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Developing a Circular Economy in China: Highlights and Recommendations



The World Bