHG emissions – but these are based on intensity measures, defined in terms of per unit of GDP. The ultimate goal, and the real challenge to innovation, is to see a decrease in absolute emissions discharged.

24. During this AGM, Council will consider China's ecological footprint. Ecological innovation is different from other types of innovation in that the environment is a public good where benefits are ill defined, hence true market value is hard to capture. The government, rather than the private sector, has an important role to play in supporting science and technology development in this area. Venture capital is also needed for environmental innovation. China can be a model for LDCs in terms of creating economic wealth and opportunity in a more sustainable manner.

25. Vice Chair Klaus Töpfer introduced keynote speaker Professor Ye Ruqiu, Counsellor of the State Council of China. Professor Ye presented to Council members the Special Policy Study（SPS）on the Strategic Transformation of Environment and Development in China: Global Experience and China's Solutions. In the course of his presentation, Professor Ye made the following points.

26. China is on the road to fundamental changes in the area of environment and development – a strategic transformation that is now at the centre of the national agenda. The evidence can be seen in the signals originating from the leadership of the GOC, namely policy pronouncements related to government adopting a "*scientific approach to development*", commitments to "*build a harmonious Socialist society*", as well as the more recent "*Three Transitions in Managing Environmental Protection and Economic Development*" and others. This was further confirmed by the 17th CPC Congress, where the

costs of environmental damage were discussed and the themes of environmental protection and building an ecological civilization were repeatedly stressed.

27. In looking at other countries' experience, the study found that the path most often taken is that of economic development first and clean-up later, following environmental accidents, media attention and public pressure; this usually culminates in a population with high awareness and leads to improved environmental governance.

28. There are several implications for China. The process of integrating environment into the mainstream of economic and social decision-making can take many forms. Improvements in living standards, education levels and public information are having an impact on people's priorities and perceptions. China, as an export-led economy, is also facing increasingly stringent requirements from its customers. The country is still under an economic growth imperative, with its economy having expanded by a factor of 58 since the reform program of 1978; 60% of the growth has been generated by the industrial sector. Industrial growth is closely related to China's present environmental problems, since rapid expansion leads to enormous emissions of pollutants. China is still pursuing an extensive, inefficient growth pattern. A recognition of the resulting problems only started some twenty years ago and has been increasing as frequent environmental accidents have heightened public concern.

29. China could seize the opportunities of globalization. China is increasingly integrated in the world economy. Increasing trade flows are bringing about a more efficient allocation of resources. China imports waste paper for the manufacture of recycled paper and other goods; this has resulted in reduced pressure on forests, for instance. Negative effects are China's rising environmental trade deficit due to low （subsidized）prices for water, power and other inputs. This in turn provides a perverse incentive for wasteful consumption of cheap Chinese goods in other countries. Estimates indicate that up to 23% of China's GHG emissions are due to the embodied energy in export goods.

30. The impact of Foreign Direct Investment （FDI）on China's environment and development has negative as well as positive aspects. Positive contributions are the transfer of technologies and management methods, improved labour flows, improved environmental management and increased investments in research and development （R&D）. Negative aspects include a rising trade surplus and a skewed balance of payment, the gradual marginalization of domestic companies and an exacerbation of geographic inequities within China.

31. China is now also an investor in other countries, and is now the 13th largest contributor to Overseas Direct Investment （ODI）. China brings skilled labour and capital

to the countries in which it invests; but it also in some cases generates environmental damage and pollution.

32. The SPS recommends to the GOC to accelerate improvements to the environmental protection system, taking full advantage of the latest technologies, management approaches and legal frameworks. As the strategic transformation accelerates, China should rely increasingly on market-based mechanisms such as pollution taxes. Public awareness and participation need to be encouraged in order to allow people to contribute to the strategic transformation. China should push for eco-innovations in all sectors, relying increasingly on endogenous technologies and approaches. China should also strengthen management of foreign companies operating on its soil, and of Chinese companies operating abroad; enterprises should be encouraged to become more socially responsible. China needs to strengthen its participation in bilateral and multilateral environmental cooperation efforts.

33. Vice-Chair Klaus Töpfer introduced James Leape, the Director General of the World Wide Fund for Nature（WWF）. Mr Leape is a Council Member and discussed the initial work of the TF on China's Ecological Footprint.

34. China was interested in having a study conducted through the aegis of the CCICED on its ecological footprint. WWF initiated this work in cooperation with the Chinese Academy of Sciences（CAS）; a full report is expected in June 2008. When discussing innovation, it is easy to think of science and technology – but innovation can also be seen in the concepts now pioneered by China, such as conservation culture and ecological civilization. It will be necessary to re-imagine sustainable cities, and the meaning of prosperity in times of constraints. Urgent action is now needed because of the dangers brought about by climate change. Decisions made today could lock us into unsustainable patterns of production and consumption that will be hard to reverse. The groundwork needs to be laid for a conservation culture. The concept of "ecological footprint" is useful to engage the public and decision-makers; it is a powerful tool to discuss big picture issues in intuitive terms.

35. The ecological footprint measure captures the area of planet required to absorb waste, house people and produce what they need. It is reduced to the common denominator of global hectares. It shows how impacts add up; and it compares how different countries fare in terms of their impact on the planet. Half of the global footprint is due to energy consumption and the production of CO_2. WWF figures show that humans have overshot the capacity of the planet to support us by 25%; the world is in ecological deficit. The responsibility for this state of affairs is not evenly distributed. The United States（US）has only 5% of the global population, but takes up 20% of the total human footprint. The

European Union （EU）is 2nd, and China is 3rd.

36. In calculating China’s footprint, the TF aims to not only capture domestic realities, but also China’s impacts abroad. A first draft of the report has been circulated and will be further developed for presentation to Council. Preliminary data analysis shows that China’s ecological footprint per capita has more than doubled over the past 40 years, and exceeds China’s bio-capacity by a factor of 2. On a per capita basis, China is behind many other countries in terms of average footprint, but this is growing fast. The study will further examine the inflows and outflows of bio-capacity – that is, how much timber, fish and other resources China is importing in order to produce what it does, and to what extent these goods are in turn exported. Preliminary data show that there is a net inflow of bio-capacity from the US to China.

37. The study will also link bio-capacity issues and human development; the United Nations Development Programme （UNDP）’s Human Development Index （HDI）is used for this purpose. Initial work indicates that as countries move up on the HDI scale, their ecological footprint also increases. Strategies need to be developed in order to allow for a rising HDI while reducing the ecological footprint, perhaps through the development of a conservation culture.

DISCUSSION

38. Vice-Chair Klaus Töpfer invited Members to discuss the presentations made during the first session of the AGM. In the course of their interventions, Members made the following key points.

39. Regarding the Council’s future workplan and given the importance of globalization and China’s role in that context, it would be worthwhile to ensure that the Council’s work meshes with planned international meetings and negotiations. This would allow for timely contributions by the CCICED.

40. The draft recommendations circulated do not fully reflect the ideas contained in the Issues Paper, the SPS reports and the initial work of the TF on China’s Ecological Footprint. It is hoped this can be remedied.

ITEM 5. SESSION TWO: INNOVATION STRATEGY FOR AN ENVIRONMENT-FRIENDLY SOCIETY

41. Vice-Chair Zhou Shengxian presided over the session, calling on Mr Feng Zhijun, the Vice Chair of the Environmental Protection and Resources Conservation Committee of

the National People's Congress （NPC）of China to address the Council on the preliminary work of the TF on Innovation and Environment-Friendly Society. During the course of his presentation, Mr Feng highlighted the following issues.

42. The report deals with the challenges of China realizing *xiaokang* while at the same time becoming a conservation society. Three areas need to be targeted: the industrial structure of the economy needs to be modified, the development model needs to be changed and the consumption model needs to be improved. Scientific and harmonious development depends essentially on innovation. Without innovation, China's resources will not be able to sustain economic growth, China's environment will not be sustainable, China's capacity to develop will be hampered and therefore social stability and security will not be maintained.

43. This presentation highlights five areas: innovations in terms of mindset, theory, technology, culture and nature. Traditionally, the human mindset was that nature was a force to be fought – that humanity struggled against nature. In rethinking this mindset and considering the types of resources in classical economics, human, financial and physical, the depletion of natural resources forces us to estimate anew the value of our natural capital, including the ecosystems of the planet.

44. Theoretical innovation is also needed. Classical economic theory considered development strictly in terms of economic growth, without factoring in social or other dimensions. The UNDP's HDI is one way to consider the social dimensions of development, but more theoretical work is needed to ensure other factors besides GDP growth are taken into account.

45. Technical innovation comprises innovations that are imported, domestically produced, or produced in a combined or integrated way. Only when China also innovates technically on its own can it really "stand on its feet". But it must also take full advantage of innovations generated abroad.

46. Institutional innovation is necessary to ensure full implementation of measures to support an environment-friendly society. This includes changes in the kind of indicators used to assess the performance of organizations and individuals; GDP cannot be the only yardstick. There are 11 key industries in China that are singled out in the report, where effective emissions reduction and good environmental management could generate substantive pollution reduction for China. Managing these key industries effectively would indeed represent institutional innovation for the GOC.

47. Cultural innovation takes for its starting point that culture is central to the health of a nation; cultural vitality is part of economic development and progress. Chinese culture traditionally has held as ideal the harmony between humanity and nature. This underpins the

current thinking about ecosystems, and greater progress can be made along this line.

48. Vice-Chair Zhou Shengxian introduced Professor David Strangway, the Co-Chair of the Task Force. Dr Strangway discussed the following key ideas during his presentation.

49. It is often thought that innovation is limited to the field of science and technology, but it is much broader. China is committed to, and has made remarkable achievements in, the area of science and technology. Fostering innovation also requires nurturing research communities; innovation is not a top-down process, but rather a bottom-up process drawing on individuals, groups, institutions in both the private and the public sector. People must be empowered to innovate and be creative; and entrepreneurs must be empowered to shoulder some of the risks. Governments can set up incentives in order to ensure quality work and reduce the barriers that innovators and entrepreneurs face.

50. China now has the opportunity to lead the world in environmental stewardship through innovation. The priority areas identified are: hydrocarbons emissions reduction, and the sequestration of emissions; air quality; automobiles and transportation; green buildings; water quality; solid waste management and the circular economy; environment and health.

51. Funding and sets of incentives must be in place to foster innovation. This needs to be led, at least in part, by government. Government can set up smart enforcement systems and standards. The focus should be on total emissions reduction, not simply on reaching intensity targets; this is because when GDP doubles or quadruples, reaching intensity targets still means increasing total emissions. The system must support action by local authorities. Smart procurement can also be a powerful tool. Finally, entrepreneurs and inventors must have incentives to innovate; allowing them to retain some of the intellectual property revenue is key.

52. The TF has begun its work and will have a full report for Council at the next AGM.

53. Vice-Chair Zhou Shengxian commended to Members the SPS report entitled *Major Issues and Policy Framework for Environmentally Sound and Strategic Management of Chemicals in China.* Professor Hu Jianxin of Beijing University, the Chinese Co-Chair of the SPSgroup, addressed Council members and made the following comments.

54. Since World War II, there has been a dramatic increase in the production and use of chemicals around the world – reaching 100,000 compounds today. Every year, new substances are invented and introduced. They are attracting attention because of their environmental and health hazards; some compounds bio-accumulate as they move up the food chain, while others spread around the world on air or water currents. Some 350 chemicals are now detected in the human body; chemicals represent 80% of all factors

contributing to cancer deaths according to the World Health Organization （WHO）. Since 1992 at the Rio de Janeiro conference, countries have supported the Environmentally-Sound Management of Chemicals （ESMC）. Several international agreements cover the production, trade and movement of chemicals; in 2006, the international community adopted strategic approaches and detailed action plans for the ESMC.

55. In China, the production and usage of chemicals is rising year by year, with 45,000 in use today. Since 1990, this increase of 30% per year has outstripped GDP growth; some 100 new substances are registered officially every year. However, chemical technologies and production processes in China are still relatively primitive, with weak environmental safeguards or processes to control waste and prevent accidents. Some chemicals have been banned elsewhere in the world but are still used in China, such as Dichloro-diphenyl-trichloroethane （DDT）and chlordane. Information is lacking on these chemicals in terms of production, storage, transportation and use.

56. Chemical pollution is getting more dire in China, with DDT, Poly-chlorinated-biphenyls （PCBs）and other toxic chemicals such as endochrine disrupting chemicals （EDCs）and persistent organic pollutants （POPs）now found in groundwater, soils, sediments and the human body, including breast milk. Perfluoro-octane sulfonate （PFOS）has been detected in the drinking water of Beijing and Shanghai. As the economy speeds ahead, there are increasing numbers of accidents involving hazardous chemicals – such as the spill in 2005 in the Songhua River.

57. In China, ESMC is traditional and focuses mostly on occupational health and safety, on flammable and explosive chemicals and those that have acute toxicity. Chemicals with potential or long time-lag effects are generally not covered. Most measures are limited to end-of-pipe controls; this differs from international best practice which is based on risk assessment and management. China has yet to take this step, since it has little capacity for risk assessment, management and monitoring. It has yet to foster cross-ministry coordination where needed. Basic legislation and administration of ESMC is still weak. The general public has not been involved in surveillance and oversight.

58. The SPS recommends that a national strategy for ESMC be determined for China. It should be compatible with existing international structures and instruments. This is in line with the guiding principles laid out during the 17th congress of the CPC. Cleaner production should be one of the basic approaches of China's ESMC, moving beyond end-of-pipe interventions.

59. The national ESMC strategy should encompass the following elements: comprehensive laws and administrative regulations need to be put in place, based on

existing statues, risk management and with clearly identified standards, testing and regulatory mechanisms for new chemicals; institutions responsible for this work need to be established; capacity among personnel and institutions needs to be built, and in particular in the area of risk assessment; the environmental governance for chemicals needs to be established, including avenues for public participation. Any risk management action plan for the management of chemicals needs to be specific and include clear milestones. A system of notification for new chemicals needs to be set up; standards should be defined in order to determine the toxic chemicals that need to be examined as a matter of priority. In addition, an early warning system for toxic spills needs to be devised.

60. Co-Chair Zhou Shengxian introduced the Director General of the Swedish Environmental Protection Agency and Council Member, Mr Lar-Erik Liljelund. In his remarks to Council, Mr Liljelund outlined Sweden's approaches on innovation and environmental protection. He highlighted the following points.

61. Environmental policy is the cornerstone of Sweden's platform for supporting innovation. The institutional framework supporting innovation is not only centred on the public sector but also encompasses private institutions and research organizations. A key element is that the scope of research goes beyond science and technology to encompass the social sciences, which provide the basis for implementation. Another cornerstone is the legislative framework, which includes intellectual property rights protection.

62. The three steps to innovation are to use the best available techniques, to adapt existing techniques to a different context, and to develop new techniques. Sweden has embraced innovation because of its focus on the environment, because of the threat posed by acid rain in northern regions, and because of the serious pollution of the Baltic Sea, shared with other countries. For the past seven years, the Swedish parliament has set environmental objectives for the public and private sectors. Legislation has been in place to control and manage chemicals since the 1980s. Sweden uses economic instruments in order to provide incentives for the private sector to behave in a more environment-friendly way. These instruments include pricing mechanisms, taxes and financial incentives. However, it is advised to avoid instruments that are too rigid and block innovation because they favour a given technology. Green procurement has also been used by the government; given its importance as a buyer, government can become a standard setter. Sweden has found that large companies are now becoming increasingly proactive – government standards become the minimum that is often surpassed.

63. Innovation in Sweden is done cooperatively between the research institutions, the public and the private sector. Universities are the research centres, while the private sector

provides the entrepreneurship needed, and the public sector provides the enabling environment and some of the funding. Sweden has found that the three elements need to be on an equal footing, and that there should be no confusion on the ownership of new technologies in terms of intellectual property rights.

64. The future challenge will be to decouple economic growth from the growth of emissions and other environmental costs. There must be a growing focus on the sustainable use of resources and on quality of life. Lessons must be learned from the past when dealing with emerging issues such as nanotechnologies. A greater challenge for innovation will be in the areas of sustainable production and consumption. The emission of GHGs is more problematic than traditional pollutants because it is a horizontal issue, cutting across most human activity. A holistic systems approach will be required; a one-sided focus on mitigation could cause problems, for example, the reliance on bio-fuels.

DISCUSSION

65. Co-Chair Zhou Shengxian opened the floor for discussion by Council Members. The following issues were raised.

66. Two issues must be considered in dealing with sustainable development: optimal use of resources and the mitigation of natural disasters and climate change. Historically, climate change has been triggered by natural disasters such as volcanic eruptions, earthquakes and so on. It would be useful for the Council to pursue this area of study. Understanding the triggers of such disasters and how the chains of events occur could help in finding ways to mitigate problems.

67. The role of the private sector needs to be further stressed. The business sector is the first one to use technologies; it is important to understand what are the incentives and barriers to adoption of these innovations in China. In the TOR for the Council's Fourth Phase, Private Sector Forums have been added as a mechanism to broaden the CCICED's impacts. It would be useful to organize such a Forum on the adoption of technology and innovation. Much has been said on the need to use best available technologies, but business needs the right enabling environment to do so. This includes pricing, standards, building codes, procurement rules and in some cases subsidies to make technologies more affordable.

68. On the issue of climate change, there is an international market for emissions trading and the Clean Development Mechanism （CDM）. China is already taking an active part in this; 20% of the carbon rights have been issued to China. But this could be enhanced if, at Bali, a more business-like concept of CDM was developed. A sectoral system might be

more effective; if the leading companies in each sector were to sign on, they could have a major impact. This topic could also be the focus of one of the Council's future private sector forums.

69. The TF on Innovation's preliminary report reveals that often the bottleneck is with political and institutional structures, as well as with cultural mindsets and structures. Perhaps the Council should consider broadening its work from a China focus to a more global focus when it comes to the identified bottlenecks. We need to shift from a narrow nationalistic focus to a fair global system of conflict resolution around distribution disputes over access to resources. This will require political and institutional innovation on a larger scale than what has been achieved so far. We need to move beyond the business-as-usual approach in the areas of international cooperation and international relations, and move towards fair global governance. We also need consensus around cultural norms when it comes to basic values such as fairness in order to resolve distributional conflicts.

70. More analysis is necessary in order to achieve some of the objectives set by the 17th CPC Congress around the establishment of an environment-friendly society. This will especially be the case for the implementation of concepts such as sustainable consumption, innovation in production and the harmonization of economic and social targets. For instance, when considering how to optimize transportation in terms of energy conservation, it is necessary to think in economically innovative ways; just designing more energy efficient vehicles will only lead to higher emissions given the present rate of increase of vehicles on the road. Similar challenges exist for the conservation of older buildings, retrofitting them to be more energy efficient; buildings in China have a short lifespan at present. Planning needs to take into account the economic externalities of the environment. There are now incentives rewarding growth; how do we change this to integrate environmental criteria as well? The early work on the Green GDP was promising and could be pursued.

71. National statistics are not capturing some of the environmental innovation taking place in China. In some areas, thanks to various departments, research institutions, local governments and the regional CDM office, existing technologies are adapted to local conditions to reduce GHGs – in one case, stone mulch is used on the Loess Plateau to grow watermelons in near-drought conditions. Adaptation is here a key component of innovation. A great deal of this work is happening at the local level in China and should be better reflected in national accounts.

72. Innovation has been the engine of economic growth and development throughout human history. Innovation requires certain enabling factors, but there are no guarantees that even under the best of circumstances inventions will be created. As the Innovations TF

continues its work, it could focus on concrete case studies in an international and Chinese context. Attention should be paid to the barriers to innovation and to strategic partnerships. Environmental Defence in the US has partnered with Federal Express to do research on a low emissions vehicle for courier deliveries; it has also partnered with the US administration to study emissions trading systems. It has drawn lessons from businesses who share the savings achieved through innovation with employees – a powerful incentive. Case studies in a Chinese context could illustrate how the creative energies of China's people could be better harnessed.

73. There has been work on the payment for ecosystem services in the past; there has also been work on assessing the values of specific ecosystem services, although this has been less successful. But there has been little success so far in creating a mechanism to ensure the benefits of ecosystem conservation accrue to the custodians of the ecosystem services. This area would benefit from innovative work in China. In addition, with the emergence of new and larger cities in China, there is scope for work on sustainable cities – allowing for improved planning around transport and other issues. China is fast becoming one of the largest consuming nations in the world; sustainable consumption models will be key to wiser resource use. Greater public awareness, the use of eco-labelling and other interventions could be key but additional work is needed in this area.

74. China's people and its leaders are increasingly paying attention to sustainable development. But more is needed, especially in the area of local governments. Decision-makers at those levels do not have high awareness or understanding. Planning is key; but even if China has broad experience with the planned economy of the past, the capacity for sound, scientific planning is still lacking. Many of the plans developed for various sectors or at various administrative levels contradict each other. Innovation, capacity building and additional analysis are needed in this area. Moreover, problems have occurred in the past due to unruly real estate development; improved governance around regional and urban planning is necessary.

75. The Chemicals SPS puts forward timely proposals in the management of chemicals. Many dangerous chemicals are spread through non-point pollution, and are therefore harder to control. But the study would benefit from compartmentalizing its recommendations in the areas of chemical production, usage and transportation. For instance, standards should be strict when it comes to licensing and regulating new chemicals. Similarly, transportation of chemicals needs more focused consideration. A staggering 20% of chemicals are shipped along the Yangtze River; yet rules are lacking for the transport of hazardous chemicals. In the use of chemicals, a paradigm shift is required; the non-harmful use of chemicals should

be promoted – hence the application of fertilizers and pesticides should be reduced.

76. It would be useful to link what the EU does in terms of risk assessment systems, and what the SPS on Chemicals proposes. In addition, were EU standards to be adopted by the GOC in its procurement practices, but not necessarily putting these standards into law, this could have a large impact on innovation. The Netherlands' experience underlines the necessity to have good cooperation between government, the private sector and universities to support innovation as a bottom-up and a top-down process. Recent work on energy saw cooperation between six ministries, facilitated by a special directorate; innovation is hastened by intersectoral approaches. Government needs to change the way it does business in order to support innovation effectively.

77. Innovation is difficult because commercial outcomes are dependent on future government policies. It is therefore important for government to consider capital support programs during the early stages of development or adoption of a new technology or process. Australia has set up cooperative research centres that get government funding but that are a blend of private sector's, research institutions' and universities' contributions.

78. Environmental innovation depends on the ability of bankers to support the work of innovators and entrepreneurs; it is also incumbent upon innovators to make a business case to their bankers. There is a lack of capacity for this kind of work in both sectors, and new curricula are needed in universities to prepare professionals for this new kind of innovative process. We need to put a head on environmentalists, and a heart into bankers.

79. China needs a system to implement its new policies of scientific approach to development, people-centred development and harmonious society. The legal framework has evolved since 1978 when the reform and opening program was put in place. China has borrowed much from other countries to set up its environmental laws and regulations. But implementation remains problematic and more innovation is needed in this area.

80. China's consumption levels are not high but they are not conducive to energy conservation. Traditionally, it has been virtuous to conserve energy and resources in China. This should be encouraged again.

ITEM 6. SESSION THREE: PRESENTATION OF POLICY RECOMMENDATIONS TO THE CHINESE GOVERNMENT

81. With Vice-Chair Klaus Töpfer presiding, the Council reviewed the draft CCICED Policy Recommendations to the Chinese Government. The Draft was produced by the Council Chief Advisor （CA）team, led by Professors Shen Guofang and Arthur Hanson.

During his introduction, Chief Advisor Shen Guofang underscored the following points.

82. The Draft Recommendations are based on the recommendations put forward in the various 2007 AGM reports, papers and presentations. They centre around the theme of Innovation Strategy for an Environment-friendly Society. They also take into account the important pronouncements made during the 17th Congress of the CPC. The main issues tackled are the policies and mechanisms needed to ensure emissions targets contained in the 11th FYP can be achieved; the control of secondary pollution from chemicals; the strategic transformation facing China; environment and development in China in the context of increasing globalization; and the establishment of a national eco-innovation system.

83. The first draft was produced in Chinese and revised by the International CA. There are still outstanding differences between the English and Chinese versions that will need to be resolved. For instance, more work is needed on the wording related to the 11th FYP emissions targets. Moreover, we need to look beyond the 11th FYP to 2020; hence we need to address the 12th and 13th FYPs.

84. Vice-Chair Klaus Töpfer opened the floor to CCICED Members for their input on the document. The drafting team, led by Vice-Chair Töpfer would then present a revised document to Council on the final day of the AGM for Members' approval.

85. During the course of the discussion, Members emphasized the following issues.

86. Among the five themes outlined in the draft, the area of institutional and structural issues in environmental management remains problematic. It would be important to ensure there is continuity with previous CCICED recommendations submitted to the GOC; in this area, the recommendation to enhance SEPA's status to a full ministry was put forward by the TF on Environmental Governance and was discussed with China's Premier Wen Jiabao in 2006. There is also a recommendation to improve the technical capacity of local governments to better perform on the environmental front; but the capacity building required is also institutional. In addition, there is a need to reform the penalty structure for non-compliance in China. This should be added to the present recommendation.

87. It is important to recognize there is environmental globalization occurring at present. In the EU and the US, proposals are being discussed around the imposition of tariffs on the goods from countries with lower environmental standards. This represents a risk for China, which is not reflected in the draft paper. In addition, it would be productive to spell out clearly the expectations the Council has of the business sector in relevant passages of the paper.

88. A recommendation should focus on the main sources of pollution in China and the volume of the major pollutants. Most of the situation is due to outdated production

processes, plants and equipment, as well as inadequate management. Therefore a holistic approach is needed in proposing recommendations; points dealing with this general issue should be consolidated. The recommendations should clearly state that the GOC should aim for a reduction of the total volume of emissions and pollution.

89. The 17th CPC Congress has determined that the environment will now be mainstreamed throughout government. A prerequisite for the implementation of this directive is to make sure there is a voice for the environment at the cabinet table. As long as SEPA is not a full ministry, this voice cannot be heard. Yet other ministries' decisions can have large impacts on the environment – for instance in the area of subsidies or taxation. China will go through an important reorganization of the State Council and ministries this spring; such a recommendation from the CCICED would be timely indeed. In addition, since the evaluation system of local officials is also undergoing revisions, it might be useful to recommend ways to integrate sustainable growth in the evaluation criteria.

90. The recommendations should highlight continuity by starting the paper with a passage linking this year's recommendations with those of past years. What is presently the third section of the paper, regarding strategic transformation, should be at the beginning of the paper, logically moving from the general to the specific.

91. The imperative to manage chemicals is the price we must pay for development; we have allowed the legacies of the creation of chemical compounds to go on for too long. China should draw from the wealth of foreign experience in the areas of science, legislation, regulation and corporate responsibility. Mechanisms also exist in the multilateral agreements reached on the management of chemicals. Acting on this promptly is essential for China's trade sector and its economy. The Council has dealt with economic globalization in the past; it is important to cast this issue in terms of opportunities, not just challenges. Changing the structure of manufacturing and trade would allow for a transition from "*Processed in China*" to "*Made in China*". Long-term competitiveness could be gained by China were it to take part in the global governance system for a fair marketplace.

92. The second section of the paper should encompass health concerns in its heading. It is also suggested that the relevant recommendation include a reference to the Organization for Economic Co-operation and Development （OECD）good laboratory practices system, which China could adopt.

93. The importance of international cooperation in solving global environmental issues is at present buried in the text and should be highlighted. China has played a critical role in the Montreal Protocol on Ozone Depleting Substances（ODS）; it could play a similarly key role in Bali on climate change.

94. While China's environmental investment decisions are made at the national level, implementation happens at the provincial level. It would be useful to recommend that SEPA have the mandate to make grants to provincial governments, which would be conditional on their implementation of environmental rules and achieving key targets.

95. Given the importance of China achieving its 11th FYP emissions targets, and the challenges existing before these targets can be reached, it may be necessary for China to ramp up current efforts. This should be reflected in the recommendations.

96. The theme of innovation strategy needs to be further emphasized in the introduction. Moreover, it would be useful to single out the importance of rule of law in the third recommendation.

ITEM 7. SESSION FOUR: ENERGY SAVING AND EMISSION REDUCTION IN CHINA AND GLOBAL CLIMATE CHANGE

97. Vice-Chair Børge Brende presided over the Council's session on Energy Saving and Emission Reduction in China, and Global Climate Change. He introduced SEPA Minister Zhou Shengxian, Executive Co-Chair of the CCICED, who addressed Council members on China's achievements in the area of emissions control and the 11th Five Year Plan targets. During the course of his presentation, Minister Zhou emphasized the following points.

98. The reduction of GHG emissions is at the top of the GOC's agenda. A leading group has been formed, presided by Premier Wen Jiabao, and an important conference was held on this issue and was televised nationally. This shows the GOC's commitment to mobilize all resources to achieve the targets set in the 11th FYP. Already, key emissions per unit of GDP are starting to decrease. This demonstrates an important shift and shows that a developing country can reduce emissions while still pursuing economic growth.

99. Decisive actions have been taken to mothball inefficient thermal power plants while putting more energy efficient plants on stream. The GOC has promoted the use of desulphurized coal, with some 40% of coal-fired power plants now operating desulphurization facilities. The situation with respect to waste treatment has also improved, with some 60% of sewage now treated before release. Similarly, plants that have outdated facilities, such as cement factories, steel mills, pulp and paper mills and others, have been shut down. These efforts have not been fairly reflected in international media reports.

100. The lessons learned from the toxic spill in the Songhua River have been summarized and a new policy for the recovery of rivers and lakes has been proposed. The

guiding directive will be to allow these water systems to rest and recover naturally. Water is the source of life and at the root of most great civilizations. China is cognizant of great civilizations now silenced because their river systems failed. Aside from putting less pressure on river and lake systems to allow for natural regeneration, China will also take positive measures to ease development pressures on these systems, and to protect the ecosystems. China will continue to use its water resources, but it will cut emissions at source and limits will be strictly enforced. This will require revisions of several laws and regulations. Sewage treatment for urban areas will be improved and a more rational use of water will be enforced. This will require the joint efforts of all stakeholders.

101. China hopes to play an important role in the fight to control climate change. China's President Hu Jintao and Premier Wen Jiabao's views on the matter can be summarized in three key points. First, all countries should continue to negotiate on a sincere and honest basis; all countries share a common responsibility for climate change, but developed countries need to face up to their historic contribution to the problem and adopt stricter emissions targets. Only in unity can we achieve a reduction of GHGs. Secondly, a change in the modalities of production will be needed to slow down climate change; the idea is not to stop development, but to change the development paradigm. China and other countries still need to grow in order to reduce poverty. Thirdly, there is a need for improved access to advanced technologies and information for LDCs, and DCs hold the key to this technology transfer.

102. Vice-Chair Børge Brende introduced Council Member and Executive Director of UNEP Mr Achim Steiner. In his address to Council, Mr Steiner emphasized the following issues.

103. A key area of innovation is innovative thinking; the 17th Congress of the CPC shows there has been a paradigm shift in the way China sees environment and sustainability as part of growth and development. Over the last fifty years, we have lived equating environment with a clean-up operation, and we have seen environmental protection as a tax on development. As we now draw near to several tipping points in terms of what the planet can sustain, drawing down our natural capital, many countries are now entering a transition phase where environment becomes central to sustainable human progress and well being. China is in the midst of rethinking environmental sustainability in the context of economic development in order to generate a transformative economy that can produce sustainably the comforts of life for people. China is at the forefront of the work on the environment as a driver for development.

104. Climate change is a sobering scenario, with the planet on the threshold of

unimaginable consequences. But this dangerous time is one of opportunity as well. Climate change and its dangers can stimulate a push for much greater efficiency, product and job creation innovation, and the transformation of various processes. This is already underway. China is facing many threats – desertification, pollution of lakes and rivers, acid rain and so on – but there are few countries that can react and take action as quickly as China.

105. New industries and jobs are being created through these opportunities. China already dominates much of the solar cell and solar power industry. In the context of the Montreal Protocol, China could soon, through technical innovation, dominate the air conditioner market with its energy efficient products.

106. In terms of natural capital, the news is grim. The UNEP report published this year on the ecosystems of the planet shows that over the past 20 years, the situation is worsening in all cases. Each is a case study of what could have been done differently with transformative thinking. Ecosystem goods and services are key to limiting climate change; the resilience of ecosystems and their ability to adapt will be crucial. It is hoped the Council will continue to adopt a holistic approach and not reduce the discourse to issues of technology and mitigation.

107. There are important positive signals. Council is demonstrating a greater pragmatism and a willingness to recognize that if 1.3 billion people can live in a more sustainable manner, this is positive for the whole world. It will be important to ensure full international cooperation, and the Bali meetings will be difficult because more than 190 countries taking part have conflicting interests and perspectives. Member states must ensure the United Nations （UN）system is supported so it can continue to play a pivotal role. The world needs a framework and an action plan by 2009. China can play an important role in ensuring the UN continues to be the forum for international action on climate change.

108. Co-Chair Børge Brende introduced Ms Wang Jirong, Vice-Chair of the China Environmental Protection Foundation and Co-Chair of the TF on Policy Mechanisms towards the Successful Achievement of the 11th FYP Environmental Targets. During the course of her presentation, Ms Wang made the following points.

109. The first part of the TF report provides an analysis of the problems posed by emissions reduction in China. Targets have been set and have been broken down for each province for key pollutants such as SO_2 and COD. The targets were based on an assumed 10% growth in GDP. But reducing emissions has political and economic, as well as technical implications. Economic theory shows clearly that it is difficult to decouple GDP growth from environmental damage due in part to increased energy consumption. Pollution reduction is a political issue because China is now one of the top emitters of COD, POPs

and other major pollutants, thereby attracting world attention.

110. While recent figures indicate that China may be able to control incremental emissions, current reduction schemes are not sufficient to reaching the emissions targets set in the 11th FYP. The current coal desulphurization capacity is still too low, and coal consumption continues to rise; moreover, some desulphurization facilities have been poorly engineered, have low technical standards, and cannot be operated. For COD, the total sewage treatment plants' capacity in China is not being maintained and a significant proportion of total sewage is still untreated. Government agencies are having difficulty implementing existing laws and regulations. Investment in pollution control processes and equipment is inadequate. There is a quality gap between the design of treatment plants and their implementation. Setting aside funds used for afforestation, only 0.5% of GDP is at present invested in the environment.

111. The TF recommends that the GOC prioritize the indicators used in assessing the performance of officials; GDP growth should clearly be less important than pollution reduction. Audits of lower levels of government and agencies should be conducted on issues such as resources and energy conservation, and pollution control. Economic policies need to be more effectively coordinated with environmental policies. There are not enough incentives for enterprises to abide by environmental standards. Pollution control needs to be conducted on the basis of total emissions. There has to be special attention paid to export-oriented enterprises, and stringent efforts need to be made to stop the importation of toxic materials for recycling. Finally, the GOC could emulate the US measures to support green buildings through tax incentives.

112. Many countries have achieved significant progress on emissions control by the adoption of new technologies and cleaner production techniques, by the use of low sulphur coal and desulphurization, and by effective administrative, financial and regulatory means. Most countries spent roughly 5% of GDP on the environment – 10 times more than China's investment. In some cases, funds have been set up to assist with infrastructure investment in pollution control. Other economic instruments such as tax incentives and subsidies have been used to generate desired change in industry. By the time the 12th FYP is formulated, China needs to study these examples in a timely manner and adopt those it deems most appropriate. Priorities for action during the 12th FYP include industrial boilers, the power-generation sector, and pollution control in rivers and lakes.

113. With Co-Chair Børge Brende presiding, Member Sir Gordon Conway, Chief Scientific Advisor of the UK Department for International Development （DFID）and Professor He Jiankun, Vice-President of Qinghua University addressed Council on

preliminary work on a proposed TF on the Low Carbon Economy. During the course of their remarks, they underlined the following issues.

114. The evidence is undeniable: carbon emissions from human activity are at unprecedented levels and are changing our climate. Analysis done by the China Academy of Agricultural Sciences shows minimum temperatures rising rapidly in northern China while precipitation is going down in the south and centre of China, and increasing in the west. A greater frequency and severity of extreme weather events such as droughts and floods is occurring. The planet is now reaching dangerous points-of-no-return – such as the melting of the Greenland icecap. There is therefore an urgent need to reach a global agreement on the price of carbon emissions, and we need to develop low carbon technologies.

115. This represents an opportunity to shift into a new competitive era. In the EU, an emissions trading scheme is now setting the price of carbon emissions. Political leaders are committing to ambitious targets, such as the UK's pledge to cut 80% of its emissions by 2050. This will drive innovation towards 0-emissions houses, and programs such as the ban on plastic shopping bags.

116. Transportation contributes to 40% of emissions in the UK, but only to 4% of emissions in China. Conversely, agriculture is a larger contributor to emissions in China. All sources of emissions must be tackled in order to control total emissions. China is committed to increasing renewable energy sources, while decreasing coal-generated power to 50% of its total energy production. But China will still be increasing its capacity of thermal power plants and will be burning increasing amounts of coal. This highlights the importance of carbon abatement technologies; higher efficiency of thermal power generation is key. The UK is keenly interested in international cooperation with China on the issue of a low carbon economy and recommends a new TF be formed.

117. There is still much room for improvement in carbon intensity in China, although significant progress has already been made. Since 1980, per unit of GDP carbon emissions have decreased by 66%. This drive for greater efficiency and for a reduction in emissions will spur new technologies and other innovations. Clean coal technologies and carbon sequestration could reduce the impacts of coal power generation. Global action on climate change is taking us down the low-carbon road. Additional international cooperation is needed in order to allow LDCs access to technologies, using the CDM. Further developments of the study and recommendations could be submitted to Council in coming years.

DISCUSSION

118. Vice-Chair Børge Brende presided over the discussion on the issues raised during

the Session. During Members' interventions, the following issues emerged.

119. The work of a TF on the Low Carbon Economy would be a valuable addition to the work of the CCICED. One of the issues to touch upon would be the so-called "no-regrets options" – actions that China should take now and that can yield immediate benefits. It would be important to also identify the foundation for the longer term development of a low carbon economy; there is a clear link here to the Innovations TF.

120. The TF on the 11th FYP Emissions Targets has highlighted an important policy contradiction in pointing out conflicting mandates of various ministries when it comes to SO_2 controls. It would be important to highlight the contradictions that can be resolved in order to move more consistently towards stated goals.

121. As China pushes for common but differentiated responsibilities in the control of GHG emissions, the price of carbon and hence energy in the developed world will increase more rapidly than business-as-usual assumptions. Even as China tries to move away from energy intensity, its relative energy price will fall compared to the global economy, unless it takes action to address energy pricing. This highlights the importance of reforming China's energy pricing policy, for exports and perhaps for domestic consumption as well. It might be useful to look at global agreements governing energy-intensive, footloose industries such as the aluminium sector.

122. The Council should look into the implementation of a low carbon economy in China over the next five years. Recommendations to the State Council could encompass the issue of effective emissions and energy-intensity indicators and targets. In addition, greater discussion is needed on the acceptable levels of temperature increases due to climate change. Developed countries can perhaps cope with a rise of 2 degrees Celsius in terms of emissions control, but this could prove a difficult challenge for poorer countries that still need to develop in order to feed people. Some countries may be willing to face the problems associated with higher temperature increases in order to make progress.

123. The two degrees Celsius mentioned is an average global value. In fact, the temperature fluctuations will be more pronounced in certain areas of the globe, such as the arctic. Many of the northern latitudes will be more affected than southern latitudes, which is important to China.

124. Emissions control needs to be considered in the agricultural sector. Grain security is still an important priority for China. Energy consumption and production in rural areas should be considered in future by the Council. Agriculture in China is still extensive, with high levels of waste and non-point pollution from pesticides and fertilizers; much improvement could be made while at the same time improving rural livelihoods. Rural areas

have significant potential for power generation through bio-fuels and waste.

125. The morning's presentations share three points in common. On the national level in China and in the OECD, as well as globally, there is a great deal of urgency for a post-Kyoto regime by 2009, in order to reach the peak of CO_2 emissions by 2015. In this context the emissions targets in the 11th FYP reflect this urgency for China. Secondly, there is no room for incremental improvement; there is a need for radical action and the proposed TF on the Low Carbon Economy is very timely. Third, in order to take this route, a system of effective global incentives will be needed in order to avoid inaction. Work on the global carbon market and what this could mean for China is very relevant. A different kind of cooperation is needed in order to support the development of a low carbon economy; priorities should be set and elements of action plans put in place for this work globally. This could be part of the TF's workplan.

126. Wastewater is the main source of COD; and much of this is urban wastewater. This poses a threat to the health of rivers and lakes, and also threatens the quality of potable water. Many areas in China are short of water, due not only to quantity, but also to low quality water that cannot be purified for use as tap water. There are 660 cities in China with sewage treatment plants, but one third of cities do not treat their sewage at all, while others have low efficiency sewage plants. In older systems, storm sewers are not segregated from the waste pipes. Massive investments are needed to bring all urban sewage under effective management. Sludge from wastewater plants can no longer be disposed of on land, as in the past. This issue still needs to be resolved. Many of the more modern treatment plants are not used at full capacity due to various administrative and policy reasons. Moreover, some 30,000 smaller towns and townships have no sewage treatment and there is a need for innovative approaches to treatment of waste water in those areas.

127. Sweden is prepared to support the work of a TF on the Low Carbon Economy. Its TOR need to be elaborated carefully in order to avoid duplication with other efforts in this field.

128. The work of the private sector in the fight against climate change needs to be mentioned. Large food producers started sustainable food initiatives and have generated data and strategies; multinationals have teamed up with universities in order to look into this. The TF should review carefully the work done in this area in order to avoid duplication.

ITEM 8 SESSION FIVE: DISCUSSION AND APPROVAL OF THE RECOMMENDATIONS

129. Co-Chair Klaus Töpfer presided over the final discussion and approval of the

CCICED Recommendations to the Government of China. The revised draft was presented to Council by International CA Arthur Hanson, who highlighted the following points for Members.

130. The revision work was done using the English version, with the contribution of several Members. A Chinese version was then produced. The initial order of the main points raised has been retained. In general, more focused statements have been produced. One of the changes has been to include the Chinese term “ecological civilization”, which has been introduced during the 17th CPC Congress; it is judged useful to be consistent with current Chinese thinking in this area.

131. Co-Chair Klaus Töpfer invited Members to comment on the revised draft. The following points were made during this discussion.

132. More time should have been allotted to discussion during the AGM. It is a waste of the talents assembled not to maximize their contribution.

133. Greater integration of the business sector, in particular China’s, in the work of the Council is needed. Implementation of any technical innovations, pollution control policies and other measures is often left to the business sector. Global sector approaches involving Chinese companies are essential, and the GOC’s support is needed to foster this discussion. Perhaps a TF on the role of business in the environmental area in China would be useful in future.

134. The discussion on the need to develop a low carbon economy is not reflected in the present version of the recommendations. The spirit and tone of the Council’s discussions should be better reflected in the document. Similarly, the section on China’s ecological footprint needs to mention that China is at present over-stripping the capacity of its land to support its population.

135. The next AGM should be organized differently. Each TF or SPS report needs to be discussed by members after it is presented.

136. The revised recommendations were approved by members for submission to the State Council of China.

ITEM 9. CLOSING CEREMONY

137. Vice-Chair Børge Brende presided over the final session of the 2007 AGM. He introduced CCICED Secretary General Mr Zhu Guangyao who presented Council with the 2007 Work Report and the 2008 Workplan. During his presentation, Secretary General Zhu made the following points.

138. Council activities in 2007 focused on the transition between Phase Three and Phase Four. The Secretariat produced its report to the GOC and worked with a variety of partners and donors. The composition of the Council was changed to better suit the requirements of Phase Four. The commissioned TFs and SPSs proceeded with their work smoothly. A report distributed to Council outlines the details of these activities.

139. As demonstrated by the comments of Premier Wen Jiabao in meeting with Council Members during this AGM, the GOC attaches great importance to the Council. During this Phase, the Secretariat is to perform at higher standards; the CA group has a more important role, providing a solid foundation for activities over the coming five years.

140. The new TOR and Rules of Procedures have been adopted during this AGM. The work of the CCICED will be based on China's actual needs and will reflect the strategic direction laid out during the 17th Congress of the CPC. In addition, the Council will pay increasing attention to China's role in the world and the impacts of globalization on China itself. Issues of priority will be energy and climate change. In order to more effectively propagate Council findings and recommendations, roundtables will be held with various stakeholders.

141. The main activities of the CCICED in 2008 are as follows. One SPS and two TFs will complete their work and report to Council. Five more TFs studying various aspects of energy and environment will commence their work in 2008 and 2009. Further proposals have been made on the low carbon economy, on rural energy and development, and on adaptation to climate change. The theme for the 2008 AGM will be Innovative Mechanisms for Harmonious Development; it will take place in Beijing from November 12th to 14th. Following the 2007 AGM, during the first half of 2008, a Roundtable will be organized in order to disseminate policy recommendations and study findings; members are welcome to attend and will be given a three months' notice of the event. In addition, Council recommendations will be distributed to local governments, media organizations and other agencies.

142. Co-Chair Børge Brende invited members to comment on the Secretary General's report. During the discussion, the following issues were raised.

143. The TF on Environmental Governance of Phase Three had encouraged participation from local and provincial governments; they made a valuable contribution. It is recognized that there are gaps between central government policies and local implementation. Perhaps roundtables could be organized regionally in order to ensure greater penetration of Council recommendations throughout China. Regional roundtables could be tailored to fit the area's chief concerns and priorities.

144. The new TOR of the Council makes mention of private sector forums. Over the coming year, such a forum should be organized in order to assess the role the Chinese private sector could play in the Council. The World Business Council （WBC）would be interested in working with the Secretariat to organize such an event. Another element of the new TOR is the provision for special observer status for business people. More information is needed on the eligibility of potential observers, but this initiative should be encouraged.

145. China is building an enormous amount of new commercial, residential and industrial construction. Despite existing building codes, the quality of the construction and energy efficiency are low. The WBC has a project in China focusing on energy efficiency in buildings. Major gains could be made if new buildings going up now were more efficient. This could also be the focus of a future TF.

146. There is a cascade of activities with TFs in the coming years focusing on energy-related issues. Energy efficiency, including in buildings and in transportation, will be considered, as will market-based instruments, the sustainable use of coal, the low carbon economy and others. The TFs need to be set up expeditiously so work can commence. Council members will be solicited for input on their TORs. Because energy and environment issues are complex, it will be important to coordinate the work of various TFs and SPSs in order to maximize their effectiveness.

147. In the past, the Council worked on bio-diversity issues. This AGM has seen mention of ecological civilization, of ecological deficit, of ecosystem services, of eco-restoration – allowing rivers and lakes to rest so they can regenerate. There is a need for additional work in the area of natural capital in times of transformation during this Fourth Phase. Additional ideas from Members would be valued.

148. Attention should be drawn to the link between ecosystems and adaptation to climate change. The focus is often put on mitigation and on improving technologies and efficiency to reduce GHG emissions, but the resilience of ecosystems to the degradation brought by climate change is an important area of study. There is an international community of professionals working on this, and there are good Chinese institutes interested in this work. The Council could provide an ideal platform for this work.

149. There should also be some attention paid on the ways the AGMs are run, who can be invited, whether or not some of the work could be done in smaller working groups that would then report to the plenary of the AGM.

150. It is important for the Council not to repeat earlier work. There was a report on Ecosystem Services in past years and this could be the basis for future work. This new TF could be timed to coincide with the next Conference of the Parties of the Convention on

Biodiversity in Bonn.

151. Rural issues are important in China and the TF should not limit itself to energy considerations. Similarly, urban areas should be the focus of work on energy, especially given the 2010 World Expo in Shanghai which has as theme “Better Cities, Better Life”. Council’s work in this area could be linked to this World Expo. Chinese entry points should be sought for the work of the Council and for its pilot projects.

152. A workshop could be held around the notion of a 2 degree Celsius climate change. A roundtable or working group looking into the current international agenda and China’s role in this regard could also be productive.

153. Caution should be exercised when using the ecological footprint measure. Although it is a useful teaching and publicity device, the common denominator of the footprint is hectares of bio-capacity. However, water is not taken into consideration. Australia would seem to have a surplus of bio-capacity, but this is not the case due to water scarcity. Many indicators are needed in order to produce a reliable picture.

154. Attention should be paid to the length of the reports submitted to members. Executive summaries should be provided.

155. It would be useful to have an analysis of the past recommendations of Council that were not adopted by the GOC.

156. Co-Chair Børge Brende introduced the CCICED’s Executive Co-Chair and SEPA Minister Mr Zhou Shengxian, who pronounced the closing speech of the 2007 AGM. During his remarks, Mr Zhou underlined the following points.

157. The AGM has been a lively one, with thought-provoking presentations and stimulating exchanges amongst Members. The objectives of the AGM have been achieved. Premier Wen Jiabao, in meeting with Council, highlighted the various areas where innovation is needed, namely science, institutions, laws and mindset. Premier Wen announced that China had turned the corner on emissions, that they are starting to decrease when measured per unit of GDP. China is paying attention to climate change and the need to build a low carbon economy as it prepares for the Bali conference.

158. The Premier emphasized the Council is a good platform for international cooperation. If the Council helps 1.3 billion people improve the environment, it is also helping one fifth of the world population. Members were also briefed by Vice-Premier Zeng Peiyan on China’s efforts and on the global perspective on emissions control. The speech from Dr Pachauri of the IPCC on climate change was important. Five sessions were held to discuss various SPS and TF report and to work on recommendations to the Chinese government.

159. Since the 17th CPC Congress, environment is to be mainstreamed in China's development. More efforts are needed in future and the Council's recommendations towards strengthening China's innovation system are timely. International cooperation will be key in this area.

160. Council recommendations are an important document. By the next Bureau meeting, the Secretariat will provide feedback on the reception given to these recommendations by agencies of the GOC. It will also look into the reasons why some of them are not implemented.

161. The Council in its Fourth Phase has an entirely new look. It is maintaining its vitality in order to fulfil its important role. The composition of Council is representative of important sectors and geographic areas. The members are specialists of outstanding repute and experience. The core of the Council's work in the coming years will be on energy, which has the most serious repercussions on the environment and on climate change. More work can be done to improve the workings of Council in order to allow members to express their views and perhaps work in smaller groups.

162. Chinese leaders are more willing than ever to listen to the Council. The recommendations are widely used in supporting more sustainable development in China. An important responsibility is the dissemination of the Council's work and recommendations. Members are invited to pay close attention to issues of importance to China, and to support the increased flow of technologies and training of personnel between China and their countries. Because the contribution of the Council is practical and timely, it is bound to play an ever greater role in China's development.

163. Co-Chair Børge Brende pronounced the 2007 AGM closed.

IV. MEETING WITH PREMIER WEN JIABAO

164. Premier Wen Jiabao met with international CCICED Members at the Zhongnanhai Compound on November 29th 2007, the second day of the AGM. The Premier welcomed his guests and engaged Co-Chairs Klaus Töpfer and Børge Brende in discussion. The following notes were made during the course of this meeting.

165. *Premier Wen Jiabao （WJB）*: Welcome to our friends of the CCICED. This is the 16th year of the Council – its continued existence demonstrates the resolve of the Government of China（GOC）to build an economy that is environmentally friendly and that conserves resources. This is indeed the strategic direction of our development program. Your theme this year of Innovation Strategy for an Environment-friendly Society is closely related to this. I have met with you now ten times; some of the faces on Council have

changed and the themes are different each year, but what does not change is your enthusiasm and your commitment to helping China.

166. We know we must, as a nation, be open to the world and inclusive and receptive to good advice; only then can we build the prosperity to which we aspire. The CCICED is an excellent platform for exchanging views and learning from each other. I am keenly interested in your ideas and your recommendations on innovation in the context of building a resource-saving and environmentally-friendly society.

167. *Vice Chair Klaus Töpfer （KT）*: International members of the Council are grateful you are devoting some of your precious time to meet with us. We are aware that this is a critical time in China's history. We are meeting with you a few weeks following the 17th Congress of the Chinese Communist Party. We have studied some of its key documents and we note you have embarked on an important transition. This is the first meeting of the Council's Fourth Phase; two thirds of our members are new. A first meeting is important for agenda setting and for members to get better acquainted. But we are doing solid work on this theme of innovation. We have determined that this phase will see us undertake some policy demonstration projects, such as piloting a low carbon economy in a small to medium size city in China. We have based our deliberations on work done by the Secretariat of the Council, and the Chinese and International Chief Advisors.

168. We remember well our discussion last year when we talked about your concept of *Three Transformations*. We know such an endeavour will require the participation of China's entire population. Our members have rich experience to share from their own countries. It is critical that awareness of this concept keep building and that people be brought on board. I am a professor at Tongji University in Shanghai and I teach your *Three Transformations* to my students, who are keenly interested in this. Transformation requires innovation – innovation in the areas of technology, politics and institutions. We would like to emphasize that in order to ensure equal importance is paid to environment and development, there is a need for a full ministry to advocate for the environment within cabinet. As a former environment minister, I know that it is critical to have a seat at the table. We feel it is important to put in place a solid architecture supporting effective environmental governance at the national, regional and local levels. It is also critical to strengthen the capacity of the institutions that are charged with making these improvements.

169. We wish to congratulate you on the outstanding success China is achieving on the economic front, with GDP growth of over 11% this year. But in line with the 2nd of your *Three Transformations*, it is important that environmental dimensions be considered now, not after economic development has taken place. We see with pleasure the plans you have to

invest in greater energy efficiency and in measures to combat climate change. There is no doubt that a "crash program" is needed in the current Five Year Plan so China can show the world that it can reach its emissions targets.

170. In addition, the Council feels it is imperative to deal with chemical pollution problems. There is a need for stronger administrative and legal measures to curb pollution. This is a global challenge, and it is one where trade implications could be serious for China. Finally, in this globalized world, China is one of the economic pace setters. The need for energy and resources will only grow as China continues to develop. In this context, it becomes ever more critical to develop green markets, protect the environment, and ensure wise use of our natural capital. China can take the lead in being more environmentally friendly and in conserving its resources. It is our hope that we can provide you with solid recommendations in thanking you for your continued support.

171. （*WJB*）: You have conveyed just now the main points of your meeting; let me highlight some of them. You have mentioned three key areas of innovation – technical, institutional and legislative. But I believe there is a fourth and most important aspect: innovative thinking. Secondly, indeed China's economic growth is very rapid, but it must be sustainable. We must consider the capacity of the environment and our natural resources and energy capital. Resource use must be sustainable. Thirdly, I note that in our discussion of the *Three Transformations*, in innovating to develop an environment-friendly society, we need the underpinning of a solid institutional framework. Only then can we achieve our objectives.

172. Fourthly, in discussing the low carbon economy and its application in cities, as well as in the discussion of environmental indicators, I want to highlight two issues with which we are grappling. Already Beijing has 3 million vehicles on its streets; the environment cannot bear further growth in this area. We must develop more options for public transit and light rail transport. Similarly, we cannot continue to rely on fossil fuels for our growing energy needs due to the pollution generated, so we must focus our efforts on clean technologies and renewable energy sources. Finally, let me underline that China's development is at the crossroads. Environmental protection and sustainable development are our top priorities. This message must be received by our whole population; we must all understand that developing first and putting off dealing with the environment will lead to disaster for our posterity and for the whole globe. The old road of development first and cleaning up second is simply not feasible.

173. *Vice Chair Børge Brende*（*BB*）: The Chinese government has taken concrete actions over the past year in both environmental and energy areas. I have studied China's

program to combat climate change and it is very good. Without energy, there can be no development, but without decoupling economic growth and the growth of emissions, China will run into greater problems with deforestation, desertification, climate change and other negative effects. China's position is a realistic one; there must be a transition between the use of fossil fuels and that of renewables – and carbon capture and storage can be such a transition. But when we report to you, Mr Premier, on a roadmap to a low carbon economy, where can the Council provide added value? This is an important aspect of the tasks facing us in this Fourth Phase.

174. *WJB:* In meeting with you, I have answered a longer exam paper this year compared to years past and it seems my performance has improved! In forming our leading group on climate change, in issuing our national program to combat climate change, in formulating a set of indicators of progress, in stipulating a reduction in emissions and in setting up mechanisms for evaluation and supervision, we have done practical work. We can provide you with all relevant documents should you be interested. Already, we are achieving results. The past trend of rising energy consumption per unit of GDP has been reversed – in fact it has dropped by 2.8%. Sulphur dioxide has similarly dropped by 1.2% and Chemical Oxygen Demand （COD）by 0.28%. We have turned the corner in our efforts in curbing emissions.

175. Our officials are changing their thinking. In the past, they were obsessed by GDP growth. Then when we had SARS, they all became familiar with the letters CDC – the acronym for Centres for Disease Control. Now they are becoming familiar with COD. To be honest, they are still vague on what a low carbon economy really means. And yet this is of vital concern for the whole world and it will be discussed in Bali. China faces some difficult challenges. On one hand our population is increasing so we need to have our economy grow; that implies the demand for energy will continue to increase. The question is how we can provide more energy while cutting down greenhouse gas emissions.

176. Our second challenge is that economic growth must be coupled with energy efficiency and resource conservation. These efficiencies apply to all sectors – industry, agriculture and people's way of life. To effect such broad changes requires comprehensive policy measures. The third problem we have is that we need to adjust and shift our old energy structure. China has many areas where wind, solar, geo-thermal and nuclear energy sources can be harnessed. The fourth issue is how we can combine lower energy consumption and carbon capture. This implies massive reforestation efforts. I am a geologist and I know about our Loess Plateau – China has the world's largest area under

loess, a geological feature that was created in the quaternary period when there was very scarce vegetation. We also face more specific challenges, such as the conservation of energy in buildings and how to prevent each family in China from owning a car. I have enumerated five key areas. How do you rate my understanding?

177. *BB*: You have a staggering grasp of the problems and that is very promising for China!

178. *Council Member Achim Steiner* （*AS*）: You have mentioned the need to innovate in our ways of thinking. What strikes us is the speed with which China has moved from a point where the environment is seen as a tax on development, to the point where it is an investment in future development. China has gotten there much faster than other countries. There is talk among Chinese leaders now of building an ecological civilization and a sustainable economy. This shows the environment can be seen as underpinning development, dissolving the tension between economic growth and environmental sustainability. We have arrived at a new paradigm.

179. *WJB:* I fully agree with you. We are now raising the environment to a much higher level. I want to be known as an environmentally friendly premier, and my cabinet to be environmentally friendly. I want my country to have a sound environment, with blue skies and white clouds. Of course, we must face many problems yet. I can only go part of the way; future generations will have to continue the work.

180. *AS:* You make reference to other countries; we must help each other. As executive director of UNEP and a member of the CCICED, I know that globalization can both help and hinder. China can emerge as a partner in global environmental governance. The problems we face will need the efforts of all and in Bali it will be critical for leadership to emerge, especially from China. The Secretary General will need your support in forging an equitable way forward in solving climate change. I convey the message that he will want to discuss these issues with you prior to the Bali meeting.

181. *WJB*: In Bali, you will notice that the Chinese delegation will demonstrate a positive, constructive and realistic approach. If we help China’s 1.3 billion population, we are helping one fifth of the globe’s people. That will be our contribution to the world. I would like to review some statistics that have cropped up. It has been mentioned that 600 billion RMB yuan would be needed to treat sewage and solid waste. But the amount is much larger if we take into account the need to also clean up our lakes and rivers systems. We are committed to increase the ratio of GDP spent on environmental investments.

182. *KT*: We are impressed that you have turned the corner on emissions in spite of

the very rapid growth. We are confident that things will improve if this trend continues.

183. *WJB*: I hope that when we meet again next year, I will have even better results to report.

184. *KT*: My colleagues and I hope we can become ambassadors of China's work and way of thinking in this area.

185. *WJB*: Each year, our meetings demonstrate your friendship and your confidence in our environmental endeavours in China.

186. *KT*: We also congratulate you on rising economic prosperity and the role China has played in ensuring the Millennium Development Goals are reached by making such progress in fighting poverty. We wish you all success in your fight for the environment.

187. *WJB*: Poverty has been reduced in China in a historically unprecedented manner. We are recognized throughout the world for our success in this area. I would be delighted if we can get recognition for our work on behalf of the environment. Thank you for your visit and for your help to China.

Keynote Speeches

Keynote Speech

Achim Steiner, Executive Director, United Nations Environment Program

Minister Zhou, esteemed Co-Chairs, Secretary General, dear colleagues and China Council,

Minister Zhou invited me this morning to briefly respond to his speech and some of the major messages that we have been briefed and briefed about and listened to during the past two days, and as always, it is a great privilege for me to be part of the China Council and part of a circle of, I think, international concerned people who both care about China's development, who are also engaged on the challenge of facing environmentally sustainable development in the global context.

To me it has been intriguing both this morning listening to you Minister Zhou and also yesterday to Premier Wen Jiabao and to the Vice Premier speaking about a new thinking, in fact it was Premier Wen Jiabao, Claus, you may recall after your remarks, who said that the forth pillar that we are looking for is a new way of thinking. We have heard about a new paradigm. I believe if you read carefully the report by President Hu Jintao to the 17th Congress, there're truly signals of a paradigm shift in how we look upon the reality of the environment, natural resources and sustainability in the context of the development discourse, the scientific approach to the development in China.

As I briefly said yesterday during our meeting with the Premier, I believe in many ways China's evolution of thinking reflects an experience that is shared by many countries, but interesting enough, often not as clearly articulated as it is now being articulated in China. We have lived for the last twenty, thirty, fifty years, depending on where you live in the world, with the notion of the environment essentially being a clean-up operation. Our generation is paying the price for a lack of intelligent development of the last 50-100 years, whether you point to local situations, Minister Zhou, you were just referring to rivers and lakes, whether you refer to whole ecosystems, whether you refer to what is happening to our fish stocks across the oceans, whether you refer to the atmosphere in global warming. Clearly our generation is already a generation that is paying a price for a lack of intelligent development. This clean-up phase has unfortunately turned the environmental dimension of development very often to an account that is drawing down resources. It is viewed as a taxiing development, because as you are trying to run forward you have to take money to clean up, first of all, the track on the train trying to run, and for much of the last twenty, thirty years, I have always been intrigued by how when we talk about investing in environmental sustainability, when we do so in the context of development, and let me emphasize here, not only in developing countries, the same is true in the more industrialized nations, environmental investment have been viewed as somehow distraction from your objectives of economic growth, economic development and progress.

As we reach some of the limits and critical points that's so called ticking point, the thresholds in what our planet can sustain, in terms of drawing down its capital, its natural capital, in terms of pollution, or in terms of degradation. We're beginning to see that in many different countries and economies you are entering into a transitional phase, and I believe that this is perhaps the most important moment in which a society, an economy, its key players start looking at the environment not as a marginal issue, but rather as an increasingly central part of sustaining human well being and sustaining economic progress.

In much of what we have heard during the last two days, China admits of rethinking the role of the environment and the role of its environmental sustainability dimension in future economic development, that second phase, the transitional phase when, on the one hand, you have an economic engine, pulling the train at the fascinating speed in China is accompanied alongside the clean-up operation also with a sense of new opportunities in the economy. And I think the third phase ultimately is when we do manage to transform the economies with which we are trying to sustain an ever growing population, an ever growing demand for services, for commodities, for human well being, for the comforts of life in the broader sense of the word. In that sense, the term environmental protection may also need to evolve in the development discourse that we have not only in China but worldwide, because the future of environmental dimensions of development should not only be restricted to the notion of protection. It is in fact in some ways an investment with great future returns in economic terms.

The notions of sustainable development that we have worked with for around 30 years now ultimately try to capture that linkage. But if you are honest to this day, we have not quite completed that process beyond the theoretical paradigms and the experimental phase. I believe that China is now the forefront of helping the world to interpret the environment in the context of development more as a driver for development. And if you take the issue of climate change, on the one hand, it is truly a sovereign scenario that we now face in the year 2007 after the IPCC report and many other national reports have been put on the tables of decision-makers and our societies, we have truly succeeded as a global community of human beings to take this planet close to some thresholds which would have been unimaginable just ten or fifteen years ago. But in every crisis lies an opportunity. It may seem a quasi statement but there's no issue that can capture this more clearly than climate change. Because I truly believe that as we move forward in facing the realities that are now before us, what we'll see is that climate change and by extension also the environmental dimension of development is turning from being a taxing development, perhaps being the greatest driver, in terms of innovation, in terms of efficiency in our economies, in terms of productivity, in terms of job creation, and indeed as a driver in the transformational processes that you have here in China often articulated in a far more powerful and essentially simple set of terms, whether it is the five balances or the three transformations, the notions of a circular economy, a harmonious society. I believe that these terms will shape the discourse on development far more powerfully in the very narrow and to some extent simplistic notions of GDP growth, per capita income, and productivity in the sense of unilateral production. Perhaps I've been optimistic but I think whenever you look at the moment that is the trend that is emerging. It does not mean that it is yet the central paradigm; I think it was one of our Chinese colleagues yesterday who said that at the end of the day we have to accept that it is the economic paradigm and economic growth which will continue to capture the attention of decision makers and also the society. Yes indeed. But the differences that as we meet here today the environmental dimension of development can express itself in terms of the variables of economic growth. I think the notion that somehow environmental protection and economic growth and development are trains pulling to different directions remains one of the great mis-readings of the twentieth century.

In that sense, climate change, always posing major challenges in the transformational context and phase are becoming the drivers of an economy and society that ultimately will have a much greater viability into the future. If you look at already what is happening in China, and Mr. Zhou just referred to it, I'm always intrigued how the notion of common wisdom that is being propagandized sometimes for very particular interests in much of the media world today of two power stations building weekly in China, why is there not a comma that mentions the other half of the story, which is that is it replacing old capacity? That China today already has twice the amount of renewable energy in its energy mix than the world average. China can sell 20% of total investment in renewable energy worldwide, and we could go on, we have heard the number of figures that indicate how far that transition is already under way here. This should not distract from the fact and now I go back toward what Hanson said on the first day. China is both a nation, a country, an economy, and an environmental reality that is deeply troubling, first and foremost, to China's people and to China's leadership. We have spent years in this Council, confronting the very sovereign reality from pollution to land degradation, desertification, the challenges of waters, and this morning Mr. Zhou referred to a major effort to address also the future of clean rivers and water systems. But we have also been witnessed of a nation capable of accepting reality, willing to confront the challenge, and most importantly, beginning to act on it. I personally have not followed a nation that has made a transition from recognizing a problem to measuring it and then to begin to manage it as quickly as in China, just in these five or six years that I have been part of the China Council. It strikes something that I once learned from business: if you can't measure it you can't manage it.

In China, it has become part of a nation's commitment to trying to address these issues. But climate change is not only a driver in the macro economic context, it is also a major driver in terms of job creation, in terms of industrial progress. There're companies today in China that are dominating already on the global market in fields of photo-voltage cells, equally in countries like India, we have wind power companies that are today global market leaders, that are vertically integrating technology development with mass scale production and also the expansion of renewable energy economy that is based on an ever reducing cost of production per unit.

China has the possibility also in the context of international decisions such as in the Montreal Protocol, which will trigger the introduction of a whole new generation of, for example air conditioning equipment, to become a major player in the global market place on the back of environmentally driven technology advance. I know that there're companies in China who have technology in their draws that will reduce by half the energy consumption of classical air conditioning equipment. If we can indeed move forward with international policies that shape a global market place, the environmental drivers are everything but a distraction from economic development prospects on the country they are part of underpinning a new market place in which innovation can actually be part of job creation and economic growth. And that logic extends also to the natural capital because in these times of climate change it is sometimes tempting to forget that we are also talking about the eco-systems on our planet. UNEP published, and this is still in a sense Claus's product because it began in his tenure as Executive Director, we published this year the Global Environment Outlook 4. It took the perspective of the last twenty years, and may I say, to my own surprise, reading that document was one of the most sovereign experiences in my time in UNEP, because even though all of us deal with these issues more or less every day, if you take GEO 4, and you take a twenty-year perspective between the Brundtland

Commission first laid out some of the major sustainability variables for the future of our planet, and you look at them twenty years later, it is a very sovereign conclusion in which none of them have we as a global community turned the corner, and what is even more frustrating is that behind that truth lies a wealth of examples of how we could do it differently if only we scale it up, if only that transformation that we talk about where to take place. So in the times of climate change, we should not forget that eco-system, eco-goods and services are an integral part of the sustainability agenda, and in fact, to cope with climate change, we must understand that the resilience of eco-systems is perhaps as critical for us to be able to live in a world of global warming and adaptation as the mitigation agenda, it is in that sense I hope that also the China Council we will have to keep that holistic perspective and not to only narrow it down to in a sense a climate change mitigation technology agenda.

Let me end by again saying that we have heard of the last two days, Minister Zhou, you just summarized the three thrusts that you say also in terms of the international agenda in China's engagement; that these are extremely positive signals. I believe we have served in this Council those words we served in previous Council a far greater pragmatism, openness, and willingness to recognize that, yes, on the one hand as Premier Wen Jiabao said if 1.3 billion Chinese people can lead a more sustainable life, this is good for the world. And therefore, the domestic agenda of dealing with issues that you laid out this morning, Mr. Zhou, are the first priority at the center of our attention. But you have also shown and the 17^{th} Party Congress has shown that China recognizes that it is a global player. We heard about the ecological footprint of China in this context. We know about the supply chains, we also know about the power of Chinese products beginning to become first-order products in a world where governments will have a green procurement policy, where energy efficiency and sustainable use of raw materials will become criteria on the global market place.

And in that sense, I believe that China's active engagement and we in the China Council becoming actively engaged in discussing theses issues will serve not only the domestic agenda, but indeed the understanding of the international community of how China can play a role. And then by saying that in the words of President Hu Jintao, it is when countries help each other when they cooperate that we have the greatest possibility of indeed making a difference. In a few days' time the world will meet in Bali, we know that what is likely to occur in Bali. It's going to a challenge, because we're meeting as a community of 190-plus nations, with very different economic interests and indeed very different perspectives. I think the United Nations will be under tremendous pressure, but ultimately will be down to the member states whether they can respect the role that the platform such as the United Nations has to play, in this case, in the context of the Framework Convention on Climate Change. We are confronted with a history and a legacy on the climate change, and we are confronted with a challenge of future emissions.

We have two years in which the world can forge a different kind of agreement. Unfortunately, the conversation of the last five to ten years has been characterized by delegating responsibility to others in order for action in one's own home yard. I think the conversation that we need to have in Bali will hopefully be characterized by a different viewpoint, one that we'll accept the reality of climate change, secondly that each one takes their responsibility and their possibility seriously of addressing it, and that thirdly, this becomes the basis upon which the industrialized world will commit itself to taking its responsibility to lead with significant emissions reductions, at the same time supporting developing nations in investing in technology transfer, Minister Zhou you mentioned as an important part of the three points at the end of your speech. I believe this is fundamental for us ensuring that we do not lose by 2009 the best hope we have of having a global framework for responding to climate change. Without that, not only is our capacity to deal with global warming severely constrained, we may very well find ourselves at the other spectrum of a prospect in which a world is not able to work collaboratively and collectively on this issue, and then the scenarios of climate change, and global security and geopolitics will kick in. And I can assure you whatever you read at the moment in that direction, it will be a grim world in which we would have to live with each other, not working together but rather against each other in facing a challenge that as you put it and also the President put it in his speech, we can only work collaboratively by helping each other to address it.

I end my speech by saying that I also hope that we in the China Council can by part of creating a different climate for conversation and dialogue. The climate change negotiations in the next two years will often face the risk of drifting in the wrong direction of nations drifting apart. I think we in the China Council must play an active role in helping the world to understand that when China talks about its development interests, it is no different than when America talks about its development interests, when Europe talks about its development interests; and that we also help the world to understand that climate action is not something that is not happening in China, but rather that one conditions the other in terms of accelerating the pace, and this is my appeal also to the Chinese leadership that it protects both the Secretary-General's intent to help convene a world response to climate change , and it protects the role of the United Nations, because it requires member states to look after the United Nations, to look after an instrument like the Framework Convention on Climate Change and the Kyoto Protocol. Because if member states do not guard this instrument, we may well face risk and lose it, and in that sense I convey also from the Secretary General's perspective, his interests and his great passion for trying to use his offices and use the office of the United Nations to try bringing to this process of negotiation a prospective that ultimately touches on the core of our common humanity and the future of life on this planet.

Thank you very much.

（Based on recording）

Climate Change and Challenges in China

R.K. Pachauri, Director General, Energy & Resources Institute, India

Your Excellency, Vice Premier, Your Excellency, Mr. Minister, distinguished Vice Chairpersons of CCICED, Members, ladies and gentlemen,

It is indeed a great privilege for me to be given this opportunity to speak before such a high level and distinguished audiences. Let me at the very outset convey my deepest gratitude for your words of congratulations, your Excellency Mr. Minister. I must emphasize the fact that this is the recognition of collective efforts by thousands of scientists, and of course all the governments that form the decision-making body of IPCC. And I would like to place on record my gratitude and appreciation to a large number of Chinese scientists and experts who indeed have contributed enormously to the success of the IPCC. I would also like to appreciate the support of the Chinese Government, the delegations of all IPCC meetings that have been extremely supportive and extremely helpful, and most notably their participation in the last meeting of IPCC in Valencia, Spain, where the synthesis report was approved on November 16.

I shall be presenting mainly some findings from the IPCC Fourth Assessment Report that I mentioned was completed with the approval of the synthesis report in Valencia, Spain earlier this month.

The contents of my speech are essentially going to reflect the fact that climate change is unequivocal. I will discuss some expected trends and impacts, then attempt to describe the impacts of climate change in China, the challenges China is facing in my view and the cost of mitigation as well as key technologies. Now if you look at the slide, the last time the Polar region was significantly warmer than present for an extended period. And this was about 125,000 years ago. The reduction in polar ice volume led to 4-6 meters of sea level rise. Of course that warming took place for very different reasons. But it is important for us to know what the consequences were at that time. The warmth of last century was unusual in at least previous 3000 years.

Now if you look at the record of observations, we find that global average temperature has increased as shown in the top part of this diagram, and you can see global sea level rise in the second part. In the bottom part of this diagram you see the decline in northern hemisphere snow cover. During the 20^{th} century, we have estimated that the average temperature increase has been 0.74℃. This is of course more than what was estimated in the Third Assessment Report just 6 years ago where it was 0.6℃. As the sea level rise during the 20^{th} century has been about 17 cm, you can see the decline in northern hemisphere snow cover. The observed impacts are shown by these pictures here. What you see on the left are the results of extreme precipitation, which is increased in intensity as well as frequency. So you get large quantities of rainfall in short period of time. Heat waves are common, droughts, floods as well as cyclones. And this trend is likely to continue.

Now if you look at the projections for the future. The IPCC suggests a large number of scenarios. If you look at the low-end of scenarios, the best estimate we get is the increase of 1.8℃ by the end of this century and the other end of the scenarios is 4℃ in the same period. Now this combines with 0.74 increase took place in the 20^{th} century clearly imposes a very difficult challenge for the world. So as I am going to elaborate later, it is absolutely essential the world gets into a vigorous program for reduction of emissions of greenhouse gases.

To reduce these emissions, we would have to stabilize the concentration of greenhouse gases in the atmosphere. If you look at the top row of this table here, you will find with this level of stabilization shown in the left hand column, we will get global mean temperature increase at equilibrium of 2～2.4℃. Now this would require that emissions peak by the year 2015. So we have window opportunity of 7 years globally. We can allow emission to increase at most for 7 years if we want to stabilize temperature increase at this level. But after that, they have to be declined. But even with that, what I would like to submit, and this is a new finding which I would like to highlight, the global sea level rise above pre-industrial period from thermal expansion alone will be 0.4～1.4 meters.

Now this clearly means bad news for a large number of small island states and several coastal areas including parts of China. Large impacts can be expected due to past emission, so I think we have to be conscious of the fact that we are not only creating problems for the current generation, but we will pass on serious problems for the next generations. Vulnerability of the poor regions is well established, I won’t spend too much time on this. This can be seen in the poorest parts of Africa, Asia and Latin America. May I say that developed countries are not in exception. If you look at what happened in the case of City of New Orleans with hurricane Cartrina, it was the poorest of the poor who were the worst victims. They were the most vulnerable of the lot. And of course vulnerability is aggravated by existing stresses, which are listed here-poverty, limited access to capital, degradation of eco-system, disasters and conflicts, and failure of government system to respond effectively.

We also know that climate change is producing major impacts on natural eco-systems. Climate change will reduce biodiversity and affect the functions of most eco-systems. As a matter of fact, of all the species we assessed in IPCC, we find that 20%～30% of larger animal species will be subject to extinction if we increase global temperature exceeding 1.5～2.5℃. This is very serious finding. And of course some eco-systems are more vulnerable than others. Some are mentioned over here. Coastal settlements will be more dangerous. The most vulnerable of these will be the mega centers in Asia. These include cities like Shanghai, Dakar, Calcutta and others.

You see in this map a listing of different locations, which shows extreme risk, high risk and medium risk. Of course the bulk of these risks are in Africa and most of them in Asia. We also know that there will be increase in the frequency of heat waves. I now refer specifically to the changes in China and the impacts, increase of number and intensity of strong cyclones, 74% increase of flood since 1950s, 20%～36% increase in rainfall in northeast since the 1950s. There has been increase in the areas affected by drought since the year 2000. So these are issues that largely concern all of us. Because the impacts of climate change in China need to be anticipated, we have to set up adaptation measures. We also know that productivity is at risk due to high temperature, drought, soil degradation, we could have a decline in productivity.

We estimate 2℃ increase in mean temperature could decrease rainfall of dry field by 5%～12% in China. I have been following the research that has been done in this field in India, and there is now growing evidence that wheat crop in particular is suffering as a result of climate change and their decline is easily measurable. Water availability in China, glacier melt water will be affected in the next two to three decades, about a quarter of a billion people depending on this water supply will be affected in China by 2050. Increasing salinity of groundwater is a problem, particularly along the coast due to sea level rise.

Human health will be addressed, increased debts, disease and injury due to heat waves, floods, storms, fires and droughts. Endemic morbidity and mortality due to diarrhea are primarily associated with floods and droughts. Every official knows that when a flood breaks out, the biggest challenge, you see, is to prevent the spread of the disease. The toxicity and abundance of cholera will also be aggravated due to increase in coastal water temperature. Now we know that there are serious challenges for China and your Excellency, the Vice Premier has told us about the remarkable efforts that have been made. But primary energy demand is projected to double by 2030. Coal demand will still dominate in power generation that requires a major shift in the technology of the use of coal. Renewable energy is growing very rapidly. We are happy to learn some of the targets in the 11th Five-Year Plan.

On energy related CO_2 emissions, this is the picture from International Energy Agency's *World Energy Outlook*. Here I would like to emphasize the common but differentiated responsibility principle that Your Excellency the Vice Premier reminds us about. The Indian Prime Minister when he went to Haligen Town Summit, he made a statement. These are here that we show you that our emissions on per capita basis will never exceed those of developed countries. And that I think it lays a challenge for developed countries to bring down their emissions per capita so that developing countries can always living below that. We are very happy to see the German Councilor has recently been emphasizing the per capital criteria for looking at what responsibility that each nation should carry.

Now of course, China has the challenge of sustainable development. May I emphasize that climate change is only a symptom of a larger problem. We are not on unsustainable path of development. If we had been on the path of sustainable development, clearly climate would not have been affected by human actions to the situation we experience. We require minimizing GHG emissions, promoting equity by spreading the benefits of economic growth and enhancing poor people's capacity to adapt to climate change. Here I would sum up that the rapid growth in China is perhaps the best insurance foreseeing that communities and people can get the ability and capacity to adapt to climate change and impacts of climate change.

Really speaking, globally, mitigation is not an expensive proposition. It has been admitted on the part of several people to say that it is expensive. Because if you look at what we have estimated in the IPCC for the scenario we projected earlier which limits the temperature increase to 2～2.4℃, the total cost in terms of GDP loss by 2030 would be less than 3%. That only means the level of prosperity that the world will reach in 2030 with best report by a few months and maximum of a year. On annual basis these represent a reduction in GDP by 0.1%～2%.

If we have the right policies, research and development activities. new technologies will be involved, that will actually lower the cost. And if you look at how these seem over a period of time, this line indicates the GDP without any mitigation. If you look at stringent mitigation to bring about the reduction that I talked about, you only shift the line a little bit, which usually tell you that is not a high cost to pay for human society.

Specifically we are predicting some serious impacts that have already threatening several parts of the world, most particularly the small island developing states and low coastal areas. We have a range of key technologies that I would not be going through. We will necessarily have to target energy supply, transport & buildings. Buildings in particular are very important with huge construction boom that is taking place in China and to a lesser extent in India. We necessarily have to see that buildings constructed are energy efficient and environment-friendly. That requires regulations and policies by which architects, builders and others adopt means by which we can improve the efficiency of buildings. This can be done with all buildings. The picture you see at the bottom is the major joint complex. My institute in New Deli has used no power from the grid. And it is cheaper to run this building and easier to provide the comfort we expect with renewable energy and good architectural design than to use fossil fuels.

Key policies and measures. Of course we need incentives for development of technologies. We heard about some of them as far as China is concerned. What is most critical is to provide a price on carbon. The most important factor, if we want to bring about the shift to low carbon technologies, is to place a carbon price. And I hope the negotiators in Bali in a week time will take some steps to see how this could bring into agreement or plans of agreement into the future.

Investments are long-term investment. Therefore I think we need to take into account a much longer time horizon in planning these investments than it has been the case in the past. We also assess this time that lifestyle and behavior changes are absolutely critical. They are important part of mitigation strategies. Each society will have to define what these life-style changes are.

National policies have to be linked with, development policies have to be linked with mitigation policies and those that address poverty and employment and others. In other words, climate change in some respect has to be mainstreamed with development policies. CO_2 mitigation potential for 2010 without net loss in China was estimated by us to be 15%-20%. Now essentially I think developing countries in particular will have to adopt new development path that is in keeping with our natural resources and government, also in keeping with our traditions, culture and heritage. And this will require changes of a number of areas economic structure, technology etc, which I do not need to spell out because there I think will be surely discussed in the Council.

I would like to quote these two statements from Chairman of China's National Development and Reform Commission: "We must reconcile the need for development with the need for environmental protection." And hope China we will take a new path toward industrialization, which will be different from the rest of the world. China today is giving so much in terms of economic logic and economic leadership to the rest of the world. I think China was to set an example of the model of political power that it would have over the rest of world and others following this path would be enormous.

Thank you very much! I am very grateful for this opportunity.

（Based on recording）

Special Topic Speech

Ecological Footprint: Creating Sustainable Society

James Leape, Director General
WWF International

Ecological footprint issue has been one of the focuses of WWF, with a series of *Living Planet Reports* published in the past several years, covering both *Living Planet Index* and ecological footprint. Concentrating on ecological footprint in China, the *CCICED-WWF* joint project has best demonstrated the attitude of Chinese government in addressing environmental problems. My short speech consists of three parts, complexity and urgency of global environmental problems, concept of ecological footprint and preliminary results of our research.

First, the theme of the *Annual General Meeting*, *Innovation for Environmentally Friendly Society*, has undertaken the importance of innovations in science and technology, which are critical to the realization of the theme as well as the target of *Ecological Civilization,* recently set by *President Hu Jintao*. As an innovative tool, research into ecological footprint in a country can help us obtain a general picture about environmental problems, i.e. forest, fishery, water and climate change, all of which are in an urgency to be immediately dealt with, either in China and over the world, as the decisions made today may have long-term impacts on our future consumption patterns and levels of sustainability. In the face of the complexity of the problems, we need to formulate consolidated strategies for transformation. In this context, ecological footprint may be helpful for both governmental decision and public awareness.

Second, I would like to share with you figures of ecological footprint either in China and the world. Expressed in the unit of global hectare, the Ecological Footprint measures the human demand for bio-capacity on the planet, including both natural resources and waste absorbing. Global ecological footprint consists of several components, like cropland, forest and fossil fuels, etc., which in the year 2003 was 25% above the global bio-capacity. In terms of individual nations, USA was responsible for 20% of the global footprint while its population accounting for only 5% in the world; China ranked third in aggregate footprint after USA and EU. In addition to its domestic impacts, ecological footprint in China has international influence as well. Our joint project has an international team of experts, from USA-based *Global Footprint Network* and the *Institute of Geographic Sciences and Natural Resource Research with the Chinese Academy of Sciences*. The preliminary research has shown that in the past forty years per capita ecological footprint in China more than doubled and its aggregate footprint in 2003 was two times larger than its own bio-capacity, apparently in a state of ecological deficit. Of course, in terms of per capita footprint, China is still at a lower level. Our footprint study also analyzes cross-border net flows of bio-capacity, which intends to explain the supply chain from Chinese imports of timber, agricultural products and fishery products, to production in China and further to Chinese exports of manufactured goods to other regions. We have also tried to link *Human Development Index* to ecological footprint and found that the more countries moving higher in *Human Development Index* the higher in ecological footprint as well. China followed the same route in its development of past twenty more years. Our objective is to keep per capita footprint at a relatively lower level through building of *Ecological Civilization* while increasing human development level in China.

The last point is to ensure achievement of the targets in the 11th *Five-Year Plan* is crucial, which would serve a good start for the following planning phases. In this regard, we need to care those investment decisions leading to high consumption patterns over time. Meanwhile, about one half of ecological footprint in China comes from fossil fuel, which is key to tackle climate change challenge.

（*Re-edited from shorthand notes*）

Innovation Strategy for an Environment-friendly Society

Lars-Erik Liljelund, Director General,
the Swedish Environmental Protection Agency

Mr. Chair, distinguished delegates,

I'm going to give a short overview about the concept, innovation strategy for environment-friendly society, from our experience in Sweden.

As we have heard this morning, innovation is a very broad concept, you can have almost every type of approach to it. It doesn't matter if it is, I think, environment-friendly society or if it's some other approaches for the innovation. It's the policy framework, environmental policy, of course, when we talk about environment-friendly society. It is the institutional framework where I would like to put both authorities, public authorities, private institutions, but also research. And research is, I think, extremely important. And then it's not only natural research, research in natural science, with when we talk about environmental issues, it's always the part to find problems. It's not only the technical science that can give solutions on some of the problems, but it's also the social science, which, in fact, gives a scientific background for implementation. And in Sweden we have a special center of authority for innovation, the authority for innovation system established five years ago, who is going to improve this work. And the third cornerstone, that kind of course can be more, is the legislative framework, which is not only in this context, environmental regulations, it's also the legislative framework when we talk about intellectual property rights and such things. And these frameworks we have found are very important to have in place and clear.

It has already been mentioned, I think, both in the background papers I hear in this morning, that we see three steps when we talk about innovations. The first is, in fact, perhaps the most simple one but sometimes forgotten, to use the existing best available technique. I think it's the existing technology can be used, and we have many areas, for example, in waste stabilization, where we don't need to spend too much money and time on research and science. The second one is, in fact, to use existing technique and technology in another context. We have many areas where we can see that, for example, the basis for the particle filters in the diesels engine we have today is coming from quite another area. So it's in many cases where we can use existing technology but in the context of development of the environment-friendly society. And the last step is, of course, to develop new technology. And that is, of course, especially for science, the scientific community, the most challenging part, perhaps the two first is more for the policy and the public part to take care of.

And now I would like to mention the most important driving forces we have found. Sweden has been working in the field of environment for many decades now, and there are many reasons for that. One reason is that we had acid rain and desertification in the north, we are in the north, or the northern hemisphere. We also have very much problem with contamination of pollutants in the Baltic, which a huge inland sea we share together with many other countries. And I think that's some of the main reasons why we started rather early to work with the environment. And what we have found, it's most important driving forces is, first of all, the holistic and system approach to the problem. Many of environmental problems as we have found is, of course, can be, the direct problem is single pollutant, but why do we have this pollutant, for example, in the Baltic create problems. And that is, by backtracking, you found it's something which, in fact, clues the whole society. So a holistic and system approach is absolute necessary to all minds. Then we need to have an environmental policy and environmental objectives in place, and this, in our case, is very much based on research and environmental monitoring. And we have now, since 7 years back, 16 overall covering 16 environmental objectives decided by the Swedish Parliament as the driving force not only for the public sector, but also we can see it's a driving force also for the private sector.

Legislation, which is the ultimate policy response of what, for example, has been found as an environmental problem is, of course, very important to have in place. Just a short reference to the speech we heard from Mr. Liu earlier is that we, since chemicals, we could see different pollutants create problems. In Sweden, we put our chemical legislation in place at the end of the 1980's, where we have chemical management and also where can see we have from this legislation and driving force in the private sector, trying to find new solution to for the areas where they use chemicals, but more environment-friendly chemicals.

Economic instruments, which we find, I mean, in general terms, it's to establish economic instruments, so it make it cheap to be environment-friendly. It's very simple saying so, but it's not so simple in reality. But to introduce pricing mechanisms of different kind, taxes, for example, some incentives we haven't experienced that some incentives can be not so good because they can lock in the system, so the innovation will stop. So it's very important that these mechanisms of economic instruments are neutral to technology but focus on the environment.

Green procurement has also been mentioned in the status report from the task force. It's extremely important to have, for example, the procurement from the public sector is enormous big, I think, in most countries, and can have a very important role as a driving force. And it's, for example, based on environmental management schemes, certifications of different kinds and also standards. And I would like to especially to mention the OECD standards for environment in different areas that is really important.

Competition. The Swedish association for the Swedish big companies in Sweden, they produce the report to the Johannesburg Meeting named "From Reactive to Proactive". And they have found that in the beginning, perhaps they were too reactive, but now they have shifted to be proactive. And where many big companies in Sweden, even if we are a very small country, we have some really big companies who are Swedish companies. And normally today, they use legislation as the bottom line, and then they add an environmental policy defined by themselves to be better than what is demanded from the legislation.

What we can see more and more, of course, as a driving force of innovation, is the need for natural resources, they are limited, and there is also, of course, a driving force for innovation for circular economy, as mentioned here, or to have this circulation and close many of the industrial systems.

Public awareness, I think it's also very important driving forces in Sweden, and it's, of course, connected to the competition part, where the companies would like to compete with each other not only with the quality of the product, but also how it is produced, and with the life cycle perspectives.

Cooperation, interaction between the research sector, private sector and the public sector, I will go into that soon, but I just would like to mention another thing, which I think it's important, and maybe we don't have developed that yet so much. And that is indicators on all levels for monitoring. If we have success or failure in this innovation system, does it give the results we want, we are looking for or not? We also have processes going on with the European Union in this area, the environmental technology action plan, I just would like to mention that, and we'll see what that means, we means for the innovation in this area.

But I would like to, just very shortly, present to you what we nowadays call triple helix. It was, it's in fact nothing new, because I think this cluster engine for innovation based on close cooperation and interaction is exactly what we did decades ago when we developed, we have car factories, factories producing airplanes and so on. And that is to put the research sector, the private sector and the public sector together, and they are working as a cluster engine for innovation. And where the research sector, mostly in Sweden, we have the universities give the science and scientific development. The public sector is very much involved regarding what belongs to the private sector, legislation such things, but also the money part. And then the private sector, where we can find the entrepreneur side of it, so we can put this innovation not only to solve problem in Sweden, but put innovations on the market. And this concept has been very successful up to now, and we are continuing working with it as an engine for innovation. But it means that it has to be established on equal footing so these three bodies, they are working together in close cooperation, but on equal footing. And it had to be clear from the beginning, what's going to happen with new technologies, when they are emerged, who will take care of them, who owns everything about this intellectual property rights and such things. That had to be clear in the beginning.

Looking for the future then, where we have the challenges to talking about innovations. I mean the overall concept of this, of course, to decoupling economic growth from environmental pressure. And that is not only when we talk about climate change and emissions, green house gases and such things. That is a general approach, how to decouple economic growth from environmental pressure. And that is not an easy task, as we all know.

Sustainable use of natural resources. I think we have much more to do in this area, where we really can say we have sustainable use of natural resources. We can connect that to sustainable development. But in general terms, I would like to say that very much what we are talking about is the quality of life, as a concept.

Traditional pollutants. They need, of course, full attention in the future. They are tackled by cleaning, closing systems, and in the industry, recycling, substitution and such things. I also think it's worthwhile to mention that we must learn lessons from the past, and we have emerging issues that we need to keep an eye on, and that is, for example, environmental impact from nanotechnology. Because now we can see an unbalance in the development of an innovation around nanotechnology concept, but the environmental side, it's not following so much. And I think just our early experience we all have, not only Sweden, is that we need to keep an eye so we don't create problems, environmental problems, or human problems perhaps is more important when we talk about nanotechnology. That is only one example.

Also another challenge is, of course, what's called sustainable production and consumption patterns. And that is also an area where within the European Union we have some steps taken, it's very difficult, I think that's sustainable production is perhaps more simple concept, compare to sustainable consumption. But anyway, I think that sustainable consumption and production is a concept that needs really more innovation and more innovative approach. How to solve, because we have to go in that direction, that's absolutely clear.

And finally, as everyone is talking about today, of course, the emissions of green house gases. That is, of course, much more problematic than, for example, the traditional pollutants. And maybe also like the sustainable use of natural resources. Because it's a horizontal issue, it's covering more or less all the society activities, and we cannot work with this if we don't have a system approach or holistic approach to the problem. It's, as we are all closely related to economic growth, necessary that solution must be based on decoupling. But finally, we are very much from, then I'm talking working with environment in Sweden, very much focused on how this problem will be solved. Today perhaps it's sometimes too much one-sided focused on mitigation that can create problems in other areas. For example, when we talk about the production of different kind of bio-fuels. And I think that the green house gases, as also effect of all the other environment problems, really, really need this, when we talk about innovation, to solve this, really needs again a holistic and system approach where we're covering the whole society. So finally innovation covers more or less everything, but this is just a short presentation of our experiences in Sweden.

Thank you very much for your attention.

（Based on recording）

Towards a Low Carbon Economy

Gordon Conway, Chief Science Advisor,
UK Department for International Development

Mr. Chair,

I am a new member of the Council and I am very honored to make a speech at the meeting. I will observe the time limit and finish my speech within 15 minutes. I will prove that I can be a good member.

What I am going to talk about is what we can do to develop low carbon economy. Before this I would like to echo Mr. Pachauri（see the figure）. Dramatic changes are shown in the figure. We can see the changes of dioxin, CO_2 and temperature in the past 400,000 years and the changes in recent time are particularly remarkable. This figure was made by Chinese Academy of Agricultural Sciences and is similar to US model. It shows the constant change of temperature in North China. We can see the changes of yellow area and dark yellow area as well as changes of precipitation. Meanwhile we can see the change of rainfall in the western and central part of China and rainfall in East China has begun to reduce. These changes actually have made a great impact on us. Here I would like to give the example of Ningxia. In the area where the Yellow River runs across the precipitation has fallen to below 200 mm, whereas in farmland area, which is the middle part of Ningxia, rainfall is between 200mm-400mm. This has affected agricultural development in the whole region. These are changes taking place in Ningxia.

（From the figure）We can see the measures Ningxia has taken to address climate change and the price it has paid for it. Climate change has brought about many problems. Dengue is a case in point. This disaster is caused by climate change that facilitates mosquito breeding. Last year a British scientist published a report indicating that if current risk of climate change continues, we will suffer a loss of 5% GDP every year. However, we must pay attention to several key points. The increasing temperature will cause more and more changes continuously and these changes are irreversible. We see melting ice in Greenland, in western Antarctica and emissions of methane mixture in seabed, which will cause sea level to rise by 5-6 meters and submerge coastal cities in southeast area. This situation will take place if the temperature rises by 2 degrees, which is key measurement. The ice in the Arctic and Antarctic is melting faster than expected. What shall we do? We must reach a global agreement on carbon pricing and make innovative policies. Meanwhile, we will phase out all practices hindering energy efficiency. We have adopted some measures in EU to create low carbon economy. We need to stress the transformation into low carbon economy, which will further promote competition rather than threaten it. Additionally, EU is the first to introduce carbon trading program which fixes the price of carbon.

The British Prime Minister made a speech the other day, raising his hope to curb temperature rise within 2 degrees and he believed that 2 degrees was an important point. He also proposed that if experts thought it proper, carbon emissions would be cut by 60%-80% by 2050. What kind of schemes do we propose in UK? We will realize zero emission by 2016 for newly built houses. And we will reduce the carbon footprint among one third of all houses in use and to be built. Use of disposable plastic bags will be eliminated or removed. For low carbon economy we can see that emissions in different countries vary. If we make a comparison between China and the UK, we find something similar and different as well. Traffic emissions account for 40% in the UK while in China they account for 4% only. This shows the two countries share something common but also have different problems. We need to analyze all the CO_2 sources marked in the figure to solve the problem. One way is to use renewable energy. Renewable energy takes various forms. China, in fact, has done a lot in this regard. The figure shows the hydropower station at Shabadu along the Yellow River. This is Ningxia. Solar panels are installed on the roof. Every solar panel costs $100. It is still expensive for Chinese families. So what we consider is not only a matter of energy, but also affordability. Bio-ethanol is another issue we are concerned about. In this figure, on the left is maize field and on the right a big plant. If we grow more maize, it will be better for the development of bio-ethanol. As we know, China has made a plan to have renewable energy account for 15% of its energy structure by 2020.

Coal is used extensively in China and there are many coal-fired power plants in the country. According to international organizations, China's coal-fired power plants will further increase by 2030 with installed capacity being 6 folds of that of EU. If this is true, CO_2 emissions of the power industry will continue to rise. Here we can compare CO_2 emissions of power industry between China and other countries. We can see many of the power plants are outdated. Of course we have seen some modern facilities in Ningxia. These new power stations are quite efficient. Hopefully we will see more of such power plants in the coming years. What is important in the process is how to make innovations in low carbon technology？For example, we can improve efficiency to conserve energy. We can apply new technologies to enhance our efficiency from 36% to 45%. Of course, we can achieve this through carbon capture and storage.

The British government has just launched a race known as carbon storage and carbon capture to support the first business program. We hope to capture and store 90% of CO_2. What do we do? We capture or store carbon arising from coal burning in the coal-fired power plants. We can also have other means by extracting carbon and burying it in the seabed. Of course, China has also created many technologies in this field.

What am I driving at here? I want to stress good cooperation in the process of developing low carbon economy which will brings us opportunities for innovation and trade. China can cooperate with EU more extensively. Moreover, the U.K. has promised to establish a fund for environmental change with a seed capital of £800 million. The fund will be launched the next year. We would like to have more consultation and cooperation with China to better use the fund.

Finally we would like to say that the British government will continue its cooperation with CCICED, particularly in the field of environmental protection, energy and climate change. We are willing to finance a task force to further promote low carbon economy.

Thank you very much.

（Based on recording）

Energy Challenge in China and Countermeasures

He Jiankun, Executive Vice President, Tsinghua University

I will talk about this issue in three aspects. First, I would like to talk about what situation China is facing in the field of climate change.

As you all know, the key to addressing global climate change lies in the reduction of the emissions of greenhouse gases. However, the emission of greenhouse gases now is still on the rise. The only solution is the promotion of technical innovation in energy field and following the path of low carbon economy. The emissions of CO_2 in China are huge with rapid increase, so China is facing grave situation in the reduction of emissions. It is expected that China will exceed U.S.A. in CO_2 emissions in 2007 and become No.1 emitting country in the world. However, per capita CO_2 emission in 2000 was about 60% of the world average. Now, it is possible that per capita CO_2 emission in China is approaching the world average. However, up to now, the accumulated per capita CO_2 emission in China is still less than 50% of the world average and 1/7 of the average level of OECD countries.

CO_2 emission intensity per unit GDP in China is relatively high. But it is going down fast with the potential of further reduction. CO_2 emission intensity per unit GDP in China is more than 3 times of the world average and over 5 times of the level of OECD countries. However, we enjoy a very fast downturn. From 1980 to 2000, this intensity had gone down by 66%. Though with slight increase during 2000～2005, it has further gone down since 2005. It is expected that there will be over 3% reduction this year.

High CO_2 emission intensity per unit GDP in China reflects the fact of high energy intensity per unit GDP. This is mainly because of low energy conversion rate and efficiency, about 30% of the level of developed countries.

In addition, the proportion of industries in our industrial structure is too big, close to 50%, while this figure of developed countries is usually less than 30%.

The added value of our product is relatively low. In international industrial division, China is at the low end of energy value, leading to high energy consumption intensity per unit GDP.

Another reason, is that coal dominates our energy mix. So CO_2 emission intensity per unit energy in China is about 30% higher than the world average.

Next, with industrialization process, it is expected that our energy consumption and corresponding CO_2 emission will have big increase. Low carbon technology will have rapid development and will play an important role. According to current development trend, it is expected that CO_2 emissions in China may increase about 3 times by 2020 as compared with 2005. However, if we vigorously promote energy saving and enhance the application of alternative energy sources, there will be big reduction of CO_2 emission. It is expected that CO_2 emissions intensity per unit GDP may go down by about 40% by 2020. Therefore, China will make remarkable achievements in the future in terms of CO_2 emission reduction. However, at global level, meeting the target of controlling the emissions of greenhouse gases will impose a serious challenge to the modernization of China.

（See the figure.）The figure on the left shows the change trend of CO_2 emission intensity per unit GDP. It is expected that it may reduce by about 80% by 2050 compared with that of 2005. If we compare with that of developed countries, energy consumption intensity per unit GDP in China will be lower than that of developed countries when per capita GDP being the same. This indicates that China has the change of following the modernization path that may conserve more energy compared with the developed countries during the same process. Now, the overall CO_2 emission of China is on the rising trend, therefore, we should not follow the same modernization path of developed countries. We must explore new modernization path.

Addressing climate change will be coupled with fierce technical competition. It will also serve as an important driver that pushes technical innovation in energy field of China.

The second aspect is the challenges and opportunities for energy technologies in China to address climate change. In the future, energy security and GHG emissions will increasingly be a concern for energy technologies. Therefore, we need to classify and analyze energy technologies from two dimensions. Also, we need to consider another two aspects: one is the maturity and accumulation of technology. Based on the time and cost of the technologies that improve energy safety and reduce GHG emissions, we may choose future energy technologies.

We have the following technologies:

1）Energy saving. Prioritizing energy saving is existing national energy strategy of China and an important countermeasure to achieving low carbon economy. Therefore, energy saving and emission reduction now is an important work in the field of economy. We should vigorously promote energy saving. On one hand, we facilitate energy saving through the application of new technology with high efficiency; on the other, we should promote energy saving by structural means, i.e. adjusting industrial structure and product structure in order to raise the added value of products.

2）Alternatives. That is, we should employ alternative energy sources. We should choose among various renewable or alternative energy sources based on our national conditions and objectives of China. Therefore, we have a clear national strategy in terms of energy alternatives. It is expected that by 2020, the installed capacity will reach 300 million KW for hydro-power and 30-50 million KW for wind power （actual power generation at 30 million KW）. And all the renewable energy in use will be equivalent to 600 million tons of coal equivalent, accounting for 15% of total primary energy consumption in China.

3）Technology. This means that China will develop clean coal power generation technology with high efficiency as well as carbon sequestration technology. This technology will store and bury CO_2, thus reducing the emissions. However, this process will correspondingly reduce power generation efficiency and raise the cost. So, time is needed for the research and development process. Therefore, thermal power generation will combine with clean coal technology. China should develop super-critical and high super-critical technologies with high efficiency, then identify gasification technology like IDCC, and finally develop carbon sequestration and bury technology combined with the development of green economy. So in view of addressing climate change and rapid development of energy infrastructure in China, it provides a broad perspective for the development of low carbon economy.

（See the figure on the screen）This is a simple figure showing future energy mix of China. You could see that coal percentage will go down with relatively big increase of renewable energy. Therefore, China should strive for mastering alternative technologies in short period and develop the mechanism for big scale commercialization of such technologies in the future and lay a solid foundation for dramatic reduction of CO_2 emissions.

The figure on the right shows the trend of CO_2 emissions. You could see that there will be a dramatic reduction of such emissions after 2020.

We should strengthen international technical cooperation. Developed countries should exercise their obligations on the provision of funds and transfer technology to developing countries in order to help their energy construction and improvement of existing technology and facilitate technology transfer under the framework of international conventions that are specified by international environmental conventions.

The third aspect is the strategy and countermeasures of China for addressing climate change. Combining with national development plan for sustainable development, China should promote the development and implementation of countermeasures and policy systems for climate change, put equal emphasis on adaptation and emission reduction and facilitate the capacity building and relevant legal development in this field.

Next, China should actively carry out policies and countermeasures to address climate change and speed up the pace of technical innovation.

Furthermore, taking the opportunity of issuing & implementing *National Program on Climate Change*, China should facilitate harmonized understanding across China and coordinate relevant activities.

In addition, China should adhere to energy security specified in the Convention, comprehensively weigh the relations between mitigation and energy development, respect the energy characteristics and development law of the countries undergoing normal economic development stage.

Moreover, China should actively take part in international cooperation in the field of climate change, play a constructive role and actively participate and promote global institutional development for addressing climate change.

Thank you！

（Based on recording）

Issues Paper

Innovation for an Environment-Friendly Society

Background

This Issues Paper is the sixth in a series started in 2002 to examine key problems in China's environment and development strategy.[①] The purpose of each paper has been to identify major policy questions and issues associated with the theme of the Annual General Meeting （AGM） of the China Council for International Cooperation on Environment and Development （CCICED）. The Council, comprised of senior Chinese and international environmental leaders, provides advice to the Premier and State Council of China based on the work of its task forces and special studies. The November 2007 CCICED AGM is the first meeting of the fourth five-year phase of the Council and therefore will serve as an agenda-setting session for work to be carried out over the coming half-decade. The AGM will examine what it will mean for China to embrace "Innovation for an Environmentally-Friendly Society."

STRATEGIC TRANSFORMATION AND INNOVATION

2007 – A YEAR OF ENVIRONMENT AND DEVELOPMENT IN CHINA AND GLOBALLY

The timing of this meeting is especially significant since it comes soon after the 17th National Congress of the Communist Party of China. This Congress firmly embraced scientific development, innovation and the need to address pressing environment and development concerns in China. President Hu Jintao noted the need for "Promoting a conservation culture by basically forming an energy- and resource-efficient and environmentally-friendly structure of industries, pattern of growth and mode of consumption." During 2007, China introduced its first comprehensive action program to

[①] Issues Papers are prepared by the CCICED Chief Advisors, Dr. Arthur J. Hanson and Professor Shen Guofeng with the assistance of others in the Chief Advisors Group.

address climate change; established a Leading Group on energy, environment and climate change that is chaired by Premier Wen Jiabao; and took numerous actions to improve performance in meeting the 11th Five Year Plan 20 % energy efficiency increase and 10% pollution reduction goals. The OECD released its first ever report on China's environmental performance, an important benchmarking and institutional analysis.

This year environment has risen to the top level of priorities in many countries, including their businesses and communities, with concern for climate change being most prominent. But many other issues are in the spotlight as well including the need for a better understanding of globalization effects, and of the environmental implications related to fast growing countries such as China and India. The International Energy Agency （IEA） in its 2007 energy outlook reference scenario calculates that these two countries would account for 45% of the global increase in energy demand in 2030. It is now 20 years since the famous report *Our Common Future* was produced by the World Commission on Environment and Development. Global progress on sustainable development is still limited, however, and "business as usual" attitudes still persist to an alarming extent.

China's Strategic Transformation of Environment and Development

China is entering a time of strategic transformation towards environment and development. This transformation is focused at present on energy efficiency and pollution control, but with much broader implications on how the world's most populous nation can rapidly align its economy, environmental protection and harmonious social development policies and actions towards sustainable development. China needs to do this on a much-compressed time frame by comparison to many other countries since its longer target of attaining a "basically well-off society" by 2020 depends not only on continued rapid economic growth but also on quality of life and a stable social system.

Ultimately this strategic transformation will affect how government governs, how all business enterprises operate within China and in their international operations, how the people of China participate in environmental decisions, and how China participates in global and regional environment and sustainable development cooperation. It will demand new approaches of institutional change, improved planning and management, and technological changes far beyond what China has so far seen in its environmental protection and sustainable development efforts. And it will place unprecedented demands on other nations to adjust and improve their own ways of dealing with issues such as environment and trade, climate change, and many other environmental matters. A CCICED Special Policy Study on Strategic Transformation of Environment and Development in China in the context of both national change and globalization will be presented to the AGM.

Innovation for an Environment-Friendly Society

President Hu Jintao has noted that innovation "is the core of our national development strategy and a crucial link in enhancing the overall national strength." Internationally there is great interest in determining how best to link innovation and sustainable development. It is difficult to believe that societies anywhere can expect to achieve substantive progress on today's environment and development problems without commitment to science and technology breakthroughs. Yet innovation must go much deeper—especially into the way decisions are taken, and the strength of institutions to implement these decisions; and into the role and functioning of markets that can either encourage or discourage desirable changes depending on pricing and other signals.

It is encouraging that at the 17th CPC Congress such topics were considered. President Hu noted that "China needs to improve institutions for democracy, diversify its forms and expand its channels, and carry out democratic election, decision-making and administration and oversight in accordance with the law to guarantee the people's rights to be informed, to participate, to be heard and to oversee," These are among the most important conditions found in nations such as Germany, The Republic of Korea, and Japan that fostered innovation during their strategic environmental transformation in earlier times.

China is in a remarkable position as it moves to strengthen its science and technology capabilities. The available funding will place it among the very top nations investing in S&T. A considerable amount of this funding will be earmarked for addressing priority energy, environment and development concerns during China's new 15-*Year Science and Technology Plan.* And in the process the existing National Innovation Strategy （NIS）will have to become much more focused on sustainable development priorities and on building independent （indigenous）technology that will fuel future economic growth and well-being in China. Yet there are many barriers to be overcome, and the gap between goals and performance progress is still large. CCICED has initiated a new Task Force on Innovation for China's Environmentally-Friendly Society that will present its final report at the 2008 AGM. Their Interim Report presented during the current AGM provides a critical examination of this topic in China.

The difficulties of implementing current environmental goals will be reported during the meeting, based primarily on the work of the CCICED Task Force on Policy Mechanisms towards Successful Achievement of the 11th Five Year Plan Environmental Targets. It is likely impossible to meeting the targets without substantial commitment to innovative approaches that are not yet in place. Furthermore the challenge will become greater over time, especially during later Five Year Plans, since more types of pollutants will have to be addressed, and since absolute levels of some contaminants are continuing to increase.

Since the dawn of the new Century China has been in an industrialization phase of heavy industry and chemical production. The rash of serious incidents involving chemical spills and contaminations suggests that a stronger approach to chemical management is needed within China. Such an approach has ramifications for large and small domestic producers, multinational chemical firms operating in China, and for China's participation in overseas chemical markets. Fortunately, this is a subject where it is possible to draw upon innovation experience from a number of other countries such as Germany. A CCICED Special Policy Study on Environmentally Sound and Strategic Management of Chemicals in China will provide recommendations at this AGM.

LOOKING AHEAD – GLOBAL PROBLEMS AND CHINA'S NEEDS

China is entering into an era when its impacts on the world will be considerable, and therefore its actions will be monitored closely and judgements made on its contribution to global environmental security and as a "global citizen." The extensive past work of CCICED on Trade and Environment, and recent efforts to understand how the effects of globalization affect China's environment and China's impacts on other countries suggest that international cooperation will become of increasing significance. It is a topic well suited to CCICED, of course, but now one that may need to be examined in ways that recognize both China's very legitimate development needs and interests, but also in terms of how other nations should cooperate to provide the environmental space for this to happen.

Therefore several exploratory initiatives were undertaken in preparation for this meeting. One is a new partnership of CCICED with WWF China to examine China's Ecological Footprint, with an Interim Report presented during this meeting, revealing how China's very low per capita demands on the world's ecological systems are increasing. This is a relatively new way of examining the effect a country may have on the resources and environments of other nations and regions through market supply chains and other ways. This information casts a very different perspective than standard economic analysis of trade and identifies the nature of ecological deficits and surpluses around the world.

CCICED's long-standing interest in Energy and Environment has always been tied to innovation, and specifically to alternative sources and approaches to energy use. Some of these ideas are now in use such as wind power, and it is clear that energy innovation will be one of the most significant areas determining China and the world's success with sustainable development. Climate change adds to the urgency of finding new ways to improve energy efficiency, sustainable use of coal, and of alternatives that will reduce greenhouse gas emission and other harmful pollutants. These topics are being proposed as important elements within the overall context of Energy and Environment for CCICED work over the next two years. In April 2007 CCICED held an exploratory meeting on "A Low Carbon Economy for China." The key points arising from this meeting will be made available at this AGM.

Clearly the coming years will not be a time of "business as usual" for China's environment and development situation. Nor is it a time when any one nation can expect to achieve its own environmental objectives in isolation from global environment issues, or without consideration of the environment and development actions of other nations. As China's President and Premier have both pointed out, the environmental burden on China is heavy and the situation is grave. It will require sustained effort, participation of all sectors and regions of the country, and new approaches that build on science, management and institutional approaches. What is called for is a broad base of investment in eco-innovation. This long-term commitment will become of ever-growing significance starting with the 11th Five Year Plan （FYP）, and certainly extending into the 12th and 13th Five Year Plans.

The Government of China has made it quite clear that innovation rather than minor tinkering will drive the new relationship of environment and development. Perhaps the clearest vision is from statements by Premier Wen Jiabao concerning this relationship in which three principles （"Three Transitions"）have been laid out: （1）environment and economic growth should be given equal status; （2）environmental problems should be considered concurrently, not after economic growth is achieved; and （3）instead of the current focus on administrative initiatives, environmental action should be broadened to include legal, economic, institutional and other approaches.

CHINA's 11th FIVE YEAR PLAN ENVIRONMENTAL PERFORMANCE

The inability of China to meet fully the environmental objectives of the 10th FYP, and the more stringent pollution reduction and energy efficiency goals during the first year of the 11th FYP, reflect systemic problems that are described in the CCICED Task Force Report to the AGM. The key point is that only by addressing such matters as institutional strengthening, and substantial upgrading of the environmental management administrative structure can real progress be expected. There is no single approach that can be implemented in isolation. This point has significant implications for success of environmental technology innovation.

While there is considerable investment in introduced technologies, and also evidence of success in their application, there also are observations that much of the investment has not been well spent in terms of improved environmental performance. The reasons vary but include lack of training, poor environmental monitoring and enforcement, and inappropriate choices.

The 11th FYP will be a time of learning and transition in relation to discovering the best combinations of technological, institutional and management innovations for environmental improvement, It should set the stage for major longer-term investments that will see their full benefits expressed in the decade after, and, in the case of some initiatives, much further in the future, for example, the ITER Project on fusion in which China is a partner. The time available between now and 2010 can be used to put in place a more functional governance system to support environmental innovation, including a much stronger participation by industry, and awareness-raising of communities and people. Fortunately, the necessary investment capital may be much easier to find in China than some other countries.

SOME GLOBAL ISSUES LIMITING PROGRESS

Of the many issues limiting progress on building a better relationship on environment and development in countries around the world, a handful are particularly significant at this time of innovation and transition for China.

- An export-driven high growth strategy, with its emphasis on continuous price reduction and mass production of consumer goods, has significant benefits both for the manufacturing country, in this case China, and the consuming countries, whether rich or poor. The reality however is that environmental conditions are being compromised in the manufacturing country, and in some of the countries supplying raw materials. And in the richer consuming countries where cheaper imported goods contribute to ever-increasing demand and over-consumption. It is hard to see how this model can ever truly be sustainable.
- Stimulating domestic consumption in China or other large developing countries from their current low per capita levels could lead to an impossible future global

environmental situation if consumption levels rise anywhere close to those of the richer countries today because ecological capacity will be exceeded even with stringent eco-efficiency measures. Ecological footprints continue to rise with economic wealth; already the global resource and environmental situation may be beyond earth's longer-term carrying capacity. Thus new pathways are needed that lead to high quality of life in China and elsewhere, but with relatively limited per capita consumption increases, while richer countries must become much more serious about their own transformative needs for environment and development and on sustainable consumption.

- Declining resource and environmental intensity （e.g., use of energy or material per capita or per unit of GDP）is a misleading measure of environmental progress in situations where economic or resource exploitation growth rates are very high. Absolute pollution amounts, or of resource decline, may continue to rise even though utilization efficiency increases. This is particularly important in the debate about greenhouse gas reductions, but also for many other of the pollutants that China and other countries are producing, and for ecological and resource decline globally and regionally.
- Social considerations of poverty reduction, equity in access to education and health care, sustainable cities and towns, sustainable rural development, and creation of new employment opportunities will continue to be drivers of sustainable development innovation in all countries. Yet this type of innovation is still often separated from environmental considerations. China, more than many other countries, is making a serious effort to make the linkages and take an integrated approach. China's success and experience will therefore be of value to many other nations.
- Corporate social responsibility is taken seriously by many large multinational corporations in particular, yet it has not taken hold to the extent that it should anywhere in the world, and certainly not in most parts of Asia, including China.
- The framework for addressing global environmental protection, and for regulation of market-driven globalization matters, including technology sharing, intellectual property rights, and international trade and investment, is still weak and incomplete. As well, new issues are appearing each year, including many health and environment problems, and new mechanisms such as carbon trading. China's own strategic transformation on environment and development will depend to a considerable extent on improvements for international action.

- Innovation in the form of new or improved scientific and technology applications, investment, management and institutional change is needed both nationally and internationally, but often the changes occur much more slowly than desired and with a limited distribution of benefits.

China has now become an "indispensable" economic partner, stabilizing the world economy, fueling international economic "booms", and raising the level of incomes for many developing countries. This success needs to be tempered with the difficult issues of declining environmental conditions. Global attention in recent months has been focused on a range of quality issues, including the efforts to improve the air quality in Beijing and the Olympic Games, to solve the problems of market supply chains and product quality, and how China will respond to climate change.[①] China needs to understand how it can balance its environment and economy relationship in the context of globalization effects.

INNOVATION FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

There are a number of specific characteristics about environment and sustainable development innovation worth bearing in mind, since these are as likely to be as applicable in China as elsewhere.[②]

- The need for innovation increases as the commitment by governments and the private sector shifts from an emphasis on cost-driven regulatory compliance to an emphasis on broader economic/financial, social and environmental benefits.
- Many environmental innovations will arise from industrial innovation not primarily oriented to environmental improvement, for example, energy efficiency and product improvement. The potential for co-benefits is large.
- Environmental innovation is often directed to maintaining public goods, which means that incentive for private investment and return on investment can be limited, especially in relation to alternatives. Market value is needed for technologies to thrive.
- Bringing environmental innovations to full commercialization can be difficult due to market imperfections and failure, or perverse incentives such as inadequate

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① See Elizabeth Economy. 2007. The Great Leap Backward? Foreign Affairs. September/October; Joseph Kahn and Jim Yardley. 26 August, 2007. As China Roars, Pollution Reaches Deadly Extremes. The New York Times.

② These points are based in part on OECD, 2007. Environmental Innovation and Global Markets. ENV/EPOC/GSP（2007）2/REV1. Environment Directorate, OECD, Paris. 101 pp.

pricing.

- Technology "lock-in" is a formidable problem for environment and sustainable development innovation, affecting institutional and financing responses even when R&D suggests better technologies are available or could be developed.
- Co-evolution of technologies is often needed, for example, in the relationship of battery technology and hybrid automobile engine development.
- Flexible instruments such as economic incentives and performance standards foster environmental technology innovation more than prescriptive measures （e.g., 'best available technology' regulation）, especially if the desired outcome is integrated changes in production or other processes rather than end-of-pipe pollution control.
- Globalization, with its fragmented supply chains, may generate considerable international demand for accelerated development of environment and sustainable development technologies and their rapid deployment, including pressure for suppliers along the value chain to conform to consumer-driven environmental demands.
- Some key environment and sustainable development technologies（e.g., for clean coal use, nuclear fusion, and sustainable transportation）are beyond the capacity of any one country, no matter how technologically-advanced, and therefore international partnerships and joint venture activities are desirable.
- Governmental intervention in choosing technology "winners" can be highly controversial. One view is that governments should concentrate on defining clear environmental goals and a framework to address them, while being "technology-neutral" on how they are addressed.

CHINA'S INNOVATION STRATEGY AND KEY LINKS TO ENVIRONMENT AND DEVELOPMENT

Scientifically-based development, wealth shared fairly among all citizens, harmonious and sustainable development that provides for environmental protection, continued rapid economic growth and improved social services and greater social equity are cornerstones of current Chinese policy. These elements therefore are reflected in many of the approaches for innovation generally, and science and technology （S&T）strategies in particular.

The context for innovation has been set broadly, as explained by Vice-Premier Zeng

Peiyan in a speech to the China Business Summit:[①]

"…Innovation is the soul of a nation's advancement, as well as the everlasting driving force for national prosperity…Problems often occur when people tend to pay attention to quantitative expansion and speed while ignoring quality…We have to upgrade our development strategies, transforming our growth pattern and optimizing the industrial structure…The objectives of reform are to bring economic and social development on the track of comprehensive, balanced and sustainable development."

He pointed out that this effort offers the potential for technological innovations that could enhance productivity and increase competitiveness for China. The focus on institutional innovation should include reforming the administrative system, accelerating corporate reform, and establishing modern market systems.

Innovation must be linked to improved governance. As noted in a review of China's S&T Strategy: [②]

"the path to creating the overall well-off society will necessarily be characterized by technology innovations supporting greater efficiency and productivity, and institutional innovations supporting improvements in governance—greater market discipline and integrity, less government corruption, and greater administrative accountability."

OECD countries are passing through a transition where stand-alone S&T strategies are now being viewed within a broader context of a National Innovation System （NIS）that can take into account many factors beyond specific S&T plans or strategy. In particular, a NIS must consider the role of the business and financial community not only for participation in research but also in linking to the demand side and in providing clear pathways to commercialization. A NIS also must take into account the development of innovation clusters with appropriate capacity building and scientific and physical infrastructure development, enabling frameworks and regulatory systems, and help with fundamental matters such as the selection of priority areas of innovation in which to initiate substantial programs.

The NIS approach, however, is that it has evolved relatively independent of sustainable development. Thus, while some environmental concerns may be addressed in specific cases, this is by no means a central element. Rather, NIS tends to focus on building competitive advantage of a country through new technologies. Sustainable development is its own form of innovation, with some specific characteristics. It is mainly in the last 5 years that NIS and sustainable development have become more closely aligned in OECD nations, stimulated

① China Daily. 11 Sept 2006. Innovation is the Soul of Nation's Advancement: Vice-Premier. www.china.org.cn/english/BAT/180675.htm

② Cong Cao, R.P. Suttmeier and D.F. Simons. December 2006. China's 15-year Science and Technology Plan. Physics Today.

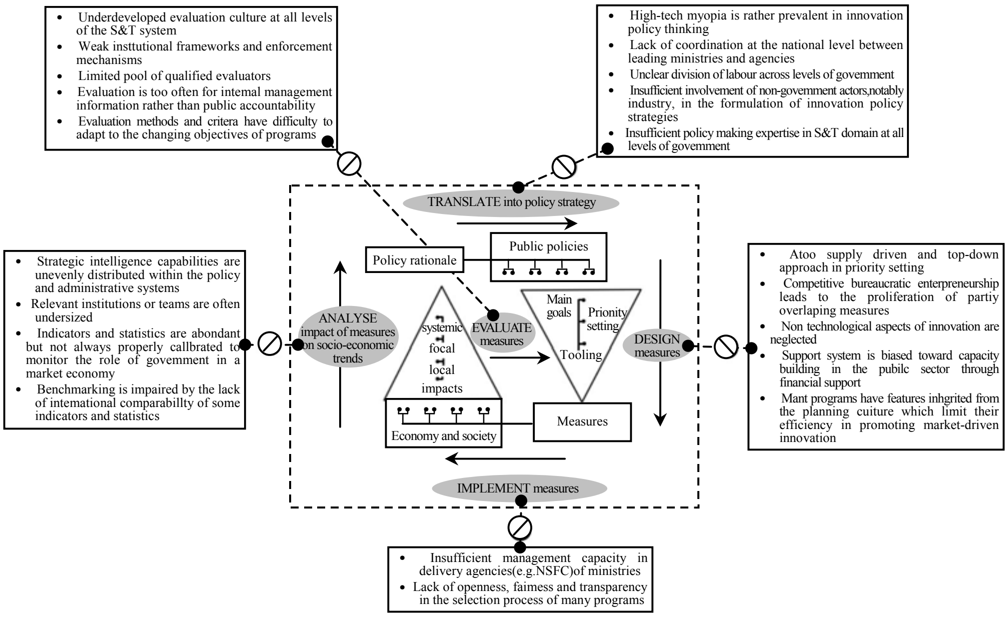
particularly through concerns such as alternative energy and climate change, industrial eco-efficiency, sustainable infrastructure development and some aspects of natural resource and environmental management.

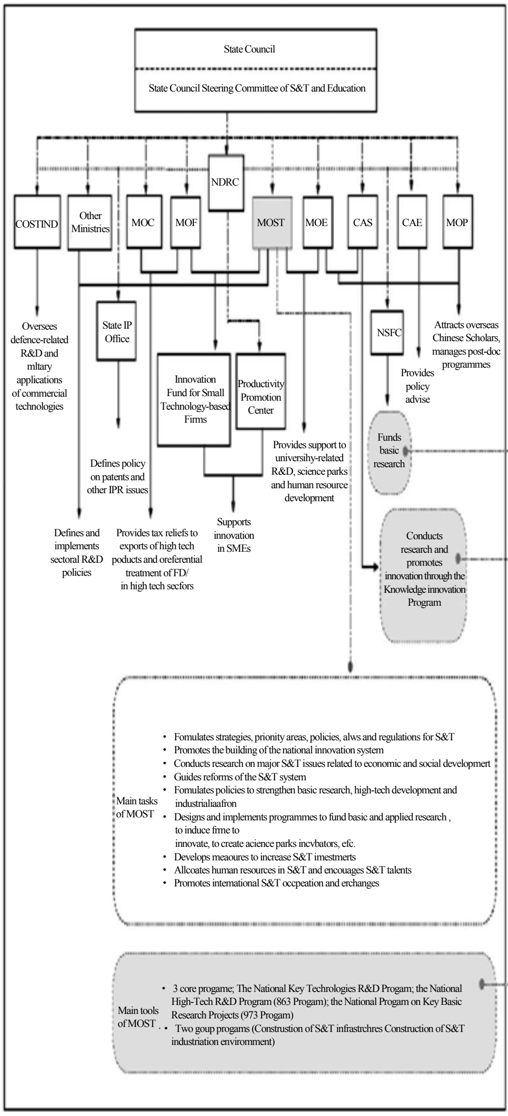
China’s National Innovation System （NIS）

China is following somewhat the same pathway as other nations in creating its approach to a NIS—with a very impressive level of S&T investment, and considerable experience with what may best be described as an adaptive approach to its NIS. This system has a number of key characteristics which have evolved over the past 25 years.[①] What sets China apart from others is the magnitude of commitment and the rapidity of transition. And China has placed development concerns front and centre in its innovation goals, with a strong commitment for environmental protection.

The public governance of S&T and innovation is relatively complex, as noted in the diagram on the following page （from OECD 2007. Synthesis Report）. There are many challenges to be faced, as noted below （from OECD 2007. Synthesis Report）.

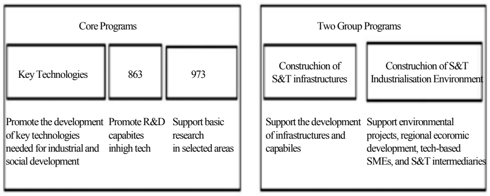
[①] See, for example, Shulin Gu and Bengt-Åke Lundvall. 2006. China’s Innovation System and the Move Toward Harmonious Growth and Endogenous Innovation in Shulin Gu and Mark Dodgson. 2006. Innovation in China: Harmonious Transformation. Special Issue of Innovation: Management, Policy and Practice. eContent Management, Queensland Australia. 218 pp; and OECD. 2007. China. Synthesis Report. OECD Reviews of Innovation Policy. OECD, Paris. 68 pp.


• Underdeveloped evaluation culture at all levels of the S&T system
• Weak insttutional frameworks and enforcement mechanisms
• Limited pool of qualified evaluators
• Evaluation is too often for intemal management information rather than public accountability
• Evaluation methods and critera have difficulty to adapt to the changing objectives of programs
• High-tech myopia is rather prevalent in innovation policy thinking
• Lack of coordination at the national level between leading ministries and agencies
• Unclear division of labour across levels of govemment
• Insufficient involvement of non-govemment actors,notably industry, in the formulation of innovation policy strategies
• Insufficient policy making expertise in S&T domain at all levels of govemment
TRANSLATE into policy strategy
Policy rationale
Public policies
• Strategic intelligence capabilities are unevenly distributed within the policy and administrative systems
• Relevant institutions or teams are often undersized
• Indicators and statistics are abondant but not always properly callbrated to monitor the role of govemment in a market economy
• Benchmarking is impaired by the lack of intemational comparabillty of some indicators and statistics
ANALYSE impact of measures on socio-economic trends
systemic
focal
local
impacts
EVALUATE measures
Main goals
Priority setting
Tooling
DESIGN measures
• Atoo supply driven and top-down approach in priority setting
• Competitive bureaucratic enterpreneurship leads to the proliferation of partiy overlaping measures
• Non technological aspects of innovation are neglected
• Support system is biased toward capacity building in the pubilc sector through financial support
• Mant programs have features inhgrited from the planning cuiture which limit their efficiency in promoting market-driven innovation
Economy and society
Measures
IMPLEMENT measures
• Insufficient management capacity in delivery agencies(e.g.NSFC)of ministries
• Lack of openness, faimess and transparency in the selection process of many programs



Program	Year of start	Implemented by	1881-85	1988-90	1991-95	1998-00	2001-2005
Key Technologies	1983		15	35	452	50	50
973	1997	MOST	•	•	•	12	21
863	1986		•	←	59	→	150
NNSFO	1986	MNSFC	•	5.7	15.9	44.7	100
Knowledge innovation	1988	CAS	•	•	•	54	200
TOTAL			15	•	•	•	521
Total as share of total public S&T expenditures							17%

Table 3,2 Main MOST Porgrams



million RMB (2004)	Key Technologies Program	863 Program	973 Program
Total funds raised	14985	9293	1031
Govemment funds	3003	4231	903
Gov. as % of total	20%	48%	88%

Origins of funds for the Torch and Spark Programs (2004)

	Total	Torch	Spark
Funds raised (million RMB)	91888	71313	20573
% govemment	3%	2%	5%
% enteronise	70%	72%	60%
% band loans	23%	21%	30%
% overseas	0.3%	0.3%	0.8%
% others	4%	4%	4%

Funds allocated by certral govemment to selected Two Group Programs (mition RMB)

	1988	2004
	125	130
State Key Laboratory Construction Program	40	85.5
National Engineering Research Centre		
Spark Program	39	105
Torch Program	51	50
Science and Technology Achievements Spreading Program	20	23
National New Products Program	135	140
Innovation Fund for Small Technology based firms	•	500
Agriculture Science and Technology Transfer Fund	•	250
Action Plan for Promoting Trade by Science and Technology	•	20
Special Technology Development Project for Research institrons	•	182

NDRC: National Development and Retom Commission COSTND: Commission of Science, Techrology and indushy for National Defence
MOC: Ministry of Commerce MOF: Ministry of France MOE: Minristy of Education MOP: Ministry of Parsonnel
MOST: Ministry of Science and Technoogy CAS: Chinese Academy of Sciences CAE: Chinese Academy of Engineering NSFC: National Natural Science Fourdation of China
Source: OECD based on data from MOST and offter sources

A strong recognition exists of the need to make the NIS enterprise-based. There are numerous mechanisms to involve the private sector, and to transform state-owned enterprises. Yet the reality is that most Chinese businesses invest little in R&D, and it is a challenge to get adequate R&D investment as part of FDI initiatives.

From another perspective, China may be able to tailor its growing innovation capacity to competitive advantage as part of a "global innovation system." As noted by OECD[1]:

"China can make a significant contribution to the world's knowledge pool and help to solve global problems. Among these are those relating to the strong demand for energy and natural resources and the environmental pressures associated with the rapid economic growth both of China and other emerging economies. China and OECD member countries have a shared interest in solving these problems."

There could be multiple advantages to China of participating extensively in such a system. It is a means of sharing the burden and drawing upon a wider range of experience on complex technologies such as those involved in new energy technologies. China can draw upon its advantages as a low cost producer to commercialize innovation technologies and sell these abroad. And China will gain credibility internationally for its science and technology contributions.

A number of strategic tasks have been identified by OECD as possible means for enhancing the efficiency and effectiveness of China's NIS. These include: （1）Adjusting the role of government to enhance provision of public goods through science and innovation; （2）Improving the framework conditions for innovation, such as enforcement of intellectual property rights （IPR）, fostering competition, improving corporate governance, fostering open and competitive markets, careful use of public procurement, and promoting technology standards appropriately; （3）Increasing research quality and efficiency by sustaining the growth of human resource for S&T; （4）Improving governance of science and innovation policy, including a focus on central and sub-national division of labour and responsibility, and improving inter-agency coordination; （5）Adjusting the set of policy instruments in order to develop the most appropriate types of R&D initiatives and programs; （6）Maintaining adequate support or public R&D, especially for public good priorities such as environmental protection; and （7）Strengthening the linkages between industry and science.

China's 15 Year Science and Technology Strategy

China is poised to become one of the world's leaders in S&T investment. The 2006 15-Year S&T Plan[2] emphasizes "indigenous innovation" and technology leapfrogging so that some 60% of contributions for economic growth will come from technology advances, with dependence on imported technology no greater than 30%. China aims to be among the top 5 countries in terms of invention patents and also in terms of overall S&T expenditure—a "global scientific centre." OECD believes that China is already the world's

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[1] OECD. 2007 China Synthesis Report.

[2] For a useful review of the S&T Plan See Cao, Suttmeier and Simons, Physics Today. Dec 2006.

second highest investor in R&D, spending slightly more than Japan's USD 130 billion in 2006, but far lower than the US investment of USD 330 billion. This represents an increase from 0.6% of GDP in 1995 to more than 1.2%.[①]

The meaning of "indigenous innovation" is somewhat complex: original innovation, integrated innovation relying upon linking of existing technologies for new uses （e.g. application of medical biotechnology for diagnostic testing of the environment）, and "re-innovation" involving improvement of imported technology. All three approaches are of value in relation to environment and development innovation. It also should be noted that emphasis on institutional and management innovation is a crucial component for all three approaches—in order to improve implementation success of off-the-shelf technologies as well as innovative technologies.

A likely transition for China is towards greater ownership of intellectual property rights and possibly to industrial standard-setting as part of its effort to become an innovation-based society. This has important implications for environment and SD technology development for use domestically and also for applications internationally. The potential dilemma is the length of time to develop new intellectual property, and therefore the uncertainty and lengthy process to bring new technologies into the marketplace.

Another view is that gaining access to sophisticated available environment and sustainable development technology from abroad is essential for the near-term, especially during the 11th and 12th FYP periods. While such an approach is appealing and in fact occurring, there are cost issues and also issues that relate to reluctance of some companies to share their most advanced features with Chinese operations. The role of China's government in setting appropriate regulations （e.g. auto emission standards）and IPR safeguards is important.

Chinese-international partnership for development and implementation of new technologies is a hybrid approach to innovation that is likely to be of increasing significance in coming years, and seems particularly important for alternative energy sources, and perhaps for water pollution control technology, hazardous waste management and prevention, etc. Many of these activities can be managed through foreign direct investment strategies but some might also be done through government-to-government arrangements. Models for the latter exist （EU, USA, etc.）

Almost all of the 20 strategic research topics noted in the S&T Plan are relevant in some way to environment and development, but several are critical including: agricultural

① OECD. 2006. www.oecd.org/sti/outlook

S&T, culture for innovation and S&T popularization, ecology, environment protection and circular economy S&T, energy, resources and ocean S&T, human resources for S&T, modern manufacturing development S&T, population and health S&T, regional innovation system, strategic high technology and industrialization of high and new technology, transportation S&T, and urban development and urbanization S&T.

Environment and development innovation may be less in need of S&T megaprojects than some other aspects of the strategy, but require greater attention to accelerating the pace of development of promising initiatives, and to the need for funding related to those initiatives where the marketplace has not yet caught up with the societal need （e.g., low cost sanitation and water treatment, brownfield redevelopment, and advanced forms of biorefineries.）

Regional and local S&T innovation and concurrent needs for implementation capacity development are significant, and involve the private sector and communities as well as governments at various levels. This aspect of innovation is critical for ecological initiatives and rural development, as well as industrialization in locations where innovative solutions may be needed to address pollution and other environmental impacts.

A NATIONAL “ECO-INNOVATION SYSTEM” FOR CHINA

The time may be right to propose creation of a national eco-innovation system for China that could address in a comprehensive way the various opportunities and challenges to innovation for an environmentally friendly society. This approach has not been widely tested, although it is being actively explored in Europe particularly. Eco-innovation is defined as any form of innovation focusing on sustainable development through reducing impacts on the environment and achieving more efficient use of energy and natural resources.

A key question would be how taking an eco-innovation system approach might influence outcomes of the 11th FYP environmental efforts? By taking a systemic approach, could performance be improved, and to what extent would the results be related to environmental technology, and to what extent from institutional improvement such as local government strengthening?

The following 10 innovation issues are indicative of the need for policies and action in a systemic approach to achieving an environmentally-friendly society.

1. Creating more widespread and effective use of existing environmental technologies that would lead to greater efficiency at a lower cost than developing new technologies, especially for industry and energy pollution control and for new building technology.

There are many environmental technologies available at the present time either within China or elsewhere. Such technologies could be introduced and adapted to specific Chinese development conditions, likely at lower cost and in a more timely way than developing new technologies. And a good part of the challenge in any case is not the technology *per se* that is a barrier, rather it is the lack of knowledge about its application, inappropriate incentives and regulation, and the need for an improved implementation management system.

It is sensible and necessary in the short run to focus on immediate opportunities even while seeking longer-term, more transformative options. Using existing technologies is a means for the industrial and construction sectors to demonstrate a commitment to corporate social responsibility in an immediate, goal-oriented and measurable way rather than via promises mainly of future, longer-term performance. It is a mechanism to maximize technology transfer by drawing upon multinational experience, especially as part of FDI packages and through cooperation programs, particularly with OECD countries. An additional benefit of maximizing use of existing environmental technologies is that it will further stimulate the rapid development of a robust environmental service sector within China.

The potential downside of embracing existing environmental technologies is that many will be from an earlier generation designed for pollution clean-up rather than prevention, and some will not be as cost-effective or efficient as newer approaches being designed today. In particular, the move towards elimination of serious pollutants through industrial ecology design and environmental planning presents more attractive longer-term options, including synergies for a circular economy, ability to control emissions such as greenhouse gases that were not of such a concern in the design of existing pollution control technology, and perhaps discovering better approaches for China’s situation.

2. Setting environment and sustainable development objectives, standards, and incentives at levels that will promote innovative responses, while putting into place regulatory frameworks that will enable innovation solutions to be implemented effectively.

While China has already taken many initiatives for addressing this set of issues, the results are still far from optimal, suggesting the need for further national and local government interventions. The problems seem to be associated with the following matters:

- Inadequate drivers for action towards desired innovations （not only for new technology, but also for institutions, investment and management systems）. The weak drivers are reasonably well understood. They include weak enforcement and punitive measures that simply become part of the cost of doing business; the continuing ambivalence of many local governments towards environmental management efforts where GDP growth may be threatened; national laws and regulations that are too general or even work at cross-purposes; etc.

- Limited returns from existing S&T investment in terms of bringing new technology to commercialization and in terms of the relative low number of patents and other indicators of productivity of the S&T system.
- Failure of much of China's private sector to develop robust environmental management strategies and to undertake the original R&D that would support innovative solutions to pollution control, energy efficiency and other problems that should engage their interest.
- Failure to engage the financial sector fully into environmental innovation strategies. For example, it is only recently that bank lending has started to consider environmental matters.

This list of problems is very significant in terms of China's future success with innovation for environment and sustainable development. But it is a list that may well grow over time as new technology innovations emerge.

Experience elsewhere suggests that public perception and markets are unlikely to embrace all forms of technology solutions. This may well be true in the future for China as well—in its domestic markets, but also, via market supply chains, for China's export-driven economy. Choice of biotechnologies for environmental matters, for example, may influence access of final products to foreign markets.

3. Developing environmental, safety, health and life cycle assessments of impacts arising from new technologies （e.g., biotechnology, nanotechnology）at all stages of their development from R&D to full commercialization.

Many assertions will exist concerning the benefits and risks of new technologies, starting with the earliest stage of scientific research. China has engaged domestically and in joint ventures with funding of initiatives and building of expertise covering a wide range of promising technologies. The new S&T strategy offers even more possibilities. How can there be reasonable assurance that the new investments actually will contribute to China's sustainable development needs in a more effective way? And what safeguards need to be put into place to ensure that the innovations do not create unacceptable health, environmental and safety problems on their own right? The design of existing environmental assessment procedures is not very robust for answering these questions since the assessment system is geared much more to construction and other types of projects. Even policy environmental assessments are likely to be insufficient.

The OECD and some individual nations have started to consider appropriate assessment tools and procedures, for example, to cover innovations such as biotechnology applications for the bio-economy and for nanotechnology and the environment. China will need to place more emphasis on these matters as its S&T strategy unfolds. The time to set in place an innovation environmental assessment system is now, before the new technologies overwhelm regulatory bodies, or before a serious incident occurs that is detrimental domestically and/or internationally.

The issue of whether assertions about the value of the potential S&T application are correct will always be difficult to assess, since the full potential often takes two or more decades in order to be fully realized. The slow unfolding of the hydrogen economy is a highly relevant example. However, the area of technology assessment for environment and development has made considerable progress over the past 5 years, with development of useful tools and scientific dialogue processes that are valuable. China is already engaged in some of these processes, but likely should be doing more to ensure that initial choices are reasonable.

4. Enhancing the contribution to environment and sustainable development innovation by multinational corporations, international joint ventures and partnerships for key technology applications.

The environmental role of the international business community investing in China has been highly variable, ranging from negative to highly positive. It would be desirable for international businesses to be in compliance with all relevant Chinese environmental laws, but compliance is not enough to address innovation. Instead, multinational corporations should be prepared to consider the following: environment and sustainable development capacity building of staff in their own business and, sometimes, with other businesses in the same sector; willingness to share cutting edge technology; support for environmental R&D within company operations and via grants or partnerships with Chinese universities and research bodies; participation in certification and other innovative voluntary environmental programs. Some international companies operating in China are already engaged in many of these activities, but certainly many others are not. Furthermore, there are many supply chain issues, including subcontracting and outsourcing within China where there seems to be limited consideration of how goods are produced. These problems are exacerbated by the intense competition among provinces for investment and for increased manufacturing opportunities.

The problems go deeper, when investments in supporting infrastructure, such as commercial and factory buildings, transportation and utilities are considered. While some excellent trial efforts for LEED certified buildings have taken place, and many individual companies operating in industrial parks have established facilities that compare well with similar operations in their home countries. But these initiatives appear to represent a small fraction of total investment. Some new industrial operations such as those for steel production tend to be designed at or above international norms. However, there is justifiable concern about the creation of many more facilities that will become brownfield sites or that will become an on-going energy and pollution burden due to the limited initial investment in environmental controls.

What is required is a much greater environmental interest on the part of both Chinese and international investors in China, including those from other parts of Asia. The reality is that only two factors are likely to have a high degree of influence. One factor is strong governmental action of both a regulatory and an enabling nature. The second is the power of markets by rejecting unsustainably-produced items, or demanding certification or other proof of sustainability. Over the coming 5 to 10 years it is quite likely that both domestic and international markets for Chinese goods will feel pressure from environmental concerns. And, especially at the national governmental level, there is an increasingly coherent approach being followed in environmental regulation.

5. Attracting much more Chinese and international venture capital and private equity in support of environmental services, and new environment and sustainable development initiatives, especially those at the start-up and scaling-up stages.

At the leading edge of investment is the role that could be played by venture capitalists in support of environmental and sustainable development innovation. Venture capitalists typically are needed in order to move innovations arising from small entrepreneurial companies from a preliminary stage of development to become a commercially viable operation. Use of venture capital in China is still at a stage where there are numerous problems, including an insufficient regulatory framework, and satisfactory relationships between entrepreneurs and the venture capital sources. There are many types of opportunities available and until recent times environment has not been the focus of as much attention as other fields such as information technologies and biotechnology. However, the highlighting of energy efficiency and pollution control as key objectives in the 11th FYP has elevated their significance to such investors.

Environmental services companies will likely prove to be attractive to private equity sources in future years. The conditions to support more private equity investment for environmental protection include: a need for consistent drivers so that there is reasonable assurance of a growing market demand and profits that are at least as good as alternative investments; fair regulatory frameworks that ensure a level playing field for enforcement and therefore interest—on the part of municipalities, the construction sector and various industrial sectors—in purchasing both environmental equipment and services; and knowledge of the opportunities that are likely in the coming years. Government may also provide some direct stimulus through public procurement policies that favour environmentally friendly products and services. Fortunately, there is a growing understanding of energy efficiency and environmental protection investment opportunities in both the venture capitalist and private equity communities within China.

6. Ensuring adequate flow of innovation benefits concerning environment and sustainable development to less wealthy areas of China and to rural areas, especially via the strengthening and support of small and medium-sized enterprises （SMEs）throughout the country.

While most funds for environmental innovation R&D and follow-up commercialization are likely to flow into urban areas where universities, research centres, industry and commercial activities are concentrated, there are many applications that must be developed to meet needs associated with the countryside. And, throughout China, the future strength of entrepreneurship will continue to be expressed largely through the remarkable number and variety of SMEs, including many located in smaller centres.

Megaprojects, including giant water and energy initiatives; some transportation projects such as the Qinghai-Tibet Railroad; regional development in China's Northeast and in the Pearl Delta; and development of new cities encroaching into rural lands all have the potential to introduce not only a wide array of environment and sustainable development innovation technologies, but also vastly improved planning and management.

While China has undertaken many unique engineering initiatives in terms of scale and complexity, they alone cannot ensure sustainable development nationally or in the various regions of China. It is particularly important that there also is sufficient scientific effort devoted to solving the many problems related to intensive use of landscapes, ecological construction and restoration, development of eco-communities and green buildings at all scales including those in smaller cities and towns, and improvement of environmental quality in coal mining, heavy industry. This need is recognized in the new S&T strategy. The Asian Development Bank has noted[①] that SMEs are "more flexible in meeting the market demand for new technology and are therefore able to achieve rapid growth in the market." However, more needs to be done to provide an integrative approach that fosters and takes full advantage of small and medium-sized enterprises potential to be local and

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① Asian Development Bank. 2002. The 2020 Project. Policy Support in the People's Republic of China. Chapter 8. Technology Policy. ADB, Manila.

sometimes national entrepreneurs.

The integrative effort should include not only capacity development within the national innovation system to build local environment and sustainable development S&T competence, but also fostering the necessary private sector and venture capital funding opportunities directed to meet needs of SMEs. In addition, within local and provincial level governance, more emphasis must be placed on building appropriate enabling arrangements for entrepreneurs to work successfully but without creating funding sinkholes.

It is at local and regional levels where considerable effort must be applied in order to create *adaptive strategies* for environmental problem-solving. This is a key concern for climate change, for addressing problems associated with natural disasters, and for issues such as desertification and maintaining ecological services. Adaptive strategies recognize that it is human behaviour that must be modified to successfully address environmental change. Such strategies depend upon a blend of technological application, good environmental planning, innovative economic incentives and a high level of public understanding and input.

7. Seeking better solutions to high licensing fees, more timely and reasonable access to advanced technology and, in general, building more proactive approaches to intellectual property rights matters for environment and sustainable development.

The balance between indigenous technology development and the utilization of environmental technology developed elsewhere will be determined by many factors, but certainly issues surrounding intellectual property rights and cost of access rank high. The problem is more complex than monetary factors only, however. Those possessing advanced technology are wary of losing control over rights, or unauthorized copying, acts of industrial espionage, etc. And there is also sometimes a concern about the absorptive capacity, which leads to a staged access rather than leapfrogging.

In the coming years, as Chinese industrial and manufacturing development matures even further, and as the domestic environmental industry sector grows, there should be a much greater capacity and opportunity to assimilate advanced technologies. The value attached to these technologies quite likely will be even greater than today. And there will be new options, especially in alternative energy technology, green chemistry, biorefineries and other applications involving biotechnology and information technology. Energy efficiency, new coal technology and transportation are other areas where major advances are already occurring.

What will be needed are more effective international partnerships and joint ventures aimed at building the levels of trust and understanding, and experimentation with new approaches towards sharing technological experience and advances. In general it should be in the best interests of the rest of the world to accelerate the pace of China's transformation towards clean and efficient technology. Despite broad agreement about this statement, action has been relatively limited by comparison to the need. This is true for both government-to-government（e.g. EU S&T initiatives)or at the level of enterprises（e.g. the limited innovation efforts by overseas automobile manufacturers operating in China）.

It is encouraging that new models are emerging, for example, the recently announced JUCCCE （Joint U.S.-China Cooperation on Clean Energy）, a not-for-profit initiative designed "to accelerate 30 years of clean energy development into 10 years." It will bring together US and Chinese government, business, research and investment interests to address China's current energy efficiency and pollution control priorities.

Existing, but still evolving international mechanisms such as the CDM （Clean Development Mechanism）, and TRIPs （trade related intellectual property rights）present future opportunities for China to make further gains towards more equitable arrangements on terms for technology access.

China also will benefit if it becomes a nation capable of exporting environment and sustainable development technology and expertise. This is already the case with solar panels, where China is a leader. New export markets for environmental products, taking advantage of China's comparative advantages such as lower production costs, could help to offset some of the fees paid to license advanced technologies. It also is a means of building economies of scale so that Chinese domestic markets can take advantage of more reasonably priced environmental goods.

8. Developing shared regional policies and practices with key countries and country groups within Asia and in the Asia-Pacific Region in order to create greater demand for environment and sustainable development innovation and to create new markets for Chinese environmental goods and services.

With the rising level of need and interest in environment and sustainable development throughout the Asia-Pacific region, and especially in South, Southeast and East Asia, there are good opportunities for China to build cooperative environment and sustainable development innovation ventures within the region. The advantages are obvious since problems often are shared or of a similar nature, costs of gaining access to appropriate levels of technologies may be less, and a clean environment will benefit all within the region. Also, there are bodies available that promote cooperation, such as ASEAN and APEC.

With huge populations and booming economies, markets for environmental goods and services in South and East Asia will become larger and larger. Yet there is insufficient cooperation to build a truly cutting edge approach that would take best advantage of the opportunities. It is striking that most of the international technology cooperation, venture capital access and capacity building necessary to supply these growing markets adequately is still via North America and Europe （along with considerable Japanese and growing Korean involvement）. China and India could change this equation very significantly through cooperation to become regional environmental innovation leaders.

9. Recognizing the role of producing and disseminating reliable information on environment and sustainable development as a central component of national innovation strategy.

People and communities need to understand benefits, costs and risks associated with innovation for environment and development and to have direct access to benefits. Otherwise there may be backlash. Fostering a culture of innovation within a country as large and diverse as China depends on education, public awareness, and a sense of opportunity. Environmental decline is now recognized as a matter of high concern by many of China's citizens, yet relatively few would be able to link problems and solutions to specific modern technologies or other innovations. Certainly the same was true in many western countries until a generation ago. Much of today's enhanced environmental perception has come about through a much better understanding of pollution science, ecosystem analysis, etc., accompanied by an active media involvement to popularize scientific findings and to interpret environmental changes. The debates accompanying the search process to define the nature of problems and possible solutions have become an important part of democratic processes.

China's future choices on how and where to engage in scientific innovation for environment and sustainable development one way or another will be influenced by the voice of its people—whether operating through consumer choice, consultative processes, or in other ways. It is essential that choices be informed by the best available Chinese and international knowledge, and that will require deliberative dialogue on technology, institutional performance, assessment of impacts and other concerns of people.

10. Using China's comparative advantages to engage in the substantial markets for green products and services both domestically and for export markets.

China's low labour costs and skilled labour supply, ability to rapidly set up modern, efficient manufacturing plants, and technological design skills can be used to build international leadership in green markets of the future. Part of China's advantage, of course, is the enormous potential size of domestic markets. Chinese businesses have been able to do this already with solar panels. Another opportunity clearly will be in the manufacture the next generation of lights to replace incandescent bulbs.

China has developed unique capabilities related to implementation of Circular Economy. Utilization of the world's waste paper is one of the most significant examples of how China can meet its needs while contributing to the solution of a global problem. The idea of a Circular Economy is an important expression of an environmentally-friendly society. It is one of the most concrete ways to address environmental innovation.

CONCLUSION

China's strategic transformation on environment and development may well be unlike that of any other country. Coming some 30 years later than transitions in the OECD countries, China's transformation can be informed by many good and bad experiences of others. The challenge is for China's effort to be more successful than any other nation. Although there are many barriers domestically and internationally, there is also good reason to believe this success could be achieved, so that China becomes a model for others.

Would it be in China's best interest to do so? And how substantial would be the economic, social, environmental and political benefits to the country? These are questions that will need to be debated. But it is clear enough that the entire world will benefit if China is successful.

Therefore China's commitment to innovation for an environmentally-friendly society is likely to become one of the great experiments of our time. It needs to be supported in many ways, including accelerated efforts to more rapidly find ways to address such difficult and pressing problems as clean coal combustion and utilization, and mechanisms to properly assess new technologies so that both domestic and international confidence is maintained. The experiment will start to demonstrate its benefits immediately, both to China and outside of its borders. But the greatest payoffs will come in the longer-term, hopefully to China's society of 2020, and to the world of 2030 where significant transitions in energy use, industrial ecology, Circular Economy and other innovations should be universal.

（Text version is provided by Chief Advisors）

Reports of Task Force and Special Policy Studies

Report on Policy Mechanism towards Successful Achievement of the 11th Five-Year-Plan Environment Target*

I. Executive Summary

At present, environmental pollution in China is still increasing, with emissions of major pollutants showing no sign of decrease and exceeding environmental carrying capacity. Environmental pollution has seriously constrained sustainable social and economic development in China and affected the improvement of public health and living standards. To implement the scientific approach to development, the Chinese Government developed the Outline of the 11th Five-Year Plan for National Economic and Social Development （hereinafter referred to as the Outline）. The Outline identifies the following binding targets: energy consumption per unit GDP should be reduced by 20% and the total emission of major pollutants by 10% by 2010 compared with that of 2005. Against this background, CCICED decided to establish the Task Force （TF）on Policy Mechanisms for Achieving the Environment al Targets of the 11th Five-Year Plan. This TF has studied the policy implementation mechanisms for reducing emissions of major pollutants including COD and SO_2 and put forward measures and policy recommendations to the Chinese Government for meeting the emission reduction targets during the 11th Five-Year Plan period. Based on the investigation of local practice in many areas, and the study of the experience of developed countries in emission reduction, the TF has drafted the Report on Policy Mechanisms for Achieving Environmental Targets the 11th Five-Year Plan. This Executive Summary of the report will be submitted to the First Annual General Meeting of CCICED Phase IV.

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PART A: ANALYSIS OF CURRENT EMISSION REDUCTION EFFORTS IN CHINA

A.1 Achieving the pollution reduction targets is a difficult challenge

1．Energy saving and pollution reduction is an important strategy of the Chinese Government to implement the scientific approach to development. The implementation of the strategy on energy saving and emission reduction is an important means for the Chinese Government to the scientific approach to development and to develop a socialist, harmonious society. It is also the necessary condition for building “a resource-saving and environment-friendly society”; and the only path for China to follow to facilitate economic restructuring and the transformation of the mode of development. In addition, it is the prerequisite for raising living standards and maintaining the long-term interests of the Chinese nation. The implementation of energy saving and emission reduction is the basic guarantee for achieving good environmental quality in functional areas, and a powerful means for facilitating the strategic adjustment of the economic structure and a fundamental shift in the mode of growth . It contributes to the promotion of technological advancement and resource saving; implementation of national industrial policies; the achievement of rational allocation of environmental resources, and supporting initiatives in the prevention and control of pollution. At the same time, with the mainstreaming of the emission reduction target into the national economic and social development plan, the total emission control system has become a tool for environmental protection departments to be involved in comprehensive decision-making processes.

2．Pollution reduction is the top priority in environmental protection for China during the 11th Five-Year Plan period. It is expected that by the end of 2010, total emissions of COD and SO_2 will be reduced by 10% compared with that of 2005. This is the solemn commitment of the Chinese Government to the Chinese people and to the world, and binding environmental targets that must be met. This is well-regarded by the international community. The key to meeting these targets lies in the integration and combination of approaches such as end-of-pipe control, consumption of energy and resources, clean production, technological advancement, industrial pollution control, supervision and management. The TF holds the view that pollution reduction is fundamentally not only an environmental issue but also a socioeconomic and political issue. Therefore, Chinese environmental policy mechanisms need to be reformed, focusing on total emission control in coming years. It means, taking pollution reduction as a core task, and systematically establishing mechanisms that promote minimization of the consumption of resources and energy, improvement of the quality of economic development and the enhancement of industrial pollution control. In doing so, the reduction of total emissions will not be just a paper exercise.

3．Meeting the pollution reduction targets is a difficult challenge. The Chinese Government has taken unprecedented policy and project measures to carry out emission reduction work in a balanced way since 2006. Environmental protection departments and local governments have made great efforts in this respect. However, the emission reduction target in 2006 was not met. Our study shows that the control of new sources of emissions should be the first priority in emission reduction. The main uncertainty in meeting emission reduction targets stems from the uncontrollability of economic and social development. Initial emission reduction programs were based on the assumption of average annual GDP growth of 7.5%. If annual GDP growth is 10%, it means 350 million tons more coal would be consumed and 1.8 million tons more emissions of SO_2 each year compared with the 7.5% growth scenario. The corresponding changes in the emission reduction target, uncertainty about achieving the energy & resource saving targets, and the actual implementation of relevant policies are all factors that cannot be fully controlled, affecting the achievement of the emission reduction targets. It is our judgment that the realization of pollution reduction targets is a very difficult task. We should not be blindly optimistic. The possibility of meeting the SO_2 reduction target is better than for COD.

4. Addressing some systemic problems in emission reduction. At present, there are some structural defects in the emission reduction program. Three main factors affect the continuity of emission reduction, and some fundamental reforms are needed. 1）Government environment investment is inadequate. Problems exist in measuring environmental investments, and in the division of responsibilities, and performance management, for environmental investment. Presently, the construction of pollution reduction projects is often behind schedule. The quality of projects is also a major concern. For example, support for COD reduction has not fully been in place, especially public investments. 2）Government enforcement capacity and programs are not sufficient. Discharge/emission standards are not comprehensive and not fully enforced. This has major negative impacts on pollution reduction. 3）There are fundamental weaknesses in policy formulation and implementation, in particular the economic policies that ensure the operation and continuous emission reduction of the pollution control facilities, including both incentive and punitive policies. At present, some policies are in contradiction with the requirements of pollution reduction, and some pollution reduction policies are not strong enough to support continuous pollution reduction.

A.2 Pollution Reduction Is a Socioeconomic and Political Issue

5．Environmental issues reflect social and economic as well as environmental dimensions. The continuous economic growth and urbanization in China over the last 30 years has been at the cost of the over-exploitation of environmental and natural resources. The pollution load is directly correlated with population, per capita GDP growth rate, and pollution intensity （emitted pollutant per unit of GDP）. To address environmental issues, we must seek the solutions in corresponding social and economic systems. Starting from the “independent variables” in the social and economic spheres, we can identify the right key to address the “dependent variable” in the environmental sphere. International experience shows that solutions to environmental issues can only be addressed in the context of the whole socioeconomic system. Pollution reduction indicators should be considered in relation to the social and economic dimensions. Greater efforts should be made in addressing the systematic, coordinated, and balanced relationship between the socio-economic and environmental systems, and the sustainability of their development using an integrated approach, rather than dealing with each issue in isolation. The responsibility of governments for pollution reduction should be further emphasized through performance assessment indicators. A comprehensive pollution reduction strategy should be implemented. Public participation should be promoted as part of these efforts. Only in this way can we avoid the situation where there are targets but no effective control, and emission reduction becomes a game of numbers for local environmental protection efforts.

6．Pollutant emission indicators reflect the quality of economic development. In general, pollutant emissions are indicators of the status and quality of economic growth. With rapid GDP growth, even though emission intensity of industrial pollutants shows some reduction, it is still far higher than that of developed countries. There has been no fundamental change in the mode of development featuring high input of energy and resources, and high consumption and heavy pollution, resulting in huge total emissions of pollutants and heavy loss of environmental resources. The main industries that drive China’s GDP growth are those with high energy consumption and heavy pollution. In the first five months in 2007, the medium- and long-term loans from major financial institutions to six line industries characterized by heavy pollution and high energy consumption have increased by 21.8% than corresponding period in 2006. Industries such as heavy chemicals, thermal power, metallurgy, and cement are still the biggest contributors to emissions. The technological level of these line industries is comparatively low, with few high quality products and low economies of scale. The construction of small-sized steel, cement, and power plants which are “prohibited or restricted” internationally is still booming in some areas, resulting in surplus production capacity. Meanwhile, heavy-polluting industries phased out by the eastern regions have been transferred to the western and other under-developed parts of China. In addition, the power industry is using the excuse of heat-electricity co-generation to expand its productivity, while supporting the fast development of the energy-intensive aluminum and coal sectors. At the same time, 33% of increased steel production is for export. Coke exports from China account for over 50% of the total export volume in the world. It is estimated that the 26% of China's energy consumption is related to exports. China has suffered a huge "environmental deficit" while enjoying huge trade surplus – exporting huge amounts of products while leaving pollution in China is equivalent to importing pollution. For example, during the 10^{th} Five-Year Plan period, the annual SO_2 "deficit" was 1.5 million tons.

7. Changing the mode of economic development is a prerequisite for achieving the pollution reduction targets. The emission reduction target could not be achieved in isolation from GDP, energy and water consumption, technological advancement and industrial structure. Pollution reduction is not necessarily a constraint on development. Rather it should result in sustainable and coordinated economic and social development. The change from an extensive mode of economic development must be achieved through the control of total emissions. The transformation of the mode of economic development is the prerequisite for the eventual achievement of the pollution reduction targets. From this perspective, the root cause of the failure to meet the environmental targets during the 10^{th} Five-Year Plan period lies in the quality of economic development. During the 10^{th} Five-Year Plan period, the average annual GDP growth rate was 9.5% with total growth of 58% in five years, 14.3% more than originally planned（average annual growth had been projected as 7.5% and total growth, 43.6%）. The heavy polluting sectors of steel, cement, power, ethylene and paper increased by 175%, 68%, 84%, 61% and 149% respectively, much higher than the growth of GDP. From this perspective, the failure to meet the 10^{th} Five-Year Plan environment targets is understandable. At present, some local authorities still take emission reduction and economic development as two antagonistic objectives and have explicitly or implicitly resist emission reduction work. In such situations, the pollution reduction and economic development plans remain separate, with the latter much more stronger than the former.

8. Pollution reduction has become a political issue facing the Chinese government. China ranks first in the world for emissions of several pollutants（i.e. SO2, COD, POPs and mercury, etc.）, even though the per capita level is still low. Emission reduction is the solemn commitment of the Chinese Government to the world and is well-regarded by the

international community. It has become a political issue that directly influences the development of a harmonious society in China, and coordinated regional development. The governments at different levels are the main entities responsible for the implementation of the pollution reduction. Progress in meeting the pollution reduction targets will be directly linked to the performance of local governments.

A.3 Achieving the "dynamic" emission reduction target is more difficult than achieving the "static" one

9. Reducing emissions by 10% compared to 2005 is a static target that does not take account of economic growth; when this is done, the reduction target is far higher than 10%. The target of the Chinese Government to reduce by 10% the total emissions of COD and SO_2 by the end of 2010 compared with that of 2005 is a static and absolute target. If GDP grows at 7.5% annually on average from 2006 to 2010, and the energy saving target is met with environmental protection measures integrated into new projects, it is expected that this would generate an additional amount of about 1.87 million tons of SO_2 and 3.1 million tons of COD compared to 2005. The required reduction target would then amount to 4.9 million tons SO_2 and 4.51 million tons COD, equivalent to 19% reduction of SO_2 and 32% reduction of COD compared to the 2005 baseline. If annual GDP growth is 10%, it is expected that SO_2 and COD emissions would increase by 3.7 million tons and 4.3 million tons respectively. On this scenario, the required total emission reduction of SO_2 and COD would be 6.73 million tons and 5.71 million tons respectively, equivalent to 26% reduction of SO_2 and 40% reduction of COD compared with that of 2005. This is 16 and 30 percentage points higher than the static scenario. In other words, with a 10% reduction in existing pollution, China would have to reduce all incremental emissions from new development projects. The dynamic reduction target for most provinces and municipalities is 2－8 times higher than the static target. However, many provinces and municipalities still do not understand this. Instead, they just evenly divide the static emission reduction target allocated by the immediate upper level government authority among the 5 years. This will certainly result in the failure to meet the dynamic pollution reduction targets by the end of 11^{th} Five-Year Plan period.

10. Controlling emissions from new pollution sources should be the first priority, followed by the reducing emissions from existing facilities. International experience shows that environmental problems must be addressed in the context of the overall social and economic system. Over the past 30 years, the social and economic development of developed countries has been achieved with a stable consumption intensity of resources and energy. This is the physical prerequisite for reaching the "tipping point" total emissions of

pollutants is controlled and gradually reduced. Right now, China's mode of economic growth is still extensive involving the consumption of huge amounts of energy and resources in proportion to the increase of GDP. Therefore, it is very difficult to meet the energy saving and emission reduction targets. During the "11th Five-Year Plan" period, preventing the incremental generation of pollution at source by changing the mode of development mode will be more important than increasing pollution control at the end of pipe. This is the core of emission reduction work.

11. The additional pollution generated by economic development will make achieving pollution reduction targets more difficult. Rapid economic growth, and difficulties in controlling consumption of resources and energy, will generate additional pollution, and the dynamic pollution reduction target may exceed the pollution reduction capacity that was originally planned. Analysis shows that even if the energy saving target is met on schedule, with environmental protection measures for new projects in place, SO_2 emission will still increase by 771,000 tons and COD by 675,000 tons for each 1% growth of GDP during the "11th Five-Year Plan" period. If annual average economic growth during the "11th Five-Year Plan" period is higher than 10%, the required COD reduction amount would be larger than the planned reduction capacity, making it extremely difficult to meet the COD reduction target. If there is no fundamental change of the current mode of economic growths driven by heavy chemical industry and with economic growth at 10% annually, then energy consumption per unit of GDP in 2010 could only decrease by 15%-16% from the level of 2005. In short: as long as annual economic growth exceeds 10%, and goes beyond the assumptions of the originally-designed pollution reduction program, it will be extremely difficult to meet the COD and SO_2 emission reduction targets. Additional policies and measures would be needed.

A.4 Achieving the Energy Saving Target is Essential for Meeting the Emission Reduction Target

12．The energy saving target is a "soft constraint", linked to the rate of economic growth. Energy consumption per 10,000 yuan GDP – energy intensity - is a ratio. As long as the rate of growth in energy consumption is less than that of GDP, then energy intensity will decrease. This can be achieved through technological advancement, higher energy efficiency or a change in the energy mix. From the perspective of economic efficiency, the decline in energy and resource intensity is an inexorable trend. In China the average annual decline of energy intensity was 4.5% from 1978 to 2004. There were only four years when the energy elasticity coefficient exceeded 1（1989, and 2002-2004）. At the macro level （nation wide and 5 year time span）, the decline of the consumption of energy and resource is almost inevitable. The current energy saving target is just a quantification of this trend. Judging from the economic development trend during the "10^{th} Five-Year Plan" period, it is expected that the energy saving target and water saving target will be probably be met "automatically", even with higher-than-expected GDP growth. However, the absolute increase of energy and water consumption will exceed the expected figures. According to estimates, if China achieves a 20% reduction of energy intensity by 2010, total energy consumption will increase by 18% compared with that of 2005（assuming annual GDP growth at 8%）. Therefore, the pressure of energy consumption on the environment will continue, but with a reduced rate of increase.

13. The emission reduction target is a "rigid constraint" requiring an absolute reduction of total emissions. Pollution reduction and energy saving are two binding targets set in the 11^{th} Five-Year Plan with a close relationship but fundamentally different in nature. The emission reduction target requires the absolute reduction of total emissions, and the subject is the total emission in a given period. Without a fundamental change in the mode of economic growth, faster economic growth and the larger size of total GDP size increases the pollution reduction challenge. SO_2 emissions will increase by 771,000 tons and COD by 675,000 tons for each 1% growth of GDP during the "11^{th} Five-Year Plan" period. The emission reduction target is a "rigid constraint" which is a challenge the "GDP-ism" prevailing in some areas. During the "10^{th} Five-Year Plan" period, COD discharge per 10,000 yuan GDP actually declined by 47%. However, the reduction of total emission failed to meet the target.

14. The achievement of the energy saving target is a necessary but not sufficient condition for achieving the SO_2 reduction target. Analysis shows that under a 10% GDP growth scenario, a 20% reduction of energy consumption would result in the equivalent of a 45% reduction of the required dynamic reduction target of SO_2 emissions. Supposing that there is no change in the energy mix, and annual GDP growth of 10% during the "11^{th} Five-Year Plan" period, if no emission reduction measures are taken meeting the 10% SO_2 emission reduction target would depend exclusively on energy saving. On this scenario, energy consumption per 10,000 yuan GDP would have to decrease by 44% during the "11^{th} Five-Year Plan" period. Obviously this is not feasible. If energy intensity only reduced by 15%-16%, then SO_2 emission would increase by 1.035 million tons, close to the planned reduction capacity limit. If energy intensity is reduced by less than 15%, the SO_2 emission reduction target could not be met. If the energy saving and water saving targets are not met, it will be extremely difficult to a 10% reduction in SO_2 emissions and in discharges of COD.

15. There is uncertainty about whether the energy saving target will be met, posing a risk that the pollution reduction target will not be met. Restructuring is often a positive factor for energy efficiency. However, the new round of industrial restructuring since 2002 involving the rapid development of the heavy chemical industry has increased energy consumption, increasing the difficulty of achieving the energy saving target. The energy saving target in the 2006 pollution reduction scheme has not been met. This increases the difficulty of achieving the pollution reduction target in the later phase of the 11th Five-Year Plan period. For the 20% energy reduction target, each one-percentage point that it is not met results in 207,000 tons more SO_2 emissions. If the coal proportion of the energy mix increases by one percentage point, it would add 172,000 tons more emissions of SO_2 each year. Study results shows that, during the 11th Five-Year Plan period, if GDP grows at 10%, achieving the pollution reduction target would require that all supporting policies such as the quality of economic development, energy saving, investment in pollution control, policy formulation and implementation, etc. would have to be fully implemented. On a business as usual scenario, and with GDP growth over 10%, the pollution reduction target is unlikely to be achieved.

A.5 The Existing Emission Reduction Program Cannot Ensure that the Emission Reduction Target Will Be Met

16. The slow development of the urban sewage pipe network seriously hinders COD reduction. At present, the development of urban sewage treatment plants across China is hindered by the size of the task, including the volume of investments required, and the long construction cycle. The demand for the construction of supporting pipelines further constrains normal operation of completed sewage treatment plants. To meet the target of new urban sewage treatment capacity of 45 million t per day under the plan, more than 160,000 km of new sewage pipelines need to be put in place. However, the total length of existing sewage pipelines across China up to the end of 2004 was only 78,000 km. The ability to construct 45 million tons of new urban sewage treatment capacity tons per day will directly affect the achievement of the COD reduction target in China.

17. Insufficient attention to sludge treatment at urban sewage plants. Sludge treatment and disposal are not given enough attention in COD reduction work. In general, sludge accounts for 0.3%～0.5% of total treated sewage（by volume）, or 1%～2%（by dry weight）. In case of tertiary treatment, sludge amount would increase by 0.5～1 times. An additional treatment capacity of 45 million tons per day for urban sewage would result in an increase of at least 450,000 tons sludge every day. In the absence of effective treatment, this will cause secondary pollution. In fact, it just transfers COD from the water to the sludge phase,

with no actual discharge reduction.

18. The reduction of COD at industrial enterprises has not been achieved. Reducing COD in some heavy water-polluting industries such as paper and chemicals has not been plants are scattered across the country and there is no vertical management structure as in the power industry. According to the Program of the State Council on Comprehensive Work for Energy Saving and Emission Reduction, 50% of the task of reducing industrial COD depends on restructuring. The experience of China during the "9th Five-Year Plan" and "10th Five-Year Plan" periods show that it is often difficult to implement the policy of phasing-out inefficient plants through industrial restructuring due to local protectionism. This often leads to stop-and-start again production, or of factories closing down but not stopping operation. The other 1.40 million tons reduction of industrial COD depends on clean production and end-of-pipe treatment. However, the available environmental information mostly concerns well-established large- and medium-sized industrial enterprises with relatively good performance. Less information is available on small industrial enterprises with high COD discharges, uneven performance in meeting the discharge standard, poor or no treatment technology. As a result, they are often not subject to control. In addition, the existing industrial effluent discharge standards for some industries are rather loose, and the total emission control target is not broken down for each industry, making it hard to achieve a sustained reduction in emissions. There are many industries with complex effluents where it is not easy to identify a good starting point for COD reduction. The Program of the State Council on *Comprehensive Work for Energy Saving and Emission Reduction* needs to specify more detailed requirements in terms of end-of-pipe treatment and emission reduction in order to make it more workable.

19. SO_2 reduction heavily depends on desulphurization equipment at thermal power plants. During the "11th Five-Year Plan" period, power-generating units with a total capacity of 355 million kW will have desulphurization equipment installed according to the plan. Of this, 188 million kW will be newly built coal-fired power plants where the sulfur removing equipment will be installed and put into operation simultaneously with the power generation equipment. Existing coal-fired power plants with total capacity of 167 million kW account for the rest. This will represent a total SO_2 reduction capacity of 5.90 million tons, accounting for about 70% of the total capacity of all reduction measures put forward by the Program on Comprehensive Work for Energy Saving and Emission Reduction. It is expected that the desulphurization rate of thermal power generating units in China will reach 64% by 2010. Taking account of about 10% of facilities that cannot be retrofitted, the potential for further desulphurization coal-fired power plants will greatly decline. However,

the authorities have only presented general principles regarding requirements for non-thermal-power industries that have close relations with the improvement of regional environmental quality, without any specific tools, objectives, measures and policies. The SO_2 reduction program during the “11^{th} Five-Year Plan” period depends too heavily on desulphurization projects of big thermal plants. This makes the program rigid and vulnerable.

20. The consumption of coal in non-power industries is underestimated; and it is difficult to maintain the current coal consumption of coal-fired industrial boilers. If the energy-saving target is met, and GDP grows at 10%, then energy demand will reach about 2.82 billion tons of coal equivalent by 2010, an increase of 540 million tons in 5 years. Part of this study involved making an estimation of the breakdown of the increase in coal consumption in different sectors. It is expected that by the end of 2010, the total capacity of thermal power plants across China will reach 620 million kW, with annual electricity generation increasing from 2.04 trillion kWh in 2005 to 3.16 trillion kWh in 2010, and an increase in coal consumption of 477 million tons. According to the industrial development and energy plans, coal consumption in the steel, building materials and synthetic ammonia industries will increase by at least 170 million tons. The total increase of coal consumption in both coal-fired power plants and industrial production processes will be 647 million tons, almost equal to the entire predicted increase. This indicates that the achievement of the SO2 emission reduction is predicated on their being no growth in total coal consumption in non-power industrial boilers during the “11^{th} Five-Year Plan” period. Clearly this is too optimistic. In 2005, total coal consumption in non-power industries accounted for 55% of the total. The annual growth rate of coal consumption in three major non-power industries of iron and steel, building materials and chemicals is 9%. Coal consumption for all industrial boilers across China went up from 320 million tons in 2000 to 458 million tons in 2005, with an annual average growth of 7.8%. Taking account of such factors as energy saving during the “11^{th} Five-Year Plan” period, the coal demand of industrial boilers across China will increase by 126 million tons. It is predicted that, if there is no change in the present development plan, the total energy demand in China will go up to 3.02 billion tons of coal equivalent in 2010 with only a 16% decline in energy intensity compared to 2005. Taking the new increase in non-power industries into account, there will be no any spare room in the planned pollution reduction capacity. In a word, in the scenario of 10% GDP growth, achieving the energy saving and pollution reduction targets will require additional strong measures to curb the development of high energy-consuming industries and to strengthen pollution reduction in non-power industries.

21．Insufficient attention to coal washing for SO_2 reduction. Analysis conducted for this study show that washing 100 million tons coal could reduce emissions of SO_2 by 600,000-700,000 tons, reduce transportation load by 10 billion t-km, and raise combustion efficiency by 10-15% thereby generating substantial environmental and economic benefits. Strong demand has made the coal industry put more emphasis on quantity than quality. Necessary technological change has not been implemented for industrial kilns, boilers, and coal washing plants. Not enough capacity for loading, transporting, and storing washed coal has been established. Pricing and investment have not been used enough to encourage coal washing. All these factors have led to situation where coal washing has long been neglected. The cost of coal washing per ton in China ranges between 12 to 15 yuan RMB（7-8 yuan higher than that of developed countries）. There is no standardized classification system for coal, and no strict policy for linking the use of different categories of coal with their possible environmental impacts. In 2005, China produced 2.19 billion tons of coal, of which 703 million tons was washed, This amounted to 32% of the total, much lower than that in developed countries（55% in Germany, 75% in Australia, 95% in Canada, and 75% in UK）. The ash content in commercial coal is about 20.5%. The coal consumption in non-power industries accounts for 50% of the total. Using unwashed coal in non-power industries has a severe negative impact on energy saving and pollution reduction.（1% ash content reduction in coking coal can result in a 1.33% reduction in the ash content of coke, and subsequently a 2.66% reduction in coke consumption, and a 3.99% increase in utilization coefficient of the blast furnace

22． Optimizing an energy mix dominated by coal is a big challenge. 90% of total SO_2 emissions are related to energy use. At present, coal accounts for about 69% of the primary energy mix in China（2005）, 42% higher than the world average. In recent years, the development of other energy sources like hydropower, nuclear power and new energy sources has received more attention. At the same time, the installed capacity of thermal power has maintained a high growth rate over the past years. According to the latest development plan for the power industry, there will be no major adjustment to the power generation mix that will continue to be dominated by coal. It is also impossible to change the primary energy mix dominated by coal. In this context, China should facilitate the optimization of the energy mix and further strengthen measures for SO_2 emission reduction.

23． Estimating the SO_2 reduction capacity is very uncertain. The assessment of SO_2 treatment capacity in the Acid Rain Plan is derived from an estimate of the material balance.

It is assumed that the coal sulfur conversion coefficient is 0.8, and average sulfur content of coal 0.8%. However, some findings suggest that the percentage of coal with less than 1% sulfur level in China is only 20%. With the increasing depth of coal mining, the average sulfur content in coal will increase. In the past few years, the sulphur content in the coal burned by the six largest power companies has been higher than 1%. The conversion coefficient of coal sulfur at the newly installed power generating units can reach 0.8～0.95. Thus combustion efficiency and coal sulfur content could generate at least 4 million tons more SO_2 emissions in coal-fired power plants（or 1 million tons more after desulphurization in coal fired power plants）– increasing the risk of not achieving the pollution reduction target.

A.6 The ability of implement of the emission reduction policy will not result in sustained emissions reduction

24．There are clear weaknesses in the system of emissions standards. For a long time, local emission standards in China have not developed sufficiently, while national discharge/emission standards cannot meet the special requirements of every region. The discharge/emission standards in some line industries have not been revised with the increasing requirements for environmental protection. There are many cases the technology used in development project is out-of-date and subject to phasing out by the time the project is completed. Taking the paper industry as an example, existing effluent discharge standards for the paper industry are equivalent to the world average level in 1990s. In most pulp plants, the water withdrawal for per ton of pulp is two times of that in the developed countries. Only 2% of the paper & pulp enterprises reach the world average size. In many local areas, the contribution of the paper & pulp industry is less than 5%, whereas its contribution to COD discharge is as high as 50%. Some local industrial parks （zones）have become “enclaves” where, national law enforcement forces cannot enter, and havens for enterprises that should have been prohibited or phased out according to national regulations. Some local authorities give the green light to new projects with high energy consumption and heavy pollution, making some “industrial parks （zones）” as “dirty places” that do not comply with national emission standard.

25．Lack of supporting policies for industrial restructuring. In most cases, industrial restructuring has been implemented by administrative means involving short-term measures, implemented in a certain period of time and without supporting policies. This results in some cases where pollution has been moved from one place to another. The implementation of industrial restructuring is very difficult because it involves many factors such as shutting down polluting enterprises, finding new jobs for affected workers and a decrease of local tax revenue. Special attention should be paid to progress in shutting down small thermal power plants across China with a total capacity of 50 million kW, as it will impact on the achievement of the SO_2 emission reduction target. Except for the closure of small thermal power plants, China lacks compensation policies for other industries. In addition, the arbitrariness and lack of a long-term policy mechanism for some industries increases the cost of industrial restructuring.

26. Some national policies go against the requirements for emission reduction. Though the message on energy saving and pollution reduction is clear and strong, it has not been turned into price signals and more stringent law enforcement. The existing taxation system, which establishes VAT as the main revenue source and where enterprises pay tax to local government, has encouraged the development of high energy-consuming and heavy polluting industries. On one hand, a change in the mode of growth is required, but, on the other hand, administrative intervention maintains resource-intensive growth and inhibits the development of market mechanisms. For example, recycling and efficient use of resources is called for, yet recycling companies often cannot get support and are discriminated against. The Chinese Government is taking measures to stabilize the consumption price index （CPI）to improve the livelihood of the people. However, these policies limit the room for raising the price of resources and environmental services. Some findings show that the cost of complying with laws is 46 times the cost of non-compliance. The rate of pollutant discharge fee has long been under-assessed. Many enterprises prefer paying the discharge fee to acquire the right to discharge pollutants legally rather than to treat them. This is one of the reasons why laws are not fully observed or strictly enforced. The central government recently issued a policy to encourage a reduction in agricultural crop output and to raise the proportion of livestock output. However, if the authority does not put in place adequate control measures, it will aggravate pollution from livestock and fowl farms as well as agricultural non-point pollution.

27. Administrative policies should be reformed based on emission reduction requirements. Though current emission reduction targets focus on total emissions control, the lack of a binding policy to control the total volume of emissions means that they primarily focus on pollution concentration. This not only means that there is insufficient information about total emissions, but also that pollution concentration is the focus during assessments at the construction phase. The system requiring polluting enterprises to treat pollution in a given period is also based on a concentration standard rather than a total emission reduction target set at regional level. In addition, the total emission targets in EIAs of new construction projects are not subject to an emission reduction target at regional level.

There even exists where big thermal power plants have repeatedly used the emission quota of "closed-on-paper" plants to obtain emission quota for new projects.

A.7 Insufficient public financial support is still a key factor constraining emission reduction policies

28. Lack of financial mechanism contributed to the failure to meet the emission reduction target during the 10th Five-Year Plan period. Various problems exist with public environmental finance that impedes the achievement of the emission reduction target: an insufficient amount, too many recipients, low efficiency and lack of government guidance in pollution control investment. Financing is one of the main factors constraining the achievement of the emission reduction target. Emission reduction work cannot be completed without necessary investment. During the "10th Five-Year Plan" period, the Chinese Government increased investments in environmental protection, with an accumulated input of over 68 billion yuan from the central budget. However, the total investment and its focus were not sufficient to meet the demand for environmental control. During the "10th Five-Year Plan" period, of the 2,130 pollution control projects identified under the national plan, 1,378 were finished, accounting for 65% of the total. A total of 86.4 billion yuan were made available, accounting for 53% of the total. The pollution treatment projects in the key river basins and regions including the "three big rivers" and "three lakes" represented about 60% of the total. The development of desulphurization projects lagged behind the requirements of total emission control. The plan required the reduction of 1.05 million tons SO_2, but only 70% of them were finished. Desulphurization projects lack of financial and policy support. It is for this reason that the "10th Five-Year Plan" emission reduction target was not met. During the "11th Five-Year Plan" period the demand for pollution control investment to achieve the pollution reduction target will be much larger than in the "10th Five-Year Plan" period.

29. Environmental investment for pollution control is not sufficient. At present, the size of environmental investment is over-estimated because some categories of investments with indirect environmental benefit, such as green areas and landscape projects, have been included in the government's statistics. This is quite different from the approaches developed by OECD and European countries, and it conceals the fact that the actual environmental investment is inadequate. If only investments in sewage treatment and garbage disposal are included as investments in urban environmental infrastructure, then this category of is only about 50% of the official figure. Thus, environmental protection investment using the most commonly-used international definition is about 0.6% of the GDP, rather than the official figure of 1.3%. In general, China is still at the stage of

acquiring "new debts" for environmental pollution and not at the stage when the historical debts are being repaid on a large scale.

30. Challenges securing funds during the 11th Five-Year Plan period for emission reductions. According to the 11th Five-Year National Plan for Environmental Protection and the National Plan for Key Projects, total demand for investment in pollution treatment during the "11th Five-Year Plan" period is estimated to be approximately 1530 billion yuan (an increase of 82% relative to the 840 billion yuan investment demand of the 10th Five-Year Plan period). This amounts to 1.35% of GDP for the same period (an increase of 0.16 percentage point over the 10th Five-Year Plan period). This is about 3.06% of total government investment in social fixed assets (an increase of 0.26 percentage point over the 10th Five-Year Plan period). In 2006, nominal environmental investment in China accounted for 1.23% of GDP, a relatively large drop compared with the past two years. At this level, it is apparent that the "paying old debts without creating new debts" requirement will not be met. At present, there is big gap in emission reduction investment, especially the allocation of government funds. Of the 150 billion yuan fund that the Central government planned to allocate, only 35 billion yuan have been allocated. The national budget does not include a special environmental protection fund. In many local governments the "221" budgetary item for environmental protection is unfunded. Many pollution reduction projects are waiting for government investment.

31. Enterprises have no feasible financing channel for pollution treatment. According to the 11th Five-Year National Plan for Environmental Protection, enterprises are required to raise 45% of the environmental investment of 690 billion yuan. However, there are no feasible channels for enterprises to raise such funds, so it is difficult to guarantee the investments. There are two reasons for the lack of financing channels: 1) enterprises find it difficult to attract funds for investment in pollution control projects and it is often difficult to obtain bank loans. Enterprises with heavy pollution often have poor operations; and enterprises with lower profits often face more challenging emission reduction goals. Thus, such enterprises are in a situation of "willing to treat pollution but unable to get loans". 2) In the past, enterprises were able to invest 7% of revenues for investment in environmental technology. The policy that allows enterprises to take a tax credit for five years for investments in pollution control and treatment is now meaningless as this policy was established for most state-owned enterprises. The previous investment channels and policies have been ineffective and new investment channels, incentive policies, and supporting measures have not been established under the new financial and taxation system.

32. Economic policies constraining emissions are not fully in place. Existing policies on investment in, and financing for, emission reduction are not complete and cannot comprehensively support emission reduction work. At present, there are still problems such as the narrow scope of collections, incomplete and inconsistent implementation, low charge rates, weak enforcement abilities for fee collection and low efficiency of fund management in China. In addition, China does not have taxes encouraging environmental protection. Existing environmental taxation measures are not complete, providing only general requirements. For example, the newly introduced resource tax is limited, targeting only mineral resources. It does not collect tax for such resources as high-sulfur coal, water and biological resources. Therefore, it is necessary to further strengthen efforts in reforming and improving the investment and financing policies for emission reductions.

33. Lack of clarity about government responsibility and financing power for emission reductions. First, there is some ambiguity of government authority. The government usually controls some functions with “rent seeking” interests that may be subject to market forces. But some basic public service functions that the government is supposed to provide have not been implemented effectively under the banner of “market reform”. Governments often invest through “market mechanism” without paying enough attention to problems of market and policy ineffectiveness. Second, there is no clear division of the distribution of authority among different levels of government. The Environmental Protection Law in principle stipulates the scope of the central and local governments’ responsibilities for environmental protection. However, there is no workable program that clarifies their authority in environmental protection. In fact, there is no evident difference in the environmental authority among government at all levels; leading to the phenomenon that no one is responsible for environmental protection. Third, there is a big gap between central-local government financial and taxation authority and the central-local government environmental authority. In 2004, local financial revenues accounted for about 45% of total national financial revenue. However, local expenditure accounted for 72% of national expenditure, indicating the inconsistency of local taxation authority and financial power. Under the current taxation regime, the financial authority has moved centrally, and the investment responsibility has moved to the local levels. There is a severe imbalance between the local governments’ taxation authority and investment responsibility of pollution control. These have aggravated the difficulty in facilitating emission reduction work.

A.8 Effectiveness of Pollution Abatement Projects is Lower than the Designed Capacity

34．The development of urban sewage treatment facilities is insufficient. The Program of the State Council on Comprehensive Work for Energy Saving and Emission Reduction requires that new urban sewage treatment plants with a total capacity of 45 million tons per day be built during the "11th Five-Year Plan" period; this level provides the capacity to reduce COD by an additional 3 million tons per year. However, the Program does not specifically require the reduction of 3 million tons of COD per year. This indicates that to turn the capacity into actual COD reductions, significant work is needed to improve the effectiveness of urban sewage treatment plants. Another issue is how to minimize facility downtime and wasted resources from ineffective environmental infrastructure, and address the issue of meeting the demands for sewage treatment（"capacity becoming reality"）. The development of urban sewage treatment plants across China has accelerated since the "10th Five-Year Plan" period. However, the development of urban sewage treatment facilities lags population and economic growth due to a lack of available investment capital. At the end of 2006, 248 cities in China did not have sewage treatment plant. In at least 30 cities, more than 50 sewage treatment plants did not operate or operated at a load of less than 30%. In addition, the construction of pipelines to transport sewage significantly lagged the development of urban sewage treatment plants. This seriously hinders the effectiveness of sewage treatment facilities.

35．Disorderly market competition affects the quality of desulphurization projects. The relatively young desulphurization industry operates in an immature market with insufficient industrial standards, relevant laws and regulations, and market access, making it difficult to ensure the quality of desulphurization projects. Over the past few years, many companies with little [experience or] technology in desulphurization have entered the industry. This has led to lower prices and vicious competition. The market price of wet limestone desulphurization has been reduced to 200-300 yuan/kW, which is too low to ensure the quality and effectiveness of desulphurization projects. The technical standards of some emission reduction facilities are low and the associated monitoring system provides poor reliability and accuracy. Some projects have such a long construction period that the technology is obsolete before the projects are completed, or when the desulphurization project is finished renovation is required Equipment quality directly influences the emission removal efficiency and resulting benefits.

36．Insufficient policy measures to support long-term operation of pollution control equipment at maximum capacity. The experience of some developed countries demonstrates that the cost of operating pollution controls will become more prominent with the completion of large amount of pollution treatment facilities. Because pollution control does not generate direct economic benefits, enterprises seldom set aside sufficient funds for the operation of pollution treatment facilities. Therefore, the government should emphasize supervision of the facilities' operations. In 2006, 24.49% of wastewater treatment enterprises lost money amounting to 148 million yuan. The sewage treatment fee in many Chinese cities is low, lower than treatment costs. This has an impact on the effective operation of sewage treatment plants.

A.9 Difficulty Synchronizing Emission Reductions and Environmental Improvement

37. There is no direct relationship between the total emission control target and environmental quality. At present, urban air and water quality of many Chinese cities does not have a direct relationship with COD discharges and SO_2 emissions. In 2006, 7% cities in China failed to meet Grade III national particulate quality standard. The emission of large amounts of NOx leads to complex impacts on NO_2 concentrations and O_3 concentrations in the troposphere. In some waterways, pollution from non-point sources exceeds pollution from point sources. Non-point source pollution is a key factor impairing water quality. However, existing policies for the reduction of both COD and SO_2 emissions are focused on the control of point sources. In particular, SO_2 reduction aims to control acid rain pollution by mainly focusing on the power industry without considering SO_2 emissions from industrial boilers that have more impact on ambient air quality. This will influence the effectiveness of emissions reduction efforts. There are no systematic measures for the control of COD, nitrogen, and phosphorus pollution from non-point sources such as livestock and fowl farms and rural sewage.

38. Lack of systematic consideration of the ancillary costs of emission reduction projects. Present emission reduction projects involve large-scale use of desulphurization equipment in coal-fired power plants and urban sewage treatment plants. Both end-of-pipe treatment approaches have similar challenges, including the market pressure on the price of raw materials for construction and operation, accurate on-line monitoring; difficulty in ensuring the quality of emission reduction projects; market saturation of the byproducts from pollution control, and secondary pollution from the stockpile of byproducts. At present, desulphurization equipment in most power plants employs a wet-limestone approach. This approach generates 2～3 tons of gypsum for each ton of SO_2 removed. Therefore, at least 11.80 million tons of gypsum will be generated each year. If the gypsum is not used in products, it will be stockpiled, which could lead to secondary pollution as weather causes dust problems. The treatment and disposal of sludge byproduct from wastewater treatment should be an important element of COD reduction. The lack of proper disposal options for sludge byproduct will greatly reduce the net environmental benefits of COD reduction

projects. There are no technical difficulties in the use of desulphurization gypsum or the treatment of sludge; the key lies in policy support.

A.10 Environmental Management Capacity Insufficient to Meet the Emission Reduction Challenge

39．Severe lack of regulations on the control of total emissions. Total emission control, notification of pollutant discharge and emission permits are common in developed countries. Laws require enterprises and individuals to truthfully report emissions and sign their name to ensure the authenticity of every report. Relevant laws also consider perjury to be a serious crime. However, many enterprises in China have not developed a culture of truthful pollution reporting, leading to inaccurate emissions data. It has been over 10 years since China first implemented the total emissions control system. However, there are no integrated regulations on the control of total emissions or emission permits.

40. Weak foundations for the “Three Systems” and lack of supporting systems. The emission reduction work reveals weak capacity in the three big environmental systems, i.e. environmental statistics, environmental monitoring and performance examination. In the near future, it will not be easy to change the limited capacity of these environmental systems due to just initiation of these systems and the technological conditions and local supporting funds. Funds for monitoring funds have not been allocated, apart from equipment for monitoring pollution sources for enforcement purposes. There are no relevant administrative systems supporting capacity building efforts for the “three big systems”. For example, there is no strong technical support for assessing the optimal distribution of total emissions, optimal responsibilities for emission reduction measures, and effects of emission reduction. In general, the development of the database on pollution emissions and the environmental monitoring network represents a good beginning. However, there is a big gap between environmental statistics and the need for emission reductions. There are no unified examination or estimation methods for calculating emission reduction. Local authorities lack an appropriate understanding of the necessary incremental and net emission reductions of major pollutants, leading to a relatively large difference between the national estimated emission reduction data and local data.

41．Emission reduction data may not be accurate and reliable. Accurate and systematic statistical data for industrial point-sources, domestic garbage, urban emissions and rural emissions do not exist. There is no accurate database for assigning emission reduction responsibilities and tracking results. 1）Point-source monitoring has just started. The monitoring scope, frequency, and technology are quite limited; relevant policies for automatic monitoring are not in place; and there is no clear understanding of the different pollution sources. 2）Data collected by the government does not fully and accurately reflect environmental quality or emissions at source. The database of source emission and the monitoring network need to be enhanced and the monitoring method need to be consistent. 3）Existing environmental data in environmental departments is in a state of disorder. There are many sets of data, such as enterprise self-reporting, environmental impact assessments, environmental inspections and environmental monitoring. The data sets are not correlated or compatible.

42. Superficial examination of reported emission reductions. At present, some local governments play the “numbers game”, treating the binding pollution reduction targets as a statistical exercise. This can lead to a situation of “meeting” the total emissions with no control, i.e., talking more but doing less. They have not put the emphasis on the implementation of pollution reduction policies and measures, or the responsibility for quality and operational control of pollution reduction engineering projects. The Central government and local authorities are playing a game with emission reduction data; this directly affects the effectiveness of the emission reduction program. In some areas, the examination of emission reductions is still quite superficial without an assessment of the target allocation of pollution reduction and without clear targets for inspection. In most areas, local authorities adopt the “subordinates follow the example of their superiors” practice, which simply allocates the reduction task to the next level of government level. As a result, the allocation just focuses on administrative regions; the process of allocating to emission sources is not well implemented, especially for industries with large discharges of water pollutants.

43. Insufficient capacity for supervising the operation of reduction projects. The experience in developed countries demonstrates that the installation of extensive pollution control facilities raises operation costs. Enterprises in China are not willing to spend large amounts of money on pollution control facilities that provide no direct economic benefit. Because of this, supervising the operation of pollution control equipment is critically important. Issues to address include insufficient measures and capacity, inconsistent enforcement and insufficient penalties for lawbreakers. Key industrial pollution sources, especially coal-fired power plants with desulphurization equipment, do not have accurate on-line monitoring which makes it difficult to supervise and operate them effectively. This affects the long-term, stable operation of the facility. According to investigations, of 829 key industrial effluent sources under the national monitoring program in 2006, only 547 had stable discharges that met the standard.

PART B: POLICY RECOMMENDATIONS ON THE ACHIEVEMENT OF EMISSION REDUCTION TARGETS DURING THE"11TH FIVE-YEAR PLAN" PERIOD

B.1 Establish a Performance Examination System with Priority for Energy Saving and Emission Reduction Indicators

1. Restrict *environmentally-damaging government* behaviors through institutional reforms. Environmental protection involves the "damaging hand", "control hand" and "shelter hand" of local governments. Information on emission controls is communicated primarily through speeches or documents. The root cause of many environmental pollution problems is the failure on the part of local governments to make decisions and their protectionist practices. Under China's current financial and taxation system, many local authorities prioritize the development and growth of industries with high energy consumption and heavy pollution. This creates local financial revenues, but is counter to the energy saving and emission reduction program of the Central government. To some extent, the environment for industries with high energy consumption and heavy pollution will exist for some time. In China, the game between local authorities and Central government is not an accidental phenomenon. The impact of the export-oriented industrial structure on emission reduction should not be ignored. Only with systematic and institutional reform can China truly curb the negative impacts of economic development on the environment. With financial, tax and institutional reforms, the government can address the problem of the Central government vigorously advocating sustainable development but local governments only seeking economic growth.

2. Identify the institution responsible for emission reductions; change the current situation in which economic growth and emission reduction targets are considered separately. The social and political system of China makes it difficult for local officials to change their approach to development, and to focus on sustainable development, if the Central government does not put a greater emphasis on environmental protection and emission reduction when assessing the performance of local government leaders. At present, many local authorities still consider emission reduction targets and economic growth separately. In addition, they treat environmental protection as a "loose" standard and economic growth as a "strict" target. It should be clear that emission reduction responsibilities lie with the local government, not the local EPBs. China should improve the responsibility and examination systems. In particular, China should strengthen the fragmented oversight of industry. China should also change the situation in which upper

environmental protection departments examine the performance of subordinate environmental protection departments.

3. Reduce the role of GDP growth in the performance assessment of local party and government leaders. Performance indicators for local officials should include scientific and green indicators, such as emission reductions and improved environmental quality. The primary focus should be emission reduction indicators. GDP growth must be based on achievement of the emission reduction and energy saving targets. The practice of giving preference to GDP growth should not be allowed. In situations in which local governments do not meet energy saving and emission reduction targets, the government should take practical measures to cut economic growth. China should increase the importance of achieving emission reduction targets in performance examinations. If an emission reduction target is not met, the local officials should be assessed as "failing" regardless of whether other targets are achieved. Appropriate and practical environmental indicators should be included in the official performance examination system to avoid the superficial examination of these indicators. The binding GDP growth target should be waived for areas subject to national restrictions or development bans. Enterprises administrated by the Commission of the State-owned Assets Supervision and Administration should take the lead in carrying out the performance assessment system by prioritizing energy saving and emission reduction targets.

4. Relevant Central government departments should take the lead to reduce emissions. Based on each department's role in emission reductions, relevant departments of the State Council are urged to take the lead to develop workable policies to support energy saving and emission reduction. This may mobilize local governments to reduce emissions and create an environment where the whole society is involved in energy saving and emission reduction. Some important government departments like NDRC should take full account of the impacts of increased productivity on the environment when developing industrial development plans（e.g. electricity, petrochemicals and electrolytic aluminum）. They should also take the lead in implementing the *Law of the People's Republic on Environmental Impact Assessment*. Financial departments should allocate 5%～10% of new incremental revenues for environmental protection and emission reductions, fully implement the financial functions for environmental protection and supervise the use of funds for emission reduction. The Construction Department should integrate infrastructure, including sewage pipelines, into the reduction target and assume responsibility for reducing the COD discharge from urban sewage.

B.2 Reduce Pollution in the Whole Production System with Emphasis on its Up-stream *and Mid-stream*

5． Implement an integrated emission reduction strategy. The achievement of the emission reduction targets will require a shift in the mode of economic growth. Traditional development and end-of-pipe treatment cannot meet the requirements for total emission control. China should develop an integrated approach including resource and energy consumption, energy and resource savings, technological advancement, pollution control, enforcement, incentive measures and higher efficiency. China should develop an integrated system for emission reductions covering the production, consumption and disposal processes. In particular, China should improve upstream emission reductions through structural adjustments and midstream reductions through technological improvements. Linking total emission reduction targets with socioeconomic development, China should achieve the emission reduction targets through measures such as resource and energy conservation, industrial and economic restructuring, production technology improvements and emission reduction projects. China should develop policy incentives, project management systems and inspection systems. Emission reduction efforts should focus on controlling new sources of emissions followed by the reduction of existing emissions. Reducing the emission increments upstream is more efficient than adding more end-of-pipe emission control. Therefore, the authorities should focus on the new increments first and then reduce existing emissions. Using this approach, the responsibility of local EPBs to monitor end-of-pipe and midstream emissions decreases, while reduction efficiency and environmental benefits increase. The Chinese government should draft regulations and management policies to implement this shift to upstream pollution prevention.

6． Strengthen the management of demand for resources and energy; control the unrestricted growth of resources and energy consumption; and implement “upstream” emission reductions. Achieving the 20% energy saving target is a prerequisite for achieving the emission reduction target. Based on current energy and industrial development plans, achieving the energy saving and emission reduction targets will limit industrial coal consumption（not including the power sector）during the “11th Five-Year Plan” period to an additional 170 million tons with no growth from coal-fired industrial boilers. This will be extremely difficult to achieve. Therefore, the government should control the consumption of energy and resources and emphasize “upstream” emission reductions. Enhanced management of resource and energy demand, combined with efforts to conserve energy and resources, should facilitate the overall reduction of resource and energy consumption. By utilizing the emission reduction approaches with the highest cost-benefit ratios, China could obtain multiple additional benefits aside from emission reduction.

7．Improve the quality of development, implement "midstream" emission reductions and control new and additional emissions. China should strengthen "midstream" emission reductions. Industrial enterprises must manage the whole production process; promote industrial restructuring, improve technology and "clean" production practices; raise the quality of economic development, all in an effort to optimize social and economic development. 1）Establish industrial policy and market access based on total emission control. China should revise and improve its environmental standards to control additional emissions. The government should speed up the development of emission intensity targets for key industries such as metallurgy, building materials, electricity and light industry. New development projects should be required to comply with emission intensity standards. China should develop policies to phase out specific industries and target pollution controls in different regions. In addition, China should gradually start to focus on the performance of emission reduction equipment. 2）Enhance efforts in industrial restructuring. With the adoption of such measures as administrative interventions and market regulations, China should expand efforts to ban new construction projects at the regional and industrial levels to constrain disorganized local investment and haphazard development. Achieving GDP growth targets should not be an excuse for poor performance in resource utilization and environmental protection. China should speed up development of a list of products with high pollution and high environmental risks; track the phase-out of small thermal power generating plants with a total capacity of 40 million kW; and track the development of industrial restructuring. 3）Raise the price of energy and resources and gradually increase charges for environmental pollution to include externality costs. The pollution discharge fee should at least cover or exceed the externality costs. It should also exceed the cost of controlling emissions.

8．Take stricter local measures to curb the growth of industries with high energy consumption and high pollution. China should strengthen its supervision of financing for industries with high energy consumption and high pollution and reduce the quota for those industries. Regulations, such as permits, bans, restrictions and taxation should be more stringent to control growth in these industries. The government should enhance efforts to encourage the import and export of environment-friendly products through direct subsidies, tax rebates or tax exemptions. The Central government should adopt administrative measures to constrain local development of industries with high energy consumption and heavy pollution. Using land as the constraining factor, the Central government should prevent the development of these industries through stringent land-use approval requirements and streamlining punitive procedures for land use by illegal development projects. The Central government should use market mechanisms, including controlling credit and loans. Measures that create loan conditions for industries with high energy consumption and heavy pollution, establish corporate environmental reporting and accelerate changes to export policies, should limit excessive investment in, and raise the financial cost of, such industries. In addition, the Central government should make full use of the economy-wide monetary and financing policies, appropriately control the speed and direction of industrial development, ensure that economic growth targets are achieved, and avoid unhealthy development of selected industries.

9. Promote regional emission reduction through EIA. Measures requiring regional EIAs can help the Central government prevent environmental pollution and ecological damage and make more appropriate strategic decisions for industrial distribution and resource allocation. These decisions can effectively solve environmental problems resulting from concentrated or excessive levels of industries with high consumption of energy and resources, and heavy pollution but low efficiency in specific regions. Using regional EIAs will aid government decision making and economic development by optimizing environmental protection. The Commission on the Environment and Resources of NPC should inspect the implementation of EIA and draw attention to government plans that have not carried out EIAs.

10. Establish a diagnostic mechanism for economic development and emission reduction. The Chinese Government clearly understands that environmental protection cannot be separated from social and economic development. Interactions exist among economic development, energy saving and emission reduction targets. China should set up a monitoring, analysis and early warning mechanism for the three indicators – economic development, energy saving and emission reductions – and regular assess progress. The government should also identify and publicize problems that affect emission reduction and present targeted solutions. EPBs should emphasize the review and approval of new development projects, formulate standards and policies, and coordinate environmental policies and targets with national economy-wide policies. This can aid with the coordination and practicality of the economic growth and emission reduction policies. In the near future, China should establish a short-term diagnostic platform that assesses the environmental situation including emission reduction trends, strengthens data analysis and macro forecasting and manages emission reduction efforts.

B.3 COD Reductions from Key Sectors and Industries

11. The government should assume responsibility for addressing issues related to the treatment of urban sewage, and the construction and operation of pipelines. Based on the

historical experience of the United States, EU and Japan, the government at all levels should consider the construction of urban sewage treatment plants as a government priority to be supported with public financial resources. The government should not put undue emphasis on market mechanisms and ignore the government's responsibility to construct urban environmental infrastructure. The operation of the environmental infrastructure can be carried out by enterprises through gradual commercialization. Financial capital, especially from the central budget, should not be used to subsidize the operation of sewage treatment plants. But the central budget should be a key source of funding for the construction of sewage treatment plants in key river basins in the central and western part of China. The authority should also consider sludge treatment and the construction of relevant pipelines as an integrated part of sewage treatment facilities. During the review and approval of sewage treatment facilities, consideration should be given to performance （COD reductions）and the principle of pipeline infrastructure as a prerequisite. If a project does not meet the policy requirements, specific funds, such as central financial transfer payments, could be cancelled. The Central budget funds should be considered a bonus, rather than subsidy, for the construction of sewage pipelines. These funds should be linked both to the total length of the pipeline and the treatment capacity and actual COD reduction potential. The government should examine the utilization factor of sewage treatment plants and the actual COD reductions and implement a policy of pro-active construction with greater subsidies. A comprehensive plan should be developed for the treatment and disposal of the sludge when designing sewage treatment facilities. The government should develop and improve relevant regulations and standards on the treatment and disposal of the sludge. The government should also promote the development of sludge treatment technologies, establish sludge management funds for financing the development and upgrade of equipment for treatment plants taking the initiative to collect and reuse sludge. This will aid in the promotion of the sludge recycling and reuse industry.

12．Develop emission reduction programs and measures for key industries. According to the requirements of the *Program on Comprehensive Work for Energy Saving and Emission Reduction*, the Chinese government is required to facilitate the development of a comprehensive program for COD reduction, allocate COD reductions for each industry and identify detailed requirements for emission reduction of each industry. The government should accelerate the COD emission reduction program for the paper making, chemicals, textile, food and beverage industries. The government should issue comprehensive, targeted industrial policies covering technical, economic and industrial policy. Case studies show that reducing COD pollution from paper making industry should focus on the distribution of the industry, adjustment of inputs in the papermaking process, the application of new technology and more stringent emission standard. Adjusting the inputs should focus on raising the percentage of wood fiber with a significant increase in the proportion of waste paper and a decrease in non-wood fiber. In other relevant industries, such as food and beverages, measures like water conservation and pollution reduction should promoted. Learning from the experience of EU and the United States, China should publish instruction manuals for emission reductions for each industry. According to the requirements of the *Program on Comprehensive Work for Energy Saving and Emission Reduction*, the government should urge local authorities to publicize enterprises that are required to phase out outdated production processes and link the program to the policy of restricting new development projects and the review of new construction projects.

13． Improve the emission standard for industries with higher compliance rates. China should encourage local governments to implement industrial emission standards that are more stringent than national minimum standards, especially in eastern China where pollution is heavy and the economy is well developed. Based on international experience, China should develop national emission standards using the best available technology and establish a system to review and revise industrial standards Priority should be given to revising the emission standard for the paper making industry. If China modifies existing *National Standards for the Discharge of Water Pollutants of Paper Making Industry*（GB 3544 – 2001）- COD < 55 kilograms per ton of wood pulp and COD < 160 kg/t of grass pulp （applying international state-of-the-art technology） - it is expected that COD emissions will be 541,000 tons in 2010 assuming 35% growth. （The China Paper Making Association estimates paper output will reach 76 million tons in 2010）. This would amount to total COD reduction of 1.06 million tons, accounting for 66% of COD discharges. In addition, China should strengthen the exchange of technical information and technology transfer and enhance research and development. It should strengthen enforcement, establish an implementation system that combines emission standards with permits, improve enforcement, and increase penalties for non-compliance. It should approve the implementation of the 11^{th} Five-Year National Plan for the Prevention and Control of Water Pollution of Key River Basins as soon as possible. Furthermore, China should encourage tertiary treatment of the treated wastewater from secondary wastewater treatment plants and require that the outlet water of urban sewage treatment plants in key river basins or sensitive regions meet the Grade A national surface water quality standard.

14． Develop economic policies to support the reuse of treated urban wastewater. The Chinese government should encourage the expanded use of treated wastewater. It should develop principles and guidelines for the recycling and reuse of wastewater, instruct local governments to plan, construct, and manage waste water recycling and reuse facilities as well as develop technologies to facilitate sustainable use and conservation of urban water resources. China should invest more in projects that recycle and reuse urban sewage and provide preferential policies, such as credits, taxes and resource prices that encourage enterprises or industries that generate neutral water. Also, it should develop compensation mechanisms and price incentives to promote the substitution of natural water with treated water. Preferential pricing policies can encourage the use of treated water, providing a win-win solution for energy saving and emission reduction. China should take measures to improve the use of treated water by large water consumers and require its use by select industries.

B.4 Systematic SO_2 Emission Reduction

15. Systematically reduce SO_2 emissions in the life-cycle of coal. Based on the experience of the EU, United States and China, cutting SO_2 emissions must be a long-term task. The government should change its focus from end-of-pipe desulphurization equipment. A comprehensive cost-benefit analysis of control options can facilitate SO_2 emission reduction efforts by assessing the entire lifecycle of coal, from mining through combustion. The government should make efforts to adjust the structure of coal production by tightening the high-sulphur coal limit from 3% to 2.5% or 2% and developing programs to encourage the utilization of low-sulphur, high-quality coal. The government should use energy-saving and emission-reduction funds to support coal washing and utilization of such coal; enhance quality of coals used by small- and medium-sized consumers; raise design standards for industrial boilers with higher combustion efficiency and optimize the energy mix. In addition, the government should enhance the monitoring and inspection of desulphurization projects, focus on pollution control for coal-fired industrial boilers, and make more efforts to use gypsum byproduct to avoid secondary pollution.

16. Increase the use of washed coal. China should, according to existing law, require new coal mines to establish coal washing facilities; streamline small coal mines and shut down small coal washing facilities with low efficiency and heavy pollution. The government should restrict the construction of new coal washing plants with capacities less than 300,000 tons per year. China should also establish funds for coal washing, enhance the development and introduction of coal washing technology, address reliability and efficiency issues of domestically-produced washing equipment and improve the design and management of coal washing technologies. China should establish policies to aid in the appropriate distribution of washed coal. Priority for the use of high-quality coal should be

given to large cities and residential areas. High-sulphur coal should be restricted to power plants with desulphurization facilities. The government should take measures to promote the utilization of coal gangue and acid manufacturing to facilitate the sustainability of coal washing. The government should also develop coal price categories based on the type, grade and quality of coal with the price of coking coal based on the ash percentage and power generation coal based on the heat value. The government should lower the transportation cost of washed coal to encourage more utilization of washed coal.

17. Implement policy measures for desulphurization at thermal power plants. It is appropriate to focus on the power industry for SO_2 emission reductions during the 11th Five-Year Plan period; though this does pose some risks. The government should closely monitor implementation of the plan. The government should fully implement the existing policy that power plants with desulphurization facilities receive a higher price for electricity and that the power grid shares the cost. New and expanded coal-fired power plants must construct desulphurization facilities in accordance with environmental regulations. These plants are encouraged not to construct flue gas bypass pipes. Coal-fired power plants should maintain records of the operation of their desulphurization facilities, including operation and maintenance, continuous monitoring data, generation load, coal sulfur analysis, limestone consumption, power consumption, disposal of desulphurization byproducts, use of bypass pipes and accidents and relevant responses. These records should be subject to inspection by relevant authorities. When coal-fired power plants install desulphurization facilities, automatic on-line monitoring system must be installed and the real-time monitoring data should be submitted to EPBs and the power grid authority.

18. Develop policies for comprehensive utilization of the byproduct gypsum. The government should develop policies that encourage the use of desulphurization gypsum in products. This will reduce the need to mine natural gypsum. The government should also expand the market for products, implement preferential policies on comprehensive utilization of resources, and reduce or exempt the value added tax for enterprises that use desulphurization gypsum. The government should also intensify enforcement efforts to ensure the normal operation of desulphurization equipment at power plants and consistent supply of raw materials for enterprises that utilize byproduct gypsum. The government should encourage efforts to develop technologies combining desulphurization and sulphur extraction. In doing so, the problem of large stockpiles of desulphurization gypsum and the import of sulphur for acids can be reduced.

19. Improve the operation of desulphurization facilities at power plants. At present, most coal-fired power plants use the wet-limestone method to remove sulphur. Although

this method is reliable and provides high removal rates, it is unlikely that Chinese desulphurization equipment manufacturers developed the necessary experience in this field in less than 5 years. The government should develop national specifications on the design of desulphurization projects in coal-fired power plants as soon as possible, formulate engineering and construction standards and strengthen the supervision of franchised equipment manufacturers. This may help avoid the scenario of recently completed desulphurization facilities being deemed ineffective and in need of reconstruction.

B.5 Central Government Should Exert Authority in Emission Reduction Through Financial Power

20． The central government should take the lead to exert "authority based on financial power" for emission reduction. At present, there is a gap between the central and local government financial and tax systems and environmental policy implementation. It is recommended that the central government exercise authority on emission reduction to a level consistent with its financial power. The experience of the United States and Japan are examples where the Central government exerts authority through dedication of national level staff and specified approval procedures for special plans and programs. In view of the urgency and long-term nature of emission reduction, it is recommended that China learn from the American practice of helping to finance the construction of urban sewage and garbage treatment facilities by the federal government. Specifically, the central government should increase the budget in sectors where environmental protection is a priority, develop more proactive national policies on investment in environmental protection infrastructure, and dedicate 5%～10% of any new financial revenue increments to environmental protection. Financial transfers from the Central Government should include environmental protection considerations. China should establish budgetary funds for emission reduction environmental infrastructure similar to the Japanese Environmental Group financing procedures, or create revolving funds for sewage treatment as in the United States. During the "11th Five-Year Plan" period, environmental infrastructure investment in 10 key projects is estimated to require150 billion yuan from the central budget. This is equivalent to 30～40 billion yuan annually. This investment represents about 10% of total environmental investment. The Chinese government should support these investments as soon as possible.

21． Local governments should assume their responsibilities and make more efforts in emission reduction. China should amend the *Environmental Protection Law*. First, the guiding role of the government for environmental investment should be specified, and a base line for financial investment established. Second, identify the proportion of environmental funding within any financial budget growth in order to ensure adequate support for “211” projects and sufficient funds to meet the emission reduction target. At the same time, the Chinese government should develop and adopt statistical methods for measuring pollution abatement and control expenditures in keeping with international practices. According to methodologies used by OECD and Eurostat, investment in green and garden areas as well as construction of natural gas heating infrastructure with indirect environmental benefits, should no longer be classified as environmental investments.

22. Develop and issue an investment and financing policy for corporate pollution management under a new financial and taxation system. The existing policies on the 9 financing channels for enterprise environmental protection, issued by the central government in 1984, should be reformed as soon as possible. China should study and issue an environmental investment policy under the new financial and taxation system. Various financing channels should be assessed and mechanisms for raising funds for pollution control identified. Enterprise expenditures for environmental protection equipment, energy savings or emission reduction should be tax-deductible. The income tax resulting from the sale/application of new state-of-the-art environmental protection equipment, reformed technology investment and adjustment of industrial processes, could be reduced by a certain amount or exempted completely. The government should apply preferential policies for corporate pollution control projects in terms of loans, interest rates, and loan repayment conditions. It should also accelerate the pace of policy development regarding land use, the price of energy for pollution treatment projects, and accelerated depreciation.

B.6 Strengthen Enforcement and the Capacity of Environmental Authorities to Ensure Facilities Play Their Role in Emission Reduction

23. Enhance the legislative and coordination mechanisms for emission reduction. The government should issue *Regulations on the Control of Total Emissions of Major Pollutants*, as soon as possible, in order to provide a legal basis for emission reduction. Focusing on emission reduction, the government should enhance and integrate environmental management practices including streamlining assessments and approvals, licensing, environmental impact assessment and timely inspection and decision-making upon project construction completion. In areas, where appropriate, the government should implement pilot projects to implement independent and vertical management of environmental monitoring and enforcement in order to control the poor environmental behavior of local governments. Learning from the Japanese experience, the government should establish a factory on-site environmental supervisor system, under the dual leadership of the enterprise and local EPB. Professional certification programs should be developed for environmental monitors and supervisors. The government should carry out a trial regular inspection and environmental

performance reporting system with key polluting enterprises. As in Canada, the government should identify relevant enterprises in three categories: up-to-the-standard, subject to risk management and advanced, with corresponding administration methods. China should strengthen national enforcement functions and tools while enhancing the independence of local EPBs in decision making and implementation. The local EPB's capacity to participate in comprehensive policy making should also be enhanced. The government should beef up the development of an effective environmental law enforcement system and standardize law enforcement down to the prefecture and county levels. In addition, it should amend the components of relevant laws & regulations that are vague in identifying legal responsibilities. An aggressive enforcement campaign should be initiated. Punishment for environmental infringements should be raised to a level where any advantage to pollute is removed.

24. Strictly supervise the operation of on-line monitoring equipment to ensure effective operation of pollution treatment facilities. The government should supervise monitoring facilities in order to facilitate their smooth operation. It should strengthen the management of on-line monitoring equipment, establish & improve the specifications for on-line monitoring in terms of testing, checking, acceptance, networking and data use. It should specify the legal validity of on-line monitoring data. In addition, China should raise the quality standards for on-line equipment, further streamline the market for introducing on-line monitoring products, develop a regulatory framework for the commercial operation of on-line monitoring equipment, and promote third party verification. The government should promote the introduction, operation and networking of on-line monitoring equipment into the process of managing sewage treatment plants and coal-fueled power plants. In addition, it should accelerate the implementation of a national plan to build capacity for environmental enforcement and compliance and put in place the finance necessary to implement the plan. It should enhance the capacity of regional environmental protection supervisory centers to enforce emission reduction according to the law.

25. Facilitate the sharing of information about emission reduction and enhance public participation. China should speed up the establishment of a database on the emissions of major pollution sources under a national control program. This database would make public information about the emissions and reduction strategies of specific polluting industries and enterprises across China. It should document case studies that encourage local government to make public information about emission reduction by key enterprises and their progress in meeting total emission control targets. China should adopt more "mixed" policy measures such as CACs, MBIs and VA tools. Learning from the experience of OECD

countries where there is a "mixing and matching" of individual environmental policies for achieving optimal outcomes, China should integrate various policy instruments to address the problems during the pollution life cycle. It should verify emission reduction outcomes by qualified third-parties and enhance public participation in the review of results. China should facilitate public involvement in all aspects, including decision making, supervision and management of emission reduction initiatives. Public awareness in emission reduction will promote the sustainability of emission reduction.

26. Strengthen the integration and dynamic management of emission reduction data. The government should strengthen and better integrate emission reduction data to provide a better basis for environmental management. China should establish the basic capacity to analyze background and baseline emission levels, and emission reductions. Efforts should be made to set up an accurate, comprehensive database of key pollution source emissions. Based on monitoring, enforcement, emissions and EIA data, a scientific check could be conducted on the data collected for key, national pollution sources. Through sample monitoring, the central government could directly control this data to ensure accuracy and avoid possible interference. It should strengthen the implementation of emission reduction projects, while analyzing the dynamic relationship between reductions in emissions from old pollution sources and incremental increase from new sources. It should combine the administration of emission permits, with point source quantitative management and appropriately assess emission reduction for each source. The "three data forms" - emission fees, environmental statistics, and emissions notification - should be reconciled.

B.7 Accelerate the Establishment of Long-term Policy Measures for Emission Reduction

27. Further promote reforms of the pricing & taxation of resources and environment. Prices should integrate the full environmental costs of water and coal resources usage. Using the pricing lever, China should establish and implement the environmental pricing mechanism where the "polluters pays". Following the example of differentiated price for power generated from facilities with desulphurization capacity, a differentiated electricity & water price policy should be adopted for heavy polluting industries such as pharmaceuticals, chemicals and paper making. The government should raise the emission fee standard, expand the range of environmental charges and increase fee collection efforts. The current SO_2 emission charge of 0.63 yuan/kg should be raised to 1.26 yuan/kg, so that the charge covers the treatment cost. It is also recommended that the government should raise the current sewage treatment and COD discharge fees of key river basins and regions to over 0.80 yuan/t and 1.20 yuan/kg respectively by the end of 2008. In addition, products made

with heavy pollution and high energy consumption should also be taxed at the consumer level. The resource tax rate for coal, petroleum and natural gas should be raised.

28．Introduce incentives to support emission reduction. The State should continue to provide incentives for power plants with desulphurization equipment. The government should assess energy saving in relation to electricity generation. The government should further implement preferential policies for power generated from desulphurization units. It should give economic compensation to enterprises that shut down or experience reduced productivity because of environmental measures. It should establish a database on the environmental performance of key polluting enterprises and strengthen information exchange about environmental protection measures. Tax, bank policies and loans should reward environmental performance enhancing initiatives. The government should award and commend in an appropriate way those enterprises that achieve the emission reduction task ahead of time, or have a good environmental performance. It should establish a reward fund for total emission reduction results, and openly recognize those enterprises or local governments contributing to emission reduction. It should adjust the loan structure for a region where the cumulative impact of new development projects is a concern. Also, it should cancel the preferential taxation policy and reduce any subsidies to those enterprises that have not met their emission reduction targets, or continue to discharge pollutants against the law. China should learn from the American experience, and actively implement pilot projects on tradable permits. If the trial is successful, emissions quota and tradable rights should be extended to enable enterprises to benefit from emission reduction. The development of a power market system should consider an emission reduction requirement. The government should extend the power generation license system, power generation tradable rights and green power quota trade. That is, it should adopt market-based approaches to promote the shut-down of small thermal generation plants, which would result in energy savings and emission reduction.

29．Advocate green consumption and promote emissions reduction in all of society. Learning from the new “Energy Policy Act” of the United States, China should adopt incentive measures such as reduction （exemption）of tax and direct consumer subsidies for energy saving and emission reduction products. This will encourage the whole society to participate in energy saving and emission reduction activities. Government should make more efforts in the procurement of green products, energy saving in buildings, water conservation and emission reductions at their facilities.

PART C: STRATEGIC OUTLOOK ON EMISSION REDUCTION FOR THE "12TH FIVE-YEAR PLAN" PERIOD

It is expected that by 2020 China will achieve the goal of a *Xiaokang Society* in an all round way, with economic development reaching the world average. This is the second-stage objective of the "three stage" strategy of China. Environmental protection has become an important component for the development of the *Xiaokang Society* in an all round way. Therefore, environmental protection and the selection of an effective emission reduction strategy during the "12th Five-Year Plan" period is of vital importance.

C.1 Emission Reduction is Still the Long-term Task for Environmental Protection

1. Implementing total emission control in China will be significant before 2020. It is expected that the consumption of energy and resources in China will peak by 2020. In 2020～2030, it is expected that environmental pressures will gradually decrease due to technological advancements and the transformation of China's economic structure and consumption patterns. The relationship between economic growth and consumption of raw materials will ease with a consequent decline in the emission of major pollutants. By the year 2050, when China realizes a development level equal to intermediate developed countries, it is expected that environmental problems may be addressed in "an all round way". However, before the decrease of pressure on resources, energy, population and industrialization, China will experience pressure from social and economic development resulting from environmental concerns. Total, cumulative emission reduction will be a long-term, onerous and complex task.

2．Emission reduction will become more difficult during the "12th Five-Year Plan" period. With the completion of initial emission reduction projects during the "11th Five-Year Plan" period, it is expected that further emission reductions across China during the "12th Five-Year Plan" period will be a bigger challenge. Identifying emission reduction strategies requires more consideration of proactive, technical and economic feasibility issues to ensure rational decision making. Local governments should be given guidance for the total control of such major pollutants such as ammonia, nitrogen and NOx. Environmental quality should be integrated into the local government performance assessment system. In doing so, it sends a clear message to enterprises about emission reduction through the linkage of emission reduction with environmental quality.

3．Promote the "five shifts" in emission reduction. It is recommended that CCICED establish a new TF to develop a strategy for emission reduction during the "12th Five-Year Plan". This TF should start in 2008 to support the long-term emission reduction strategy of the Chinese Government. The emission reduction strategy during the "12th Five-Year Plan" period should reflect shifts in the following 5 aspects: 1） shift from an exclusive focus on reduction of total emissions to one that combines total emission reduction with an in improvement in environmental quality; 2）shift from an over-dependence on the reduction of emissions from key industries to a reduction of emissions from all industries; 3） shift from increasing the capacity of emission reduction projects to improving their quality and achieving real environmental outcomes; 4） shift from depending on administrative intervention into utilization of long-term tools that have rational economic cost-effect ratio; 5） shift from the total control of single pollutants to the coordinated control of many pollutants.

4. Pollution control is not total emission control. When promoting total emission control and emission reduction, care must be taken to not assume that pollution control is total emission control, and that the problem will be solved as long as total emission control is implemented. As a system, total emission control has its conditions and prerequisites. Pollutants suitable for national total emission control must meet the following conditions: （1）regional pollutants rather than local; （2）measurable, checkable and could be included in statistics with certain foundation; （3） primary pollutant, preferably not a mixed, composite pollutant; （4）options available for emission reduction are controllable in terms of technological and economic aspects. Therefore, the pollutants suitable for total emission control at national level are rather limited.

C.2 Strengthen Implementation of Total Emission Control

5. Actively facilitate the application of more legal and scientific approaches for total emission control. Through legal amendments, the government should shift from existing total emission control to environmental quality control with supporting legal responsibilities, including the development of more laws and regulations. Regional differences should be considered when identifying total emission targets that are related to the environmental capacity. The government should study national strategy on total emission control based on environmental capacity. Using a scientific basis, coordination of regional development and industrial development could be handled more appropriately, minimizing fragmentation and achieving the total emission target. The government should further focus on the examination of emission intensity （pollutant emission per unit GDP）, and transfer relevant experience across the country. It should provide leadership, and promote the shift in development while facilitating technical progress. At the same time, it is possible for some local areas with available environmental carrying capacity and good environmental quality to experience an increase in total emissions compared with that of 2010. This reflects an administrative

flexibility to deal with different regions or industries. Generally, however, emission intensity must continue to decline.

6. Implement a targeted system for total emission control and improvement in environmental quality. The improvement of local environmental quality should be taken into account when examining the performance in emission reduction. The government should gradually promote achieving the targets for both total emission control and improving environmental quality. It should improve its capacity in the identification and comprehensive analysis of result-based data. Total emission reduction targets need to be linked to other environmental performance indicators and supported by monitoring and enforcement. In doing so, all indicators will form part of an integrated system that facilitates the achievement of national environmental policy objectives.

7. Strengthen the workability of total emission control target at local level. National government will continue to set the base control targets for the country. Local governments should be encouraged to adopt their own total emission reduction targets that address special, local conditions. The government should take bottom-up, total emission control plans as the foundation for national total emission reduction work. It should promote the implementation of LEAP and SIP initiatives that involve the participation of all local stakeholders. Government should encourage the identification of reduction options with more rationality and innovation in the decision making process. In addition, the government should develop alternative emission reduction options, creating competition among options in order to lower the cost of emission reduction. In doing so, it will shift from a binding management mode to a sustainable mode.

8. Implement demonstration projects to control several pollutants at the same time. The benefit of controlling several pollutants from a source is higher than that of single pollutant control. Experience has shown that the control of a pollutant could lead to an incremental increase in pollution in another medium just a transfer of the problem. A trade program taking into account more than one pollutant may stimulate polluters to seek a comprehensive, lower-cost emission reduction solution. Because of the dominance of coal in the energy mix, and the emission of several pollutants from such plants, demonstration projects to exploit synergies in the control of SO_2, NOx, Hg and CO_2 should be carried out. Coal-fueled power plants in well-developed regions should be the focus of these demonstration projects during the "12^{th} Five-Year Plan" period. From mid and long-term perspective, SO_2 tax covering the full treatment cost should be collected.

C.3 Change the ways of reducing SO_2 Emissions

9. Start desulphurization in coal-fueled industrial boilers. The large amounts of

coal-fueled industrial boilers across China causing heavy local pollution should be the focus of emission reduction during the "12th Five-Year Plan" It is expected that total demand for primary energy in China will reach 3.2 billion tons coal equivalent by 2015. The installed capacity will reach 10,500 billion kW, and coal-fueled power plants will be 8,400 billion kW（6,200 billion kW in 2010）. Consequently, coal consumption of power plants will increase by 477 million tons coal over that of 2010. With the assumption that the coal sulfur release rate is 0.9, and the sulfur removal rate 0.81, it is expected that coal-fueled power plants will emit 1.6 million tons more SO_2 by 2015. This increase must be compensated by a reduction of other pollution sources. Total SO_2 emission from coal-fueled industrial boilers during the "11th Five-Year Plan" period was 6～7 million tons. If there is no reduction requirement for coal-fueled industrial boilers during this period, it is expected that these boilers will emit 10 million tons more SO_2 by 2015. Therefore, total SO_2 emission control targets must include coal-fueled industrial boilers during the "12th Five-Year Plan" period. Coal fueled industrial boilers, in particular the small capacity coal fueled industrial boilers, should use clean fuel. Measures such as coal washing, processing, shaping, gasification and liquidization should be utilized to further enhance clean combustion. China should develop preferential policies on providing "good quality coal" to coal fueled industrial boilers, develop a more stringent emission standard for such industrial boilers, adopt a more stringent emission standard for the design and manufacture of coal fueled boilers in order to improve their performance.

C.4 Develop New Indicators for Total Emission Control

10．Implement total NOx emission control in thermal power industry. The power industry is the most significant sector for NOx emissions accounting for 5.632 million tons, or 35% of the national total. It is expected that NOx emissions will increase by at least 2.5 million tons by the end of 2010. NOx from thermal plants is emitted from high chimneys, and consequently can move to distant areas, contributing to regional acid rain. By increasing the combustion temperature, and concentrating flue emissions, it is relatively easy to install NOx pollution treatment equipment for boilers in power plants. This has been shown to be the most effective way to curb NOx emissions from this source. At present, there are many mature, low NOx combustion technologies available in the world. In addition, the experience of developed countries such as the United States, Germany and Japan in the control of NOx emission shows successful NOx reduction experience at thermal power plants. Based on this experience, the focus of NOx emission control in China should be coal-fueled power plants. Specific recommendations include: 1）China should establish NOx emission monitoring and statistical analysis methods for the thermal power industry by the end of 2010. 2）Revise and issue new NOx emission limits for thermal power plants. To effectively control NOx emission of thermal power plants, it is necessary to implement new and more stringent emission limits for thermal power plants in 2012. By meeting the emission limit of less than 200mg/m^3 for new power plants, and phasing out old plants that do not meet the standard, NOx emissions from thermal power plants in China will not continuously increase after 2020. 3）Carry out demonstration projects on nitrogen removal of coal-fueled boilers in sensitive areas. Relevant national departments should actively organize resources to conduct relevant research on flue de-nitrification technologies, including introduction of foreign technologies. Also carry out trial work on flue de-nitrification devices such as SCR and SNCR and combined desulphurization and de-nitrification technology for boilers of power plants in key cities（including those in the Beijing-Tianjin-Tangshan region, the Pearl River delta and Yangtze River delta）to facilitate the development of a domestic flue de-nitrification industry. 4）Actively promote the extension and application of advanced clean coal technology. More efforts should be made to develop clean coal combustion technology, including the demonstration and commercialization of advanced clean-coal power generation technologies such as CFBC, PFBC and IGCC. 5）Develop and implement a unified NOx control plan with supporting policies. It is recommended that relevant departments should work out a unified NOx control plan and schedule as soon as possible. Economic policies encouraging emission reduction should be adopted. The NOx emission charge rate should be raised and the on-grid price of electricity from production plants with de-nitrification facilities should be given a differential rate. 6）Adjust and optimize the geographical distribution of thermal power. Most coal-fueled power plants in China are located in the central and eastern parts of China. These areas are heavily populated, have fast economic growth, are high in their pollution load, but relatively weak in buffering ability for acid precipitation. New power plant construction should take into account the existing carrying capacity of these developed regions. In addition, NOx emission from the transportation sector has exceeded 30% of the total national emissions and this figure is expected to continue to rise. It is recommended that all light vehicles implement Euro IV emission standard during the “12^{th} Five-Year Plan” period in order to address NOx from these sources.

11. Choose key river basins and lakes to carry out total ammonia/nitrogen control. The total emission control targets for water pollutants during the “10^{th} Five-Year Plan” period mainly focused on COD. Other pollution indicators like ammonia and nitrogen were included in the total emission control list but not as binding targets. However, the No.1 pollutant of many waters in China now is ammonia/nitrogen. China is currently carrying out

a national investigation on pollution sources, and it is expected that ammonia/nitrogen discharges will be better understood by the end of the“11^{th} Five-Year Plan” period. It is recommended that the Chinese government include, on a priority basis, the ammonia/nitrogen level into the total emission control and performance assessment system of the “12^{th} Five-Year Plan.” This will enhance efforts to reduce this pollutant. It is also recommended that all new, reformed, expanded and built urban sewage treatment facilities within key river basins and regions finish the construction and upgrading of nitrogen & phosphorus removal facilities as soon as possible. This will enhance the comprehensive treatment of effluents from key industries that discharge nitrogen & phosphorus pollutants.

12. Carry out trial work on the control of total nitrogen and phosphorus levels in some sensitive lakes and reservoirs. International experience in the control of total nitrogen and phosphorus shows that it is a long-term and arduous process. Experience has shown that it is more difficult to control than COD. The sources of TN and TP pollutants are complex and most of them come from non-point sources. At present, China does not have the scientific & technological information to implement basic management practices for total nitrogen and phosphorous emission control. It is recommended that China carry out trial work on the control of total nitrogen and phosphorus concentration in sensitive lakes and reservoirs. Such trials should include the control of total nitrogen and phosphorus contaminants from inflowing rivers. According to nitrogen and phosphorus control mechanisms, lakes or reservoirs like Erhai Lake could be selected to carry out basic investigations. Work could be started in 2009 to understand the baseline situation, trial the total emission control and establish relevant demonstration sites.

C.5 Gradually Expand the Scope of COD Reduction

13. Assess alternative methods for controlling non-point emissions in some areas. According to the bottom-up philosophy, efforts should be made to carry out trial work on the control of non-point sources in selected areas. The purpose should be to investigate alternative approaches and understand baseline conditions. The authorities should develop monitoring and statistical methods that focus on typical industries （e.g. livestock and fowl breeding）in the trial areas. China should establish a national, non-point, COD pollution reduction strategic system, including systematic rural environment management plans. EIA procedures should be revised to accommodate non-point pollutants. Successful international experience in the control of non-point pollution by organic and chemical fertilizers, as well as pesticides, should be investigated. This will be an important area for China in emission reduction work. China should strive to gradually mainstream the control of non-point pollution into the total emission control programs in the future.

C.6 Actively Pay Attention to Emerging Environmental Issues

14. Put new pollution problems on the agenda. Certain prerequisites must be met to carry out a total emission control program. Strengthened environmental control does not necessarily fully depend upon the implementation of total emission control. Special attention should be paid to emerging pollutants of interest in the Chinese environment, including mercury, POPs, greenhouse gases and VOCs during the "12th Five-Year Plan". With proactive prevention and control measures, the government will be able to create fundamental conditions for the implementation of total control of the above pollutants at a specified future date.

II Policy Recommendations

The Chinese Government set the binding target of reducing total emissions of major pollutants by 10% by 2010 as compared with 2005. This is a key part of the Chinese Government's strategy to implement the scientific approach to development in a balanced way, and is well-regarded by the international community. The Task Force believes that achieving the emissions reduction target will be a major challenge for China. The challenge is particularly difficult due to relatively weak mechanisms for implementing an emissions reduction policy in the context of rapid economic growth, excessive dependence on desulphurization at coal-fired power plants to achieve SO_2 reduction, insufficient progress in constructing urban sewage pipelines, and lack of an effective program for reducing industrial COD.

It is very difficult to improve environmental quality at the same time as experiencing rapid economic growth. Gradual reduction of emissions will be a long-term task. Overall, it is difficult to be optimistic about achieving the immediate emissions reduction target. To make further progress, China needs to improve mechanisms for policy implementation. At a strategic level, China should establish a performance monitoring system that priorities energy saving and emissions reduction, and promotes the reduction of pollution in the whole production cycle with emphasis on its upstream and middle stream. At a tactical level, China should further optimize and improve the programs and policies for COD and SO_2 reduction. At the same time, the Chinese Government should strive to change the current situation where appropriate investment, enforcement, management, and economic policies are not in place, and start work soon on a study of emission reduction in the 12th *Five-Year Plan* period in order to ensure that new, fundamental policy reforms with *the five shifts* are implemented.

1. ESTABLISH A PERFORMANCE MONITORING SYSTEM THAT PRIORITIZES ENERGY SAVING AND THE EMISSION REDUCTION TARGET

（1）Change the current situation where economic growth and emission reduction indicators are considered separately. Emission reduction indicators are measures of the status and quality of economic and social development. The achievement of emission reduction targets is closely related to economic growth, energy consumption, water consumption, technological progress and industrial restructuring. Total emissions in China remains high and far exceed the absorptive capacity of the environment. Economic growth is driven by heavy and chemical industries, those industries with high energy consumption, high pollution and resource consumption. China is experiencing a "resource and environment deficit" within its territory due to the high volume of inefficient production, while enjoying a huge foreign trade surplus. In many regions, local authorities still consider the emission reduction and economic growth targets separately, focusing on the latter and neglecting the former. The authorities should better understand the essential linkages between emission reduction and the overall level of economic and social development. They should start from economic and social "variables" to seek solutions to the environmental "dependent variable." They should strive for harmony, balance and sustainability among social, economic and the environmental systems, and facilitate coordinated economic and social development through emission reduction.

（2）Fully emphasize the direct impacts of the pace of economic development on the achievement of the emission reduction target. If China's GDP grows 10% annually during the "11th Five-Year Plan" period, there will be an incremental amount of 3.7 million t of SO_2 and 4.3 million t of COD produced. This suggests that, for the attainment of the "11th Five-Year Plan" pollution reduction targets, the actual reduction of SO_2 and COD required would be 26% and 40% of the total emission amount of SO_2 and COD in 2005 respectively, which is far higher than the 10% reduction of 2005 stockpile. It is estimated that if the average annual growth rate of GDP is higher than 10%, then every additional 1% GDP growth would bring an additional increment of 771,000 t SO_2 and 675,000 t of COD to the total. Analysis shows that if there is no fundamental change in the mode of growth driven by heavy and chemical industries, and with 10% growth of GDP, the required SO_2 and COD reduction will reach the maximum potential of emission reduction program foreseen in the 11th 5 Year Plan. If economic growth exceeds 10% without a fundamental change in the mode of growth, the Chinese government will have to take further policy measures to reduce emissions to achieve the target. Economic growth in the first three quarters of both 2006 and 2007 exceeded the assumptions of the original scenario and the emission reduction plan of the 11th 5 Year Plan, creating substantial uncertainty about achieving the emission reduction target.

（3）Further reduce the weight of GDP when assessing the performance of local party and government leaders; effectively manage governmental actions that are not supportive of emission reduction. It must be made clear that responsibility for emissions reduction lies with local governments rather than local Environmental Protection Bureaus （EPBs）. Higher-level environmental protection departments should not assess the performance of subordinate departments. The achievement of the binding emission reduction target should be a prerequisite for achieving projected GDP growth. If the energy saving and emission reduction targets are not met, local governments should cut the GDP increment above what had been predicted. In areas with heavy pollution, the "one vote rejection"① system should be strictly enforced. Efforts should be made to identify environmental protection indicators when assessing the performance of officials, and to increase the weight of emission reduction. For protected areas, the GDP target should not be binding. Enterprises under the administration of the Commission of the State-owned Assets Supervision and Administration should take the lead in implementing the performance assessment system taking energy saving and emission reduction as a priority.

2. REDUCE POLLUTION IN THE WHOLE PRODUCTION SYSTEM WITH EMPHASIS ON ITS UPSTREAM AND MIDDLE-STREAM

（4）Implement an emission reduction strategy that considers the whole production system. To achieve the emission reduction target, China should change the mode of economic growth. It should reduce pollution in the whole production cycle, targeting the consumption of resources and energy and the generation of pollutants, and systematically promote energy and resource saving, technological advancement, pollution control, enforcement, incentive measures and higher efficiency. China should develop a comprehensive emission reduction program covering production, consumption and circulation, and stress the guiding role of the government. In particular, it should strengthen emission reduction through structural adjustment and technological progress. Reducing pollution at source is more efficient than reducing emissions at the end-of-the-pipe. Accordingly, the government should first aim to reduce emissions from new investments, and than reduce emissions from the existing capital stock in order to meet the emission reduction target.

① The Environmental protection department can exercise the veto in the approval procedure on a project based on the EIA result.

（5）Strengthen the management of demand for resources & energy; control the unrestricted growth of resources & energy consumption; and implement “upstream” emission reduction. On a 10% annual GDP growth scenario, and assuming the achievement of the 20% energy saving target, total energy consumption in 2010 would increase by 18%, and SO_2 would be reduced by an amount equivalent to 45% of the required total reduction. In the case of no emission reduction measures, no change in the energy mix, and meeting the 10% SO_2 reduction target only by the conservation of energy and resources, energy consumption per 10,000 yuan GDP would need to be reduced by 44%, which is not feasible. The energy and water conservation targets are relative targets expressed in per cent, whereas the emission reduction target is a “rigid indicator” requiring an absolute reduction in the total amount of emissions. Achieving the target of a 20% reduction of energy & resource consumption is a necessary but not sufficient condition for meeting the emission reduction targets. Based on the current energy and industrial development plans, achieving the energy saving and emission reduction targets would require an increase of coal consumption in the non-power sector to be limited to 170 million tons during the “11th Five-Year Plan” period. It would also require zero growth in the coal consumed in all coal-fueled industrial boilers. Both of these objectives would be extremely difficult to achieve. Accordingly, the government should control the consumption of energy and resources in an appropriate manner and create the basic conditions for emission reduction.

（6）Control the growth of “high energy consumption and high pollution” industries to improve the quality of development; reduce pollution at the middle-stream of the production cycle in order to control incremental increases in emissions. The government should make stringent environmental requirements for investment in industries, and improve the independence and the capacity of environmental protection departments to participate in comprehensive decision making for economic development and environment. It should implement industrial policies based on total emission control, and promote integrated policies for economic development and emission reduction. It is recommended that the National People’s Congress examine the implementation of EIA on planning developed by government departments and improve the capacity of local governments to implement environmental policies. The Chinese government should continue to implement administrative measures such as “restricting/banning new industrial projects”[①] enhance the monitoring and control of credit for industries with high energy consumption and high

[①] The development of new industrial projects may be banned in certain areas, river basins, and line industries where the total pollutant emission has reached its ceiling. The ban can be lifted only when the total pollutant emission is going down by taking effective pollution control measures.

levels of pollution; and reduce the export quota for such industries. Instruments such as licenses, bans, restrictions, credit and taxation should be used more stringently. The government may make use of direct subsidies and tax exemptions in line with the principles and policies on public finance for the import & export of environment-friendly products. It is recommended that a joint early warning mechanism for economy-energy-emission reduction should be established. In the near future, China should establish a platform for diagnosing the short- to medium-term situation of economy-energy-environment-emission reduction linkages, and carry out regular analysis of, and macro predictions for, these indicators in order to provide a technical support platform for decision making on emission reduction.

3. SIGNIFICANTLY REDUCE COD DISCHARGES FROM KEY SECTORS AND INDUSTRIES

（7）The government should invest in the construction & operation of urban waste water treatment facilities and pipelines. Based on the experience in the United States, the EU, and Japan, government at all levels should prioritize the construction of urban sewage treatment plants—a public service that requires sufficient public fiscal resources. The government should not try to avoid the responsibility of constructing environmental infrastructure by placing excessive emphasis on market-based approaches for infrastructure investment. However, the operation of urban environmental infrastructure could be gradually commercialized through the involvement of private operators. Government resources, especially the central budget, should not be used to subsidize the operation of sewage treatment plants. But the central budget should remain a key resource for the construction of sewage treatment plants in key river basins of the central and western part of China. At the same time, the government should consider sludge treatment and pipelines as a necessary part of sewage treatment facilities, taking a holistic view of the construction of sewage collection and treatment, and sludge disposal. During the review and approval of sewage treatment facilities, the government should take full account of COD reduction system performance and strictly require that sewage pipelines be constructed as a first priority. The central government should take account of the actual treatment rate and implementation of the sewage treatment policy when prioritizing financial support. When a local government does not meet policy requirements, funds, such as the central transfer payment, could be partly cancelled. Central government funds should be considered as a bonus, not a subsidy. Allocation of government funds for the construction of sewage pipelines should not only consider the total length of the pipeline, but also the treatment capacity and the actual COD reduction. The government should assess the load factor of a sewage treatment plant and the actual COD reductions, and implement the policy of "early construction with more subsidies."[①]

(8) Develop a COD discharge reduction program and measures for key industries. The Chinese government should develop a comprehensive program to reduce COD from major polluting industries, establish individual COD reduction goals for each industry, and create detailed, industry-specific requirements and measures to reduce discharges. First, it should accelerate the COD discharge reduction program in the paper making, chemicals, textile, and food and beverage industries. It should issue comprehensive industrial policies covering technical, economic, and industrial issues. Learning from the experience of the United States, the EU and other developed countries, China should publish industry-specific guidance manuals for reducing COD discharge. According to the requirements of the *Program on Comprehensive Work for Energy Saving and Emission Reduction*, the government should urge local authorities to publicize the name of enterprises that are required to phase-out outdated approaches to controlling discharges in a given time, and link these requirements with the measure of "restricting or banning new industrial projects" and the approval process of new construction projects.

(9) Develop more stringent discharge standards for some industries, and promote greater compliance. China should encourage local governments to implement industrial discharge standards that are more stringent than national standards, especially in Eastern China where pollution levels are high and the economy is well developed. The government should establish a system to regularly review and revise national discharge standards for selected industries. Priority should be given to revising the discharge standards for the paper making industry. In addition, it should facilitate the exchange of technical information and transfer of technology, and enhance the role of science & technology to promote discharge reduction. China should strengthen enforcement, establish an implementation system that combines emission standards with permitting, make greater efforts to punish non-compliance including excessive pollutant discharges, and enable more enterprises to meet emission standards. Furthermore, it should approve the implementation of the 11th Five-Year National Plan for the Prevention and Control of Water Pollution of Key River Basins as soon as possible.

4. FOCUS ON SYSTEM-WIDE SO_2 REDUCTION

(10) Reduce SO_2 emissions from mining and utilization of coal. The Chinese

① This is to encourage local government to complete the construction of their planned urban waste water treatment infrastructure as early as possible and get more subsidiary fund from the central government budget.

government should aim to achieve continuous, system-wide control of SO_2 emissions. Efforts should be made to tighten limits on high-sulphur coal mining, reducing them from a maximum of 3% sulphur content to 2.5% or 2% sulphur content, and facilitate the development and utilization of low-sulphur, high-quality coal. The government should employ energy saving and emission reduction funds to enhance quality management of the coals used by small and medium-sized consumers; and raise the design standards for industrial boilers requiring improved combustion and energy efficiency, and an optimized energy mix. In addition, the government should enhance supervision and post-construction assessment of desulphurization projects, focus on pollution control from coal-fired industrial boilers, and expand efforts to promote the utilization of gypsum from desulphurization equipment at power plants in order to avoid secondary pollution.

（11）Increase the use of washed coal to reduce SO_2 emissions. First, China should, according to law, strictly require coal mining enterprises to set up coal washing facilities when developing new mines, streamline small coal mines, and shut down small coal washing facilities with low efficiency and heavy pollution. The government should restrict the construction of new coal washing facilities with an annual capacity less than 300,000 tons. Second, China should establish the earmarked fund to support the development and introduction of advanced coal washing technology, address the issues of poor reliability and low washing efficiency of domestic-designed equipment, and improve the design and operation of coal washing and processing technologies. Third, distribute in an appropriate way the flow of washed coal. High quality coal should be used firstly in combustion sources in cities and for domestic purposes, while high-sulphur coal should be mainly used in power plants with desulphurization equipment. Fourth, take measures to address such issues as the utilization of coal gangue and acid manufacturing to facilitate the sustainability of coal washing. Fifth, develop coal prices based on the type, grade, and quality of coal, with the price of coking coal based on the ash percentage and that for power generation based on the heat value. At the same time, the government should lower the transportation cost of washed coal and encourage greater use of washed coals.

（12）Implement improved policy measures for desulphurization at thermal power plants. The power industry is the appropriate focus for SO_2 emission reductions during the 11^{th} Five-Year Plan period. However, there are some risks. The government should carefully oversee the implementation of the policy measures. The government should issue national specifications for the design of desulphurization projects for coal-fired power plants, establish engineering and construction standards, normalize the markets for construction and operation of desulphurization equipment, improve the supervision of franchised desulphurization equipment providers. The government should enforce existing rules that desulphurization equipment must meet a minimum removal rate in order for the power plant to qualify for preferential “green” pricing for the electricity supplied to the grid. Restrictions on the use of exhaust gas bypass should be encouraged in new（or expanded）coal-fired power plants Coal-fired power plants should maintain records on the operation of desulphurization facilities and provide on-line reporting from the monitoring system to the national, provincial, and city level.

（13）Develop a policy for the comprehensive utilization of byproduct gypsum from desulphurization equipment. The government should develop policies to encourage the use of byproduct gypsum in products, limit the mining of natural gypsum, expand the market for products using byproduct gypsum; intensify the policy support for the utilization of byproduct gypsum, improve and implement policies to encourage the comprehensive utilization of byproduct gypsum, and reduce or exempt the value added tax for enterprises that use byproduct gypsum from desulphurization equipment. In addition, the government should intensify its supervision of desulphurization equipment at power plants and the supply of raw materials to enterprises that employ byproduct gypsum. At the same time, efforts should be made to actively develop the technology combining desulphurization and generation of raw material for acid making. In doing so, China can reduce the problems of stockpiling and disposing of byproduct gypsum and the import of large amount of sulphur for acid making.

5. THE CENTRAL GOVERNMENT SHOULD USE ITS FISCAL POWER TO MEET EMISSION REDUCTION REQUIREMENTS

（14）The central government should take the lead in using its fiscal power for emission reduction. At present, there is a large gap between the central- and local-level financial and tax distribution system and the central- and local-level environmental oversight system. The central government should expand its authority over emission reductions based on its fiscal power over the local governments. The experience of the United States and Japan could be followed: The central government is responsible for develop and approve the special panning or programs, and bears the related cost. In view of the urgency and long-term need for emission reductions, China should adopt the United States practice of central-government financial contributions for the construction of urban sewage and garbage treatment facilities. The central government should increase the share of the budget devoted to environmental protection where it is a priority, develop more effective national policies on investment in environmental protection, and use 5%-10% of incremental fiscal revenues for environmental protection. Fiscal transfer payments should also be used more for environmental protection. The necessary financial resource from the national budget should be provided to adopt practices similar to that of the Japan Environmental Corporation and the revolving loan funds for sewage treatment in the United States. These funds could provide the foundation for emission reductions and the development of environmental infrastructure.

（15）Local governments should meet their environmental responsibilities and enhance efforts to reduce emissions. China should amend the Environmental Protection Law to include provisions for environmental protection investments, clarify the role of the government in environmental investment, and ensure the investment of a baseline amount for environmental protection. It should identify the proportion of environmental funds in government budgets and the growth rate of investment in environmental protection, ensure the financial resources in the national budget for environmental protection, and guarantee sufficient funds to finish the emission reduction activities. At the same time, the Chinese government should develop methods for categorizing environmental protection investments for pollution control that reflect reality. According to international practices, such as that of the EU, projects with indirect environmental benefits, such as investment in green and garden areas and the construction of the infrastructure for natural gas heating, are not counted as environmental investments.

（16）Develop and implement investment and financing policies for pollution treatment under the new financial and taxation system as soon as possible. The central government's 1984 policies on nine financing channels for enterprises' environmental protection cannot adapt to the current situation. China should issue a new environmental investment and financing policy under the new financial and taxation system, and expand the financing channels and mechanisms for raising funds for pollution control. Enterprises' investments in environmental protection equipment for saving energy and reducing emissions should be deductible from income taxes. Income resulting from the application of state-of-the-art environmental protection equipment, upgraded technology and adjustment of the product mix should be taxed at a lower rate or exempted from taxes. The government should provide preferential policies for enterprise pollution control projects in terms of loans, interest rates, and loan terms. It should accelerate the pace of development and implementation of supporting policies for pollution control projects on such aspects as land use, electricity pricing, and accelerated depreciation of pollution control equipment.

6. STRENGTHEN ENFORCEMENT AND THE CAPACITY OF ENVIRONMENTAL AUTHORITIES AND ENSURE THAT FACILITIES PLAY THEIR ROLE IN EMISSIONS REDUCTION

（17）Strengthen the legislative framework and coordination mechanism for emission reduction. The government should issue *Regulations on the Control of Total Emissions of Major Pollutants* as soon as possible to provide a strong legal basis for emissions reduction. Focusing on emissions reduction, the government should enhance and integrate environmental management activities, including by streamlining and linking licensing and permitting, environmental impact assessment and inspection. The independent and vertical administration of environmental monitoring and enforcement affairs[①] should be exercised on a trial basis in some regions where conditions exist. Drawing on Japanese experience, the government should establish an environmental supervisory system, with responsibilities allocated to both enterprises and local EPBs. A professional qualification system should be established for environmental supervisors. Pilot schemes for environmental inspection and reporting on the environmental performance and emissions reduction of key polluting enterprises should be implemented. Drawing on Canadian practice, the government should assign relevant enterprises to one of three categories, and allocate enforcement resources accordingly: regulatory driven, risk-based, and leading edge.

（18）Strictly supervise the operation of on-line monitoring equipment; ensure the continuous operation of pollution treatment facilities. The government should treat the operation of pollution treatment facilities as an important component of environmental enforcement. It should monitor and facilitate the smooth operation of such facilities. It should strengthen the management of on-line monitoring equipment, raise the access standards for on-line equipment provider, promote third party verification of data, and clarify the legal status of on-line monitoring data. The government should strengthen the treatment of emissions reduction data, establish the capacity to analyze background and total emissions, and set-up facilities to provide needed data. In addition, it should accelerate the implementation of the *National Plan for Capacity Building in Environmental Inspection,* including the financial and other implementation mechanisms. It should enhance the capacity of regional environmental centers; strengthen their inspection and law enforcement functions, especially enforcement of legislation related to emissions reduction.

[①] The environment monitoring station and enforcement department at lower level should be directly under the leadership/administration of the monitoring station and enforcement department at higher level, not administered by the government at the same level.

（19）Enhance the transparency of, and accessibility to, information on emissions reduction; promote public participation. China should speed up the establishment of a database on emissions by pollution sources under a national control program. It should make information available to the public about emissions and reductions in emissions of key pollution sources and major polluting industries and enterprises across China. It should adopt “mixes” of policy measures including command-and-control, economic and voluntary tools. It should implement pilot projects to reduce emissions through the involvement of third-party and social forces, and link emissions reduction to public environmental interests by enhancing public participation.

7. ACCELERATE THE INTRODUCTION OF LONG-TERM POLICY MEASURES FOR EMISSION REDUCTION

（20）Further promote the reform of pricing & taxation for resources and environment. The pricing mechanism which takes the environmental cost into account should be established for water resource and coal. Following the example of a differentiated price for power from coal-fired power plants with desulphurization, the price of water could be linked to discharges from heavy polluting industries such as pharmaceuticals, chemicals and paper making. The government should increase discharge fees, expand their range, and strengthen fee collection efforts. It should include products with heavy pollution and high energy consumption into the scope of consumer taxes, and increase the resource tax rates for coal, petroleum and natural gas. When developing an independent environmental tax program, the government should focus on products associated with large emissions, for example gasoline or cars.

（21）Strengthen incentives to achieve emissions reduction. The government should strengthen the price differential for electricity supplied by coal-fired power plants with desulphurization equipment meeting specified standards. It should provide compensation to enterprises that are required to shut down because they cannot achieve pollution reduction targets at a reasonable cost. It should establish a database on the environmental performance of key polluting enterprises; strengthen information exchange between environmental protection, and taxation authorities, as well as with the banking system; establish energy-saving, emission-reduction and environmental performance as important prerequisites for preferential policies and granting of loans. It should give appropriate recognition to those enterprises that achieve emission reduction targets ahead of time or with a good environmental performance. The appropriate adjustment should be made on loan policy in areas where the approvals of new industrial projects are strictly restricted. It should cancel the preferential taxation policy and reduce subsidies to those enterprises that have not finished their emission reduction task or which illegally discharge pollutants. It should draw on American experience, and actively implement pilot projects for tradable permits, gradually extending the scope of the scheme and enabling enterprises to benefit from emission reduction.

（22）Encourage consumers and the whole society to participate in emissions reduction efforts. Learning from experience with the new “Energy Policy Act” of the United States, China should adopt incentive measures such as tax exemptions and direct subsidy to consumer to facilitate the production and consumption of energy-saving and low-emission products, and encourage the whole society to participate in energy saving and emission reduction. Government should make more efforts to promote government procurement of green products. It should establish criteria and provide incentives for green government procurement, energy saving in buildings, water conservation and emission reductions.

8. CONTINUOUSLY PROMOTE EMISSIONS REDUCTION DURING THE “12TH FIVE-YEAR PLAN” PERIOD, 2011-15

（23）Achieve “Five shifts” in emission reduction. It is expected that the pressure of economic and social development on the environment will not be fundamentally alleviated in the next 20 years. These pressures will continue, and it will be a long-term and arduous task to reduce emissions in China. Starting from now, and during the “12th Five-Year Plan”, the Chinese government should implement a new “Five shifts” strategy for emission reduction: 1）shift from an exclusive focus on reduction of total emissions to one that combines total emissions reduction with an improvement in environmental quality; 2）shift from an over-dependence on the reduction of emissions in key industries to the reduction of emissions from all industries; 3）shift from the total emission control of single pollutants to the coordinated control of many pollutants; 4）shift from increasing the volume of emission reduction projects to the improving the quality of emission reduction projects and achieving real environmental outcomes; 5）shift from depending on administrative measures to a greater use of market-based tools.

（24）Choose a strategic path for emissions reduction during the “12th Five-Year Plan” period. The Chinese government should actively facilitate the application of more legal and scientific approaches to control the total emissions of pollutants. It should set up and implement an indicator-based system focusing on both total emission control and environmental quality improvement. It should strengthen the feasibility of total emissions reduction at local level; carry out emissions reduction of coal-fired industrial boilers as part of the strategy to reduce SO_2 emissions; gradually implement total NOx emission control from the thermal power industry; choose key river basins and lakes to control the total discharge of ammonia/nitrogen; select some sensitive lakes and reservoirs to pilot test approaches for the control of total nitrogen and phosphorus discharges; assess approaches for the control of non-point pollution sources in some areas; actively prevent and control emerging environmental problems such as POPs, mercury and VOCs; implement demonstration projects for issues such as the remediation of polluted sites, the treatment of contaminated soil, and environment-friendly disposal of electronic waste.

Background Paper on Innovation and Environment-friendly Society*

Forward

Since the industrial revolution in the UK in 1800s, the world entered a fast stage of economic growth and civilization. This can be seen in the increase of the wealth per capita, first in developed countries, now in the developing countries in the last two centuries. A variety of manmade goods were invented and used each year. But the global resource- and environmental situation is already beyond the earth's longer term carrying capacity. The modern existential crisis, which the Western capitalistic structure has placed itself in, is getting out of control, and is manifesting itself in a self-destructive process. Though many government, international organizations and non-government organizations have already spent lots of effort to reverse the process, it seems that incremental environmental improvements are not good enough to deal with the ecological-, health- and development challenges of rapidly rising consumption and population growths.

Today, it seems that there is no global recognized strategy for economic growth leading to sustainable development.

China, as a fast catching up country, has entered a period of rapid economic growth. From the 1980s onward, China has witnessed fast economic development and outstanding achievements, which, however, come at the price of its resources and environment. The conflict between economic growth and resources and environment in the nation is becoming increasingly acute.

The unique Chinese growth and crises have their roots. Firstly, China is a world manufacturing base and produces a lot of goods for the world. Secondly, China is entering its heavy-chemical stage of industrialization. In this stage, pollution per GDP is higher than at other stages. Thirdly, for a long time, there has been mismatched strategy: government

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emphasized economic growth and neglected the equally important sustainable development.

As China faced a challenge that other countries do not have, the Chinese government has decided to build environmentally friendly society. China could lead the world in environmentally friendly technologies, provided it seizes the opportunity for radical innovations.

Introduced into China in 2005 as a development concept, an environment-friendly society is one where harmony between man and nature and between man and man is promoted on the basis of the carrying capacity of the environment and resources, under the guidance of natural law and by means of sustainable economic, technological and cultural policies. The aim of such a society is to create an efficient productive system, a moderate consumption and living system, sustainable and recycling resource environmental systems, a stable and efficient economic system, an innovative technological system, open and orderly trade and financial systems, a fair distribution system and an enlightened and progressive socialist democratic system. For the 11th Five Year Plan period, China has set the goals of reducing energy consumption per unit of GDP by about 20% and cutting down the total discharge of major pollutants by about 10%. To achieve these goals, it is necessary to uphold the scientific development outlook, develop recycling economy by dint of advanced technologies, and accelerate the building of a resource-efficient and environment-friendly society though innovation. These efforts are also fundamental to breaking restrictions of resources and the environment and realizing better and faster socioeconomic development. Currently, a conspicuous problem that China faces is that it has accumulated some advanced environmental protection and energy-saving technologies, but without strict technical controls. Related technologies from the developed world have yet to be introduced to businesses and families. In this sense, it is imperative for the nation's environmental sector to accelerate the entrance of environmental technologies into economic activities and put them to good use. In response, this study aims to find a workable solution from the perspective of the national innovation system（NIS）, to help China transform into an environment-friendly society.

Innovation comes from the bottom up, not from the top down. China needs to develop incentives to stimulate innovative ideas. This could form a major investment to ensure competitive proposals are received and evaluated strictly on a merit basis. In the longer run it is clear that many ideas need to be supported as only very few innovations will become commercially relevant in the short term. Basic research in fields such as Information and Communication Technology, Nano-/Material technologies, and Bio-Technologies need to be fostered at globally competitive levels. Some of these can lead to short terms implementation, but others will provide the basis for capturing longer range ideas.

Of the key elements of a successful innovation system is a cultural setting that allows entrepreneurs to try a new idea, fail without being disgraced and be given the resources and opportunity to try again.

Creativity and innovation while having somewhat different meaning, to a very large degree are one and the same. China（along with many other countries）has focused much of its education on developing highly specialized skills. These are important in today’s global world. But it is important also in today’s world to release the creative potential of individuals and group. The culture of breaking down disciplines is essential for innovation in science, technology, institutions and societies that this report documents is needed for the environment-friendly society.

Ⅰ. Achievements and Challenges of Technology Innovation in the Building of an Environment-friendly Society

1.1 ACHIEVEMENTS OF INNOVATION IN THE BUILDING OF AN ENVIRONMENT-FRIENDLY SOCIETY

Environmental protection technology application and innovation is carried out in China either through domestic development or introduction of technologies from developed countries, by means of joint investment, technical cooperation or technical transfer. China’s environmental technologies generally develop rapidly and promise a large potential, with some approaching or even having reached the developed world’s levels.

With its rapid economic development, China has increased resources to address environmental issues with greater inputs into advanced technologies.

Firstly, China rapidly reduced its electricity consumption per GDP since 1980s. It means that China continuously introduced new technology to improve production efficiency（Figure 1）.

Secondly, over the past years, it has implemented the national key “water pollution control technology and treatment project”, which has led to a workable technological plan and a supporting technological system for water pollution control. Plus, the application of environmental monitoring technologies and facilities, the research and development of such pilot programs as purification of vehicle exhaust gases, desulphurization of flue gas discharged by coal-fueled boilers, disposal of solid waste, cleaner production of key sectors and other key technologies have effectively improved pollution control and environmental quality in some areas (river basins). Wasterwater discharge per unit of GDP has been decreasing in the last five years (Figure 2).

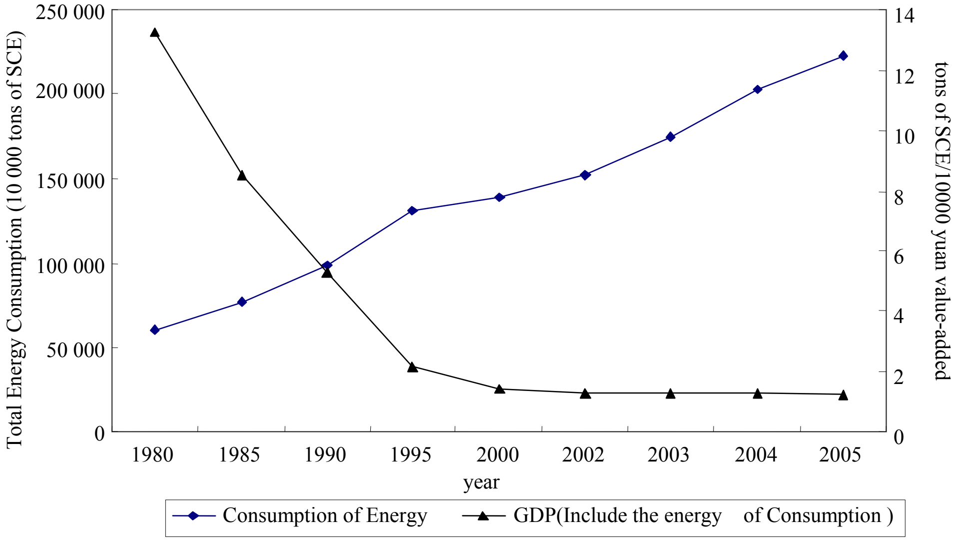

Figure 1 Consumption of energy in China

Source: China Statistical yearbook (2006). Beijing: Chinese Press of Statistics, 2007.

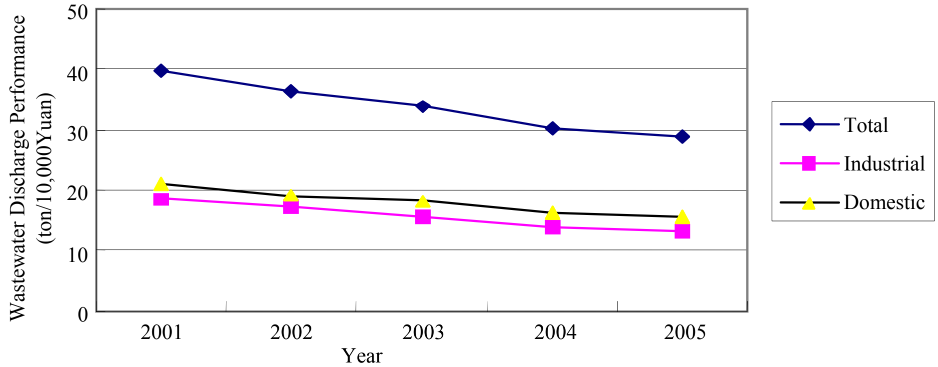

Figure 2 Wastewater Discharge Performance per Unit of GDP in the 10th Five-year Plan Period

Thirdly, new processes and techniques have been developed to cope with the needs for urban sewage treatment in China by means of advanced approaches for nondegradable wastewater such as bioaugmentation, catalytic oxidation and membrane-biotreatment as well as high-efficiency inorganic polymeric flocculants. Application of these technologies has helped effectively control water pollution in the key river basins nationwide. Of the 2,130 water pollution prevention and control programs in key drainage areas in the 10th

Five-Year Plan, 1,378, or 65% of the total, had been completed by the end of 2005. In the drainage areas of the three rivers（Huaihe, Liaohe and Haihe）and three lakes（Taihu, Dianchi and Chaohu）, 416 wastewater treatment plants have been completed or are under construction, with a daily treatment capacity of 20.93 million tons. More than 80% of the over 5,000 heavy polluters in these basins have reached the standard for discharge level. As a result, water pollutants in these areas have been greatly reduced, the trend of water environment deterioration has been basically controlled, and quality of water in some parts of the rivers and lakes has notably improved. Statistics show that adoption of new environmental technologies and strengthening of pollution control during the 10th Five-Year Plan period has led to remarkable reduction in China's COD emission performance, with more noticeable results seen in 2001-2004 and less reduction in 2005. The emission of COD per unit of GDP in 2005 was 39.45% lower than in 2001.

1.2 CHALLENGES TO CHINA'S SUSTAINABLE ENVIRONMENTAL DEVELOPMENT

It is important not only to consider improvements in environmental management on a per GDP basis（this is referred to as intensity targets）, but to ensure that total pollution is being reduced（this is referred to as absolute reduction – see Table 1）. Continued commitment to GDP growth means that the pollution emission per GDP while important does little to solve the overall problem. The pollution emission levels must be reduced.

Table 1 some indicator of air pollution in China

Atmosphere Environment	2001	2002	2003	2004	2005
Industrial Waste Air Emission （100 million cu.m）	160863	175257	198906	237696	268988
Fuels Burning	93526	103776	116447	139726	155238
Production Process	67337	71481	82459	97971	113749
Sulphur Dioxide Emission （10 000 tons）	1947	1927	2159	2255	2549
Industry	1566	1562	1792	1891	2168
Non-Industrial	381	365	367	364	381
Soot Emission （10 000 tons）	1070	1013	1049	1095	1183
Industry	852	804	846	887	949
Non-Industrial	218	209	202	209	234
Industrial Dust Emission （10 000 tons）	991	941	1021	905	911
Industrial Sulphur Dioxide Removed （10 000 tons）	565	698	749	890	1090
Industrial Soot Removed （10 000 tons）	12317	13998	15649	18075	20587
Industrial Dust Removed （10 000 tons）	5322	5570	5995	8529	6454
Number of Soot Control Zones Established （unit）	3203	3369	3599	3693	3452

Source: China Statistical yearbook （2007）. Beijing: Chinese Press of Statistics, 2007.

China now faces a very serious situation in sustainable development. Take the year 2006 for example, the total discharge of wastewater was 53.68 billion tons, up 2.3% from a year ago. To be specific, industrial wastewater declined by 1.1% from the previous year to stand at 24.02billion tons, accounting for 44.7% of the total; and municipal domestic wastewater rose by 5.8% from the previous year to reach 29.66 billion tons, representing 55.3% of the total. The volume of sulfur dioxide rose by 1.5% from the previous year to reach 25.888 million tons; and that of the soot emission fell by 7.9% from a year ago to 10.888 million tons. Investment in pollution control across the country grew by 7.5% from a year ago to hit a record of RMB 256.78 billion Yuan, or 1.23% of the then GDP. Serious accidents of environmental pollution and damage occur nationwide. The quality of 26% of the nation's major rivers was lower than grade V standard. Seventy-five percent of the lakes became eutrophic to varying degrees. 360 million rural population had no access to up-to-standard drinking water[①]. It is estimated that China's current discharge of major pollutants, like sulfur dioxide, carbon dioxide and chemical oxygen demand（COD）, far exceeds the environmental capacity, indicating the nation has already entered a period of high incidence of environmental pollution accidents. The grave reality tells a fact: unless China breaks the resource and environment bottleneck, it will see its resources, energy and eco-environment no longer able to sustain and guarantee its national security. Vice Premier Zeng Peiyan recently said with reference to the current status of the environment and prospects going forward, that "The sustainability of China's economic and social development is at stake".

To sustain its economic development and become an environment-friendly society, China needs to make four major transformations. First, in terms of economic growth pattern, the impetus to growth should be transformed from investment and export driven to domestic consumption and international demand driven. Second, from the perspective of industrial structure, the manufacturing industry should give way to a combination of industry, service sector and agriculture as the driving force behind economic expansion. A steady migration to the knowledge economy is going ahead. Third, on the level of production factor inputs, the basis for development should be shifted from capital and natural resources to human resources and technical progress. Fourth, with respect to resource utilization, the unidirectional linear process of resources- products- waste should give way to the feedback cyclic process of resources- products- waste- resource recycling[②]. These transformations

① China Environment Statistics Bulletin 2006

② Ma Kai, Development of Recycling Economy, Building a Resource-efficient and Environment-friendly Society, Qiushi, 16th edition （2005） aim to base economic growth on optimized economic structure, increased technical content, improved quality of population and enhanced quality and efficiency and to give rise to an economic growth pattern characterized by low inputs, high yields, low consumption, low discharge, recycling and sustainability. The core idea here is to promote the development and application of energy-saving and environment-friendly technologies, with technology innovation as the source, institutional innovation as the guarantee, and social innovation as the basis.

1.3 PROBLEMS IN ENVIRONMENTAL TECHNOLOGY INNOVATION

Despite the successes in the development and application of environmental technologies, we should understand that China still faces a grave overall environmental situation and lags far behind developed countries in environmental engineering equipment. Its common problems remain pronounced and it has not yet met the requirements of environmental management. Thus the harmonious development of the environment and economy is inhibited. The problems are shown in the following aspects:

(1) Lack of overall strategic planning results in repetitive technology introduction

China currently has 11,555 environmental protection bodies and 266 environmental research institutes. Nevertheless, one basic feature of its environmental technology development is "taking everything", which means it has used technologies of different countries and different standards, either in R&D or in engineering practice.

In 1987-2001, China received a total of USD 5.55 billion in loans, of which, 49.7% was from the World Bank, 23.9% from Asia Development Bank and 26.4% from the Japanese government, to support 45 environmental protection programs.

During the 8th Five Year Plan period, China borrowed USD 1.21 billion from international financial organizations, and the figure more than trebled to hit USD 3.98 billion in the subsequent five years' time[①]. The amount borrowed from international financial organizations accounted for over a half of the total foreign capital that went to the nation's environmental protection programs.

In terms of project implementation and completion, capital from these organizations made up for serious fund shortages, helped improve the production and living environments, pushing forward the development of China's environmental protection sector. However, the lack of overall strategic planning on technology selection, coupled with the rather exacting requirements on procurement that generally come with international loans, made it

① He Kaili, Song Jianjun, China Environmental Protection Industry, 7th edition, 2002.

impossible to guarantee that the procured technologies were the best.

For instance, the German government requires that limited competitive bidding should be carried out for a project financed under its loan and over 50% of the project's goods and services should be supplied by Germany. The Netherlands requires that procurement of technologies, equipment or services worth more than 50% of the values of a contract financed under its loan should be made in the country, and supplies other than from the Netherlands should be contracted by the Dutch suppliers and be insured with Credit Insurance Ltd. NCM. In the case of South Korea, the government requires that the successful supplier of a project funded under its loan should be selected through limited competitive bidding from eligible South Korean suppliers. Besides, 75% of the equipment and services should in principle be procured in South Korea with the remaining 30% in China or a third country.

Due to the above restrictions, the primary instrument and elements for process control of pollution treatment facilities and for environmental monitoring cannot be localized and thus have to be imported again and again.

Besides, China has not put in place specific policies, guidelines and equipment （products） standards to provide overall strategic guidance for technology introduction. This has also contributed to the blind and repetitive introduction, impeded introduction channels and introduced technologies that are unsuitable for China. An example of repetitively introduced technologies is the desulfurization technology for thermal plants.

China has now substantially improved it's overall funding capabilities and should therefore address the issue of overall strategic planning in a new light. Major funding would be needed in order for China to take the global lead. This would not only help China to deal with it's own dramatic environmental problems, but by developing this as an indigenous specialty by creative funding incentives for the private sector, governments, universities, and research institutions, new growth industries would emerge for the global markets.

（2）Absence of technical assessment standards and means prejudices the effectiveness of technology introduction

Absence of assessment, pilot programs and tracking for technology introduction, combined with the headlong pursuit for "popularity" to the neglect of maturity, has turned China into an experimental field for all kinds of technologies. Huge amounts of money have been spent only to find the results are unsatisfactory. Unavailability of corresponding specifications and standards （for interface for example） has led to the introduction of different types of monitoring devices, which cannot operate on a uniform platform. Besides, no scientific and effective assessment means are available to assess these devices for accuracy and reliability. As a result, many online monitoring devices cannot be connected to the networks of the environmental departments, or even if they can, they are unable to provide reliable data to support the management of the environmental departments. These problems have not only prejudiced the effectiveness of technology introduction but also resulted in a huge waste of state capital.

A remedy to this situation would be to establish a number of competence centers for research focused innovation with a high international scientific quality. Emphasis should be given to cooperation between research-intensive companies and renowned research institutions. In this context, transfer of technologies, internationalization, and education of scientific researchers should be strengthened and adequate incentives provided. By using such centers to establish rigorous standards, and then applying these standards rigorously innovation in itself would result.

(3) Most domestic developed new technologies are not mature enough to be put into industrial application

A longstanding problem in China's development efforts is the lack of connection between development and production engineering. This is primarily attributable to the fact that the results are not mature enough to be put, or effectively put, to practical, commercial and industrial use. Solution of this problem requires creation of a development system integrating production, education and research, a system that is oriented toward economic development and environmental protection and based on the support of businesses. In addition, capabilities should be enhanced for market demand forecast, technology selection and assessment, and technology application forecast, so as to identify environmental protection technology development plans that meet market demands. It is also necessary to strengthen capabilities to make the research results more practical and to introduce them to the market and expand their market share. A technology extension system and a venture capital investment system for technological development and application should be created.

(4) Incomplete technological assessment system impairs transformation of technological results

China has made great headway in the transformation and extension of environmental protection technologies along with its ever improving technological system. Nevertheless, it still lags far behind the developed countries in the transfer rate and contribution rate of technological results, with some virtually becoming stagnant and unable to be connected effectively with production. For instance, 84% of the technological achievements in the 7th

and 8th five-year plan periods reached the intended advanced levels, but few of them were applied. This result is attributable to （a）lack of an objective and equitable environmental technology assessment system; （b）failure to connect technical assessment with the overall strategy on environmental protection and strategy on environmental technology development; （c）failure to gear the technological project assessment toward the state's major demands on environmental management and pollution control;（d）absence of widely applicable and representative assessment technologies; （e）the extension efforts, which are not systemic and not connected to the targets of environmental management are thus unable to provide support for environmental management; and （f）disorderly competition, which makes the effective transfer and extension of good technologies impossible, leading to poor investment results, huge waste and slow pace in minimizing pollution.

（5）No systematic management and scientific guidance is available for pilot programs

Pilot programs cover new technologies and introduced technologies. As for new technologies, constant improvement and follow-up development will still need to be made during the pilot process. Since all pilot programs have limited applicable conditions, so in order to make a program serve as a model and provide guidance to other similar techniques, a systematic management system and the corresponding supporting research and monitoring means should be provided to make known the program's conditions, results and applicable scope in a comprehensive, systematic and complete manner. But, instead of whole process management, current management is limited to technical assessment after program completion.

（6）A national environmental technology innovation system with businesses as the main players is yet to be created

Environmental technology development in China largely relies on specialized colleges and universities and institutes. Over the past years, domestic environmental engineering firms have grown rapidly with improved strength in capital and technology. However, they are too preoccupied with undertaking projects to devote any resources, technological or economic, to development. That explains, in part, why China still has to import some core technologies and key equipment. Besides, these firms have not established a technology innovation system; and most users, averse to the possible localization risks, require procurement of a certain proportion of foreign equipment. All these lead to the low localization rate of environmental engineering equipment. The low rate directly affects China's environmental protection technology development, which, in turn, makes localization more difficult.

Ⅱ. Environmental Technology Innovation: International Experience

2.1 MEASURES AND EXPERIENCE OF THE EUROPEAN UNION （EU）IN PUSHING FORWARD ENVIRONMENTAL TECHNOLOGY INNOVATION

The European consumers are increasingly concerned about environment and health. The EU has become a leading manufacturer and exporter by encouraging consumers to buy green products, which lead to more stringent environmental standards, and by promoting environmental technologies which have boosted the competitive advantages of some sectors（e.g., power generation, photoelectricity, wind energy, water management techniques and treatment）.

The Environmental Technologies Action Plan （ETAP）adopted by the European Commission on January 28, 2004 aims to harness all potential to reduce pressure on natural resources, improve the quality of life of European citizens and stimulate economic growth. ETAP complements EU's sustainable development strategy and supports the Lisbon strategy and is therefore ready to be adopted by developing countries. The EU encourages adoption of advanced environmental technologies in each investment and makes corresponding target decisions. These measures will further expand market and lower cost and are supposed to be jointly implemented by the commission, member states, research bodies, organizations, industries and communities.

The objective of ETAP is to eliminate obstacles, develop environmental technologies in an all-dimensional manner, protect environment, promote competitiveness and economic growth; to ensure the EU in the forthcoming period to become a leading force in the development and introduction of environmental technologies in the developing world; and to mobilize all the involved parties to actively participate in this plan. To better implement the plan, EU has studied the three key points of environmental technologies: from development to market, improvement of conditions for market operation and global actions.

Given the worldwide economic growth and pressure on natural resources, existing technologies are not, in the longer term, adequate to safeguard sustainable development. The Action Plan puts forward actions to attract more private and public investment for the development and demonstration of environmental technologies. The actions aim to improve the innovation process and to take inventions out of laboratories and onto the market.

EU has made two initiatives of creating technology platforms and test networks, with an intention of understanding how to establish public-private partnerships and how to bring research closer to the market. A technology platform brings together all the interested stakeholders to build a long-term vision to develop and promote a specific technology or solve particular issues. EU decided to build two environmental technology platforms for hydrogen, fuel cells and photovoltaics in the first half of 2004 and technology platforms for water supply and sanitation in early 2005. These platforms are built on projects with environment, economic and social benefits.

Test of environmental technologies inures to verification of the performance of innovative technologies and to the protection of human heath and environmental safety. The establishment of networks of testing centers makes the information consistent and comparable and assessment parameters reliable.

2.2 MEASURES AND EXPERIENCE OF THE US IN PUSHING FORWARD ENVIRONMENTAL TECHNOLOGY INNOVATION

The Environmental Protection Integration （EPI）initiated by the US aims to integrate the environmental concerns into the existing departments, related policies, organizational arrangement and power structures.

Development of EPI experienced four stages, from reliance on the state governments to federal regulation, further to support for sustainable development. EPI as a policy tool has been widely adopted across the US.

Apart from having spent substantial funds over decades in developing environmental technologies, the US government has put great emphasis on partnership with businesses and research bodies. A case in point is the Advanced Technology Plan （ATP）carried out by the Department of Commerce in 1990-1999, which covered the technological field of energy and environment. Implementation of the Plan involved the US government, research bodies as well as private businesses, which contributed over half of the total investment and were entitled to use the technological results derived from the Plan. This method not only leveraged funds from more diverse sources but also promoted technology application. What’s more, the US government has set great store by research cooperation between various departments. The （Environmental Protection Agency）EPA-led cooperation plan in 1994 which was designed to enhance technology sharing among departments facilitated the application of environmental technologies in various sectors. The national environmental technology strategy unveiled in 1995 aimed to guide, coordinate and push forward the development, application and commercialization of environmental technologies.

The Environmental Technology Verification Program （ETV）initiated by EPA verifies the performance of environmental innovative technologies. ETV greatly accelerates the entrance of environmental technologies into the domestic and international marketplaces. Created in October 1995, ETV carries out assessment of performance of environmental technologies （air, water, soil, ecosystem, waste, pollution prevention and monitoring）as a public-private partnership. ETV efforts are guided by the technology purchasers and vendors, license holders, consulting engineers, financiers and exporters in particular technology sectors. Vendors of all kinds of technologies may apply for verification. All the test/quality assurance plans require the joint participation of technological experts and applicants, and update is subject to peer review or test. Immediately after a technology has been verified, all the related test procedures, performance reports and verification statements will be published on the ETV website. Execution of ETV quality management plan （compatible with the quality standards recognized by the US and internationally） assures the highest data quality.

Starting in April 2004, ETV conducted four surveys: consumer satisfaction with ETV website, ETV's impact on the sales volume of environmental technologies, degree of technology innovation, and the purchasing power for the verified technologies and adoption of such technologies in decision-making process. The first survey was conducted in February 2004 while the latter three ones were carried out from 2005 to 2006. By far, 272 technologies have been verified.

Ⅲ. Environment-friendly National Innovation System（NIS）: a New Model

Building of a resource-efficient and environment-friendly society necessitates pursuit of a sustainable development road that is of high technical content, well performing, consumes few resources and causes little pollution. But how to deal with the lack of initiatives to innovate during the process as well as the underlying causes? How to deal with the failures of governments, markets and systems that are commonly seen throughout the process? Only by combining NIS with sustainable development can we establish a new technology-economy model featuring resource-efficiency and environment-friendliness.

The education systems of China and many other parts of the world focus on training people with highly specialized skills. It is often the case that these specialists are trained to a level of expertise that does not permit them to be creative. The concept of creativity as a key to innovation needs to be introduced into the universities and colleges of China. This may take some radical restructuring.

Another aspect would be to establish a national network of centers, with the task of assessing all current situations affecting the environment on a continuous basis, and monitor the developments towards the target conditions for improvements with the overall objective of reaching a status of excellence which is a prerequisite for taken the global lead.

3.1 BUILDING OF AN ENVIRONMENT-FRIENDLY SOCIETY REQUIRES THE NIS TO BE GEARED WITH SUSTAINABLE DEVELOPMENT

A NIS is an institutional arrangement whereby technologies are integrated into the economic growth process. The core of the system is to, on the basis of interactions among the technology developers, disseminators and users and government bodies, create a favorable mechanism under which technology and information flows and is applied throughout the society. The system in reality is manifested as a network of businesses, universities and government bodies in a nation, who, focusing on technological development, create an interactive network mechanism, under which, all players carry out a variety of technological, commercial, legal, social and financial activities to develop, protect, support and regulate new technologies.

It is generally held that a NIS primarily consists of businesses, research institutes, research-oriented universities and colleges, general education institutions, public labs, intermediaries and others innovation-related government bodies. The core elements of them are businesses as the main player of innovation, research bodies and research-oriented universities and colleges as the technology suppliers, education, training and intermediary organizations as the major force for technology transfer and diffusion. The relations among these elements have a direct bearing on the information flow within the NIS. The governments as the coordinating bodies in the system and a nation’s financial system, history and culture, which constitute the basic ecological environment for NIS operation, have a direct impact on the system’s operation performance. The NIS setup refers to the framework of the relationships among the parts involved in technology and information flow. The core of the NIS is the interaction among the developers, users and disseminators of technologies. Other factors actually function as the conditions or background for the NIS. There are two core issues: information flow and system failure.

First, from approach of NIS, it is not enough to just have resource-efficient and environment-friendly technologies and what is of real importance is the flow and wide application of technologies among players.

Second, the external factors that influence the efforts to build an environment-friendly society through environmental technology innovation include not only the institutional guarantee and financial system, as provided by the Chinese government, but also historical and cultural factors that are hardwired in the people's ideology. Therefore, technology innovation aside, it is also necessary to initiate social innovation to create social and cultural environments that encourage all players （governments, businesses and citizens）to actively adopt environment-friendly technologies.

Third, environmental technology innovation is plagued by the failures of markets, governments and systems. The key for creating institutional innovation that is favorable to environmental technology innovation is ideological innovation which leads to innovative social transformation.

The NIS under the guidance of the scientific development outlook is an institutional system that fully reflects the values of natural resources and ecology. It is also a sound development mode under which the economic reproduction is organically connected with natural reproduction. By allowing the sustainable development to be based on technology innovation, this mode greatly promotes the sustainable development of the human society. The NIS guided by the scientific development outlook is reflected in the following three aspects:

（1）"Green" technology innovation. Efforts to develop environmental technologies should be strengthened to ensure that the supply meet the requirements of socioeconomic development. Environmental requirements should be proposed for all the research development activities through assessment from the perspective of environment-friendliness. Judgment of technological programs should take into full consideration their environmental values, rather than merely economic values.

（2）"Green" institutional arrangements. Related systems should be designed to encourage the diffusion and application of green technologies. These include systems for encouraging businesses to carry out environmental technology innovation and take environmental technologies to the market, to enable them to consume fewer resources, produce less pollution, reduce environmental costs and enhance competitiveness; systems for encouraging social organizations and members to actively adopt environment-friendly technologies and products; and systems for realizing win-win of economy and environment on a broader level.

（3）"Green" economic and social management. The governments' functions should be "green", which means economic functions are combined with environmental protection functions. The scientific development outlook requires us to base ourselves on a system that is conducive to the constant environmental technology innovation. Under the system, environmental technologies flow and are applied among the technology developers, disseminators and users and governments; under the system, a sound internal mechanism that enables environmental technologies to facilitate sustainable social and economic development gradually emerges.

3.2 NIS GUIDED BY THE SCIENTIFIC DEVELOPMENT OUTLOOK NEEDS TO OVERCOME FAILURES

A general view of the status quo of China's environmental technology innovation system reveals market, system and government failures for technology innovation. As the demand of social development for a "green" NIS becomes increasingly urgent, the adverse impact of these problems appears ever more pronounced.

（1）Market failures. Generally, the majority of environmental technology innovation is not likely to directly get equitable economic returns or compensation from the market for the time being, largely due to the current systems and mechanisms. Considering the long lead time and large investment of environmental technologies, the businesses that seek short-term profits are unwilling to invest much in such programs. Besides, inputs by the Chinese government are too limited to remedy these failures. As a result, in its transmission process towards a society featuring harmony between man and nature, China lacks the fundamental technological support.

The reasons for market failure are that: （a）under the incomplete socialist market system, businesses are not established as the main players of environmental technology innovation. The businesses, therefore, do not feel motivated to echo the government's voice, leading to limited directions of innovation;（b)the markets for technological results transfer and transformation are still underdeveloped and other related technical and financial markets have just been developed; （c）the nature of environmental technology innovation makes the failures more prominent. The demands of environmental technological research and supply of results are, to a large extent, decided by the government, instead of the market. But in drawing up policies, regulations and standards, the government rarely considers the response of the market from the aspects of economy and benefit; （d）management and decision-making still follow administrative orders, rather than guided by the concept of market economy;（e）lax law enforcement is rather prevalent, making acting within the law more expensive than acting against the law. The lack of motivation to adopt environmental technologies gives rise to a vicious circle.

It is difficult to establish businesses as the main players of environmental technology innovation efforts in the absence of an appropriate institutional guarantee. Businesses, as the main players in the market, are primarily driven by prospects of profits, without which, they are unmotivated. If businesses are unenthusiastic about environmental innovation, the research personnel will feel unenthusiastic as well. Because if there is no market demand, results are unable to be translated into productive force and to realize values and bring returns from the market. The research personnel are then unlikely to gear their innovation efforts towards the needs of businesses or to give much attention to results transformation. They never even give any thought to whether there will be a market potential at all in the course of innovation. The important guarantee and prerequisite for environmental technology innovation is to put in place commercial systems, measures and platforms, and to remove the obstacles to commercialization in the course of technological development, diffusion and application.

（2）System failures. If interactions between industrial sectors and universities and research bodies and between government bodies and businesses are impeded, untoward situations will result. For technology developers, they will see results pileup and a level of profits that is insufficient to sustain the necessary follow-up investment. For technology users, they will not be able to access the leading-edge technologies to replace the backward ones that they have used for a long time. Eventually their demands for environmental technology innovation are diluted. These situations not only result in serious waste of social resources, but also dampen the enthusiasm of technological suppliers and users, putting shackles on the long-term development of environmental technology innovation.

（a）Disconnections exist between industrial or specialized departments and technological authorities and between different industrial departments that are related to environmental resource management and innovation. The different administrative authorities inevitably give rise to selfish departmentalism. It is a rather common phenomenon that different stages of an environmental issue are managed by different departments, which, without clearly defined responsibilities, are often locked in disputes and even conflicts with each other. The technological authorities have different opinions and judgments on environmental technology innovation from the industrial departments, because of their different interests. The industrial departments largely proceed from the perspective of solving the actual problems that they currently face and their understanding of the demand for environmental innovation are relatively practical; whereas the technological authorities usually comprehensively balance the resource distribution throughout the course of innovation, with activities that are related to industrial development being emphasized over environmental protection and other public interest.

（b）Fragmented management systems restrict innovation efforts. The intrinsic nature of environmental issues requires systematic and comprehensive innovation. But in China, technological system and business management system are fragmented, leading to a lack of coordination as to the targets, process and management.

This situation affects the efforts to work around the comprehensive and systematic environmental problems. Plus, environmental polices formulated in different stages are inconsistent, causing a large amount of repetitive work and serious waste. In China, less than 20% of environmental technological results have been translated into productive force and no more than 5% have formed industry scale; whereas in the developed countries, such as the US and Japan and other, the two figures are over 80% and over 30%① respectively. Statistics show that China sees an average of 2-3 new environmental protection technologies every day and a total of about 800 every year, but only 10%② of them are extended and applied.

（c）Innovation efforts are not systematic. Internal relationships between environmental technologies, e.g., those between the environment and energy, between water resource and water pollution, between industry and agriculture, and between local factors and holistic factors, require innovation-related activities be considered as a whole. It is important to form the concepts of regions and river basins. China's environmental problems are structural, complex, cumulative and holistic. Its environmental dilemma is closely related to the history of its economic and social development, and is the result of problems of different periods stacking up. It is attributable to the erroneous development concepts, and to human mistakes. Thus it is technically impossible to determine which government in which period should be held accountable. And it is also impossible to make the polluter pay by simply separating responsibilities. Solution of the environment problems necessitates the efforts of the central government. Under this context, the current innovation activities are not systematic.

Take, for example, the impact of foreign capital on China's efforts to build an environment-friendly society. On the one hand, China tries to attract foreign direct investment（FDI）through various forms and levels of policy incentives; on the other hand, a large percentage of FDI that has flowed into the nation goes to pollution-intensive businesses in the secondary industry, which, deemed as "marginal businesses" in the developed nations, account for 84.19% the total businesses that have received FDI. So, it is certain that FDI contributes considerably to pollution. According to the data of the third national industrial census, most of ozone depleting substances （ODS） were produced and

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① Gu Haibo: Exploration of China's Legal Incentives for Diffusion of Environmental Technologies, Science & Technology Progress and Policy, 8th edition, 2005.

② Xu Wei, Development and Application of Environmental Technologies and Related Property Rights Policies, Decision and Information, 11th edition, 2006 consumed by foreign-invested businesses. Many a foreign-invested business takes advantage of the local government's anxiety to develop economy to exploit the loopholes in the environment-related laws and regulations.

（3）Government failures. Currently, how and by what means environmental technologies are managed still follow orders. Governments work out related regulations and standards and require businesses and other economic entities to follow. Under socialist market economy, the involvement of the market diversifies interests. Even the interests of local and central governments do not always agree, for they inevitably base their decisions on their respective maximum interests. The current environmental legal system and the status of law enforcement don't motivate businesses to consciously meet the requirements of environmental regulations. In an ideal scenario, environmental regulations standards would be stringent and laws would be strictly enforced. Businesses would pay far more for causing pollution in violation of the law than they would for acting according to the regulations and standards, or they would get far more from control than they would spend. Such being the case, the businesses would actively seek every technology possible to lower their pollution control costs. The strong market demand would then push forward the related innovation activities, which, in turn, would be able to generate returns from the market. But the problem is how to make regulations and standards achieve such results. At present at least, it is something impossible, since decisions will have to be supported by information of businesses, obtaining of such information, although theoretically possible, entails huge costs and difficulties. So far, governments have adopted a host of regulations, policies and incentives and carried out promotion and education activities with the aim of promoting technology flow and application and improving the situation where inputs are limited and production, research and education are disconnected- but the results are unsatisfactory.

This shows that only by providing corresponding organizational guarantee and pushing forward system reform, can the obstacles to the efforts to build a NIS that is guided by the scientific development outlook be surmounted. The existing organizational systems must be reformed and a system must be created which allows environmental technologies to flow among the developers, disseminators and users. All social organizations and members, including governments, businesses, universities and colleges, research institutes, intermediaries and individuals, should be involved in the process. Businesses should always be a main force in the creation of NIS, and governments should be responsible for remedy market and system failures. Governments should establish a good system framework and implement effective measures to make every social organization and member consciously spread and use environmental technologies. In an environment-friendly society, the harmony between man and nature will be stable and long-lasting.

3.3 THE GOVERNMENT IS A KEY FORCE BEHIND THE SUSTAINABLE NATIONAL SYSTEM OF INNOVATION

Participants in the NIS include businesses, governmental research institutes, universities, colleges and technological organizations and intermediaries. The linchpin of facilitating the creation of a NIS that is guided by scientific development outlook is to enable these participants to interact in a sound manner so as to promote the flow and application of environmental technologies. In this process, the government plays a critical role.

（1）Support businesses to become the major player in technology innovation.

If and how businesses as the major player can boost environmental technology innovation depends, to a large extent, on the government's guidance and stimulation. To provide guidance and stimulation, the government should actively invest in development and effectively utilize the existing domestic and foreign achievements. It should provide necessary conditions, improve environment and deepen reform, to encourage and invigorate businesses to engage in innovation and international cluster innovation. To be specific, it should （a）provide guidance by formulating related economic and technological policies to make businesses become the major investor for innovation; （b）change its current manner to support businesses to undertake national research and development tasks; （c）improve the technological transfer mechanism to support technology integration and application by businesses; （d）help accelerate the creation of a modern corporate system to boost the internal dynamic of businesses for technology innovation; and （e）create an enabling environment for the innovation activities of small and medium sized enterprises.

（2）Stimulate environmental technology innovation through financial policies.

Financial supporting policies are the most directly and widely adopted policy tool by the world's governments, which function as the rectifier of market failures, to encourage technology innovation. Detailed means include direct subsidy, tax incentives and government procurement. The Chinese government should, by making reference to the international experience and taking into consideration China's own conditions, use its enormous government resources to design a green financial policy package that is sustainable and effective, to encourage domestic technology innovation and international cluster innovation. It should encourage and guide businesses to, under the concept of green operation, take the initiative to invest in development and try to adopt green technologies. It should encourage the large businesses with capital or technology strengths to actively carry out environmental technology innovation in response to the environment that promotes the development of green industries. It should support businesses to strengthen education of their employees, making them realize that technology innovation has a direct bearing on the sustainable development of businesses and the society as a whole. Therefore, they will consciously promote and safeguard the green images of businesses in the course of production operations.

（3）Pool strengths to create a financing mechanism for environmental technology innovation.

New environmental technologies are characterized by large inputs, long lead time and low profits. Considering this, development cannot rely solely on the funds provided by the government or depend entirely on the spontaneous workings of the market. Rather, we should pool the strengths of both sides to create a new mechanism. On the one hand, the government should provide funds to create a dedicated financing channel for businesses carrying out technology innovation and allocate more of its special environmental funds as loan subsidy and loan discount for these businesses. On the other hand, social capitals should be attracted to build a commercial financing support mechanism. For instance, financial bodies dedicated to such businesses can be established by way of borrowing, providing guarantee, issuing corporate bonds and shares and absorbing private capital, to compensate for the absence of institutions when businesses try to get funds for innovation.

（4）Create an intellectual property rights protection system that encourages environmental technology innovation through laws and regulations.

According to *the Paris Convention* as well as the patent compulsory license system under the TRIPS Agreement, in order to protect the environment and prevent and eliminate environmental pollution, the advanced environmental technologies of developed countries may be used under a compulsory license system. China should broaden the applicable scope of *the Law on Environment Impact Assessment* which only applies to planning and construction projects to cover the intellectual property rights system, particularly patented and unpatented technologies. It should introduce a self-assessment system; produce more and better environmental protection laws, regulations and standards; step up law enforcement; and popularize environmental education to enhance the public’s awareness.

（5）Green assessment for technological activities.

When research institutions and firms or institutions of higher learning, try to introduce their new technology into use, all should be assessed for technology ethics. Clear conclusions should be provided as to the social and environmental impact that may result from related technological activities or results, to serve as the basis for project approval.

Ⅳ. Push Forward Environmental Technology Innovation: Foresight and Realization

China is experiencing accelerated industrialization and urbanization and at the same time witnessing pronounced conflicts between economic growth and environmental protection. The overall environmental situation in the nation remains grim. In some regions, the serious environmental pollution and ecological deterioration goes unchecked; the discharge of major pollutants surpasses the carrying capacity of the environment; water, land and soil are seriously polluted; pollution by solid waste, vehicle exhaust gases and persistent organic pollutants increases. In the first two decade of the new century, China will see a continuous population growth and the GDP quadruple from the level of 2000. The very greater demands of the economic and social development for resources will put increasing pressure on environmental protection.

4.1 BOTTLENECKS PLACED BY THE ENVIRONMENT AND RESOURCES BECOME MORE SEVERE, POLLUTION AGGRAVATES.

Although on a per capita basis, the energy and resource utilization rate is low, the total energy and resources utilization is extremely high, discharge of major pollutants has exceeded the carrying capacity of the environment. Worse still, pollution and damage has spread from land to offshore, from surface to underground, and from single to combined. Industrial structure pollution is spatially showing a pattern of gradient transfer and change. In some key economic regions and river basins, point source pollution, line source pollution and non-point source pollution co-exist, domestic and production pollution stacks up, new and old pollutants are mixed, pollution of water, air and soil mutually influences, and safety of nuclear and radio environment is under threat.

4.2 HARM CAUSED BY NEW POLLUTANTS AND PERSISTENT ORGANIC POLLUTANTS IS INCREASINGLY VISIBLE

Some new pollutants, like antibiotics, endocrine disrupting chemicals, algae toxins, pesticide oxidation degradates, pose a larger, longer and more unpredictable threat to the ecosystem, food safety and human health. Persistent organic pollutants are causing greater harm.

In addition to detrimental national hazards, these problems are starting to have a negative effect on export products.

4.3 ECOLOGICAL AND ENVIRONMENTAL PROBLEMS BECOME MORE COMPLEX AND BRING MORE RISKS

Social stability and the environment are increasingly imperiled by such problems as eutrophic lake and inshore water, regional acid deposition, combined air pollution, soil pollution and non-point source pollution, harmful and toxic pollutants, regional （river basin） ecosystem degradation, biodiversity reduction, alien species invasion, genetic resource loss and environmental emergencies.

Facing the mounting pressure on resources and the environment, the government puts forward that we should uphold the scientific approach in achieving economic and social development, accelerate the building of a resource-efficient and environment-friendly society and promote the harmonious development of man and nature. The government has placed resources saving and environmental protection in an important strategic position as it works out the country's development goals. The fundamental tasks of environmental technology innovation are to build an environment-friendly society and, while ameliorating the overall environment, to realize sustainable and rapid economic growth.

4.4 CREATE RADICAL INNOVATION LABORATORIES FOR INTENSIFIED RESEARCH FOR A MORE HARMONIOUS LIFE.

Appealing physical and virtual places （experimentarium）for modern living should be established, based on a substantial reduction of non-renewable resources. A place, or places, which would attract Chinese and international scientists, researchers, PHD students, designers, architects, artists, philosophers, politicians and business people to meet, work and study how to approach sustainable development from different perspectives based on a profound understanding of the ecological system on planet earth.

Target what the world could come to look like as it alienates the cycles of nature. Understand how materials flow. Utilize materials over and over again. A place that shows the world that it is possible to live with a high standard of living and yet have no waste since everything is utilized. Establish cross disciplinary and cross cultural collaborative projects in almost every activity humans are performing. Focus on what is really needed and why, away from superfluous lifestyles. Identify large projects which need the contributions of several countries. China provides ecological conditions with enormous diversity; hence it would be beneficial to roll out such projects in China as global pilot demonstrations.

China’s future environmental technology demands:

Facing the mounting pressure on resources and the environment, the government has put forward strategy of upholding scientific development outlook in achieving economic and social development, accelerating the building of a resource-efficient and environment-friendly society and promoting the harmonious development of man and nature. If China wants to solve the environmental problems that it may encounter in its future development, it must build a resource-efficient and environment-friendly society. To achieve this important goal, we should fully exploit the existing technologies to boost environmental technology innovation. We should focus on and strengthen the development of technologies in the key areas of an environment-friendly society, areas such as human health, food safety, pollution control, comprehensive resource utilization, advanced intelligent traffic design for cities, design of energy-saving architecture, new energy development and utilization, biodiversity protection, rural eco-environment protection, marine ecology protection, recovery and restoration of degraded ecosystem, protection and enhancement of fragile ecosystem. It is also important to put in place a NIS that promotes environmental protection.

China, as a responsible power, not only works to solve the environmental problems that it encounters in the course of its development, but also seeks to contribute to a better global environment. China has participated in the international cooperation in almost all fields. It has set targets for energy conservation and greenhouse gas emissions reduction for the 11th five-year plan period. The nation will, as required by the scientific development outlook, include the combat of climate change, implementation of the sustainable development strategy, acceleration of the building of a resource-efficient and environment-friendly society as part of the overall and regional plans for national economic and social development. It will enhance its abilities to combat climate change and perform the international conventions by driving forward the research and development in the key areas of climate change, stepping up the creation of a climate monitoring system, and developing global climate change monitoring technologies, greenhouse gas emissions reduction technologies and climate change adaptation technologies （low carbon emission technologies）.

China’s near-term and future demands for environmental technologies are-

（1）Medium and long term demands:

A comprehensive analysis of China’s social and economic development trend in the light of its medium and long term plan for science and technology development shows that the nation’s environmental technology development in the next 10-15 years will be chiefly in the following aspects:

- Guide and support the development of recycling development. Develop integrated cleaner production technologies for pollution-heavy sectors; enhance waste reduction, reclamation and safe disposal; and step up research on common technologies for the recycling economy.

- Provide comprehensive treatment of regional environment. Implement technology integration and demonstration for comprehensive treatment of river basin water environment pollution and regional atmospheric environment pollution, and for comprehensive treatment of typical degraded ecological function zones; develop technologies for guaranteeing the safety of drinking water and for environmental monitoring and early warning; and greatly increase support for the development of technologies that have the potential to improve the environmental quality.
- Promote the development of the environmental protection industry. Focus on the research of environmental protection equipment, instrument and facilities that are suitable for China; expand the market share of domestic environmental protection products; and raise the level of environmental protection equipment and technologies.
- Actively participate in the international environmental cooperation. Strengthen studies on measures for the implementation of global environmental conventions, and on uncertainties of climate change science and the resultant impact; develop technologies for monitoring global environmental changes and for cutting down greenhouse gas emissions; and enhance capacities for responding to environmental changes and for implementation.

（2）Priorities:

Comprehensive pollution control and waste recycling: Focus on the development of regional environment quality monitoring and early warning technologies; develop key technologies, like the technology for controlling city-cluster air pollution; develop unconventional pollutant control technologies; waste reclamation technologies, integrated cleaner production technologies for pollution-heavy sectors, and establish a technological demonstration mode for developing the recycling economy.

Rehabilitation and restoration of ecosystem functions of the fragile ecological areas: Focus on the development of dynamic monitoring technologies for ecosystems of such typical fragile ecological areas as karst terrains, Qinghai-Tibet Plateau, the upper and middle reaches of the Yangtze River and Yellow River, Loess Plateau, desert, desertified land, agriculture-animal husbandry zones and mining areas; technologies for controlling grassland degradation and rat damage; ecosystem rehabilitation and restoration technologies; technologies for protection and rehabilitation of ecology along the Three Gorges Project and

Qinghai-Tibet Railway Project and in the complex mining areas; build technical support models for rehabilitation and constant improvement of different ecosystem functions; and design systems for comprehensive assessment of ecosystem functions and for technological evaluation.

Marine ecology and environment protection: Focus on the development of marine ecology and environment monitoring technologies and equipment ; strengthen research on technologies for marine ecology and environment protection; develop technologies for protection and restoration of offshore ecology and environment and for dealing with emergencies at sea; and develop high- precision technologies for forecasting dynamic marine environmental data.

Global environmental change monitoring and measures: Focus on the development of technologies for accurate monitoring of large-scale environmental changes; technologies for control, disposal and utilization of such greenhouse gases as carbon dioxide and methane discharged by major sectors; biotechnology for carbon sequestration and carbon sequestration engineering technologies; and conduct studies on measures for combating climate change, biodiversity protection, ozone layer protection, and persistent organic pollutants control.

Ⅴ. NIS-based Environment-friendly Society: Institutional Realization

Effective social management provides the basis for a resource-efficient and environment-friendly society. If China is to build such a society, it has to complete basic social engineering of basing its environmental technology innovation efforts on reliable institutional guarantee and social management structure, by pushing forward social innovation through planned institutional innovation and social management system reform, in the next 10-15 years which constitute a key period for the nation’s dramatic social transformation.

Building of an environment-friendly society requires creation of a NIS under the guidance of the scientific development outlook.

5.1 INSTITUTIONAL INNOVATION

To build the system, it is necessary to （1）improve the statutory tax system that encourages technology supply and adjust the government’s functions; （2）improve the market system that is oriented toward environmental technology innovation, particularly, allow businesses to play a bigger role as the major player of innovation; use government procurement policies; （3）innovate the social management system; （4）encourage ideological innovation. The ultimate goal of environmental technology innovation is to create a society-wide system that promotes environmental technology innovation, technology supply, sharing and application.

5.2 INNOVATION OF SOCIAL MANAGEMENT SYSTEM IS THE GUARANTEE

The objective of stimulating the population at large to be environmentally aware is very important. The leadership should show why this is important, and show the population that they can take pride in seeing China work to become a global environmental leader. Is it possible that regional levels of government could be encouraged to demonstrate that they can take the lead to compete with each other to be the best environmental jurisdiction? This will in the long run ensure that they can also be the most economically successful. What this means is that in the context of “It’s glorious to be rich”, it is necessary to be environmentally friendly if the objective of being rich is to be sustained

Innovation in the social management system means to create an environment and atmosphere suitable for constant innovation of environmental technology through re-allocation of social resources, thus to encourage all organizations and members of the whole society to voluntarily participate in the creation, application and popularity of energy-saving and environmental protection technologies.

1. Give full play to the basic roles of the community.

Community is the cell of the society, and also one of the basic units of society. As for construction of resource-efficient and environment-friendly society, we, first of all, are required to build the community into “environment-friendly community”. Traditionally, China has laid less emphasis upon the concept of the community, and the social management function of grassroots communities. Instead, China has exercised supervision and management over grassroots through registered permanent residence. Along with the transformation of social structure and changes of social management system, the community is becoming a network for social management, public service and social support which may replace the "units". In implementation of social welfare, social relief, social charity, occupational support, public security, family planning, health services, judicial correction, environmental protection, grassroots mediation of social disputes, and life services, the community is playing increasingly active roles.

2. Active action of social groups.

In order to achieve an environment-friendly society, it is not only necessary to set up environment-friendly social groups, but also to bring full play to linking the roles of social groups, which may absorb all social forces such as enterprises, relevant governmental departments, institutes, and colleges and universities to build the environment-friendly society. China has a large number of social groups, with rational layout and constantly-optimized structures, and the scope of their businesses covers science and technology, education, culture, public health, labor, civil affairs, sports, environmental protection, legal services, social intermediary services, and rural special economy, so social groups have already become an important force to build environment-friendly socialism. Up to the end of 2006, there have been 192,000 social groups nationwide, up by 12.3% compared with that of the previous year.

The participation of all social members is fundamental to successfully build the environment-friendly society, and for all social members, the important way to participate in community construction is joining non-governmental organizations such as social groups. In this way, all social members may exchange and talk with the government, and then make decisions[①]. This can create a favorable environment and conditions for building environment-friendly society. Besides, industry associations can unite relevant enterprises together to complement each other, form an integrated composite force and scaled economy. Enterprises will share the risks and profits together, greatly enhancing the competitiveness of Chinese enterprises in domestic and international markets, and also boosting the industrialization of green technological achievements made by enterprises and institutes. By guiding, service, self-discipline, coordinating and supervising roles, the social groups may maintain market order and boost fair competition. At the same time, the social groups may take full advantages of prompt information and controlling the overall situation to assist enterprises to resolve difficulties in production.

3. Orderly participation of the public.

The development of environmental protection activities in western countries is inseparable from the active participation of the public. Many environmental issues have been gradually resolved as the public, especially those who suffer from the environmental hazards as well as environmentalists. Some groups who suffer from environmental hazards have launched a series of environmental protection campaigns. Such moves have often made the government to legislate environmentally and take management measures. China's environmental protection has been dominated strongly by the government, so it is worth

[①] Licheng: "Construction of non-governmental organizations and harmonious community", Weishi, Jan. 2007 studying how to reflect people's will in the process of technological innovation. Green and environmental protections are not only matters for the government, but also for people's living and production. Therefore, it is necessary to include environmental protection awareness into technological innovation. Only in this way can we achieve sustained economic and social development. The most typical and effective event is that in April 2005, the State Environmental Protection Administration （SEPA）held the first public hearing on Yuanmingyuan's anti-seepage project; In February 2006, the *Provisional Measures for Public Participation in Environmental Impact Assessment （EIA）* were issued. Meanwhile, the higher specification and broader coverage of *Measures for Public Participation in Environmental Protection* have also been under legislation. Public higher participation in environmental protection is closely related to the environmental policies and people's daily life, and also to rapid development of environmental NGO. During the process of public participation, NGO may converge public opinions and then form policy gaming capacity.

Attention should be paid to the Blue Planet Prize most recently awarded for drafting environmental laws that support citizen action for the protection of the environment. As for public participation in system of technological innovation, the public shall have the right to inquire and supervise projects that damage the environment. They shall have the right and channels to obtain ecological technology. Public supervisory systems include public announcement, hearing system, mass reporting system, police and people joint supervision system under EIA, as well as public opinion system for civil green organizations and public media. We should, through public education, training and publicity, mobilize the public to carry out direct and grassroots-orientated supervision, so as to promote the development of technological innovation for ecology.

Ⅵ. Overall Strategy and Preliminary Actions

Construction of a resource-efficient and environment-friendly society is a strategic move to implement the scientific view of development, and also necessary requirements to enhance the independent innovation capability and build an innovative nation. A resource-efficient and environment-friendly society shall be constructed based upon technological innovation, so first of all, we should adopt the scientific view of development to guide the construction of national innovation system. In doing so, we objectively need to adjust China's environmental developing strategy, so that technological innovation may truly become the main driving force and fundamental basis to build the environment-friendly society. In addition, the environment-friendly society of China must be the way along with Chinese characteristics. As China is in the development stage, characterized by large population and scarce resources, so China's environment-friendly road will reflect Chinese characteristics.

On this basis, we put forward the following policy suggestions for achieving the environment-friendly society through innovation:

6.1 ACTION FOR SYSTEM FAILURE

1. The State will strengthen the guidance, support and supervision on local environmental protection, improve regional environmental supervision agencies, coordinate inter-provincial environmental protection, and focus on the outstanding environmental problems. Local people's governments will be responsible for regional environment quality, supervise the environmental protection of the lower level's governments and environmental action of key units, and establish corresponding regulatory mechanism for environmental protection. Legal persons and other organizations will be responsible for resolving relevant environmental problems. Local people's governments above the county level should strengthen the construction of environmental protection agencies, clearly define the functions, organization and outlay, further summarize and explore the regulatory mode of urban environmental protection agencies, and perfect local environmental management system.

2. In accordance with the regional ecosystem management approach, we will gradually straighten out the division of responsibilities, and enhance the coordination and wholeness of the environmental supervision; establish and perfect environmental supervision system monitored by the State, supervised by the locals and charged by the units. Environmental protection departments at all levels should be strict in implementing various environmental regulatory system, order polluting units to treat within time limit and suspend production for rectification, and convene relevant experts and representatives to put forward the review opinions for EIA of development, construction and planning; improve transfer procedures for environmental crime cases, and coordinate judicial authorities to deal with various environmental cases.

3. Mobilize the central and the local enthusiasm for innovation. It is mainly to mobilize the local enthusiasm, because excessively stringent environmental protection is always inconsistent with the economic development goal of local government. Under normal circumstances, we can see that the Central Government has good policies, but they are not well implemented locally. For instance, the energy consumption of unit GDP shall be reduced by 20% in the "11th Five-Year Plan", and it is required that all provinces shall make

great efforts to reduce the energy consumption to a certain extent. If weighing the reduction goals of energy consumption in the "11th Five-Year Plan" proposed by all provinces, we can see that the State's goal of 20% energy saving cannot be achieved in the "11th Five-Year Plan". However, given that the "11th Five-Year Plan" of each province has legal effect inside the province, and is approved by the people's congress at the provincial level, so under these circumstances, it is worth considering how to set up the binding mechanism for national constraint indicators. Therefore, it is more urgent than R&D of new technologies to rationalize these factors and put these technologies into use.

6.2 ACTION FOR MARKET FAILURE

1. We should truly encourage enterprises to become the main body in the construction of environment-friendly society. Enterprise is the main body of environmental technology input; the main body of innovation and decision-making; the main body of bearing risks; and the main body of environmental ethics. All of these have required that enterprises should consciously undertake social responsibilities, promote environmental technological innovation, and develop resource-efficient and environment-friendly enterprises.

2. We should strengthen the R&D and popularity of environmental technology. Energy-saving technology, environmental protection technology and low-carbon energy technology are the basis for environmental technology, so we should increase the investment, and vigorously promote technological cooperation and transfer. Through the government technology program and great efforts of research units, we have made a lot of important technological breakthroughs. However, the lack of commercialization and active enterprises has made it ineffective to popularize new technologies. A large number of new technologies have not been applied in a timely way, and the existing system and incentive measures do not promote long-term innovation of environmental technologies.

3. Popularize and use environmental protection technology in the construction of new countryside.

4. Speed up hi-tech industrialization and popularity of the advanced applicable technologies. Optimized integrating and demonstrating of major environmental pollution control technologies, cleaner production technologies and recycling economy technology to effectively promote the development of innovation of China's environmental protection technologies and industrialization, and accelerate the upgrade of technologies of China's environmental backbone enterprises. The State Environmental Protection Administration will select a batch of enterprises with independent IPRs or the advanced environmental protection technological achievements according to the annual plan to carry out national

demonstration projects by adopting fund grants and discount loans on the key demonstration projects, provide preferential policies for the successful environmental technologies, and popularize them throughout the country.

5. System for perfecting government procurement. Thus in the government procurement, the top priority will be given to energy-conserving and environment-friendly technologies and products.

6.3 ACTION FOR GOVERNMENT FAILURE

1. Achieve the adjustment of governmental functions. The governmental departments shall bear more responsibilities to promote the construction of environment-friendly society, and increase the investment in the development of environmental protection technologies and financial support on transformation of technological achievements.

2. Increase the executive force for various laws and policies in the construction of environment-friendly society.

3. Boost policy coordination. In the process of specific technological innovation and practice, the policy makers often tend to proceed only from their own departments and units, rather than from the overall situation or from problems and goals. The policies formulated, in general, are not consistent. As a result, lack of coordination and the contradictions between policies have become obvious and frequent.

4. Create a radical innovation structure with major funding/incentives. Government should spend more money on innovation in both basic as well as applied environmental science. The new funding can give related institutions more freedom to do radical innovation.

5. Raise the public quality of environmental science. We will launch various green educations throughout the society to raise the public quality of green science and culture as well as green consciousness; implement the Action Plan for All-people Scientific Quality, create a favorable social environment for technological innovation; strengthen innovative education, and cultivate young people’s innovative awareness and capabilities.

6. Actively implement the sustainable development strategy as well as the sustainable consumption policies and action programs for achieving China's sustainable consumption patterns specified in *China’s Agenda* 21; establish a meaningful consumption view and consumption patterns; open up more publicity channels, make multi-directional and multi-form green publicity, guide green consumption and advocate green lifestyle.

7. Make full use of local and civil advantages to actively launch green civilization creation activities, such as green districts, green communities, green schools, green parks,

green cities, and green units, etc., to gradually form the social style of all-people participation in green action.

8. Establish administrative guidance and administrative contract with legal system. Many ecological technologies have been implemented by scattered farmers, herds or fishermen and residents in grassland, farmland, woodland, and rural communities, etc. The land use right and disposition right are decentralized given that the household contract policy has been implemented. In the implementation of technological innovation and ecological results, the administrative agencies should adopt voluntary, beneficial and contractual principles. The administrative guidance and administrative contract are most suitable for the popularity of technological innovation and ecological results. Great importance shall be attached to administrative guidance and administrative contract for environmental protection in China's eco-environment laws, in particular to the indemnificatory measures, such as investment, benefits distribution, risk sharing, preferential policies for rewards and punishments, etc.

Report on Environmentally-sound and Strategic Management of Chemicals in China*

Introduction

CHEMICALS: THEIR HAZARDS AND RISKS

1. There are about 7 million chemical substances produced in the world with more than 70,000 in common use. Some 1,000 new substances are introduced each year. There are 45,000 substances listed in the 'Inventory of Existing Chemical Substances in China' and about one hundred new substances are added into the inventory every year. Chemicals are an indispensable means of production of consumer goods in the modern world, and are used in medicine, pesticides, fertilizer, plastic, textile fibre, electronic chemical, domestic decoration material, soap and laundry powder, cosmetic and food additive applications. However, many chemicals harm human beings and the environment in different degrees. Misuse, abuse, chemical accidents or improper disposal during production, storage, distribution, transportation, usage and waste disposal may bring negative influence to human health and environment.

2. It took a long time for the environmental and health hazards of chemicals to be well understood. Along with the development of human civilization, many chemicals have been are produced and widely used, which has led to local and global environmental and health hazards and occupational safety issues, such as persistent, bioaccumulative and toxic chemicals（PBTs）, endocrine disrupting chemicals（EDCs）, accidental leakage of hazardous chemicals, transboundary movements of hazardous wastes and their disposal and ozone depletion substances（ODS）, et al.. Hazards of unintentionally produced toxic and hazardous chemicals such as Dioxin also emerged. According to the WHO, global cancer rates have increased so fast since the last century that today, 4-5 million people die from cancer which accounts for about 12-25% of the total number of deaths; and chemical factors

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account for 80% of the total factors for cancer.

Demands for Environmental Management of Chemicals in China

3. In China, as traditional pollution problems are gradually addressed, the demand for environmentally-sound management of chemicals is gradually increasing.

CHANGE OF GOVERNANCE CONCEPTIONS

4. The Chinese government has confirmed its determination to realize three transformations during 2006: （a）to change from emphasizing economic growth while ignoring environmental protection to stressing both environmental protection and economic growth; （b）to change from environmental protection lagging behind economic development to environmental protection progressing simultaneously with economic growth, to try to pay back the old debts without accumulating new debts and change the situation that treatment follows pollution and destruction accompanies treatment; （c）to change from depending mainly on administrative measures for environmental protection to comprehensively taking legal, economic, technical and necessary administrative measures to solve environmental problems. The 'Decision of the State Council on Implementing the Scientific Development Concept for Strengthening Environmental Protection', part five, which concerns establishing and improving a long-term effective mechanism for environmental protection, points out that necessary environmental regulations and standard systems on chemical pollution should be improved.

ADJUST THE INDUSTRIAL STRUCTURE TO MEET THE DEMANDS OF ECONOMIC DEVELOPMENT AND SUSTAINABLE DEVELOPMENT

5. According to the 'Outline of the Eleventh Five-Year Plan for National Economic and Social Development', China will speed up the change of the economic growth model. Resource conservation should be considered as a basic national policy of China, to promote recycling and reuse, protect the environment, promote a resource-conserving and environment-friendly society, take a practical new road to industrialization, clean and safe development, and finally realize sustainable development. Chapters like 'adjustment of industrial distribution' et al. specify a development plan relevant to optimise the structure of the chemical industry, including basic chemical feedstock, and fine chemicals while eliminating pollution-intensive chemical enterprises.

DEMAND OF INTERNATIONAL ENVIRONMENTAL PROTECTION

6. Since 1970, developed countries have established legal systems related to chemical management and they have also urged relevant UN bodies to establish and implement several global conventions and concepts successively, such as: Convention concerning Safety in the Use of Chemicals at Work, Prevention of Major Industrial Accidents Convention, Basel Convention on Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Rotterdam Convention on International Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, The Stockholm Convention on Persistent Organic Pollutants, The Globally Harmonized System of Classification and Labeling of chemicals and the Strategic Approach to International Chemicals Management, et al.. While developed countries and regions have established comparable improved chemical management systems, there is a big gap in chemical management between a majority of developing countries including China and the developed countries. Therefore Environmentally Sound Management of Chemicals （SMC hereafter） has become a requirement for economic development and social progress for developing countries, especially for China, wlhich is a large producer and consumer of chemicals.

DEMAND OF INTERNATIONAL TRADE

7. China has become one of the world’s largest exporting countries. Foreign trade is an important driver for continuing increases in the national GDP. China faces a challenge meeting WTO requirements. However, in recent years, China has encountered stricter technical barriers to its export trade （hereafter TBT） from developed countries, and especially ‘green barriers’ to trade. According to an investigation by the Ministry of Commerce, in 2002, the year China joined the WTO, exports in the six sectors including the agricultural product sector were frustrated severely by TBT constraints. About 71% of export enterprises and 39% of export products encountered the foreign TBT limit, which caused a loss of about 17 billion USD, equivalent to 5.2% of the total exports. Until now, nearly 90% of food and agricultural products were blocked resulting in a 9 billion USD loss. Laws and standards related to chemicals and their marketing in China still do not protect human health, and the environment sufficiently.

EXISTING PROBLEMS IN ENVIRONMENTALLY SOUND MANAGEMENT OF CHEMICALS

8. SMC is weak in China. Relevant laws and regulations include: the ‘Law on the

Prevention and Control of Environmental Pollution by Solid Wastes'; 'Regulations on Safe Management of Hazardous Chemicals'; and 'Regulations on Pesticide Management'. Involved departments include environmental protection, commerce, safe production and customs. However, the environmental management of chemicals in China cannot fundamentally safeguard the environment and human health. Major problems include: （a） lack of a clearly-defined national policy and/or strategy; （b） the legal system （laws and regulations） not being well established; （c） inadequate capacity of administrative organs, law enforcement and supervision capacity; （d）lack of public participation; （e）a technical support system for management not being well established, and insufficient integrated management measures.

FIELDS OF ENVIRONMENTAL MANAGEMENT OF CHEMICALS

9. The management of chemicals includes （1） environmental management of chemicals; （2）management of protection of consumers of chemicals and （3）management of worker safety and health. 'Environmentally sound management of chemicals' is quoted from chapter 19 subject 11 of Agenda 21, programmatic document for the international environmental management of chemicals, where six programme areas are proposed: （1） expanding and accelerating international assessment of chemical risks; （2） harmonization of classification and labeling of chemicals; （3） information exchange on toxic chemicals and chemical risks; （4） establishment of risk reduction programmes; （5） strengthening of national capabilities and capacities for management of chemicals; （6） prevention of illegal international traffic in toxic and dangerous products, moreover the International Forum on Chemical Safety （IFCS） and the Inter-Organization Programme for the Sound Management of Chemicals （IOMC） are proposed to be created here. The aim is to develop management of chemicals from an environmental viewpoint in order to protect the environment and human health.

TASK SOURCE AND OBJECTIVES OF THIS RESEARCH

10. The China Council for International Cooperation on Environment and Development （CCICED）established a multilateral consultation mechanism, which offers a platform for China to widely absorb international experiences in environmental pollution prevention policy, precautionary mechanisms, pollution treatment and environmental management. In a deployment meeting of CCICED's work, Vice Premier Zeng Peiyan pointed out: "special attention should be paid to environmental pollution caused by chemicals, there are lots of pressing problems that need to be resolved in such

areas as well as equipping environmental protection installations for chemical industrial enterprises, strengthening the safety management on storage and transportation of chemicals, prevention and timely control of the accidental leakage of hazardous chemicals; then, hope to arrange some specific studies and provide some effective intellectual support to the government".

11. To improve the regulatory system and chemical management capacity in China, it is desirable to analyze and evaluate the environmental management system of chemicals in China, learn advanced international experiences about that, and bring forward major policy suggestions for the SMC in China.

DRAFTING OF THE REPORT

12. This research is supported by the Environmental Policy Programme of the Deutsche Gesellschaft für Technische Zusammenarbeit （GTZ）GmbH on behalf of the Sino-German Cooperation of the German Federal Ministry for Economic Cooperation and Development and the State Environmental Protection Administration （SEPA）. The report is accomplished by four domestic experts, Jianxin HU, Zhengyu LI, Jianguo LIU, Yan MAO and three international experts, Ulrike Kowalski, Silke Schmidt and David van Hoogstraten. In development of the report, stakeholders, at home and abroad, were consulted many times. Through symposium and consultation, opinions were listened to and taken into account from experts from related domestic agencies, local governments, and related sectors, enterprises, non-governmental organizations, and revisions were made accordingly.

Chemical Industry & the Main Environmental Issues

GENERAL SITUATION OF CHEMICAL INDUSTRY IN CHINA

13. Since the 1990s, the annual rate of production value of the Chinese chemical industry has increased more than 30% in China. According to the national standard classification of the national economy （GB/T4754-2002）, the Chinese chemical industry includes 10 sectors: chemical ore mining, basic chemical raw materials, chemical fertilizers, chemical pesticides, paints, inks and dyes, synthetic materials, specialized chemical products, rubber products and chemical manufacturing equipment. The basic chemical raw materials and synthetic materials sectors account for 20% of the total production value of chemical industry, the fine chemicals, rubber products and chemical fertilizer sectors each

account for 10-15% respectively. These five sectors account for about 85% of the total. In 2005, the total production value of the chemical industry in China was 2.1 trillion RMB（or 257.7 billion USD）which is 8.4% of the total GDP. The total value of import and export of chemicals in China was 133.5 billion USD in 2005. The value of exports is 48.1 billion USD, and the value of imports is 85.5 billion USD. There are about 4.1 million employees and more than 21,000 enterprises （with annual sales value of more than 5 million RMB） in the chemical industry, while 90% are small and medium sized enterprises.

14. At present, there are more than 20 kinds of chemicals with the world's leading production and consumption in China. Production capacity of sulfuric acid and ammonia and other basic chemical raw materials, chemical fertilizers and dyes, and synthetic fiber ranks the first in the world, production of chemical pesticides and painting output ranks second and third in the world respectively, production capacity of the main type of synthetic resin and synthetic rubber ranks the fourth in the world, consumption of pesticides, synthetic rubber and other chemicals ranks first in the world[①②]. According to the OECD, the annual increase in the rate of global production value of the chemical industry will be 2.6% to 3.5%. Considering China's economy and chemical industry development trends, future production and consumption of chemicals in China will keep rapidly increasing, and will have a significant impact on the global production and consumption of chemicals.

15. Chemical enterprises in China are mainly located in Eastern China （Shanghai, Jiangsu and Zhejiang, Anhui, Fujian, Jiangxi and Shandong Provinces）and the central region （Henan, Hubei, Hunan, Guangdong, Guangxi and Hainan Provinces）, which accounts for 71% of the total chemical enterprises. Under the dual pressure of the need for environmental protection and industrial structure adjustment, chemical enterprises in China began to transform and restructure to collectivization and large-scale production in recent years, and have established many chemical industrial parks for centralized chemicals production. At present, more than 60 chemical industry parks have been approved by government above the provincial level.

16. The widest applications of chemicals include medicine, pesticide, fertilizer, plastic, textile fibre, electronics, domestic decoration material, soap and laundry powder, cosmetics, and food additives.

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① Tuyuqin, China's pesticide Industry before entering the WTO, World Pesticide, 2001

② Feng Shiliang （China Association of Petroleum and Chemical Industry）, the Economic Situation and Outlook on China's Petroleum and Chemical Sectors in 2005, Economic Analysis on China's Petroleum and Chemical Industry, 2005

ENVIRONMENTAL ISSUES OF CHEMICALS IN CHINA

17. As a developing country, the technology of chemical industry and risk management of chemicals in China is still far behind the developed countries. Many harmful chemicals banned or severely-restricted by the international community or that have begun to be phased out in developed countries are still produced and consumed in China.

18. Scientific monitoring shows that the concentration of DDT and other chlorinated pesticides which have been banned internationally for nearly 30 years, is above the international standard of risk assessment in the Pearl River Delta region sediment. Concentration of POPs pollutants like DDT and BHC in tea and aquatic product like fish and shellfish in some regions are relatively high, concentrations of DDT and BHC in breast milk are still significantly higher than in developed countries. Due to the wide use of synthetic detergent nonylphenol is in the Beijing-Hangzhou Grand Canal and water in Jiangnan water, and is detected in tap water in Shanghai. Recent monitoring shows high concentrations of toxic organic pollutants in the lower reaches of the Yangtze. The detection rate of PCBs, HCB and lindane approaches 100%. In Chongqing waters of Three Gorges, there are 178 persistent organic pollutants detected and 18 of these substances are on the ‘black list’ of preferred controlled pollutant in water by EPA.

19. Many environmental incidents take place involving toxic chemicals. According to a SEPA report, the total number of environmental incidents was 1,406 in 2005, including: 693 water pollution incidents, 538 air pollution incidents, 19 ocean pollution incidents, 48 solid waste pollution incidents, and 108 other pollution incidents. Direct economic loss from pollution is about 105.15 million RMB （excluding the Songhua River incident）. The polluted area reached 46.91 million m², including 43.1891 million m² of crop area, 3.455300 million m² of water ponds, and 266,800 thousand m² of nature reserve. In the November 13, 2005 explosion incident at Jilin Petrochemical Company of Petro China, six people died, 60 people were injured, and more than 10,000 people escaped in an emergency evacuation. The explosion caused about 100 MT benzene substances to be released into the Songhua River, seriously polluting its lower and middle reaches. Millions of coastal residents have been affected.

20. According to national statistics reports, from 2002 to 2004 there are 435 non-explosive hazardous chemical incidents occurred in Beijing, Chengdu, Chongqing, Guangzhou, Harbin, Nanjing, Qingdao, Shanghai, Shenyang, Wuhan, Xi'an and Zhengzhou, 189 people died, 390 people were injured and 962 people were poisoned in the incidents. Among the 435 hazardous chemical incidents, 70 happened in production enterprises near urban areas, resulting in heavy poisoning and evacuation. E.g. the chlorine tank explosion

on April 16, 2004 in the Chongqing Tianyuan chemical plant led to an evacuation of 150,000 residents near the Jiangbei District.

21. Existing information indicates that these problems are getting worse. The whole society is facing increasing environmental and health risks from chemicals.

Safety and Environmental Management of Chemicals in China

LEGISLATION ON SAFETY AND ENVIRONMENTAL MANAGEMENT OF CHEMICALS

22. China has promulgated a series of laws and regulations on safe management of hazardous chemicals, pesticides, pharmaceuticals, animal medicine, as listed in Annex 1, tables 1 and 2. Relevant ministries of the State Council also establish corresponding departmental rules and regulations for implementation. China has also promulgated a series of safety standards on classification of hazardous chemicals, storage, transportation, packaging and labeling, environmental standards for the control of chemical pollutant discharges and hazardous waste disposal, and occupational health standards.

23. China has established supervisory agencies for safe and environmental management of hazardous chemicals within the central government and at the local level. AT the State Council level, they include State Environmental Protection Administration （SEPA）, State Administration of Work Safety （SAWS）, Ministry of Health （MoH）, State Food and Drug Administration （SFDA）, Ministry of Agriculture （MoA）, General Administration of Quality Supervision, Inspection and Quarantine （AQSIQ）, Ministry of Communication, Ministry of Railways and General Administration of Aviation, and the Ministry of Public Security （MPS）. A description of their tasks is given in Annex 2.

24. Under the authority of relevant national laws, regulations and the State Council authorization, the National Development and Reform Committee （NDRC）is authorized to establish environmentally-friendly industrial policies, including cleaner production and recycling and reuse, and restriction or elimination of outdated production techniques, equipment, and products, as well as production licenses for some pesticides; the Ministry of Foreign Affairs （MoFA）has authority to engage in international negotiations on chemicals convention implementation; the General Administration of Customs（GAC）is authorized to inspect and audit the import/export of hazardous chemicals; the Ministry of Commerce, the Ministry of Science and Technology （MoST）and other ministries have authority over the import and export of chemicals and research and development of pollution prevention

technologies.

25. SEPA has set up administration of solid waste and toxic chemicals specializing in registration of hazardous wastes, and review work on registration of import and export of toxic chemicals and reporting and registration of new chemical substances. The Bureau of environmental supervision is responsible for guidance and cooperation in the settlement of major environmental problems of local, departments, trans-regional and inter-basin; establishing emergency response plans in response to serious environmental pollution accident and environmental damage. The Division of international cooperation is responsible for external negotiations of environmental conventions, coordinating with MoFA and managing implementation of environmental conventions related to chemicals.

26. Relevant ministries of the State Council have set up special agencies for management and technical support, such as the SEPA chemical registration center and solid waste management center. Under the direct guidance of respective administrations, they are responsible for specific functions such as registration of new chemical substances, environmental management and registration of import/export of toxic chemicals; safe registration of hazardous chemicals and pesticides, etc.

27. There are local supervision and management institutions of hazardous chemicals and environmental management in China. Environmental protection bureau, production safety bureau, the health bureau, agriculture bureau, quality and technical bureau in the provinces （autonomous regions and municipalities）and municipal districts and the county government are in charge of supervision and management of hazardous chemicals and pesticides for safety and environment protection in these areas.

28. The relationship between local government departments and relevant superior departments is generally one of operational guidance. E.g. local environmental protection bureaus in the people's governments above the county level are under the guidance of government of the same level, and also accept operational guidance from higher levels of environmental protection departments. There are local environment monitoring stations and environmental science research institutes in the local governments' environmental protection agency.

29. China has adopted 'Rules on Management of Hazardous Chemicals' and established a multi-sectoral system framework for national management of hazardous chemicals, which contains the full process of production, management, storage, transport, usage and waste disposal of hazardous chemicals. To coordinate supervision and safe management of hazardous chemicals by relevant ministries of the State

Council, and approved by the State Council, an inter-ministerial meeting system for safe production supervision of hazardous chemical was set up in June 2007. It includes the following 16 ministries and committees of the State Council: SAWS, NDRC, MPS, MoST, Ministry of Finance （MoF）, Ministry of Construction, Ministry of Railways, Ministry of Communication, State Administration for Industry and Commerce, AQSIQ, SEPA, CAAC, All China Federation of Trade Unions, Ministry of Labor and Social Security, MoH, SASAC, and the Information Centre Legislative Affairs Office of the State Council.

30. China also has established the National Coordination Group for Implementation of the Stockholm Convention（NCG）, consisting of 13 ministries and agencies: SEPA, MoFA, NDRC, MoST, MoF, the Ministry of Construction, Ministry of Commerce, MoA, MoH, the General Administration of Customs, and the AQSIQ, et al..

MAJOR ENVIRONMENTAL AND SAFETY MANAGEMENT REGULATIONS AND THEIR IMPLEMENTATION

31. The NPC Standing Committee and the State Council issue laws and regulations on management of drugs, cosmetics, food and food additives, feed and feed additives, pesticides and other specialty chemicals, a system of safety evaluation and production permit on special chemicals as set out in the Annex 1 Table 3. Supervision and management of other industrial chemicals used as industrial raw materials and raw materials of chemicals for daily use are primarily in accordance with the 'Regulation on Management of Hazardous Chemicals' issued by the State Council.

32. In May 1994, China began implementing environmental management of the import and export of toxic chemicals. SEPA placed the hazardous chemicals controlled by the 'Prior Informed Consent procedure for certain hazardous chemicals and pesticides under the Rotterdam convention' onto the list of toxic chemicals banned or severely restricted in China, implements registration of environmental management for import and export, and implements the PIC procedure. In June 2005, SEPA together with GAC, issued the 'List of Toxic Chemicals Banned or Severely Restricted in China （the second group）', and added seven highly toxic chemicals onto the management list and within the scope of import/export list of environmental management, which came into effect on July 10th, 2005. In December 2005, SEPA together with the GAC issued the 'List of Toxic Chemicals Severely Restricted on Import and Export in China', which came into effect on January 1st, 2006, and the number of restricted chemicals on the list increased from 34 to 188.

33. To prevent and control the hazard and risk to human health and the environment by

industrial chemicals at the source, SEPA issued and implemented ‘Measures for Environmental Management of New Chemical Substances（Order No.17）’ on October 15th, 2003, and then began to implement the declaration and registration of new chemical substances before import or production. Based on the identification and assessment of health impacts and environmental hazard of new substances, it approves the registration and permits the production and import of new chemical substances which meet the risk evaluation standards, while taking measures to ban or restrict production and use of chemicals with high risk to human health and the environment.

34. Since the registration system of new chemical substances was put into practice in 2003, SEPA has established and updated the ‘inventory of existing chemical substances in China[①]. After the fifth supplement and update, identification information exists for 45,000 chemical substances.

35. To identify and evaluate hazards and environmental risks of new chemical substances, SEPA set up an accreditation committee of experts on new chemical substances consisting of technical and management experts on chemistry, toxicology and ecological toxicology, environmental science and safety science. The committee engages in physical, health, environmental hazard and environmental risk assessment for each new chemical substance based on ‘the guidelines for the hazard evaluation of new chemical substances（HJ/T154-2004）’, and makes recommendations on scientific management.

36. In the environmental management of construction projects for chemical production, China has made great progress in the strict environmental impact assessment （EIA） management of industrial construction projects and in strengthening capacity for management of responses to environmental emergencies. In the past years, the implementation rate of the EIA report（questionnaire）for large and medium-sized chemical construction projects remained at over 98%. Since 2005, SEPA has required that the project sites meet national industrial policy, plan and environmental requirements, and choose environmentally friendly production technology and product programs. New projects are required to reduce pollutants in the region. Expansion and reconstruction projects are required to implement ‘carrying the old with the new technologies’ and generally achieve ‘increased production without new pollution’ or ‘increasing production and reducing pollution’.

37. After the explosion in China's Jilin chemical plant in November 2005 causing serious pollution in Songhua River, SEPA issued the ‘notice on strengthening the

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① Existing chemical substances means that the substance already include in the name list “inventory of existing chemical substances in China”. The existing chemical substances used to be produced or be imported in China.

management of environmental impact assessment, environmental risk prevention [UNCED（2005）152]', requiring the strengthening of EIA and planning of chemical and petrifaction industries, preventing environmental risks from the source of decision-making, strict review of the projects, strengthening the environmental risk assessment management of construction projects and comprehensive investigation, supplementing and improving the preventive measures for environmental risks.

38. Based on the 'national emergency plan for the environment' issued by the State Council in 2005, the Environmental Monitoring Bureau of SEPA issued relevant emergency response procedures, and guided the provincial environmental protection departments to formulate and improve the local environmental contingency plans and emergency response systems.

39. In accordance with 'Regulation on Safe Management of Hazardous Chemicals' issued by the State Council, the SAWS, since 2002, carried out the system of licensing for the safe production, for operation production and safety registration for enterprises that produce, store and use hazardous chemicals. It also established an emergency planning system for hazardous chemical facilities listed as major hazard sources, and established a national emergency rescue command center for safe production of hazardous chemicals and a local emergency rescue center.

MANAGEMENT LIST OF CHEMICALS AND MANAGEMENT FOCUS

40. Of the 45,000 chemical substances that China has produced or imported from 1992 to 2005 that are listed in the SEPA 'Inventory of the existing chemical substances in China', there are, according to the State Council 'Regulation on safe management of hazardous chemicals', 3,700 hazardous chemicals on the 'List of hazardous chemicals（2002 edition）' issued by SAWS.

41. By September 2006, there were more than 1,000 banned or severely restricted chemicals on the control list of safe and environmental management issued by relevant ministries of the State Council （see Annex 1 Table 4）.

42. According to the 'Regulation on safe management of hazardous chemicals' by the State Council, the objects of management of hazardous chemicals in China are chemicals in the 'Name list of dangerous goods', acutely toxic chemicals, production and storage facilities of major hazardous sources of chemicals. Priority chemicals to be managed are chemicals with explosive, flammable, oxidizing, corrosive and acute toxic characteristics.

43. The environmental management of chemicals by SEPA is mainly focused on the supervision and management of toxic chemicals with acute toxicity. Management by SEPA

is mainly focused on life cycle emissions of chemical pollutants, end of pipeline control and disposal of toxic chemicals released into the environment and the environmental management on import/export of toxic chemicals.

TECHNICAL SUPPORT FOR MANAGEMENT OF CHEMICALS

44. Under the jurisdiction of the national and local environmental protection, public health, agriculture, quality inspection, industrial, technological and educational departments, there are thousands of national and local research institutes for research of environmental monitoring of chemical pollutants, monitoring of pesticide residues, research and development of pesticide alternatives, standards establishment, pollution prevention and control, prevention of diseases and poisoning, information management, et al. They provide the government departments with technical support.

45. Environmental monitoring in China is a four-grade monitoring and management system consisting of general station, provincial, the city and county stations. The general and provincial environmental monitoring centers （stations）are equipped with large-sized advanced analytical instruments, better specialized technical personnel and capabilities for detection and analysis of chemical pollutants.

46. China has established a number of laboratories testing physicochemical, toxicological and ecotoxicological properties of chemicals. Most of these laboratories belong to relevant research institutions of ministries or large enterprises.

47. There are 8 ecotoxicological testing laboratories under the SEPA system, including the key laboratory of ecological effect and risk assessment of chemicals, Chinese Research Academy of Environmental Sciences, et al., which may engage in assessment and test of environmental hazards.

48. There are 25 health toxicology testing laboratories under the MoH and the SFDA, including the occupational health and poison control stations of Chinese Disease Control and Prevention Center, etc., which may engage in testing research of acute toxicity, chronic toxicity, carcinogenicity, mutagenicity, reproductive toxicity, safety pharmacology and toxicokinetics of drugs, cosmetics and other chemicals.

49. There is a pesticide testing laboratory system consisting of hundreds of pesticide laboratories under the MoA, including the centers for agrochemical, biological and environmental technology, institute for the control of agrochemicals, MoA, which may engage in testing and evaluation projects of pesticide residues, pesticides toxicology, environmental toxicity, pesticide efficacy and in biological testing.

50. There is a group of testing and evaluation laboratories engaging in industrial

chemicals, cosmetics, electronics chemicals and food under the AQSIQ system, including the institute of industrial product inspection, the Chinese Academy of Inspection and Quarantine, and there are 10 testing laboratories for hazardous characteristics of chemical combustion, explosion and other physico-chemical properties being built currently.

51. As for the certification and supervision of chemical testing laboratories （Good laboratory practice, GLP）, these laboratories are supervised by different related ministries respectively. According to the 'OECD chemical testing criteria' and the GLP, SEPA promulgated 'the guidelines for the testing of chemicals - test method for chemicals （HJ/T153-2004）' and the 'guidelines for chemical testing good laboratory practices （HJ/T155- 2004）' in 2004, and began to develop management of ecotoxicology laboratory and inspection of qualified laboratory GLP.

52. SFDA issued 'information on promoting the implementation of quality management criterion for non-clinical drug research in November 2006, the notice requirements since January 1, 2007, for Chemical Raw Pharmaceuticals and its preparation, biological products, traditional Chinese medicine injection that are not in the domestic market should have their non-clinical safety research and evaluation in GLP certified laboratories. Otherwise, their applications for drug registration will not be accepted. At the same time, a list of 22 GLP certified pharmaceutical laboratories is also issued.

53. MoA issued the 'good laboratory practice for toxicological safety evaluation of pesticide' in 2003, and implemented in the 'measures on evaluation management of good pesticide laboratory' in November, 2006, and began to carry out GLP inspection and evaluation of pesticide testing laboratories.

54. The MoH promulgated the 'criterion of management of identification of toxicity of chemicals' in 2001, raised regulatory requirements to the identification of toxicity of chemicals and identification agencies, but didn't implement GLP criterion management to the safety evaluation laboratories of cosmetics and toxicological testing laboratories under its supervision.

55. The National Certification and Accreditation Regulatory Committee promulgated a 'General requirements for the competence of calibration and testing laboratories' and 'criteria for laboratory accreditation evaluation' in 2006. In accordance with international standards of 'General requirements for the competence of calibration and testing laboratories （ISO/IEC17025: 2005）' and national standard 'General requirements for the competence of calibration and testing laboratories （GB/T15481: 2000）', they begin to develop evaluation and certification of laboratories based on their capacity and qualifications

56. China is not a member of OECD. It does not fully adopt the internationally accepted 'OECD guidelines for testing of chemicals' and 'principles of good laboratory practice' on criteria for evaluation of new chemical substances, qualified laboratories assessment, certification and review, and supervision and management of Labs. Whether the testing methods, management program and management requirements in the majority of chemical testing laboratories accord with international management criteria must still be determined. Evaluation and certification management of chemical testing laboratories in China is in the beginning stages, laboratory testing ability and management cannot meet the domestic demand for safe and environmental sound management of chemicals. Therefore, chemical test results are not recognized and accepted by other countries.

Regulatory systems and good practices on SMC in developed countries and international policies

57. From 1970s to 1980s, as a result of the significant impact of and general concern over environmental issues caused by certain synthetic chemicals, ie., DDT and PCBs, Chemical legislation was widely established in developed countries. As a result of such chemical legislation, regulatory systems on environmentally sound management of chemicals were set up step by step, with risk assessment and risk management as the basic idea, whose core content is to carry out notification, evaluation and authorization of new chemicals newly produced, imported and entering into market, and to carry on hazard testing, risk assessment and risk management of existing chemicals in the market according to special priority principle and order. Meanwhile, the developed countries have established a number of basic systems on pollution control, accident prevention and emergency response during the life cycle of hazardous chemicals, to control the environmental and health risks of hazardous chemicals. Whereas the processes of information, collection, evaluation and risk assessment of hazards and risks of existing chemicals are slow, since the beginning of 21 century, to accelerate the information collection, evaluation and risk management processes of hazard and risk information of existing chemicals, some developed countries have further reformed the current system on risk assessment and risk management for existing chemicals, pursued chemicals testing, evaluation and priority chemicals risk management system by taking the "precautionary principle" and extending risk responsibility of chemicals' manufacturers as main content, such as the EU REACH legislation. In addition, a number of effective new chemicals environmental management approaches were explored and implemented, to accelerate the process of existing chemicals

hazard risk assessment, and to continually identify, screen, and eliminate the PBT chemicals and other hazardous chemicals with high environmental risks.

BASIC SYSTEMS OF CHEMICAL ENVIRONMENTAL MANAGEMENT

New Chemical Substance Notification System

58. New chemical substance notification system is a basic system for environmental management of chemicals. New chemicals manufacturers or importers notify the basic property and hazard information of new chemicals to the state administrative departments, and the competent departments carry on assessment and authorization of chemicals hazards and environmental and health risks and take management measures according to the actual condition before placing on the market or import of new chemicals, such as notification, prohibition or restriction etc. From 1970s to 1980s, most developed countries have established new chemicals notification systems by legislative acts specifically for chemicals, e.g. “Chemical Control Act” of Japan in 1973, Toxic Substances Control Act（TSCA）of the United States in 1976 and 79/831/EEC Directive for dangerous substances classification, packaging and labeling （the sixth amendment of EU 67/548/EEC）in 1979.

59. In the EU the volume for notifications of new chemicals marketed or imported was divided into three grades and the higher the marketed / imported volume of new chemicals, the stricter and more detailed the data required. EU requires declarers to provide various heath and environmental hazard data consistent with the OECD’s Good Laboratory Practice （GLP）requirement and the testing guidelines. The OECD developed a unified minimum data requirement for new chemicals notification generally followed by EU and other OECD countries, the so-called “Minimum Data Set”, and its contents are basically consistent with the “Base Set” shown in Annex 3.

60. TSCA can be divided into 4 parts: （1）general information, including types, molecular formulas, composition and purity of new chemicals, preparation process, production/import volume, use and the occupational safety notes of new chemicals, etc.; （2）human exposure and environmental release information, including operating rules, occupational exposure assessment and protection measures, environmental exposure assessment and control technology information; （3）appendix safety and testing information, including material safety data sheet （MSDS）, existing health and environmental toxicity data, physical and chemical nature, etc. test data （optional）; （4）information that is optional to provide, including related information of pollution prevention. The extensive health and environmental hazard information of chemicals evaluated and reviewed under the U.S. new chemicals notification system is shown in Annex 4. Unlike the

EU, data in connection with new chemicals notification under TSCA, the U.S. statute, is based on existing data and usually additional testing is not mandated.

61. For new chemicals proven to have unreasonable health and environmental risks after the evaluation, new chemicals notification system prescribes to take risk management measures, such as the prohibition or restriction of their production, use, import and export.

Risk Assessment and Risk Management System on Existing Chemical Substances

62. "Existing chemical substances" are the chemical substances which were produced, sold and used in the market during certain time in the past （EU） or from certain time to now （USA）. In 1993, EU promulgated "Regulation EEC （No）793/93 on the evaluation and control of the environmental risks of existing substances", requiring the manufacturers and importers of chemicals for information notification who had produced or imported in quantities in excess of 10t/y by stages before 1998 and prescribing the manufacturers and importers of HPV chemicals which are produced or imported in quantities in excess of 1,000t/y to submit a few sets of chemicals risk assessment data including the approach to environment and fate, eco-toxicity, acute toxicity, sub-acute toxicity and so on. EU established an inventory of existing chemicals named "EINECS[①]: European Inventory of Existing Commercial Substances", and started 1993 an existing chemicals priority risk assessment and risk management plan EU countries, in order to gradually assess and control the environmental and health risks of existing chemicals.

63. In TSCA, EPA may request the chemical producer or importer to provide hazard testing information of a chemical substance, and take regulatory measures in the form of prohibiting the manufacture of the substance, or of strictly regulating its use, or both, when the chemical substance presents an unreasonable risk of harm to health or the environment or the amount of the chemicals could cause significant human or environmental exposure but the data for basic risk evaluation was lacking and toxicity testing was necessary. TSCA also authorized the establishment of a testing advisory committee for EPA to provide priority chemical substance list for testing, evaluation and risk management of existing chemicals.

64. Given the large number of existing chemicals and the complexity of chemicals risk assessment, priority risk management has become the basic policy for the risk assessment and management of existing chemicals. This has led to institutional or systematic hazard testing for the high production volume chemicals （HPV, production volume> 1,000 tons /

[①] "EINECS" means the European Inventory of Existing Commercial Substances. This inventory contains the definite list of all substances deemed to be on the Community market on 18 September 1981, see Article 2 para 1 lit. h）Council Directive 92/32/EEC （OJ L 154 p. 3, 5 June 1992.

year）which generally means high exposure probability, and risk management measures being taken according to specific standards for certain high-risk or priority chemicals, e.g., prohibit or restrict the production or use of certain “priority toxic chemicals”, such as PBT, CMR or vPvB chemicals. Priority risk management is also reflected in the new EU-REACH system that requires manufacturers and importers of substances in quantities of 10 tonnes or more per year to assess the risks arising from the “identified” uses of their substances.

65. Risk assessment and risk management of existing hazardous chemicals, risk information notification, necessary testing and risk assessment, and risk management principles for priority chemicals, can enable governmental managers to obtain the basic information on hazards and risks of existing chemicals. Based on that, risk management actions including, prohibition or restriction of the production and use of certain priority chemicals with high environmental and health risk can be reasonably conducted by the governmental authorities, and the environmental and health risk of existing chemicals may be gradually reduced. Therefore, risk assessment and risk management system for existing chemicals has becomes another basic tool of chemicals environmental management, EU’s REACH legislation can be considered as its reinforcement. REACH aims at companies doing their risk assessments themselves. In addition, it provides mechanisms for the authorities to introduce European wide risk management measures for substances with unreasonable risks by adopting restrictions and through the authorization system.

EU-REACH System （2006/2007）

66. In December 2006 the EU adopted its “REACH-Regulation” which entered into force on 1st June 2007. The Regulation replaces a number of regulations on environmental management of major chemicals that had been established since the 1970s. The purpose of the REACH-Regulation is “to ensure a high level of protection of human health and the environment, …, as well as the free circulation of substances on the …[EU] market while enhancing competitiveness and innovation.” Thus, it combines economic growth and the protection of human health and the environment. Also the precautionary principle has been taken into account when the REACH Regulation was developed and its requirements were fixed, and the principle now “underpins” the provisions of the Regulation.

67. REACH inter alia aims at resolving the problem of lack of information on existing chemical hazards and risks, and at accelerating the existing chemicals risk management process. REACH reverses the “burden of proof” for existing substances from the authorities to the enterprises so that it is up to them to perform the risk assessment for the “identified” uses of the substances they manufacture or import above a certain quantity and to

communicate the results both to the authorities and to downstream user-customers. The REACH system includes the main contents as in Annex 5[①].

Pollution Control and Right-to-Know System——TRI or PRTR System

68. Pollutant Release and Transfer Register （PRTR）is the list or registration book for the release and transfer of toxic chemical pollutants from various sources to the environment, which includes the release data of toxic chemical pollutants from various of pollution sources to air, water and soil, and the transfer data of them to the pollution control facilities or disposal sites, and also includes integrated report of total situation of the toxic pollutants release to the environment.

69. Toxics Release Inventory （TRI）system is a major original version of PRTR system. The United States passed the “Emergency Planning and Community Right-to-Know Act”（EPCRA）in 1986, which established a TRI system, stipulating that all enterprises having the release of certain toxic chemicals regulated in the inventory up to a certain amount should annually report the amount released into the environment. At present, more than 600 toxic chemicals are reported in the TRI system. At the same time, EPCRA requires EPA to gather the above data, form a TRI report and publish it annually so that it is publicly available. The TRI system has been very effective with respect to pollution control and the prevention of major accidents of hazardous chemicals, e.g. gathering the release information of toxic chemicals which provided the basic support for identification of the risk, the evaluation of the effectiveness of the pollution control measures and then the environmental management decision-making.

70. Though the name and form of PRTR systems vary in different countries, it usually has the following basic elements: chemical pollutants are reported according to a toxic chemicals list）; industrial enterprises report; total release and transfer report; the fate of various of environmental media （air, water, soil）report; periodic report （annually）; unified data reporting formats and database systems; information open to the public （subject to protection of certain confidential commercial information）; improve environmental quality and promote cleaner production technology. Currently, PRTR systems have been established in most OECD countries. At the third meeting of IFCS, establishing a PRTR system was listed as one of the major targets of the chemicals management action of the international community after 2000. In May 2003, 36 European countries jointly signed a “PRTR Protocol” to build a unified PRTR system in the international community.

[①] For more information please check the Annex.

Environmental Standards and Monitoring System of Toxic Chemical Pollutants

71. In 1972, the "Clean Water Act"（CWA）issued by the United States put forward the "prohibit large emissions of toxic substances" policy requiring EPA to publish a list of toxic pollutants, and establishment an "adequate safety margin" standard. In 1977, the "Clean Water Act" amendment formally proposed a standard control inventory including 129 priority toxic pollutants, requiring EPA to establish corresponding emission standards of toxic pollutants for the temporal 21 types of industrial sources. Currently, water quality standards established by the United States, Europe and the WHO generally have more than 50 indexes, most of which are toxic pollutants. Current drinking water standards in the United States contain more than 50 kinds of toxic organic pollutants and more than 10 kinds of heavy metals and other inorganic toxic pollutants. Meanwhile, toxic pollutants are usually the important indexes in environmental standards of drinking water sources and hygienic standards of drinking water quality. In 1990, the United States put forward the toxic pollutant inventory including 189 species in the "Clean Air Act", requiring EPA to establish and enact the emission and control standards for 41 categories of pollution sources. Till 1996, EPA had established the water pollution emission standards for 52 industries and the toxic air pollutant emission standards for 47 types of pollution sources.

72. In the EU, under the Water Framework Directive, a list of EU priority substances will be established[①], EU drinking water standards are also fixed in a Directive[②], and there are also rules on air quality[③].

73. Because of the many types of toxic chemical pollutants, they are often difficult to monitor on a day-to-day, routine basis, but in developed countries, toxic pollutants are always included in the annual environmental quality report. For example, the United States annual report on environmental quality has a specific chapter, "toxic chemicals", reporting the actual results of toxic pollutants environmental monitoring throughout the country. Monitoring and reporting of the environmental pollution of certain priority hazardous chemicals is the basic work of chemicals environmental risk identification, assessment and risk management.

Major Hazard sources Management and Emergency Response Plan

74. Major hazard sources management and emergency plans system is a chemicals management system established especially for prevention and emergency disposal of major hazardous chemicals leakage accidents harming the environment and public health. In 1993,

① http://ec.europa.eu/environment/water/water-framework/priority_substances.htm

② http://ec.europa.eu/environment/water/water-drink/index_en.html

③ http://ec.europa.eu/environment/air/index.htm the International Labor Organization （ILO）organized countries all over the world to sign "Convention on the Prevention of Major Industrial Accidents" （Convention 174）, to make the major hazard sources management system be universally established in the world. According to the definition of Convention 174, "major hazard sources" refer to the facilities used for permanent or temporary production, processing, transit, use, disposal or storage of one or more than one kinds of hazardous chemicals whose volume exceeds the threshold value. Convention 174 regulates that member states should establish, implement and periodically review the national policy on protection of workers, public and environment and prevention of major accidents risks in accordance with national legislation, conditions and norms.

75. Major hazard sources identification standards and safety reporting system are basic elements of a major hazard sources management system. Annex 6, taken from the "Directive on Prevention of Major Accident Hazards of Dangerous Substances（96 / 82 / EC）"（Seveso Directive II）established in 1996 by EU, shows that this major hazard sources identification standard compartmentalizes the harmfulness of hazardous chemicals in accordance with the hazardous character and hazardous degree, which especially includes an "environmental harm" index. The EU major hazard sources identification standard is divided into two threshold levels, taking the management measures of different degree according to different magnitudes and differences in corresponding hazardous degree. EU classification identification standards of the major hazard sources have broad significance, and ILO has established the major hazard sources identification threshold for 180 species （categories）of chemicals according to Seveso Directive for reference by all countries in the world. The safety reporting system means that the enterprises with major hazard sources must first report various information and data related to major hazard sources to the governmental authorities, to carry on dynamic information management. Seveso Directive II respectively adopts the so-called "safety notification book" system and "safety report" system according to different magnitudes and corresponding different hazardous degree.

76. An emergency response plan is a plan or scheme established in advance of the possible major accidents or disasters, to ensure to that rapid, orderly, effective emergency and rescue actions are taken to reduce accidents and losses. It is an integrated and detailed arrangement based on the identification and assessment of potential major hazards, accident types, the possibility of occurrence, , consequences of the accidents and the severity of the impact, that elaborately designate the response agencies and duties, personnel, technology, equipment, facilities, materials, rescue actions and their command and coordination, etc. In general, the emergency response plan creates a systemic emergency response mechanism in

which enterprise, government, community and the public all play an active role. Most government agencies are involved, such as public security, fire protection, environmental protection, medical care, sanitation and the media, etc.

77. In the United States EPCRA places toxic chemical accident emergency response plans within the legal system. In the EU, emergency response plans are part of the Seveso II Directive.

78. In 1993, the International Labor Conference passed “Convention on the Prevention of Major Industrial Accidents” also list emergency plans as necessary measures for prevention of major accidents.

NON-REGULATORY MEASURES AND ACTIONS ON SMC IN DEVELOPED COUNTRIES

Voluntary Agreement （VAs）

79. Since the 1990s, voluntary agreements signed between the government and the chemical industry in order to implement risk assessment and risk management of chemicals is developed widely in developed countries, and it has become an important means of environmental management policies on chemicals in many countries. European Commission statistics showed that among the more than 300 Voluntary Agreements on environmental management signed by European governments and businesses, the proportion of the VAs between the government and the chemical industry is nearly 30%, while the remaining several industries probably about 10%. There has been greater use of VAs in chemical environmental management in the USA and they have become a major means of implementing chemical environmental management policies and strategies. “33/50 Plan” is a VAs plan developed by EPA to reduce the polluting emissions of 17 species of toxic chemicals. In 1998, the government of the United States issued a government motion called “Chemical Right-to-Know” in order to accelerate the test of environmental and health hazard caused by chemicals and the publication of the risk information, and initiated the “HPV chemicals challenges （HPVCP）” and “Voluntary Child Chemicals Evaluation Plan” （VCCEP）, which have succeeded in establishing a working relationship among government, the chemical industry and public interest groups. Many community stakeholders voluntarily committed the hazardous test and risk assessment of most existing chemical substances and some preferential high risk toxic chemicals in more than 2800 HPV chemicals. In January 2006, EPA and 8 companies agreed on the “2010/15PFOA responsibility management plan”, in order to reduce and eliminate PFOA; and its related precursors step by step before 2015.

Responsible Care

80. “Responsible Care” is chemical industry’s voluntary action, hammering at improving the environmental, safety and health information and performance in technology, throughout a chemical’s life cycle, publicizing the information, communicating and cooperating with community stakeholders, prompting chemical businesses to take responsibility for chemical management in chemical industry and supply chain, and to protect the environment and human health.

81. The ideas of RC were first initiated by the Canadian Chemical Producers Association in 1985, and they were then adopted by the U.S. Chemical Manufacturers Association and the Chemical Industry Association of the EU and Japan. Later, under the promotion of the International Council of Chemical Associations （ICCA）, they have been adopted in 52 countries around the world; the production volume of those enterprises taking part in them is close to 90% of the global total. ICCA specially set up RC leading group responsible for the cooperation with the national chemical industry organizations, developing and improving the rules of RC, and continuing to promote the wider use of the RC norms. The RC operations are mainly implemented by chemical industry associations. ICCA/RCLG developed 8 terms of RC core criteria which should be followed by all of the countries. Also chemical companies must sign a formal commitment protocol, and take corresponding actions.

82. RC movements were recognized by UNEP at the Johannesburg Conference on sustainable development in August 2002.

Green Chemistry

83. The “Green chemistry” project aimed at establishing extensive partnerships among the governments, scientific and technological circles and industry’s research institute to develop the innovation design of environmentally friendly products and the process, reduce environmental and health risks from chemicals. In 1991, EPA pollution prevention and toxic substances office （EPA/OPPT）launched the “pollution prevention substitutive synthetic route” plan. Its four main areas include: （1）Green chemistry research projects: in 1992 and 1994, EPA / OPPT signed a memorandum of understanding with the National Science Foundation （NSF）, to build a partnership, establish a “sustainable environmental technology” Assistance Program, jointly funded green chemistry research. The Presidential Green Chemistry Challenge Program is an annual award scheme for outstanding performance of the chemical industry in promoting green chemistry Awards are given to honor those who promote green chemistry. Under the Green Chemistry Education Program, EPA and the American Chemical Society （ACS）establish partnerships and promote green

chemistry education among chemical engineers, students and research staff in university or scientific research institutions. Under the Green Chemistry scientific communication plan, the “green chemistry” project provides funds to various industries, policy makers and the scientific community for green chemistry science, technology advocacy and popular activities.

BASIC PRINCIPLES AND POLICIES IN SMC IN DEVELOPED COUNTRIES

84. Based on the systems and general practices of environmentally sound management of chemicals in developed countries, several basic principles and policies could be summarized as follows.

Prevention and Precaution

85. Many chemicals that had been produced largely and applied widely but lately were testified harmful to the environment and human health, such as DDT, PCBs in 1970s and PFOS recently. They have caused countries to introduce systems that require generation of information before new substances are produced or placed on the market （prevention）. Furthermore “to protect the environment, every country should take appropriate precautionary measures. Where there are threats of serious or irreversible damage lack of full scientific certainty should not cause a country to delay cost- effective measures to prevent environmental degradation.” This basic approach was embodied not only in the basic policies and systems of environmental management of chemicals in developed countries and is reflected in the U.S. toxic chemicals regulatory regime, such as with respect to the notification systems of new chemicals, and the risk assessment and risk management systems of existing chemicals, but also underpins the new REACH Regulation. A balance was found in the new Regulation between the burden that enterprises will have to face and the amount of information to be generated on the hazards and risks of substances on which the risk management measures will be based.

Priority Management

86. At present, there are probably over 100,000 industrial and commercial chemicals circulating on the market. Many countries therefore adopt “priority management” as the basic policy and principle of environmental management of chemicals and first manage the chemicals which have higher health and environmental risk, such as HPVCs, PBT, vPvB and CMR. “Priority management” is not only carried out in every basic system of environmental management of chemicals, such as environmental monitoring of toxic chemicals, PRTR, control of major pollution, but is also embodied in international treaties such as POPs and PIC, etc.

Polluter Pays, "Burden of Proof" and Sharing Responsibility

87. During the strategy and system reformation of the environmental management of the chemicals in Europe in recent years, the responsibility of chemicals environmental management has been mainly devoted to manufacturers and importers. In REACH, downstream users are included as well, however the main burden with regard to the generation of information on hazards and risks lies with the manufacturers and importers. The REACH Regulation takes a different approach than United States where the government is mainly in charge of hazards test as well as risk assessment. REACH requires that the chemical manufacturers and importers are mainly responsible for hazard testing and risk assessment.

Public Participation

88. PRTR system as well as VAs and RC action widely pursued by chemical environmental management in developed countries to promote public participation.

INTERNATIONAL POLICIES AND ACTIONS ON ENVIRONMENTALLY SOUND MANAGEMENT OF CHEMICALS

89. In the 1992 Rio Conference on Environment and Development, the sound environmental management of chemicals was written into the sustainable development of human society programmatic document "Agenda 21". Since the 21st century, international chemicals management activities developed especially in three areas: the gradual promotion of the Globally Harmonized System of Classification and Labeling of Chemicals （GHS）; the extensive subscription of the chemical environmental management conventions; and the Strategic Approach to International Chemicals Management.

Globally Harmonized System of Classification and Labeling of Chemicals

90. Human society has developed a gradual awareness of hazards caused by chemicals. A classification system for hazardous chemicals was first applied by the United Nations Exports Committee on dangerous goods in the 1950s. It produced the concept of hazardous chemicals, and divided them into explosives, compressed gas / liquefied gas, flammable liquid, flammable solid, spontaneous articles / contacting-water-flammable materials, oxidizers / organic peroxides, drugs, radioactive materials and corrosion materials in total of 8 Classes. As human understanding of the hazardous caused by chemicals expanded, particularly for chronic, potential health and ecological hazard, the EU adopted the Directive 92/32/ EEC （the 7th Amendment of 67/548/EEC）to amend the existing classification system, expanding the classification of harmful chemicals from 8 to 15, and mainly adding health and environmental hazard categories of "sensitizing", "carcinogenic",

"mutagenic", "toxic for reproduction" and "dangerous for the environment". In 1992, the establishment of GHS became an important element of international chemicals environmental management strategies in "Agenda 21". In 2003, GHS was completed and published. The basic classification system is shown in Annex 7. The international community has made the promotion of GHS in 2008 a basic strategic goal of international chemical management actions. GHS will become the future uniform classification system for hazardous chemicals generally followed by countries, and will greatly promote the process of international chemicals management.

Chemical Environmental Management International Conventions

91. In 1998, the international community came to an agreement on "Rotterdam Convention On the Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in international trade". In 2001, it reached agreement on "Stockholm Convention on persistent organic pollution". UNEP and other international organizations are also active in their continued assessment of mercury and endocrine disrupting chemicals globally.

Strategic Approach to International Chemicals Management — SAICM.

92. This global voluntary initiative is built on the concept that "chemicals or chemical uses that pose an unreasonable and otherwise unmanageable risk to human health and the environment based on a science-based risk assessment and taking into account the costs and benefits as well as the availability of safer substitutes and their efficacy, are no longer produced or used for such uses." The World Summit on Sustainable Development（WSSD） in 2002 developed an Implementation Plan for push forward the world to achieve sustainable development goals of a 21st Century Agenda. The Implementation Plan sets a strategic and time-specific goal to achieve environmentally sound management of chemicals: "to achieve the sound management of chemicals throughout their life-cycle so that, by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment."

93. From Feb. 4-6 2006, through the common efforts of the international community, the "Strategic Approach to International Chemicals Management" was identically passed in the international chemicals management convention and 9th special conference of UNEP council global environment ministerial conference held in Dubai, United Arab Emirates.

94. SAICM and WSSD both help to achieve the objects of minimizing chemicals' environmental and health risks, bringing forward collective policy strategies and a series of unified strategies and action schemes with time lines to synthesize and harmonize existing international chemicals safety management actions, including risk reduction, knowledge

and information, public treatment, capacity building, and technology cooperation.

Gap Analysis of SMC between China and Developed Countries

DIFFERENCES IN GUIDELINES OF ENVIRONMENTAL MANAGEMENT OF CHEMICALS

Guiding Principles for Environmental Management of Chemicals

95. Safe production of hazardous chemicals in China must ensure the safety of people's life and property, and prevent accidents and environmental pollution. According to 'Regulation on safe management of hazardous chemicals', supervision and management scope includes the production, placing on the market, storage, transport, use and disposal of hazardous chemicals, but the regulation places particular emphasis on labor production safety and prevention of chemical accidents, while it does not emphasize health and environmental safety. The environmental supervision and management of chemicals by SEPA focuses particularly on hazardous chemicals with acute toxicity. Environmental management also particularly stresses the "end of pipe treatment" of discharged chemical pollutants.

96. The decision-making with respect to safe and environmentally-sound management of chemicals in China is basically according to certain inherent properties of a chemical and the degree of potential hazard, but less considering its exposure scenarios and risks. For example, China implements a very strict license management system for acutely toxic chemicals, including systems on purchase voucher, purchase license, record-keeping and registration and record of users et al. The 335 acutely toxic chemicals listed in "List of Management of Acutely Toxic Chemicals" in China are determined entirely by the acute toxicity of chemicals to mammals: Determining indicators do not involve the chronic toxicity health harm factors directly related with chemicals, such as the possible chronic toxicity, especially for carcinogenicity, mutagenicity, reproductive toxicity and other special toxicities caused by long and repeated exposure to chemicals, environmental fatalness including biological toxicity, persistence and bioaccumulation et al., volume and methods of use and so on in the long-term and repeated exposure to chemicals. China still lacks a set of comprehensive and scientific policies and guiding principles for the environmentally-sound management of chemicals.

Key Objects of Chemicals Environmental Management

97. Environmentally-sound management of chemicals should establish clear objectives

and management focus to spend the limited resources on priority areas for improvement.

98. Hazardous chemicals under key management in different countries generally have the following characteristics: （i）chemicals with carcinogenic, mutagenic properties and those toxic to reproduction, teratogenicity （CMR chemicals）; （ii）PBT chemicals with persistence, bioaccumulation and toxicity; （iii）chemicals with dangerous characteristics, such as toxicity, flammability, explosiveness and hazardous to the environment and so on, which may lead to a major hazard installation when their production or storage volumes exceed a certain threshold value.

99. Safe management of hazardous chemicals in China doesn't distinguish between specific key objectives and general objectives. For any hazardous chemicals, no matter how serious the hazard, use volume and possible exposure are, relevant departments must implement registration management of it, and review and issue safe production licenses or operating licenses to relevant production and operating units. Currently there is no prioritization mechanism for the numerous existing chemical substances produced and marketed. Neither is there any requirement for production enterprises to carry out tests to determine its inherent hazards and assess the risks, nor any measures on identifying and managing PBT and CMR chemicals, which are chemicals of very high concern.

Social Responsibility for Enterprises

100. Inherent dangers and risks information of a chemical substance is important not only for proper risk control of chemical, but also for protection of environment and human health, accident prevention and emergency rescue. In developed countries chemical manufacturers and importers have the clear responsibility to provide chemical safety information to the government, company staffs, their customers and to consumers. Enterprises which cause chemical contamination risks should be responsible for carrying out proper classification, packaging and labeling of the hazardous chemicals that they produce, providing the safety evaluation data of chemicals that they produce and sell, assessing the risks and identifying appropriate measures to control the risks, and for monitoring the risk management, the prevention and control of chemicals pollution taken by the competent departments of government.

101. Competent departments of chemicals in China lack understanding of the importance of requiring manufacturers and importers of chemicals to establish and report chemicals safety data by the laws and regulations implemented to identify and manage chemical risks. Although China follows the "polluter pays principle" and implements the pollution discharge system, the establishment and report of chemical safety information are

not taken as the unshakable social responsibility for production and import enterprises in the chemicals management. Existing regulations like "Regulation on safety management of hazardous chemicals" do not require enterprises to develop tests of chemicals that they produce or import and to submit testing data and risk assessment reports. Furthermore, given the insufficient analytic ability of the testing laboratories for the supervision and management of chemicals, most of the industrial chemicals produced in China, even high volume chemicals, are not required to undergo hazard testing and assessment and cannot be classified and labeled properly, and their risks are not managed adequately.

DIFFERENCES IN REGULATIONS AND MANAGEMENT SYSTEMS

102. China lacks a comprehensive basic law or administrative regulation by the State Council on environmental pollution prevention and control and the management of industrial chemicals.

103. The main differences in regulations of environmental management of industrial chemicals and corresponding management system in China and developed countries are as follows:

Gaps in Control of New Substances

104. China began to implement the notification system of new chemical substance in October 2003. On the basis of identification and evaluation of health and environmental risks of new substances, the new substances according with the standards of hazard evaluation are required to register, before production and import, while chemical substances with high health and environmental risks are banned or restricted with respect to production and use.

105. Implementation of report and registration system of new chemical substances is still at beginning stage. Methods of assessment of new chemical substances are basically based on hazard evaluation, so there are many aspects of exposure evaluation and environmental risk assessment that need improving. 'Provisions on the Environmental Administration of the New Chemical Substances' issued by SEPA is a ministerial rule. Due to its low legal position, the executive implementation is quite unsatisfactory. There is also a big gap in implementation of Notification and Review System of New Chemical Substances in China compared to developed countries.

Gaps in Control of Existing Substances

106. Considering the numerous existing chemical substances produced and sold before chemical safety legislation was developed, and because there is no requirement for testing, evaluation and assessment of risks of most existing chemical substances, it is difficult to

achieve accurate hazard classification and safety management. Starting from the idea of prevention and control of risks of chemicals of high concern and the implementation of key safety management, developed countries have universally established the priority chemical test, evaluation and assessment system. Priority chemicals are chemicals which may cause or are likely to cause serious adverse effects to human health or the environment, and are listed on the priority list by competent authorities for testing and evaluation to impose controls.

107. China has no regulation for prior testing and evaluation system of existing chemicals. There are no legislative provisions for screening of chemicals for potential health and environment risk, and relevant risk assessment in existing laws and regulations for safe management of chemicals. At present, China has established a system on prohibition or restriction of production and use of the chemicals under such international agreements as the POPs Convention and PIC Conventions. However, it is difficult for its national competent authorities to take timely countermeasures to forbid the production and use or limit the use of other chemicals of very high concern.

108. Chemicals of very high concern may be exported from developed countries to China, which might lead to a significant increase in risk relevant to hazardous chemicals and safe production in addition to the domestic safety problems.

Report and Emergency Plan of the Major Hazardous Installations – Gaps in Control of Major Installations

109. In China hazardous chemicals only include four categories of dangerous substances – those with explosive, combustibility, reactivity and acute toxicity characteristics. They do not include carcinogenic substances and environmentally hazardous substances and there are only 142 substances in the control list, but due to the lack of any Category criteria, it is impossible to identify other key sources of dangerous substances. Because many such substances, which have attracted international attention, are not included in the national standards on identification of major hazard installations, and the report and emergency plan system of major environmental hazard installations is not established, it is impossible to ensure effective implementation of prevention and emergency management of accidents of environmentally hazardous chemicals.

Register System of Pollutant Release and Transfer: Gaps in Emission Control

110. Since the early 1990s, according to the authorization of environmental laws and regulations like *Law on Prevention and Control of Water Pollution*, *Law on Atmospheric Pollution Prevention and Control* et al., China has promulgated and implemented the “Provisions on administration of report and registration of pollutants discharge”. There are

12 pollutants （COD, oil, cyanide, phenols, arsenic, mercury, cadmium, hexavalent chromium; smoke, dust, sulfur dioxide and industrial solid）the discharges of which are controlled, but other chemical pollutants are not included in the system. Implementation of the system enables environmental protection departments of the government to acquire discharge information of major pollutants from national enterprises, for environmental management purposes including checking the basis of pollution discharge, environmental statistics, analysis of pollution sources, and environmental planning, et al. The information acquired by report and registration for pollution discharge is regularly published in the "Annual Statistic Report on Environment in China" by SEPA for public inquiry usage.

111. There is no PRTR system for environmental management of chemicals in China, and the existing system of pollution discharge reporting and registration is very different from the international PRTR system Because it is hard to master and announce information on production, use, discharge and pollution prevention of environmentally hazardous chemical substances of high concern on health and environment, environmental management of chemicals is not fully reflected in pollution prevention regulations and management policies.

Classification and Labeling System of Chemical Hazards: Gaps in Classification Management

112. Classification and labeling of chemicals is an important means for hazard communication of chemicals. Developed countries have generally established and perfected communication systems for the classification, labeling and material safety data sheet （MSDS）of chemicals. China has already established a classification, labeling and MSDS system of hazardous chemicals. Hazardous chemicals in the existing 'Name list of chemicals' refer to the list of hazardous chemicals in the U.N. 'Recommendations on the transport of dangerous goods'. Chemicals in the current classification system of U.N. 'Globally Harmonized System Classification and labeling of Chemicals（GHS）' with other health and environmental hazard are not included within the scope of hazardous chemicals in China. There are no or very few chemicals of high concern with CMR and PBT characteristics within the scope of safety management in China.

113. Existing "List of Hazardous Chemicals" in China is also established in accordance with the list of hazardous goods in the UN "Recommendation on the Transport of Dangerous Goods", and only includes about 3,000 hazardous chemical substances. For substances or preparations for marketing but not included in the list of hazardous chemicals, manufacturers are not required to make risk assessments and carry out classification and labeling of other hazardous chemical substances or preparations. It is urgent to revise and

perfect the category of classification and management of existing hazardous chemicals according to the United Nations GHS classification standards.

DIFFERENCES IN THE SUPERVISION AND MANAGEMENT METHODS

114. In order to prevent and control risks of chemicals, developed countries take many measures and countermeasures including （i）testing chemicals to identify their inherent properties; （ii）carrying out classification and labeling of dangerous chemicals and making dangerous warning marks; （iii）establish exposure scenarios and assess the risks, （iv）transferring and notifying hazard and risk information of chemicals by establishing MSDS and notifying information to the authorities; （v）taking measures to ban or restrict use of chemicals et al., when there is no appropriate way to control chemical risks.

115. In China, the competent departments favor command and control license management system and methods of registration management, but rarely consider other means to encourage and facilitate enterprises to voluntarily participate in the safe management of chemicals. Many leaders of domestic enterprises regard chemical safety and environmental protection as what the country requires and they have to deal with, rather than as a social and ethical responsibility of the enterprise. There are great gaps in the right-to-know and participation of the public on chemical safety and environmental protection decision-making between China and developed countries.

116. Considering the gaps mentioned above, priority area of Environmental Management of Chemicals in China should include following aspects:

INSUFFICIENT REGULATIONS AND STANDARDS SYSTEM OF ENVIRONMENTAL MANAGEMENT OF CHEMICALS

117. China has established management of special chemicals like pesticides, pharmaceuticals, veterinary drugs, and food additives, which keeps up with the international management program and standard of safety assessment of in-kind chemicals, but needs a set of laws or regulations on pollution control of environmental safety for industrial chemicals. There are many blank spots and imperfections in the aspect of industrial chemicals risk identification and assessment, authorization management system and pollution control standards, et al. Compared with the international chemical safety management system, there are great differences in chemical health and environmental risk assessment and management and hazardous chemical classification and labeling system in China.

118. Current laws on environment prevention, such as ‘Law of prevention and control

of atmospheric pollution', 'Law of prevention and control of water pollution' and 'Law of prevention and control of environmental pollution by solid waste', place particular emphasis on end-of-pipeline controls on chemical pollution..

119. Therefore, it is necessary to establish a set of laws or administrative regulations of the State Council on pollution control of industrial chemical environment safety, and take measures of risk prevention and management to solve the pollution prevention problems of environmentally hazardous chemicals.

120. In order to identify and evaluate risks to human health and environment caused by chemicals, chemicals risk assessment guidelines, standards, chemicals environmental standards （such as quality standards of atmospheric environment and water environment, and pollutant discharge standards）, and management technology standards, et al. are needed.

LACK OF CLEAR PRINCIPLES AND GUIDELINES FOR ENVIRONMENTALLY-SOUND MANAGEMENT OF CHEMICALS

121. There is no comprehensive and scientific management policy and guiding principle for environmentally-sound management of chemicals in China. For the following series of problems involved in national environmentally-sound management of chemicals, the clear policy guidance should be suggested by research:（1）What are the position and importance of environmentally-sound management of chemicals within the overall strategy on national environmental pollution prevention and control?（2）What are the objectives and guiding principles of environmentally-sound management of chemicals?（3）What are the similarities and differences between environmentally-sound management of chemicals and safe management of chemical? （4）Which categories of chemicals should be subject to environmentally-sound management? （5）How to screen priority test substances from huge quantity of existing substances and assess to determine the list for priority management chemicals? （6）How to strengthen capacity building for environmentally-sound management of chemicals?

122. China cries for more international cooperation, and needs to establish environmentally-sound management of chemicals by referring to the successful management experience and effective practices of developed countries.

STRENGTHENING OF ENFORCEMENT AND SUPERVISION ABILITIES OF ENVIRONMENTAL PROTECTION ADMINISTRATIVE DEPARTMENTS

123. Although there are a series of environmental laws, regulations on management

and prevention of environmental pollution of chemicals in China, for the numerous management links of production, management, usage, import/export and prevention of pollution from hazardous chemicals, and lack of personnel and necessary measures and experiences for evaluation and supervision, all of the above lead to insufficient safe and environmental supervision and management by some administrations. Especially in cities and towns with districts under the provincial administrations, many laws and regulations are not effectively implemented.

124. As a developing country, people's standard of living in many areas is low and China needs to develop the economy to resolve social problems such as food and clothing. For the consideration of economic benefit, some local administrations provide poor supervision, which leads to ineffective supervision and management of chemicals. It is urgent to enhance the understanding of people at all levels of environmental protection administrative departments on the importance of environmentally-sound management of chemicals, and strengthen the capacity building of executed supervision and management mechanisms.

125. Secondly, building a system for the environmentally-sound management of chemicals in China is still in the initial stages. With respect to environmental pollution prevention, there are neither clear guidelines for environmentally sound management of chemicals, nor the establishment of chemical risk assessment and risk management systems and technical guidelines that are in accord with international initiatives. China also lacks the experts needed to support a system of environmental risk assessment of chemicals and to develop the necessary evaluation and supervisory capacity

126. At present, the focus of national pollution prevention is still on prevention and control of problems caused by “three wastes” at the end of the pipeline of industrial production, and environmentally sound chemicals management has not yet been added as an important item on the environmental protection agenda. The State has not yet developed definite principles of environmentally sound management of chemicals policies to establish environmental risk assessment and risk management systems and technical guidelines that are in accordance with what the international community has done. The state also lacks the ability to support a chemical risk management system and to evaluate and monitor management.

127. Third, enforcement managers of environmental protection lack the necessary training. The lack of experienced, well-trained hazardous chemicals environmental managers and professional and technical personnel is also a constraint on effective implementation of supervision and management.

128. The reform of the State Council and local governments and the reduction of personnel in all levels of environmental departments, would result in a great change of personnel and great changes in management posts. Currently, the protection agencies of environmental protection bureaus at the provincial and city levels only have 1 or 2 part-time management officials in charge of prevention of environmental pollution from toxic chemicals. Both of the discordant management capacities of managers and their unfamiliarity with relevant laws and regulations on environmental management of chemicals restrict supervision and management.

129. It is urgent to strengthen the technical training of environmental protection managers at all levels, improve their understanding of the importance of environmentally sound management of chemicals and improve their ability to manage, supervise and enforce.

INSUFFICIENT TECHNICAL SUPPORTING SYSTEM OF SMC

130. The establishment of a technical support system for environmentally-sound management of chemicals is the important technical support for and guarantee of safe management of chemicals. The technical supporting system includes the criteria of a qualified laboratory system for testing and analysis of chemicals, guidelines for testing and evaluation, principle of qualified laboratory and risk assessment et al., and safety information management system of chemicals.

131. There is no unified qualified laboratory standard for testing and evaluation of chemicals in China. Most of the laboratories are not testing according to internationally agreed “Qualified Laboratories Norms Principle of OECD”, and are not certified by national bodies, so they cannot ensure the reliability of testing results and meet the domestic demand of testing data for safe and environmental management of chemicals. The administrative departments of environmental protection, health, agriculture, safe production et al. and their technical supporting units have established their own chemicals registration and management database systems, and carried out related information queries through a chemicals safety database system established by foreign authorities, such as the RTECS database of NIOSH, USA, Hazardous Substances Data Bank （HSDB）of USA medical libraries, the INCHEM database of IPCS of UN, Search System for the International Chemical Safety Cards et al.. However, it is still difficult to obtain basic information on domestic production, use, location of production equipment and the storage, transport and disposal of chemicals, pollution hazards to human health and the environment by exposure of hazardous chemicals, hazard characteristics, toxicity, environmental fate and potential

effects on health and environment of related chemicals and chemical products et al. It is difficult for the public to obtain information on classification indicators, fire protection, leakage disposal, and safety protection and pollution prevention of hazardous chemicals. Therefore, establishing and perfecting the management and notification system of safety information on chemicals is also an important issue in strengthening capacity building when it comes to environmental management of chemicals in China.

Recommendations for Policies and Regulatory Framework Building for SMC in China

132. With increased globalization, developed countries have been facing various environmental problems step by step while today developing countries have to face these problems simultaneously. In China, environmental pollutions are characterized as “multiplex and compressed”. China is facing either the traditional or the first generation of environmental problems like city air pollution or lake eutrophication and so-called “new” or “second-generation” environmental problems like environmental issues of chemicals at the same time. Attention as well as understanding of environmental issues and environmental management of chemicals has always been insufficient. In addition, the current chemical management system is a traditional chemical hazard classification system which has great limitations both in management scope and goals. Chemical management in China so far, in fact, is primarily focused on the occupational safe management of specific hazardous chemicals with highly active physical and health hazards, i.e. flammable, explosive, acutely toxic chemicals etc., and there are many gaps in environmental management for a large number of chemicals with potential and long-term hazards to human health and environment. Because of the lack of a basic legislative and administrative foundation, the SMC in China requires improvement. The current environmental management related to chemicals is primarily limited to end of pipe treatment of a few toxic chemical pollutants rather than pollution prevention measures, which does not reflect the basic principles and methods of environmental management of chemicals, such as precaution and risk management.

133. While the environmental management of chemicals is underdeveloped, China is facing increasingly serious pollution from chemicals: many hazardous chemicals widely controlled internationally, are still produced and used without restriction in China. In addition, accidents involving hazardous chemicals happen frequently. Due to this, the ecological and health risks caused by chemicals in China are increasing. Besides, since the

beginning of the 21st century, the developed countries have been constantly strengthening their environmental management of chemicals. Results are mainly reflected in legislation and a variety of measures to speed up testing, evaluation and management of health and environmental risks of chemicals. The international community vigorously pushes forward the global agenda on environmentally sound management of chemicals, which was always an important component of the global strategy of sustainable development, and has put forward a strategic goal and the corresponding strategic action plan - SAICM. The SMC is directly related to environment safety and human health in China. China is committed to reform the industrial infrastructure and build an environment-friendly society. Environmental management of chemicals was sure to be put on the agenda of national environmental protection in the context of scientific development.

134. Based on an integrated analysis of the situation of environmental management of chemicals in China and the experience of developed countries and international policies, the following suggestions are put forward regarding policies and regulatory framework for the SMC.

ESTABLISH A NATIONAL STRATEGY ON SMC

135. Generally, all future measures on SMC should become a part of the national strategy.

Recommendations

A. The strategy of SMC in China should define the basic guidelines, principles, policies and overall strategic objectives of the nation’s SMC, which should comprehensively consider the precautionary approach and the basic national situation of chemical industry and consumption of chemicals and set reasonable strategic objectives.

B. The strategy shall be consistent with ‘scientific development’. To promote recycling and reuse, to protect the environment, to promote a resource-conserving and environment-friendly society, clean and safe development should be considered in the strategy.

C. The manufacture and management of chemicals shall follow the ideas of clean production and green chemistry.

D. Chemicals with high risks to health and environment should be replaced first provided economically feasible alternatives are available.

E. The strategy of SMC in China should establish a national plan of capacity building on SMC including the legislative system, institutional functions, technical supporting systems, information exchange and public participation mechanisms etc.

F. Chemicals management strategy should include a long-term action plan for risk assessment and risk management of existing chemicals with set deadlines, following national specific priority principles to collect information on hazards of existing chemicals, carry on risk assessment and risk management actions, gradually reduce and eliminate the production and consumption of chemicals with unreasonable risk to the environment and human health, and last but not least achieve China's "environmentally friendly environment". The strategy chosen must be WTO compliant.

G. For development of the national strategy of SMC, one national coordination group should be established from environment and human health protection basis to insure the drafting strategy to reflect on interests of the stakeholders.

ESTABLISH A LAW OR ADMINISTRATIVE REGULATION ON SMC

136. In light of current national legislation in regard to chemicals management establish a specialized law or an administrative regulation on SMC as the fundamental way to fill most of the existing gaps in SMC in China.

Recommendation:

A. The law or the administrative regulation of SMC should comply with the approach of risk management, establish hazard testing requirements, adopt the GHS for classification and labeling of chemicals to contribute to effective risk assessment and risk management of chemicals, include the GLP requirements for new tox and ecotox tests, establish basic SMC systems mainly including new chemical substances notification, risk assessment and risk management of existing chemical substances, environmental monitoring system for priority toxic chemical pollutants, information gathering and a right-to-know system for the release of toxic chemicals, a major environmental accident prevention and emergency response system, which should be coordinated with the current relevant legislation on occupational safety and public health management.

PRIORITIES FOR BASIC ADMINISTRATIVE FRAMEWORK（SYSTEM BUILDING）ON SMC

Implementation of GHS as Soon as Possible in Accordance with Internationally Agreed Goals

137. A scientific and comprehensive system of classification and labeling of chemicals is a fundamental condition of chemical hazard identification to contribute to effective risk assessment, information communication and risk management of chemicals. The currently used classification system from hazardous chemicals in China does not fully reflect various

potential environmental and health hazards and risks of chemicals, which severely restricts the development of SMC in China.

Recommendation:

A. Comprehensively implement the GHS for the classification and labeling of chemicals as the basis for new chemical substances notification, risk assessment and risk management of existing chemical substances, and major hazardous installation management system, MSDS system and other systems. This requires manufacturers and down-stream users of chemicals to classify, label and communicate information on the hazards of chemicals according to the GHS in order to effectively control environmental and health risks of certain chemicals.

Promote and Improve the New Chemical Substance Notification System

138. New chemical substance notification is a basic element of SMC. Developed countries have established such a system through specialized legislation in the 1970s, and built up a system with comprehensive guidelines, procedures and good technical and institutional supporting systems. By contrast, the new chemical substances notification system in China was established only three years and launched by a ministerial rule.

Recommendations:

A. Raise the legal status to strengthen enforcement and establish a specialized legislation for SMC containing the system proposed above.

B. Take full advantage of advanced experience from developed countries to further improve the enforcement procedure and the cooperation mechanism among relevant government departments.

C. Create obligations to improve domestic cooperation and information exchange in both ways between relevant ministries and authorities horizontally and vertically

D. Improve the corresponding technical guidelines and institutional supporting systems, such as GLP criteria and the international mutual recognition of test data, etc., so that the new chemical substance notification system is in accordance with international systems.

E. Streamline procedures and introduce mechanisms to reduce bureaucracy for cases of less concern such as chemicals in very small quantities or samples. Pay special attention to those chemicals with high risk to health and the environment.

Establish the System of Risk Assessment and Management of Existing Chemical Substances

139. A system of risk assessment and management of existing chemical substances is the basis of collection of risk information of existing chemical substances and risk management. It is also the emphasis of current environmental management of chemicals all

over the world. Because of the deficiency of the system, the Chinese government had little awareness of current domestic environmental and health risks of chemicals, did not conduct administrative measures for chemicals with high risks, and always lagged behind the international chemical management approaches.

Recommendations:

A. Build upon a system of risk assessment and management of existing chemicals close to the requirement of testing and data corresponding to new chemical substances notification, which will mainly include: establishment of a system of priority setting and a system of collection of hazard and risk information of existing chemical substances,

B. Regulate the obligation of the producers or importers on hazard testing and information notification, whose production or import of existing chemical substances is above a specific volume and collect the hazard and risk information on existing chemical substances in the market;

C. Put forward basic principles, policies and regulations of priority risk management, e.g., prohibition or restriction of production, use, import and export on priority chemicals, such as PBT, CMRs and vPvB, etc.;

D. Carry out classification and labeling of existing chemical substances according to GHS;

E. Determine the implementation mechanisms of the system of risk assessment and management of existing chemical substances; establish specialized legislation for SMC containing the system proposed above is the appropriate way forward.

Establish National Criteria for the Prioritisation of Chemicals of High Concern

140. National criteria for the prioritisation of chemicals of high concern shall be established according to domestic situation of the chemical industry while taking account of international criteria.

Recommendations:

A. Set criteria and procedures for prioritisation of chemicals of very high concern while taking into account international criteria for prioritization of toxic chemicals, types （number of chemicals）, and volumes of domestically produced and imported existing chemicals. Nationally prioritized chemical types may include PBT, vPvB, CMRs and EDCs, etc.

B. The risk management of priority chemicals should be based on their different features and their potential risks and hazards towards environment and health. It should take into consideration the exposure during production, utilization and distribution of those prioritized toxic chemicals. Establish national principles for risk management of priority chemicals. Based on this approach, reformulate risk management policy and systems for prioritization of chemicals of very high concern such as PBTs.

C. Draft a risk management strategy and action plan, in a step by step manner to reduce, restrict or ultimately ban the production and consumption of those chemicals of very high concern to promote the implementation of the Stockholm Convention and other international agreements and arrangements on chemicals management.

Establish a System of Release Recording and a Publication System for Toxic Chemical Pollutants

141. The PRTR is a model for gathering emission statistics on toxic chemical pollutants and informing the public. This type of system acts as a control of environmental pollution of toxic chemicals, prevention of accidents, information publicity and public participation in many countries.

Recommendation:

A. Make suggestions to assimilate successful experiences from abroad, adopt specific principles of priority management, rationally determine the extension of inventory, industry and enterprises of toxic chemicals which are needed to notify, establish corresponding management information system of collection and publication of data, and gradually establish the system of collecting emission statistics of toxic chemical pollutants and informing the public in China.

Establishment of Environmental Monitoring System for Emissions of Priority Toxic Chemical Pollutants

Recommendation:

A. Establish a system for the monitoring of priority toxic chemical pollutants, such as PBTs etc. commensurate with the capacity of the existing Chinese environmental and hygiene monitoring system carry out institutionalized and systemic environmental monitoring of the chemicals with high ecological and health risks, compile and release an annual report on the monitoring of national priority toxic chemical pollutants to enable the government and community to understand the situation of environmental pollution from chemicals and their ecological and health risks and provide the basis of decision-making for the efficient promotion of environmental management.

Improve the System of Registration and Reporting of Major Hazard Installations

Recommendation:

A. Revise standards of identification of major hazard installations （especially need to add corresponding categories and standards of environmentally hazardous substances）, improve the current mechanism of implementation and supervision of the registration and reporting system for major hazard installations, enhance data sharing and the responsibilities and rights of supervision and implementation in the system of registration and reporting of major hazard installations, strengthen the law enforcement ability of relevant organizations, sufficiently prevent serious leakage accidents of hazardous chemicals and their environmental effects. Improve the relevant legislative system for the management of existing major hazard installations by reference to relevant international rules and practices of management of major hazard installations, such as ILO, EU Seveso Directive and EPCRA etc.

CAPACITY BUILDINGS

Build upon Existing National Administrative Functions and Organizations for Environmental Management of Chemicals

Recommendations:

A. Build upon the national system of administrative enforcement of environmental management of chemicals, supervision and management by setting up a coordination mechanism among all national level authorities responsible for chemicals management.

Elevate the role of SEPA within the Chinese chemical management system including by increasing the capacity of relevant divisions and departments. Set up specific administrative functions （departments or divisions）for chemicals management and increase the number of staff involved in environmental management of chemicals in central and provincial organizations for environmental protection, including additional relevant managerial departments and officers.

Reinforce corresponding staff training.

Establish a Comprehensive National Information System for Chemicals

142. Availability of information on hazards of chemicals and risks is necessary for environmental management.

Recommendations:

A. Carry out centralized collection, arrangement and publication of various relevant national information on environmental and health risks of chemicals based on systems such as notification of new chemical substances, risk assessment and risk management of existing chemical substances, environmental monitoring of priority toxic chemical pollutants and their emissions and registration and reporting of major hazard installations, consistent with the protection of confidential business information.

B. Link existing national chemical information sources and management system such as those concerning existing and new chemical substances, as well as occupational health and safety issues.

C. Further enhance global information exchange on chemicals.

Strengthen National Capacity on Testing, Evaluation, Research and Monitoring of Chemicals

143. Promote cooperation among departments including those managing national environmental protection, public health, science and technology, and others in the following areas.

Recommendations:

A. Increasing capacity for testing of environmental and health hazards of chemicals by establishing laboratories for testing and evaluation of chemicals in accordance with OECD / GLP guidelines and by introducing GLP monitoring and other programmes such as mutual acceptance of data （MAD）.

B. Increasing capacity to conduct basic research on and to monitor the environmental and health components of risk assessment, particularly with respect to priority high-risk and toxic chemicals.

C. Development of international cooperation related to hazard testing and risk assessment of chemicals, learn and adopt international chemical risk assessment practices to continually improve capacity in China.

D. Strengthen Environmental Governance on Chemicals

Promote and Support Policies for Voluntary Risk Management of Chemicals

144. While gradually improving the governmental management system, promote participation of all chemical stakeholders, especially the wide participation of the chemical industry as the basis for successful implementation of state environmental policies for the sound management of chemicals. Voluntary Agreements（VA）between government and enterprises and Responsible Care（RC）action taken by chemicals enterprises are good practices carried out for the environmental management of chemicals in developed countries. The Chinese *Cleaner Production Promotion Law* has already established the legal status of VA, and put forward a number of incentive policies.

Recommendations:

A. Encourage the implementation of VA, RC and Product Stewardship in China, in communication with Chemical Industry Association. Research and establish a series of relevant matching policies and measures of management to promote the gradual implementation of VA and RC of environmental management of chemicals in China on the basis of current regulations of *Cleaner Production Promotion Law*.

B. Improve performance under VAs including by clarifying their legal status, and control procedures, and engaging in performance audits.

Improve Information Publicity and Public Participation Mechanisms for the Environmental Management of Chemicals

Recommendations:

A. Enhance publicity of and communication information concerning the environmental and health risks of chemicals by making information on pollution emissions and environmental monitoring of toxic chemicals publicly available.

B. Establish education programs on the environmental and health risks of toxic chemicals for the general public.

C. Establish public participation mechanisms that provide stakeholders with a platform to participate in government decision-making on chemicals management consistent with international trends.

Abbreviations

Abbreviation	Detail
ACS	American Chemical Society
BAT/BEP	Best Available Techniques and Best Environmental Practice
BHC	Benzene Hexachloride
CAAC	Civil Aviation Administration of China
CCICED	China Council for International Cooperation on Environment and Development
CEC	Commission of the European Communities
ChemRTK	Chemical Right-to-Know
CMR	Carcinogenic, Mutagenic, or Toxic for Reproduction
COD	Chemical Oxygen Demand
CRAES	Chinese Research Academy of Environmental Sciences
DDT	Dichloro-diphenyl-trichloroethane
EC50	Median Effect Concentration
ECB	European Chemicals Bureau
EDCs	Endocrine Disrupting Chemicals
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency of the United States of America
EPA/OPPT	Office of Pollution Prevention and Toxics
EPCRA	Emergency Planning and Community Right-to-Know Act
GAC	General Administration of Customs
GAQSIQ	General Administration of Quality Supervision, Inspection and Quarantine
GDP	Gross Domestic Product
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
GLP	Good Laboratory Practice

Abbreviation	Detail
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit （GmbH）
HCB	Hexachlorobenzene
HPV	High Production Volume
HPVCs	High Production Volume Chemicals
HPVCP	HPV Challenge Program
HSDB	Hazardous Substances Data Bank
ICCA	The International Council of Chemical Associations
IFCS	International Forum on Chemical Safety
ILO	International Labor Organization
IMOC	Inter-Organization Programme for the Sound Management of Chemicals
IPCS	The International Programme on Chemical Safety
ITC	International Test Commission
IUCLID	International Uniform Chemical Information Database
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
MII	Ministry of Information Industry
MoA	Ministry of Agriculture
MoC	Ministry of Communication
MoFA	Ministry of Foreign Affairs
MoH	Ministry of Health
MoR	Ministry of Railways
MoST	Ministry of Science and Technology
MPS	Ministry of Public Security
MSDS	Material Safety Data Sheet
NCG	National Coordination Group for Implementation of the Stockholm Convention
NDRC	National Development and Reform Commission
NIOSH	The National Institute for Occupational Safety and Health
NIP	China’s National Implementation Plan for the Stockholm Convention on Persistent Pollutants
NPC	National Patent Council
ODS	Ozone Depletion Substances
OECD	Organization for Economic Cooperation and Development
PBT	Persistent Bioaccumulative and Toxic Chemicals
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethylene
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PIC	Prior Informed Consent
POPs	Persistent Organic Pollutants

Abbreviation	Detail
PRTR	Pollutant Release and Transfer Register
RC	Responsible Care
RCLG	Responsible Care Leadership Group
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RTECS	Registry of Toxic Effects of Chemical Substances
SAICM	Strategic Approach to International Chemicals Management
SASAC	State Asset Supervision and Administration Commission
SAWS	State Administration of Work Safety
SBIR	Small Business Innovation Research
SEPA	State Environmental Protection Administration
SETC	State Economic and Trade Committee
SFDA	State Food and Drug Administration
SMC	Environmentally Sound Management
TBT	Technical Barrier to Trade
TCE	Trichloroethylene
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
UNCED	United Nation Conference on Environment and Development
VA（s）	Voluntary Agreements
VCCEP	Voluntary Children's Chemical Evaluation Program
vPvB	very Persistent and very Bio-accumulative Chemicals
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization

Report on Strategic Transformation on Environment and Development: Global Experience and China's Solution*

1. Introduction

In recent years, China has embarked on a strategic transformation of its approach to environment and development, representing the start of new efforts by the central government to integrate environmental protection and socio-economic development in a mutually productive way. Two significant characteristics mark this change: First, environmental issues are being placed at the center of the national agenda, with environmental protection starting to enter into the mainstream of national development. Second, economic and social policies are starting to incorporate environmental considerations in a substantive way. Such changes are motivated by the interactions among environment, economy, society and politics in China and accelerated by globalization.

Strategic transformation of China's environment and development agenda implies that China will seriously engage in the mitigation of its severe pollution and ecological degradation, and will have to reconcile environment with socio-economic development. A series of creative strategic thoughts and policies on environment and development were presented at the 17th National Congress of China Communist Party（CPC）which concluded on 21 October, 2007. Internationally, a similar strategic transformation occurred in Japan in the late 1960s and the early 1970s, Korea since the mid-1980s, Germany since the mid-1970s and quite radically in the mid-1980s, and Los Angeles and the USA since the late 1960s. However, each of these transformations occurred at an earlier era of technology and policy development, and China now has the chance to benefit from the lessons of those

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countries that have gone before—and to emphasize, among other things, pollution prevention as well as pollution control.

The objective of this report is to provide an overall framework for strategic transformation of the environment-development relationship in China. To this end, Section Two elaborates and explains the strategic transformation taking place in China, based on both Chinese domestic evidence and comparison with past international experiences. Section Three analyzes the domestic background and motivation for the strategic transformation now underway, including the relationships among the environment, economy, society and politics in China. Section Four elaborates the motivation for strategic transformation from the perspective of globalization—mutual environmental impacts on, and responsibilities of China and the world in the context of environment and development. Section Five makes policy recommendations to the Chinese Government on how to accelerate strategic transformation towards sustainable development.

2. Strategic Transformation: The Chinese and International Context

Recognition of the need for strategic transformation of China's approach to the environment and economic development can be seen in several government pronouncements and policy initiatives that have occurred in the early years of the new century. Taken together, they appear to signal fundamental changes, reflecting growing understanding of the importance of environmental sustainability by the Chinese people and their leaders.

2.1 LEADERSHIP SIGNALS

Signal 1: The Scientific Outlook on Development / Building a Harmonious Socialist Society

In 2003, the Chinese Government announced its intent to "stick to the principle of people first, adopt the concept of comprehensive, coordinated and sustainable development, promoting integrated development of economy, society and people", also known as "the Scientific Outlook on Development" The Scientific Outlook on Development takes development as its essence, putting people first as its core, comprehensive, balanced and sustainable development as its basic requirement, and overall consideration as its fundamental approach, which has been addressed in the President Hu Jintao's report at the 17th CPC Congress and now formally written into the amended Constitution of CPC.

In 2006, the Government announced the goal of achieving a "harmonious socialist society". Among the eight objectives and tasks to build a harmonious socialist society, the important one in the context of environment reads that "resource utilization efficiency should be greatly increased, the environmental quality should be sharply improved, and the building of a resource-conserving and environmental-friendly society should be accelerated." This signifies that the Government has started on a new pathway for strategic transformation of environment and development.

Signal 2: New Path of Industrialization and the Path of Peaceful Development

To take the new path of industrialization, as presented at the 16th Party Congress, there are five criteria to meet: high scientific and technological content, good economic effects, low resource consumption, less environmental pollution, and full use of human resource advantages.

Environment has become an important component factor for China's effort to follow the Path of Peaceful Development. The President of China announced the country's desire to "assist and cooperate with each other in conservation efforts to take good care of the Earth, the only home of human beings" in 2007.

Signal 3: "Three Transitions" in Managing Environmental Protection and Economic Development

The "Three Transitions" formulated at the 6th National Conference on Environmental Protection in 2006 are the guidelines for environmental protection in the new era. "Equal Attention" requests governments, enterprises, and relevant stakeholders to give equal attention to environmental protection and economic growth. "Synchronization" suggests keeping environmental protection abreast of economic development. "Integration" indicates that to settle environmental problems, legal, economic, technological and administrative measures shall be used in an integrated manner.

Generally, specifying step by step from strategy to tactics and supplementing each other, the "three transitions" constitute the guidelines for the undertakings of environmental protection in the new era.

Signal 4: Sound and Rapid Economic Development

In recent decades, the Government has advocated "rapid and sound" economic development. This motto was changed to "sound and rapid" at the 5th Session of the 10th National People's Congress this year. This change indicates that economic development must be coordinated with social needs within the context of resource and environmental limits and capacity. The most immediate implication is that the target economic growth rate is no longer subordinated to the need to improve efficiency, reduce consumption of resources, and protect the environment.

Signal 5: Mandatory Targets for Population, Resources, and Environment

In 2006, the Chinese Government for the first time set up systematic quantitative targets for population, resources, and environment within the 11th Five-Year National Economic and Social Development Plan Outline. Some of the targets are mandatory indicators, including reduction of 20% of energy consumption per unit of GDP and 10% of emission volume of SO2 and COD against 2005. In June 2007, the State Council set up a Leading Group for Energy Conservation and Pollution Abatement led by Premier Wen Jiabao, and published the "Scheme of Energy Conservation and Pollution Abatement" that includes 45 concrete measures and actions in 10 groups.

Signal 6: Circular Economy Law and Other New Policies

According to the legislation plan, the National People's Congress will discuss and approve within this year the first law in the world entitled "Circular Economy", which will promote the economic mode to improve eco-efficiency through waste reduction, reuse and recycling. The government is also considering reforms in national economic instruments in order to provide strong incentives to energy-conservation and pollution abatement. The reform of resource taxation also has entered a fast track mode and an approach is expected to be released soon. The state has invested in building capacity for creating emission-reduction indicators, monitoring, and performance review.

All these signals have been amplified and integrated in the most important documents for the country and the Party. Taking into account of the significant signals above, the report at the 17th CPC Congress notes seven innovations and progresses: first, when reviewing the work of past five years, "our economic growth is made at an excessively high cost of resources and the environment" is listed as the first outstanding problem on the country's way forward; second, the Scientific Outlook of Development has become a component of a system of theories of socialism with Chinese characteristics and a general outline to balance environment and economy development; third, Conservation Culture has been put forward for the first time; fourth, it's confirmed that the development pattern must be transformed through optimizing the economic structure and improving efficiency while reducing consumption of resources and protecting the environment; fifth, the principle for international cooperation of environmental protection is clearly defined in the statement of the Path of Peaceful Development; sixth, the consideration of environmental requirements is incorporated in the improvement of the basic economic system and macroeconomic regulation; seventh, building a resource-conserving and environment-friendly society has been put highly on the agenda in China's strategy for industrialization and modernization, and it also demands each organization and family to act accordingly. Environmental issues have been lifted to a higher level than before with the greatest importance attached to them since China's founding.

2.2 INTERNATIONAL EXPERIENCES

This section of the report explores for instances of strategic environmental transformation over the past half-century: industrial pollution and energy efficiency in post World War II Japan; industrial pollution in Korea following democratization in 1987; acid rain in the 1980s and recycling in the 1990's in Germany; and air pollution in Los Angeles, especially following the 1977 amendment of the Federal Clean Air Act.

2.2.1 Japan

Extremely rapid economic growth in the post-WW II years, carried out with little or no concern for the environment, led Japan to severe public health problems, first manifested in the 1950's, including mercury poisoning（Minamata disease）, cadmium poisoning（Itai-Itai disease）and inhalation of sulfur oxides （Yokkaichi asthma）. These generated tremendous public concern, and citizens' movements （often in spontaneous reaction to specific pollution-related incidents）, stimulated by the mass media, put pressure on elected officials to take action. This created a watershed in Japanese social, economic and industrial policy, in effect placing the environment at center stage, and initiating a series of measures that led in a relatively short time to major improvements in public health and the quality of urban life.

Critical to the rapid success Japan achieved in reacting to the public health catastrophes of the 1950's and 1960's was political equality and freedom of speech. Educational policy, particularly in technical fields, has played a key role in the development of Japan's environmental movement. Establishment of a partnership between the public and private sectors has also been a uniquely Japanese characteristic and an effective means of reconciling pollution abatement and economic growth objectives. Another Japanese characteristic is the extreme concern on the part of individuals and enterprises to avoid public criticism for anti-social behavior, particularly within their local community. The structure of government in Japan has also been conducive to sound environmental management at the local level. National-local government relations with regard to environment follow the conventional pattern, with actual implementation of pollution control, including establishment of local standards and regional pollution control plans, being entrusted to local governments.

These factors resulted in major environmental improvements in the 1960s and 1970s, which took place in parallel with a sustained period of rapid economic growth. Japan still faces important environmental issues, but, it can now be seen clearly in retrospect that the country experienced a strategic transformation in environmental policy and practice in the 1960s.

2.2.2 Republic of Korea

The Republic of Korea experienced a dramatic decline in environmental quality as the economy developed rapidly in the 1970s and 1980s. Rising living standards and the emergence of a democratic system in 1987 dramatically created the opportunity for a new look at environment and development relationships. Korean citizens expressed their unhappiness about environmental conditions, as seen by citizen action in response to the incidents of Onsan industrial complex, of nuclear facility construction projects in Anmyon Island and Gulup Island in 1990, and the phenol contamination of the Nakdong River by the Doo-San industrial conglomerate in 1991. While severe environmental problems remain in Korea today, the decade after 1987 was a period in which environmental issues began to take center stage, laying the foundation for continued improvement in environmental performance in the country.

The new priority given to environment by the Korean government in the late 1980's and early 1990's is illustrated by the rapidity with which new environmental legislation and policies were introduced. In 1996, the government established "Green Vision 21" the blueprint for period from 1995 through 2005 that was designed to raise Korea's environmental standards over the long-term to match those of the industrialized countries. While tightening these regulations, the government also skillfully redirected public environmental concern towards the environmental problems caused by consumption. The institutional and legal frameworks to ensure environmental protection were firmly in place.

The local self-government system was introduced in 1995 and this decentralization has changed the dynamics of environmental decision-making in Korea. However, the transfer of all enforcement duties in the areas of air, water quality and municipal waste management to local authorities since 2002 has led in some cases to a general weakening of the permitting and enforcement systems.

As in Japan, the basic enabling factors for the development of more effective environmental governance in the time period considered here included education, public awareness about the environment, and the ability of people damaged by environmental pollution to influence political decision-makers. But the route was slightly different, using environment as part of a general platform for political and social change,with NGOs rather than spontaneous citizens' movements, being the driving force. Public participation in policy making has been improved through an amendment to the Act on Administrative Procedures that protects the rights and interests of citizens. In addition to such critical internal forces, Korea has been influenced by external pressures, including its entry into the

OECD, which placed assessment of its environmental performance closer to that of the industrialized nations.

Despite the dramatic improvement in environmental awareness and policy that took place after democratization, the overall environmental record of Korea is mixed and the longer-term sustainability of the changes remains to be seen.

2.2.3 Germany

Germany has not always been an environmental pioneer. As in other European nations, after World War II, both East and West Germany's main goals were promoting economic development although under different political- economic models. Environmental protection was not yet a major public concern before 1972, when United Nations Conference on the Human Environment （UNCHE）was held in Stockholm.

Initial changes to Germany's environmental laws were made primarily as top-down decisions （as opposed to a response to public opinion）. Internationally, environmental problems, such as acid rain, were starting to attract more attention and other countries. Domestically, a change in government proved critical in the timing of West Germany's initiation of a national environmental program. The formation of a coalition government between the Social Democratic and the Free Democratic （Liberal）Parties in 1969, just as environmental policy changes were beginning in other Western countries provided a window of opportunity for change. In the following years there was a transfer of control over measures to combat pollution from the Ministry of Health to the Ministry of the Interior, which was eventually, in 1986, named the Ministry of the Environment, Nature Conservation, and Nuclear Safety. In 1972 an amendment to the Constitution conferred on the federal government the power to enact legislation that, in effect, overrode the states in areas such as air and noise pollution and waste management. In addition, the federal government was able to issue guidelines on the enactment of state legislation on matters such as water quality and planning as well as the preservation and conservation of nature. Another significant action was the formation in 1974 of the Federal Environmental Agency.

Despite the important changes that took place during the 1960s and early 1970's, the government's decision to expand massively the system of nuclear power plants in the wake of the 1973 Organization for Petroleum Exporting Countries （OPEC）'s oil embargo brought a powerful counter response. This came in the form of citizens' initiatives for environmental protection, antinuclear protests, and the formation of a green political organization, Die Grünen（the Green Party）. Green lists and parties were increasingly successful in elections at the local and Länder levels during the 1970s. The German Green Party's performance in federal elections improved progressively in the 1980s. This shift in Germany's political culture began West Germany's transition towards international environmental leadership. In the past two decade German major political parties have all greened considerably.

Germany's public and its leaders have come to the conclusion that pollution and energy inefficiency come with unacceptably high costs to the economy, society, and the environment. This was the result of a number of factors including learning from abroad（the case of the early 1970s）, value change, the electoral successes of the Green Party, and acceptance by German political leaders and industry of the need to find new approaches to economic development.

Germany's current Chancellor Angela Merkel, was head of the German Environment Ministry at the time of the Kyoto Protocol negotiations. Germany's political and economic leaders also appear to believe that if Germany can succeed in the areas of environmental protection, energy conservation, and clean energy development, its industries will have a stronger chance of remaining internationally competitive.

German policies are especially noteworthy because of the international impact they have had. Because Germany's economy is so large, changes in German environmental policies tend to reverberate internationally. To give just a few examples, Germany's 1983 Large Combustion Plant Ordinance became the basis of the European Union's 1988 Large Combustion Plant Directive, its 1991 Ordinance on the Avoidance of Packaging Waste helped shape the EU's 1994 Directive on Packaging and Packaging Waste, and its national greenhouse gas mitigation policies account for close to three-quarter's of the entire EU's emission reduction pledge under the Kyoto Protocol. In many environmental areas, Germany is setting international environmental benchmarks and shaping European approaches to environmental protection.

2.2.4 Los Angeles

Strategic transformation of environmental policy in Los Angeles stems mainly from citizen concern about dramatic increases air pollution caused by industrial and automotive emissions after World War II, compounded by temperature inversions in the greater Los Angeles area, and evidenced by significant adverse impacts on public health. The transformation has evolved gradually over the last fifty years, with a succession of legislative and regulatory measures enacted at the Federal, State, County and City levels of government. However, environmental awareness and policy in California has typically led the rest of the United States towards ever higher environmental standards..

Indeed, concern for the natural environment had for a long time been a particular concern of Californian residents, and evidence about the public health impacts of air pollution had been well documented. Highly educated in these matters and led by a number of national NGOs （Sierra Club, Environmental Defense Fund etc）, the issue confronting Californian residents by the mid-1970's was not awareness, but frustration with the inability of public agencies to address their problems. The amendment to the Federal Clean Air Act in 1977 permitted democratic processes to become more effective at the local level, and in the case of the Los Angeles area, public pressures contributed to the creation, in 1978, of the South Coast Air Quality Management District （AQMD）.

The release by AQMD of its 1989 and the slightly modified 1991 regional air quality plan was the toughest, most intrusive set of air emission regulations ever in Los Angeles, or anywhere else. AQMD proposed 130 measures that could in principle be adopted in the short term, using current technology and existing regulatory authority.

Overall, the combined federal-state-local government regulatory approach has been successful in reducing emission of pollutants in the USA. Furthermore, California standards not only for auto emissions, but emissions from paint, small engines, etc., have influenced products used in many parts of the world. As in the case of Japan and Korea, basic enabling factors included education, public awareness about environment, and the ability of people damaged by environment to influence political decision makers. Such forces have been mobilized in various ways in California, including some spontaneous citizens' protests against specific projects or policies, as well as the on-going role of specifically environment-oriented NGOs in putting pressure on elected representatives. Combined, when the overall national legislative structure permitted it, they became effective in influencing local policies, with the creation of AQMD being a major contribution.

2.2.5 Implications for China

The cases briefly described in this paper show that the process of integrating environment into the mainstream of economic and social decision making has taken many forms. It may take place rapidly, in response to specific environmental problems, or may evolve gradually, based upon growing understanding of the issues and changes in governance that permit such awareness to lead to action. In this regard it may be said that China is already on the path to such a transformation, with rising living standards and public awareness, combined with increased technical efficiency and the international requirements associated with its export-led economy and membership of the WTO all contributing to this. Progress is exemplified by legislative measures and specific examples such as the solar powered city of Rizhao in Shandong Province, where many of the enabling factors seem to have come together. Nevertheless, China has a long way to go before transformation becomes a reality on a national scale, with implementation and enforcement of legislation and standards being of central concern.

Some of the lessons from the case studies about the requirements for successful transformation to take place are summarized below.

Growth vs. Environment

China has already experienced several serious environmental crises and should not wait, for additional public health catastrophes to further galvanize public action. China has made strenuous efforts to improve environmental quality in the country, but the severe pollution problems now facing China's cities and some parts of the countryside require more dramatic action including the integration of environment into the mainstream of economic decision making rather than as an add-on.

Enabling Factors

As illustrated by each of the cases, a significant effort at reducing environmental pollution at the city or regional level in the face of the imperatives of growth and development in any society requires a combination of public awareness and participation and a responsive political and administrative system. Emergence of a strong system of environmental governance will typically require a major driving force.

Holistic View

A key issue in environmental management concerns the role played by agencies other than those with specific environmental mandates. Sectoral policies, which, often designed with no environmental objective in mind, may in fact be of critical importance in influencing environmental behavior.

Maintaining the Momentum

Achievement of standards in the short term should not encourage a government to rest on its laurels; continued improvement will doubtless be required as living standards continue to increase. The societies that have successfully achieved strategic environmental transformation have realized on-going economic benefits arising from commitment to innovation, tightening of standards, and increased competitiveness.

3. Domestic Motivation and Foundation for Strategic Transformation

3.1 DILEMMA OF ENVIRONMENT AND ECONOMY

3.1.1 China's Economic Growth, Industrialization, and Environmental Quality

In the years since economic reforms began in 1978, China's aggregated GDP has expanded by 58 times, increasing by an average of 9.78% annually, to become the 4th largest economy in the world.

The industrial sector has always been the major driving force during this time of rapid economic growth. Since 1978, the aggregate industrial output has generally sustained the double-digit rate of growth. Since 1991, the contribution rate of the secondary industry to GDP has been basically over 60%, with two peaks of 70.5% and 69.8% appearing respectively in 1994 and 2003. In terms of the industrialization process, China has experienced four stages after 1978 （Figure 1）.

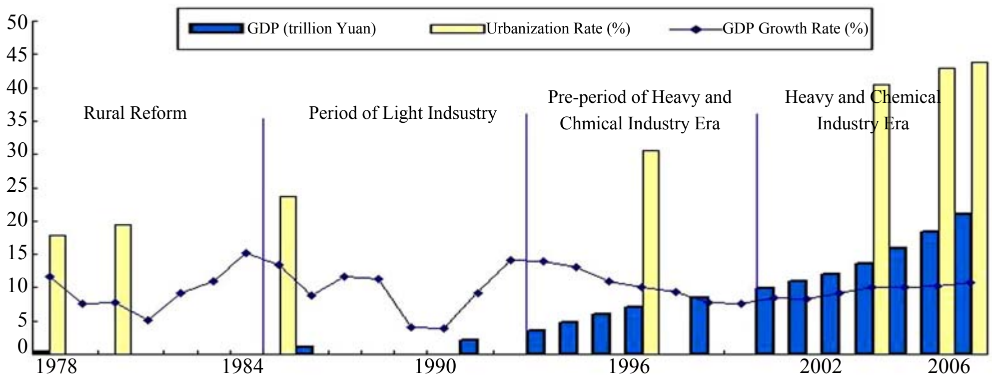

Figure1 China's Economic Growth and Its Stages （1978-2006）

Data source：China Statistical Yearbook，1990-2007.

The first stage is from 1978 to 1984, a period of economic recovery, featuring rural reform and booming in agriculture. In that period, the proportion of the agricultural output to GPD had been over that of the tertiary industry till 1985, in which the two industrial sectors became equal in output, both accounting for 28.5% of GDP. The second stage is from 1985 to 1992, when non-agricultural industries developed at relatively high speeds, characterized remarkably by the growth of light industries and textile industries and catering mainly to the needs of feeding and clothing of the residents. The third stage is from 1993 to 1999, a pre-period of the heavy- and chemical-industry era, when the output of the heavy- and chemical-industry began to apparently surpass that of light industry. High growth industries included energy and raw materials, like petroleum and natural gas exploitation, infrastructure and basic public facilities, like road, harbor, and electricity, and household electric appliance like color TVs, refrigerators, washing machines, and air conditioners.

The fourth stage is 2000 to date, when China has entered the heavy- and chemical-industry era. Electrical power generation, steel, machinery equipment, vehicles, ship building, chemical industry, electronics, construction materials have become the major driving forces for economic growth to meet the residents' consumption needs of durable goods like private residences and vehicles.

The acceleration of urbanization has become another key driving force for the development of the Chinese economy. China's urbanization rate in 1999 doubled the rate of 17.92% in 1978. By 2005, the rate had reached 43%.

The economic growth and industrialization process noted above has determined four features of the environment problems in China:

（1）The types of environmental problems and the degree of their deterioration are closely connected with economic growth and industrialization process.

In the late 1970s, pollution from industrial point-sources mostly located in urban areas appeared in China. By the late 1980s, air pollution and river pollution in urban areas were becoming serious. In general the environment during that time was being polluted and damaged even though environmental protection activities were taking place, because the protection activities lagged much behind the pollution and damage activities. As a result, the environmental situation worsened rapidly in the 1990s. In particular, the large-scale pollution accident of the Huaihe River in 1994, and the floods of the Yangtze River, the Songhua River, and the Nenjiang River in 1998 warned China that its environment and ecological conditions were badly deteriorated. During the mid-1990s, the scenario was "partial deterioration and general development towards worsening", and thereafter the scenario changed to "partial improvement, general deterioration or the deterioration trends still unchanged". The previous "partial deterioration" was an outcome of the initial period of industrialization. The "general deterioration" thereafter represents the cumulative effect of partial deteriorations, a result of the mid-term of industrialization of heavy-industries oriented, while "partial improvement" was the major achievements of environmental protection endeavors.

（2）A compressed industrialization process brings about multiple and interactive environmental problems.

In developed countries, different stages of the century-long industrialization process have experienced different environmental problems, on the contrary all environmental problems that have been recognized up to now have their presence in the past two decades in China. When its per capita GDP reached US$ 1000 at the turn of this century, China at the same time was faced with a complex of environmental problems, including industrial pollution, household pollution, acid rain, ecological degradation, global environmental problems, and persistent organic pollution （POPs）, and so on. Thanks to the structural, compound and compressed nature of the environment problems, environment protection in China is destined to be a complex, arduous and protracted undertaking.

（3）Rapid economic expansion leads to enormous pollutant emissions.

Since entering the era of heavy- and chemical-industry in 1999, China has reached a fast growing stage of pollutant emissions, for example, the volume of industrial waste gas, waste water and solid waste have increased by 22%, 8.5% and 17% annually respectively. The rapid expansion of economic size has created an enormous amount of pollutant emissions. It is estimated that currently China ranks the first in the world in terms of SO_2 and ODS （ozone-depleting substances）, and the second in CO_2 emissions. China is also among the world top emitters in terms of COD and NO_x emissions.

（4）The dual structure of economic development has led to the "dualization" tendency of environmental problems.

China started and strengthened its industrialization in urban areas and in the coastal areas of the East. Therefore, environmental pollution appeared and deteriorated first in these areas, while pollution in the West and the rural areas was less serious before the 1990s. A new dualization tendency is being created in environmental quality and capacity of environmental protection between urban and rural areas, as well as the East and the West Region. The dualization of environment-related matters is also reflected in the imbalanced distribution of environmental benefits and its relevant economic benefits between natural resource exploitation regions and other regions: the upper and lower reaches of river basins, and the key ecological function conservation zones and others.

3.1.2 China's Economic Growth Pattern and Its Eco-efficiency

Generally speaking, China's economy is still in the extensive pattern heavily sacrificing resources and environment, with features such as high capital input, intensive resource consumption, heavy pollutant emissions, and low-efficiency output. If China's development pattern was still maintained as before, it would be unsustainable with its limited capacity of resource and environment.

The Chinese Academy of Sciences projected three scenarios of the impacts of China's socio-economic development on resources and environment in 2020[4], given the situation of 2000 as the base point.

- Scenario 1, if the current resource and energy efficiency and the pollutant emission level were retained, by 2020, the impacts of socio-economic development on resources and environment would be four to five times the level of 2000;
- Scenario 2, if the environmental quality of 2000 is to be maintained, the resource

productivity （resources consumed per unit of GDP）or eco-efficiency （GDP per unit of pollutant emissions） must be improved by four to five times;

- Scenario 3, If the environmental quality is to be improved by a very big margin by 2020, in other words, the impacts on resources and environment are halved against that of 2000, the resource efficiency or eco-efficiency must be improved by eight to ten times.

In a word, China's pattern of economy growth with high costs of resources and environment has run its course. The only options are the above-mentioned scenarios 2 and 3. That is to say, the paradigm changes in relationship between environment and economic growth must take place. There are no other ways out for China.

3.2 CONFLICTS AND COOPERATION AMONG RELEVANT STAKEHOLDERS

The essential manifestation of the environment-society relationship is the influence of environment on the public life and the degree of concern of the public about environmental quality and their attitude to environmental protection. These criteria can be employed to judge whether the environment-society relationship has changed in fundamental ways. Many factors influence the environment-society relationship, including the amount of damage caused by pollution and ecological degradation, the standard of living and environmental consciousness of the public, access to information, and the rights of the people.

The environment-society relationship in China has experienced three stages by and large.

（1）Before the 1990s, most of the public had little understanding of environmental risks, and seldom participated in environmental activities. The mainstream appeal of the society at that time was to shake off poverty and get rich. This retrospective judgment will not necessarily be totally accurate. However, at least there is currently not any literature that can repudiate it.

（2）In the 1990s, especially in the latter half of the decade, environmental pollution raised the level of public concern and attracted growing media attention. Starting with the 9th Five-Year Plan, China launched the large scale Comprehensive Program of Regional Pollution Control, implemented the massive "Zero O'Clock Action" for industrial enterprises in the Huaihe River basin to comply with emission standards, and the total pollution control plan. The Chinese Government gradually attached greater importance to environmental protection, and rules on disclosure of environmental information were introduced.

（3）At the beginning of this century, as China's living standards continued to improve, the environment-society relationship reached a new stage. Currently the environment-society relationship in China presents four major features:

- The environmental consciousness of the people has been generally enhanced;
- The public demand for environmental improvement is constantly rising;
- A more open, transparent and interactive exchange mechanism is starting to come into being between the environmental protection authorities and the public; and
- The era of frequent environmental accidents has increased public concern and led to a growing number of protests as citizens seek to protect their environmental rights.

The environment-society relationship in China appears to be reaching a strategic transformation point. Conflicts between the government bodies responsible for environmental problems and the affected public are increasingly common. If handled properly, the "conflicts" can turn into social cooperation as public consciousness and capacity increase.

3.3 PRESSURES ON GOVERNANCE AND POLITICAL WILLINGNESS

The environmental issue is also an economic issue, a social issue, and a cultural issue. Hence, it is necessarily a political issue. The domestic and international experience has shown that the success of the environmental endeavors depends more often than not on the strategic positioning of environmental issues in the political and governmental agenda of a country.

In 1972, the Chinese Government sent delegates to attend the United Nations Conference on Human Environment held in Stockholm. Subsequently, in 1973, the Chinese Government held the first National Conference on Environmental Protection, initiating the process of environmental protection in China.

China's first Environmental Protection Law came into force on September 13th, 1979, and was formally promulgated and implemented in 1989. At the second National Conference on Environmental Protection held at the end of 1983, it was for the first time stipulated that protecting the environment was a basic national policy, and the environmental protection guidelines of "Three Synchronizations for the Integration of Three Aspects"[①] was established. In the same period, three basic policies for environmental protection were formulated: "application of comprehensive measures with the first priority of prevention and combination with treatment", "the polluter is obliged to treat the pollution," and "reinforcing administration". In order to strengthen environmental protection, the Chinese Government promulgated two "State Council Decisions" in 1981 and 1984.

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① This means to synchronize the planning, implementation, and development in economic construction, urban and rural construction, and environmental protection in purpose of reconciling environment, economy and social development.

In the 1990s, the Chinese Government accomplished five major changes in the strategies of environmental protection: First, starting from 1997, the Government has held an annual "Central Government Meeting on the Population, Resources and Environmental Protection" that sets the year's agenda for environmental protection. At the same time, the Chinese Government also promulgated two "State Council Decisions" on strengthening environmental protection in 1990 and 1996 respectively. Second, the Chinese Government released the first independent five-year plan for environmental protection with definite quantitative objectives （such as the total volume control of pollutants）in 1996, namely the National 9th Five-Year Plan on Environmental Protection and the Long-Range Objectives for 2010; Third, at the macro-economic level, the Chinese Government took measures such as economic structural adjustment to reduce pollution burdens from industrial sectors, and enhanced investment in environmental protection through pro-active fiscal policies; Fourth, against the backdrop of thinning the central government organizations, the former State Environmental Protection Agency was upgraded to the SEPA in 1998 with position promoted from the vice-ministry to ministry level and jurisdiction expanded and strengthened; Fifth, in 2000, the Chinese Government included the environmental protection capacity and the sustainable development capacity in the objectives of strategies for building a moderately prosperous society in an all-round way in the coming 20 years.

In the new century, the Government went further to raise three significantly strategies: The Scientific Outlook on Development, Harmonious Society, and Peaceful Development. These strategies accommodate environmental protection and social-economic development in one organic and integrated system, where environmental protection is enshrined in a more important strategic position. Gradually, China's Government has begun to understand the profound and difficult relationship between environmental and socio-economic development, and has lifted environmental protection to an unprecedented level of priority. In recent months, the Government has signaled that it is prepared to promote the strategic transformation of environment and development. However, it is also clear that translating these ideas into effective action will be a difficult task.

4. Globalization Forces Affecting the Strategic Transformation

4.1 OPPORTUNITIES AND CHALLENGES THROUGH GLOBALIZATION

4.1.1 Impacts of International Trade on China's Environment and Development

Since its reform and opening up at the beginning of the 1980s, China has been experiencing continuous opening up at an increasing scale; China's entry to the WTO in 2001 indicates that Chinese economy is even further interlocked with the world economy. At present, China already ranks third in the world in terms of export and import of goods; China is not only a main supplier of manufactured goods for the world, but also an important market for goods from many countries. According to statistics from WTO, for year 2005, China's export and import of goods accounted for 7.5% and 6.3% respectively of the world total, ranking the third in the world. And for 2005, the contribution rate of China's export and import of goods to the world total was 14.3% and 8.3% respectively.

Impacts of international trade on China's environment and development are relatively complicated. The impacts can be positive or negative. Potential positive influences refer to the expectation that China can improve its resource allocation efficiency through international trade, because it can seek resources from sources throughout the world; and at the same time drive forward the sustainable development of Chinese economy by way of introducing advanced technology and equipment from outside in order to improve the utilization efficiency of resources and the environmental treatment level.

Negative influences refer to the greater environmental pressure brought about by the growth of production, and other negative influences on the environment arising from the increases of domestic consumption accompanying rising income standards and the growth of transportation.

（1）Positive influences of international trade on China's environment and development.

International trade makes it possible for China to solve the problem of supply shortage by way of importing natural resources and taking advantage of the ecological goods and services from other countries. Therefore it makes it possible for China to produce and export by making use of resources where it does not have enough domestic sources or comparative advantages, and thus to still develop its economy. Generally speaking, because of the optimization of its resources, international trade has played an important and obvious role on promoting Chinese economy; it is mainly demonstrated through improving China's industrial structure and employment structure, promoting scale operation and specialized production, and alleviating scarce restrictions on Chinese economic development for the shortage of resources.

Conflicts between the shortage of resources and unbalanced energy supply and demand are alleviated through the import of raw materials and energy.

Because of its increasing need for resources and energy, China's import of raw materials and energy has been accelerating and China has become a main importer for raw materials and energy in the world.

Import of materials has expanded the supply base and alleviated the conflict between market demand and supply. For instance, China's import of cotton increased by five times between 1999 and 2005; in recent years, the fast growing Chinese economy and the rapid development of the transportation sector led to the accelerated growth of energy import, such as import of petroleum; China turned from petroleum net exporter to net importer since 1993 and became a net importer for crude oil since 1996 with net import of crude oil reaching 148 million tons in 2006. From 2001 to 2006, China's import of petroleum increased by 122.4%, with an annual increase averaging 17.3%; its dependence on petroleum imports increased from 29.1% in 2001 to 47.3% in 2006.

In addition, because resources are embodied in the imported products, China can realize benefits from the indirect import of natural resources. From 1996 to 2001, China's import of agricultural products equals a saving of 186 billion cubic meters of water resources. Because China's import of crops is in accordance with comparative advantage for utilization of water resources, the trade would therefore alleviate to a certain degree the endangered water shortage situation in China and improve global utilization efficiency of water resources.

China reduces its direct import of resources through the import of recyclable and waste materials.

China has become the largest importer for waste materials in the world. In recent years, driven by the potential economic benefits, imports of wastes into China increased at quite a fast speed. From an objective point of view, the import of waste materials replaces part of the direct import of raw resources, and can play a positive role for the recycle and reuse of resources in China and throughout the world. Also, disposal costs for wastes are quite high in developed countries, while the relative cost in China is cheaper. Therefore, China enjoys a certain degree of comparative advantage in the trade for waste goods and resources.

Recycling and reuse of those imported wastes which contain relatively little toxic substances and comparatively higher content of reclaimable resources present overall advantages. Examples include scrap iron and steel, paper, wood, second-hand mechanical and electronic products. When compared with mining of mineral products and other resources, the import is conducive because the recycling of wasted resources can improve smelting and processing efficiency, lower resource consumption and reduce direct import of resources. In 2006, China imported a total of 38.95 million tons of waste materials worth US$13.347 billion; and for some categories, import of wasted resources has accounted for a quite high proportion.

For instance, in 2006, China imported a total of 4.188 million tons of wasted steel, which equals to 1/5 of total import that year for iron and steel; a total of 19.62 million tons of waste paper, about twice as much as imported that year for paper pulp （7.96 million tons）. According to a report issued on July 13, 2007 by Forest Trend, an organization headquartered in Washington D.C., the flourishing waste paper recycling industry in China has saved a large area of forest in the world. And for 2006 alone, China avoided cutting a total of 54 million tons of lumber by way of waste paper recycling.

Through international trade, China has introduced foreign advanced technology and equipment, improved its utilization efficiency of domestic natural resources, and upgraded its environmental treatment standard.

Active international trade activities provided China with optimized resource allocation, technological bases and management experiences for solving problems concerning environment and development. Under the current situation that developed countries far exceed China in terms of resources utilization efficiency and environment treatment standard, China can greatly improve its resources utilization efficiency and upgrade its environment treatment standard by carrying out international trade for technology and goods, and introducing advanced technology and equipment directly from developed countries.

By introducing advanced production technology and pollution treatment technology, China would be able to produce more environment-friendly products, carry out more efficient means of production and obtain foreign advanced management experience more easily, and discharge less pollution. In recent years, trade for services has grown quite fast in China. From 1982 to 2005, import and export of trade for services increased from US$4.34 billion to US$157.08 billion, an increase of 35.5 times within slightly more than 20 years time. At the same time, China has already become an important importer for high-tech products in the world; the import of high-tech products even exceeds the import of resources which are in short in China, such as energy. Taking the figure in 2005 as an example, the import of computer chips amounted to US$81 billion, 1.6 times the import volume of crude oil for that year.

（2）Negative influences of international trade on China’s environment and development.

With China’s increasing contribution to world trade, including the large quantity of manufactured goods to the world and China’s role as an important processing base for the world, the global resources consumption and environment pollution are also becoming more concentrated on China, and further aggravate the damage to China’s ecological environment. In fact, while China rapidly has accumulated a trade surplus, it is accumulating an environmental trade deficit, also at fast speed. However, because current Chinese statistics for trade balance are calculated by volume, the trade surplus figures neglect the hidden resource consumption and environmental pollution costs. It behooves us to calculate embodied energy, as well as environment pollution and carbon dioxide discharge problems associated with trade.

Negative influences of international trade on China's environment are mainly reflected in three aspects. First, the export of goods, especially those goods whose production requires high consumption of energy and causes severe pollution further aggravates pressure on China's environment and resources, accelerates the over-consumption of non-renewable resources and the degradation of ecological environment in some areas. Secondly, in recent years, the import of waste to China has been accelerating, and in particular the illegal import of electronic waste goods has led to serious environmental problems. Some 80% of the exported electronic wastes in the world are exported to Asian countries, of which 90% was exported to China. Thirdly, China imported a large number of luxury goods. These imports tend to bring several negative influences:

- Luxury goods such as cars consume large amount of petroleum and resources and therefore will cause severe pollution;
- Import of luxury goods consumes large amount of capital, and has a high opportunity cost; their import would make less capital available for investment for environment improvement;
- Consumption of luxury goods motivates the social drive for luxurious means of consumption, and from an objective point of view, it will intensify the domestic pressure on environment.

Costs have been paid on resources and environment to fulfill fast growth of foreign trade

Since its reform and opening up, China's total import and export of foreign trade increased by 45 times, and its ranking in the world increased from 26th in 1980 to 3rd place in 2005. In recent years, total foreign trade of China has become huge and continues to be at surplus, with import and export of goods totaling US$1760.69 billion in 2006, a surplus of US$175.5 billion, the balance for current account reaching around 9% of China's GDP. The excessive trade surplus has not only resulted in serious imbalance of BOP （Balance-of-payments）, causing trade conflicts, but also forced China pay high prices on resources and environment.

First of all, because the national tax on resources and the compensation charge for resources are quite low in China, environment pollution cost is not listed in the enterprises' books as a cost. This phenomenon leads to the excessive supply of resource-intensive products and stimulates the over-investment in heavy industry. Moreover it has resulted in the export of a great number of resource-intensive products with high consumption of energy and high pollution to the environment. The export of such products utilizes China's resources and raw materials to subsidize foreign consumers, meanwhile keep the great amount of pollution in China, causing net loss of welfare to Chinese citizens. For example, through the assessment on environmental influences by export of goods of textile industry from 1999-2004, it was found that pollutants and energy consumption increased as textile exports scaled up.

Secondly, research on trade for waste materials has shown that many renewable metals were shipped back to some developed countries after their treatment and recovery in China. Therefore the import of wastes did not always play its role to supplement for domestic shortage of resources. Instead, sometimes it is merely a means to earn scanty profits in return for pollution to the environment, and further consumption of energy and resources.

Evaluating China's core resource and environment issue from the perspective of net export of embodied energy

Although China continues to upgrade its import and export structure, it is still operates mainly at a relatively lower end in the supply chain of goods. Compared with imports from developed countries, exports from China have low added-value, while consuming more resource and energy per unit of export trade volume. According to some research, the embodied energy implied behind import and export of foreign trade is huge, either in its absolute value or in its speed of growth. In recent years, China has already become a net exporter for embodied energy. It is estimated that, from 2001 to 2006, China's net export of embodied energy increased from 210 million tce to 630 million tce, and it is growing at a relatively stable speed. The net export for embodied energy totals 240 million tce in 2002, around 16% of primary energy consumption for that year. It is mainly exported to countries such as the U.S. and Japan, with net export above 75.24 million tce and 48.94 million tce respectively, some 50% of the export total for embodied energy.

Some traditional export industries are leaders in terms of export of embodied energy because of their large export quantity. The top three are garments and other fiber products, instruments, meters,cultural and office machineryfacilities, and electric equipment and machinery. In 2002 for example, the three industries accounted for 13.4%, 12.3% and 12.5% respectively of total embodied energy export. Industries engaged in raw chemical materials and chemical products manufacturing, and smelting and pressing of ferrous metals, account for little in total export trade （3.5% and 1% respectively）However, because these are typical energy intensive products, they account for 7.1% and 2.3% in embodied energy export respectively, far exceeding their proportion in trade volume. After deducting the influence of semi-finished goods, the ratio increases even further, accounts for 8.0% and 2.8% respectively. This phenomenon indicates that the processing of energy intensive goods for export would consume great amount of domestic raw materials and intensify negative influences on domestic energy and environment.

China's consumption of energy would at the same time lead to discharge of pollutants and carbon in large quantities. At the time when China exported net embodied energy, it also net discharged a large amount of carbon dioxide and sulfur dioxide. According to investigations, the embodied energy export in 2002 equals to 238 million tons of carbon, while the embodied energy import equals to 70 million tons of carbon, therefore resulting in a net discharge of 168 million tons of carbon. In 2004, the embodied energy export was 462 million tons of carbon, while the embodied energy import was 140 million tons of carbon, resulting in a net discharge of 322 million tons of carbon.[①]

Besides, equilibrium assessment for trade and environment reveals that of the discharge of SO_2 during China's 10th Five-Year Plan period （2001-2005）, foreign trade resulted in a SO_2 deficit of around 1.5 million tons, which accounts for around 6% of the annual total discharge of SO_2. When considering the differences between production structure and trade structure, because trade growth far exceeds the growth of production, the SO_2 deficit caused by foreign trade would be much higher.

It is obvious that the research on embodied energy demonstrates the unique role which China plays as 'the world manufacturer' in international trade, and reveals that China's fast growth of energy consumption, major pollutants and discharge of carbon dioxide results not only from expansion of its domestic investment and demand-stimulated consumption, but also from the accelerated export of goods driven by consumption demand from other foreign markets. Developed countries import goods from China to replace their own production. Thus at the time when China increases its energy consumption and waste discharge, these developed countries actually decrease their own need for energy and discharge and were the main beneficiaries. Especially for the U.S., which accounts for 31% of China's net export embodied energy, followed next by Japan and then the countries of the European Union.

In sum, it is not a complete consideration of impacts if merely the wealth accumulation

[①] The Tyndall Centre for Climate Change Research （Tao Wang, Jim Watson，2007）has just published a new briefing. It suggests that 23% of China's carbon emissions are due to the manufacture of goods that are exported to industrialised countries; which has a similar result with our result on the net value of net emission.

effect of trade is taken into account. Although international trade can promote economic growth and provide economic and technological bases for environment treatment, China should at the same time take into consideration the negative influences of the fast growth of international trade on the environment. With the deepened globalization of the world economy and the accelerated growth of Chinese foreign trade, it would be difficult for China to avoid in the near future, negative situations such as high energy consumption, aggravated pollution and increased carbon dioxide emission, which are caused by trade for waste materials, net export of embodied energy, etc. In fact, China's current growth mode of trade has brought about great pressure on its resources and environment at the time it stimulates economic growth. Considering its limited resources and environment, the Chinese government should pay high attention to the environmental price that China has been paying for its trade growth, and drive forward with the adjustment on its domestic industry structure and optimization of the trade development mode.

4.1.2 Impacts of FDI on China's Environment and Development

Since the 1990s, China has been a major destination for global foreign direct investment and in the leading position among developing countries. Especially since 2001, despite periods when global flow of FDI decreased sharply, FDI entering China continued to increase at high speed. According to statistics from the UN Conference on Trade and Development, global FDI totaled US$916 billion for 2005, an increase of 29% from 2004, in which FDI to developing countries totaled US$334 billion, which is a record high in history. Although China adjusted its foreign investment policy since 2005, the FDI to China still totaled US$72.4 billion in 2005, and China became the third largest FDI recipient in the world, accounted for 22% of total FDI to developing countries. At present, countries and region which have investment in China exceed 190. Over 450 of the Fortune 500 companies invest in China.

Influences of FDI on China's environment and development can be positive or negative. In terms of its positive influences, with the expansion of the scale and the improvement of its utilization in China, FDI speeds up China's technological improvement and industrial structure upgrading; FDI can improve the resource utilization efficiency as well as China's capability for treatment of environmental pollution. Some companies making FDI set an example in terms of environmental protection and play an active role with the environment protection industry and environment protection technology development, and contribute in other ways to the improvement of China's environmental situation. FDI actively contributes to China's economic and social development.

On the other hand, FDI brings about great negative influences on China's environment and development. The negative influences mainly reflected in issues such as international trade conflicts, unbalanced economic development, technological lock-in effect, and the outstanding problem of achieving harmonious development between local and foreign invested companies. Meanwhile the transfer in larger scales of industries with high energy consumption and high pollution to China also aggravates the pressure on China's resource and environment.

（1）Contribution of FDI to China's environment and development

The contribution of FDI to China's environment and development is reflected in promoting China's technological improvement and industrial structure upgrade; at the time it improves China's resource utilization efficiency, it also upgrade China's capability for treatment of environmental pollution. FDI speeds up China's economic growth and technological improvement, accelerates domestic industrial structure upgrade, promotes fast growth of foreign trade （import and export from foreign invested companies accounts for around 60% of China's total import and export volume of foreign trade）, and drives forward labor flow and transfer among regions and industries, and improves Chinese labor qualification structure.

In particular, since the 1990s, under the guidance of Chinese policy for utilization of foreign capital, many global companies invested a lot on research and development and technological transfer activities in China at the time of their expansion of investment in China. For relevant industries, the 'spillover-effect' caused by this type of technological transfer has introduced not only advanced technological products and equipment, but also improved the managerial level of local companies. Regionally, eastern coastal areas are foreign investment intensive, and while the concentrated foreign investment improves the industrial development level nearby, it also sets up an example. The experience is radiating outwards and stimulates labor transfer and technology upgrade into the middle and western parts of China.

Moreover, because many global companies attaches great importance to social responsibilities such as environmental protection, at the time of their investment, they also brought with them advanced pollution prevention and treatment technology, environment management ideas and measures, carried out clean production actively, and set up a good example in terms of environmental protection within China. Many international companies saw the great market opportunities for development of the environmental protection industry and environmental protection technology in China, and therefore promoted actively to introduce their environment industry, technology and equipment into China.

（2）FDI’s negative influences on China’s environment and development

With the accelerated growth of FDI inflow, its negative influences on China’s environment and development have become obvious. First, the great scale of export by foreign invested companies leads to a rising trade deficit for other countries and the aggravation of unbalanced BOP, which causes great pressure on RMB appreciation.

Secondly, China’s preferential policies to foreign invested companies lead to the ‘squeezing-out-effect’ on domestic companies, and curbs the development and expansion of local companies. A survey report by the Development and Research Center of the State Council pointed out that, of all the industries which have been opened up to foreign investment, the largest five companies in each industry are almost all controlled by foreign investment. Of the 28 main industries in China, foreign investment owns majority control in 21 industries. Meanwhile, Chinese national brands are repeatedly threatened by foreign global brands.

Thirdly, because of drawbacks in China’s policy for foreign capital introduction and the unbalanced structure of these investments, FDI aggravates the unbalanced nature of China’s industrial structure, regional structure and enterprises structure. In recent years, the actual foreign capital which was used in manufacturing industries accounts for around 70% of the total, in which agriculture and service industry takes much less. In regional distribution, 85% of FDI concentrates in the eastern area, and only 15% is in the middle and western area, and this pattern results in the weak position which middle and western regions have in terms of sharing capital and technological advantages of FDI.

It is worthwhile to mention that, even though technology which FDI employs is more advanced than the average domestic level, it is far from the internationally recognized advanced technology, and the related resource utilization efficiency and environmental performance are lower than the advanced technology applied in their home country. Because of the lock-in effect of these technologies, it is difficult to implement more advanced technology in China, and therefore delaying technological upgrade and innovation of Chinese industries. Besides, due to factors such as the technological barrier and privacy of global companies, in recent years, more and more companies with foreign investment have begun to turn to solely owned operations and therefore it is impossible for China to fully utilize their advanced technology and experience.

With the deepening of economic globalization and the expansion of the introduction of FDI to China, the negative influence of FDI on China’s resource and environment has been increasing. Statistics shows that foreign invested companies come to concentrate on industries with high consumption of resources and produce high pollution. In 1995, foreign invested companies engaging in pollution-intensive industry accounted for 30% of the total, and this figure rose to 84.19% in 2005. High polluting and high resource consumption industries became the major investment directions for FDI, with industries such as chemical, petroleum, leather, dying and printing, electroplate, pesticide, paper making, mining and metallurgy, rubber, plastics, construction material and pharmaceuticals.

Foreign investment which played a more direct role in environment protection amounted to less than US$100 million, less than 0.2% of the total. Furthermore, there is also research which indicates that FDI is the main driving factor for environmental pollution and resource exhaustion in eastern regions. Because of the increasing requirement on environmental standards in eastern regions, foreign companies, driven by China’s strategy for developing the middle and western regions, will possibly engage in mining industry and manufacturing industry in the middle and western part of China, and transfer the backward and eliminated industries from eastern region to the western. The final result would be ‘pollution transfer’ to the middle and western regions of China.

When consider fully the influences of FDI on China’s environment and development, FDI brings more obvious economic benefits to enterprises and the local level. However, when considered from a macro level, we should pay high attention to the negative influences of FDI on China’s environment and development.

There is a big divergence of the influences seen from a micro and macro level. Reasons for the divergence are quite complicated: there is no clear-cut policy dealing with foreign capital introduction in China and no mature mechanism for the assessment to the local government. Therefore local governments tend to exchange environmental quality for access to foreign capital, and local officials use the amount of capital investment introduction as the means to fulfill their political careers. Meanwhile, the current regulatory situation in China also causes the divergence, including low prices for resources, some low standards for environment, unhealthy environmental rules and regulations, and lax enforcement of environment rules.

All these problems related to FDI should be adjusted and solved through policy adjustment, and therefore further explore the positive aspects of FDI on China’s environment and development and reduce or avoid its negative influences.

4.2 GLOBAL IMPACT OF TRANSFORMATION OF CHINA’S DEVELOPMENT MODE

4.2.1 China’s Economic Growth and its Global Impacts

The fast growth of the Chinese economy has both positive and negative influences on global environment and development. Globalization creates a platform for win-win positions between China and the world. China's active participation in economic globalization strengthens its own comprehensive national power base and also creates active influences for the world economy. On the other hand, the fast growth of the Chinese economy creates large demand for energy and resources. It brings pressure not only on domestic resources and environment, but also has a certain degree of influence on the world environment and development.

（1）China's contribution to the world's economic and trade growth

Thinking globally, China can fully make use of 'two resources, two markets' by developing international trade and global investment, and thus promote the sustainable development of China's economy. Since its reform and opening up, especially after China's entry to the WTO in year 2001, China has made active contribution to the world economy and international trade at the time when it benefits from economic globalization.

The influences are firstly reflected in its role as a new driver for the world economic growth and the engine for the growth of the world economy and international trade. According to statistics provided by IMF, in calculation with purchasing power parity, China's GDP in 2005 accounted for 15.4% of the world GDP total; and according to statistics from the World Bank, since its entry to the WTO, the contribution rate of China's economic growth to economic growth rate of the world averages 13%, and in 2005, the figure was close to 29%.

Secondly, by leading the change of global industrial structure, China upgraded the position of some countries for export of their primary products, and these developing countries thus benefited from this change. Due to the growing demand from China for petroleum and raw materials and the rising international market price, some developing countries thus improved their BOP situation, and more developing countries realized fast economic growth.

Thirdly, China's economic and trade growth improves the global resource allocation efficiency, provides the international market with large amount of cheap goods, drives forward the structural adjustment of developed countries and holds down inflation. For instance, following the five years after China's entry to the WTO, European Union countries benefited from their investment in China. Their import from China doubled, and cheap Chinese products helped them to offset inflation and interest concerns.

Fourthly, with the fast growth of China's foreign investment and through aid programs, the Chinese government and enterprises helped to build a lot of infrastructure, and to conduct personnel training and technological transfer to other developing countries. These activities have greatly improved the local economic development and employment in developing countries and regions, such as countries and regions in Africa.

Furthermore, China also has promoted the recycling and reuse of waste materials at a global level through trade and investment, and this activity has not only alleviated shortage of domestic resources, but also drove forward the effective allocation and utilization of global resources.

（2）China’s ever-increasing development need brings pressure on the world environment and development

At a time when China’s economic development brings about active influences on world development, it also creates a certain degree of pressure on the world’s resources and environment. The pressure is reflected in two aspects.

First, the fast growth of the Chinese economy and large production and consumption activities following this growth have brought great pressure on global resources and environment. Besides huge demand for petroleum and other raw materials, the growth ultimately is limited because the energy structure relies mainly on coal. China’s ever increasing energy consumption results in the acceleration of carbon dioxide discharge, and the discharge would create a certain degree of effect on the global climate change. From 1973 to 2004, CO_2 emission in China increased from 5.7% to 17.9% of the world discharge total. In 2004, China’s GDP accounted for around 5% of the world total; however, according to calculations by the World Bank, during 1994 to 2004, China’s energy consumption accounted for around 30% of the world newly increased consumption, in which coal 59%, petroleum 28%, and iron consumption accounted for more than half of the world newly increased total.

Secondly, Chinese companies, in the process of obtaining outside resources and exploring foreign markets, because of the lack of advanced technology and experiences, also brought about some negative influences on the local environment of other countries and regions. In essence these problems came into being not only because of the great economic and social development needs in China, they are also driven by international market needs under the economic globalization.

Energy consumption and carbon emission are the main factors which influence world climate change. From the perspective of world climate change, the concern is how to assure future self-development room for developing countries, including China. Because its initial human development needs have not yet been satisfied, carbon emission in China will continue to increase. However, with the fast growth of the Chinese economy, consumption needs and structural needs of China’s residents have already taken tremendous change.

Taking into consideration the development needs brought about by the large population scale of China, and the economic benefits brought by China to other countries in the world, it is a topic facing all countries in the world—how to share the world climate resources equally, and at the same time cause no damage to security of the world environment.

4.2.2. China's Overseas Development Investment （ODI） and its global impact

China's accelerated economic growth has created huge demand on natural resources. It also is bringing about a wave of investment by Chinese enterprises in other countries.

Driven by the needs for resources and market power, in recent years, investment by Chinese companies overseas is growing quite fast. From 1990 to 2006, investment by Chinese companies overseas increased by 23.5 times. From 2002 to 2006, investment overseas increased at an annual average rate of 60%, forming a leading position in the world. To the end of 2006, more than 5000 Chinese enterprises set up around 10,000 overseas enterprises in 172 countries, with net foreign direct investment accumulated at around US$90.63 billion. In 2006, direct investment by Chinese company overseas accounted for 2.7% of the world total, and China ranks the first among developing countries, and ranks 13th in the world.

Accompanying investment by Chinese companies overseas, the export of services by Chinese companies also has grown quite fast. The proportion of export of service by Chinese companies increased from 0.7% of the world total in 1982 to 3.3% in 2005, and the ranking also upgraded from 28th to 8th place. As one important point of China's opening up policy, the development of investment overseas and service trade all promoted the prosperity and stable development of the world economy.

In terms of regional distribution, the main investment destinations for Chinese companies are South America, Asia, Europe and Africa. Besides, because of its abundant labor resources, China has provided through service trade a large number of technology-oriented labor resources to developed and developing countries; for instance, China has provided many construction and designing engineers through ODI mode to countries such as Japan, South Korea, Singapore, Algeria, Sudan, etc. For these countries and regions, growth of China's investment overseas and service trade is a win-win choice. Developed countries can obtain cheap commodities and service, and developing countries such as African countries can get more development opportunities by attracting Chinese companies to explore their local resources, which results in investment growth, more employment opportunities and improvement of their infrastructure conditions.

The development history of Chinese investment overseas reveals that it has already experienced the process of going from government-oriented to market oriented investment.

At present, policy for Chinese investment overseas has entered a deep transformation stage that is mainly reflected in three aspects:

- A transformation from political objective oriented to business benefit oriented investment;
- A transformation from unified adjustment by the central government to self management by local government and enterprises; and
- A transformation from single objective for resources to multi-objectives combined by seeking for resources, technology and market.

Driven by their own interests, as well as poor supervision and management, some Chinese enterprises have created pollution and damage to the local environment during their investment overseas and have caused some degree of negative influences in the world. These companies should start from a position of developing the corporate environmental responsibilities of their relevant enterprises, and embrace 'Corporate Social Responsibility', a voluntary measure internationally. These concepts should be brought into national trade policy, investment policy, financial policy and credit policy, and therefore promote the continuous and healthy development of Chinese companies.

4.2.3. China's choice of different development modes and the impact on the global environment

From the history of industrialization of countries in the world, energy consumption intensity curve of leading industrialized countries appears as an upside down 'U', corresponding with different stages for industrial structure. At present, China is at a stage of capital-intensive industrialization, which is a stage when energy consumption and pollutants discharge are accelerating. From statistics, in 2006, China's energy consumption strength and unit GDP pollutant discharge began to appear at a point of inflection. From the latter half of 2006 to the first half of 2007, the energy consumption intensity has been decreasing continuously for four quarters, and discharge of SO_2 also started to decrease; growth of total discharge of nitrogen oxide substances became stable, while manufacturing industries with high added-value and high processing degree became the leading industry for growth.

However, China's great industrial scale could lead to further increase of energy consumption and CO_2 emission. With the limited capacity of global environment and the obvious impact by climate change, China should prepare for further energy saving and less discharge of pollutants.

A different industrialization mode would result in different impacts on energy and environment. To differentiate from its traditional industrialization mode, Chinese government is setting up a new path for industrialization. The so called 'new type of industrialization' is the type of industrialization which bases its foundation on being resource-saving and environment-friendly, and it not only has some of the features of traditional industrialization, but also follows up and utilizes the newest achievements from the world's scientific and technological reform; it is in accordance with the industrial development of leading industrialized countries, and enables modern service industry to develop at a fast speed also.

Based on the relationship between the mode for economic development and energy consumption and pollutants discharge, three scenarios for China's future development might be considered:

- The new type of industrialization mode with a high objective to achieve; this mode can realize discharge reduction objective of all stages;
- To continue the traditional industrialization mode with high energy consumption and environmental pollution;
- The medium mode with a lesser objective for the new type of industrialization; under this mode, discharge reduction objectives for all stages would not be achieved.

The above three scenarios differ a lot in terms of their support of energy and environment to China's economic and social development. When considering fully the relationship between China's economic and social development, its energy and environmental carrying capacity, and its influence to the world, China should try its best to realize the new type of industrialization mode and to avoid the continuation of the traditional industrialization mode.

From a general point of view, China carried out compressed industrialization, a type of industrialization which could greatly shorten the process for industrialization comparing with that of pre-industrialized nations. However, as the process is carried out in a short period of time, energy and resources consumption strength grows quite obviously. Because of its large population and great economic scale, China would possibly consume tremendous amount of energy and resources during its industrialization process, and it would bring severe impact on the world. Thus in reference to China's industrialization road, the relationship between industrialization, resources and energy, and its impact on the world energy and environment situation, there are five considerations:

First, restrictions facing industrialization in China are different from thoes facing other pre-industrialized countries; the restrictions are more reflected on population, resources and environment, although there also exist restrictions by capital and technology. Secondly, destination for China's industrialization is different from other pre-industrialized countries, and the difference is in particular reflected in per capita occupancy of resource consumption and material wealth. Thirdly, China will carry out industrialization under a context of peace and development and under the current international law and organizational framework. Fourthly, there is no clear cut line for China's industrialization; industries with all types of production factors exist at the same time. Fifthly, China's industrialization is being carried out under the background of continuing development of economic globalization and China's deeper involvement in the world globalization. The resource sourcing issue for China therefore should not only be solved at the level of country's in the world but should also take into consideration its negative impact on the world environment. And it is an important issue which must be solved properly in China's process of industrialization.

5. Conclusions and Policy Recommendations

China is entering a period in which strategic transformation of its environment and development has become an urgent priority. The experiences of other countries suggest that such a transformation could have great benefits for human health and natural systems, and that the economy will in the end benefit from the transition. A growing number of stakeholders at the national, provincial, and local level recognize the historic opportunity to become an environmentally friendly society while improving economic qualities and developing a harmonious society.

Evidence from other countries also suggests that significant environment and development transformation can take 15 years or more, and needs an integrative approach of public support, enlightened political leadership nationally and locally, and participation by business and industry. While much can be accomplished immediately through better implementation of proven environmental technology and management, environment and development strategic transformation is most successful when it proceeds beyond end-of-pipe pollution control, to build new approaches based on the social and economic strengths of the nation; to create new products and services that lead to improved international competitiveness, and to implement responsible environmental action internationally.

Taking these observations into account, China will need to frame its environment and development strategic transformation in a way that maximizes opportunity, especially during the coming 15 to 20 years. In this time frame, China needs to establish a practical pathway that fully reflects scientific-based development, the “Three Transitions” principles for reconciling environment with economy, and other guidance that has set in motion the strategic transformation. Such a practical pathway shall lead to systematic actions in all dimensions of political, economic and social as well as environmental factors and conditions in order to move strategic transformation forward.

In the political dimension, good environmental governance needs to be established for the purpose of mobilizing governments at all levels and inter-agencies, enterprise, the public and other stakeholders. In the economic dimension, sustainable consumption and production is the right way for China to attack the conflicts among sustained growth of the economy, natural resource shortages and environmental pollution. In the social dimension, encouraging public and NGO participation in environmental affairs through establishment of concrete mechanisms is a pressing issue, while also cultivating an environment-friendly culture including consciousness and life-style.

And in the environmental management field, efforts need to be concentrated on resolving key problems such as inadequate legal authorities for environmental policy enforcement, a still weak environmental voice in decision making for national development, poor capacities, and loose enforcement of environmental laws and policies. In so doing, strategic transformation on environment and development in China will be distinctive, carried out more quickly than in any other society, and lead to benefits that will far outweigh costs.

The following seven policy recommendations are proposed for consideration by the Chinese Government to accelerate its strategic transformation.

（1）Accelerate improvement of China’s existing environmental protection system to take maximum advantage of the latest environmental technology, management techniques, and legal frameworks.

To accelerate the pace in the strategic transformation period, the Chinese Government should attack three pressing and interactive problems in the existing environmental protection system: loose enforcement of environmental laws and policies, poor capacities of environmental agencies for fulfillment of their responsibilities, and a weak environmental voice in the process of decision-making for national development, Three solutions to those three problems are needed:

- Revise the existing environmental laws to adapt to new requirements of strategic transformation, including the 1989 Environmental Protection Law, the Water Pollution Prevention and Control Law, the Air Pollution Prevention and Control

Law and others as soon as possible. Among a number of new requirements for revising the existing environmental laws, it is critical to set up increasingly stringent environmental standards and rigorous punishment for non-compliant environmental behaviors, with the aim of changing the existing locked-in situation in China where the costs of non-compliant environmental behaviors are much lower than those of compliant ones.

- Install sufficient human resources and allocate sufficient funding to environmental agencies at all levels to ensure good capacities for fulfillment of their environmental responsibilities. As compared with the situations in other countries with success in environmental protection, poor capacities of environmental agencies at all levels in China, including human resources, know-how, funding and equipment such as monitoring, have become a bottleneck to improvement of Chinese environmental performance.
- Upgrade the status of environment agencies at all levels in order to increase the environmental voice in the decision making process of socio-economic development. This is of critical important for socio-economic decisions and policies to take environment into consideration, which is beneficial both for strengthening environmental protection and for facilitating changes of economic growth pattern. Upgrading the SEPA to become a ministry of environment and improving coordination among different ministries in environmental affairs are good starting points.

（2）In the process of accelerating strategic transformation, China should rely more on the application of market-based policies, including environmental cost internalization via pollution taxes, energy, and fuel taxes.

OECD country experiences have demonstrated for many years that market-based policies, such as natural resources pricing reform, environmental taxes and fees, emissions trading systems, and green financing, are the most cost-effective measures for both environmental and economic purposes. The application of market-based policies has been discussed for a decade or more in China. For the purposes of both structural adjustment of “sound and fast economic growth” and achievement of energy-saving and pollution abatement targets, China should immediately start an intensive process to introduce more environmental economic instruments for internalizing environmental costs of economic activities. This is actually particularly well addressed in the “Three Transitions Principles” for reconciling environment and economy raised by the Chinese Government in 2006. The immediate actions in this regard should be enhanced with joint efforts among economic, financial and environmental agencies of China.

（3）Build public awareness and participation so that the entire society plays a role in the strategic transformation, including household and workplace consumption and environmental health, monitoring of local development, and direct participation in environmental improvements.

Three reasons why China needs to build public awareness of strategic transformation and public participation are: 1）strategic transformation is still at an early phase in China, relevant stakeholders including local governments, enterprisers and citizens are less aware of the arrival of the strategic transformation and its implications; 2）as compared with the governmental and enterprises' efforts in environmental protection, the role of the public has been weak for a long time in China; international experiences show that the public plays a critical role in not only motivating but also accelerating the strategic transformation; and 3）in terms of awareness and know-how, strategic transformation of environment and development has a broader context than normal environmental education and communication in China. Therefore, China should strengthen and renew the public awareness education and communication activities for strategic transformation and establish formal mechanisms for the public and NGO participation.

（4）Accelerate eco-innovation in all key sectors, based increasingly on Chinese endogenous technologies and approaches, placing particular attention on how accelerated adoption can take place.

China has set up new ambitious and detailed strategies and planning for science and technology innovation. From the perspective of accelerating strategic transformation, science and technology innovation in China needs to draw more attention to four points: 1）innovation should be environment-friendly, i.e., eco-innovation; 2）emphasis of innovation should be on all key sectors such as environmental industrial sector, energy sector, building and infrastructural sectors, transportation sector and those industrial sectors with intensive energy consumption and heavy pollution; 3）make full use of Chinese endogenous technologies and approaches while introducing advanced technologies from abroad; and 4）provide more financial supports for dissemination of better technologies.

In accordance with the transformation of China's environment strategy, changing the current growth mode of trade is necessary in order to adjust the relationship between trade, resources and environment.

Fast growth of China's foreign trade is closely related to its position in international distribution. China has become an important importer for energy, raw materials and high-tech products and a net exporter for textile products, machinery, heavy industry materials and equipment. Research on embodied energy has revealed that the fast growth of energy consumption and pollutant discharge in China is not only a result of meeting its domestic investment and expansion of consumption needs. Fast growth of exports led by external demand is also a very important driving force. Initial research suggests that at the same time as China is accumulating its trade surplus, its 'deficit' for environment and resources is also expanding.

In order to turn around this situation, China should not only adjust import and export structure of foreign trade, but also turn around the current extensive mode of trade which has been carried out for a long period of time. The following proposals are suggested:

- Make full use of China's trade surplus to import products and technology with high embodied energy; reduce unbalanced trade of goods and reduce problems concerning imbalances created by net export growth of embodied energy. Owing to the tremendous domestic need, it is not possible for China to avoid importing large amounts of oil and gas resources. But at the time when China imports such energy products as petroleum, natural gas, etc., it should also find and expand substitutes for goods that require high energy consumption in their production, or sometimes, import them; and restrict the export of such goods.
- Speed up transformation of the current foreign trade growth mode, moving from the traditional growth mode relying mainly on price competition, quantity expansion and seeking very high growth rates, to a mode relying on improvement of quality, increase of profit and optimization of structure.
- Reduce the resource and energy deficit at the same time as reducing China's trade surplus; levy an environmental pollution tax on enterprises with high energy consumption and high pollution; and increase the current low price of some resource products and assign costs for environmental damage to the responsible enterprises.
- Restructure the current processing trade mode, to further develop trade for service industry and continue to optimize domestic industrial structure. Optimize regional structure for manufacturing goods for export, including promoting the upgrade of processing trade in eastern areas, making full use of the local abundant human resources in the middle and west of China, and introducing environment-friendly processing trade to these areas. To expand the export of services, strengthen international competitiveness of Chinese commodities and services. At the same

time, introduce advanced foreign technology and equipment, and promote energy saving and emission reduction activities in order to improve domestic environmental quality.

- Strengthen environmental monitoring of trade for recyclable and wasted goods; conduct regional planning for environmental management of trade for recyclable and waste materials, and maintain the environment for sustainable development. Conduct life cycle analysis for imported recyclable and wastes that could be used as raw materials, and enforce strict environmental entry standards into China of such materials. Have comprehensive assessment on environmental impacts on the origin countries for import of raw materials such as cotton, wood, ore, etc., and take steps to prevent negative influences on the environment in the countries of origin.
- Strengthen the honoring of international agreements, domestic policy and legal monitoring in order to curb illegal trade in toxic wastes. Restrict processing enterprises that import recyclable and wastes from exporting the resulting raw materials, in order to ensure that it is used for meeting domestic needs, or for producing high value export products, not merely for getting foreign exchange, while leaving behind pollution.

（5）Strengthen management of global enterprises and Chinese companies that invest overseas, and improve the Corporate Social Responsibility awareness of these enterprises on environmental protection

In essence, ODI and FDI both refer to the home country attaining capital, technology and resources from other countries. It is an effective means to expand markets. From the point of process and usual patterns of globalization, gradient transfer of industries has some common features, and investment activities from developed countries to developing countries would provide meaningful experiences for China’s investment abroad.

Under the current situation of globalization, as a developing country, China can make use of FDI in its industrialization process, and introduce advanced production technology, operation principles, environmental protection awareness and social responsibility from industrialized countries, and coordinate these with independent innovation, and removing constraints from resources and technology. At the same time, in order to break through restrictions on industrialization from its own resource and environmental capacity, it is also an effective solution for China to make use of global resources through the implementation of ODI. In order to make full use of the advantages of ODI and FDI and to avoid problems related to environment pollution and sustainable development at home and abroad, policy monitoring should be strengthened in the following aspects:

- Strengthen enterprises through institutional restrictions; raise environmental and technological standards for investment; and set up green principles for investment. On the one side, conduct Environment Impact Assessment of programs for foreign investment and encourage the entry of enterprises and industries which are environment-friendly. On the other side, promote the active cooperation between governmental departments and enterprises. By setting up guidance for green investment, urge enterprises to carry out their social responsibility by means of setting up environment terms in foreign investment programs, and in particular by realizing green investment and clean production in natural resource exploration fields, and lower the environmental and social impact to the host country.
- Enact policy directives for foreign invested industries, and carry out assorted guiding policy for FDI. Put into practice market entry policies in categories of restricted, limited and permitted enterprises based on their technological level, pollution level and environmental capacity of relevant invested regions. With the help of government policy, coordinate and strengthen the close relationship between economic development and environment, and promote orderly development of FDI and ODI with overall consideration for the national sustainable development strategy.
- Encourage Chinese enterprises to obtain international advanced managerial experiences and environment-friendly technologies through their investment overseas or establishment of joint ventures in other countries. Such investment will strengthen the long term competitiveness of Chinese companies in the international market. International organizations, NGOs and private companies should be encouraged to get involved in investment activities in the field of environmental protection; to strengthen the management and monitoring of FDI so as to avoid erosion of natural resources and deterioration of the environment.

（6）Strengthen China's participation in bilateral or multilateral environmental cooperation, and therefore impelling the successful transformation of China's environmental strategy.

The exploration and utilization of resources by China is inevitably having a great impact on the world's environment. As the largest developing country, it is both a requirement for economic and social development for China and a contribution to the world to solve well the issue of China's environment and development. Being a responsible nation in international affairs it is important for the Chinese government to strengthen its international dialogue and cooperation in the following aspects:

- Promote the implementation of international environmental conventions through active participation in all types of implementation activities, learning from advanced implementation experience, and setting up complete implementation mechanism, management system and framework of policies and regulations; and make use of these conventions to protect China's resource and environmental interests.
- Participate actively in the construction of the global environmental regime; adhere to the principle of common but differentiated responsibilities; maintain the right for development of all developing countries including China; set up the international image of China as an active and responsible nation; shoulder international obligations within its capability; explore technological cooperation opportunities such as South-North Cooperation, and carry out effective cooperation activities between South-South countries.
- Strengthen environmental governance from the perspective of production and consumption. Regulate market behavior of Chinese enterprises which have investments abroad; upgrade environmental standards for investment; improve environmental awareness of policy-makers and the public.

Name List

Name List of Council Members
CCICED Phase IV

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Mr. Zhu Guangyao	Former Vice Minister, SEPA, Secretary General of the Council
Mr. Feng Zhijun	Vice Chairman, Environment Protection and Resources Conservation Committee, National People's Congress
Ms. Jiang Zehui	Vice Chairwoman, Committee of Population, Resources and Environment, the National Committee of the Chinese People's Political Consultative Conference
Mr. He Yafei	Assistant Minister, Ministry of Foreign Affairs
Mr. Zhu Zhigang	Vice Minister, Ministry of Finance
Mr. Yi Xiaozhun	Vice Minister, Ministry of Commerce
Mr. Li Ganjie	Vice Minister, State Environmental Protection Administration
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表 1　Table 1　Revenue and expenditures: CCICED Phase III August 2002 - October 2007　　（US dollars）

Category	Canada	Norway	Sweden	UK	Switzerland	GTZ	Janpan	The Netherlands	Italy	WWF	Shell	EDF	China	Total
I. Revenue	7,943,867	1,490,736	2,062,515	1,406,930	992,000	2,015,000	787,500	780,000	260,000	400,000	80,000	200,000	1,300,000	19,718,548
II. Expenditures														
1. Task Forces														
WTO & Environment	295,522				992,000								27,000	1,314,522
Protected Areas	369,176	165,685	179,714										27,000	741,575
River Basin Management	62,198	116,262	147,902							400,000			27,000	753,362
Nonpoint pollution	138,692	161,921	141,003										27,000	468,616
Energy	287,246	43,690	62,605										27,000	420,541
Economics	38,574	74,846	18,207	1,406,930									27,000	1,565,557
Env. Industry						520,000							27,000	547,000
Financial Mechanism							270,000						27,000	297,000
Cleaner Production							180,000						27,000	207,000
Enterprises and Env.								364,000					27,000	391,000
Agriculture	425,014	108,146	39,109										27,000	599,269
Transportation	602,766	56,367	291,614						91,000				27,000	1,068,747
Review and Prospect	224,234	56,692	74,451										27,000	382,377
Circular Economy						520,000							27,000	547,000
Economic Growth & Env.	527,009	67,568	109,016					416,000					27,000	1,146,593
Urbanization	591,984		257,164										27,000	876,148
Eco-compensation		87,813	181,115				270,000						27,000	565,928
Governenance		28,916	62,560			520,000						200,000	27,000	838,476
11th FYP	50,367	100,042	100,000										27,000	277,409
Transformation	48,656	3,995	50,000										27,000	129,651
Innovation	5,516	50,043											27,000	82,559
Subtotal	3,666,954	1,121,986	1,714,460	1,406,930	992,000	1,560,000	720,000	780,000	91,000	400,000		200,000	567,000	13,220,330
2. Council AGM	1,199,916	107,028	151,884			273,000							130,000	1,861,828
3. Secretariat operations (SERI)	360,732	66,053	97,178			182,000	67,500		169,000		80,000		503,000	1,525,463
4. Lead Expert Group	1,010,579	190,355	93,655										100,000	1,394,589
5. SISO Administration	1,705,686	5,314	5,338											1,716,338
Total expenditures	7,943,867	1,490,736	2,062,515	1,406,930	992,000	2,015,000	787,500	780,000	260,000	400,000	80,000	200,000	1,300,000	19,718,548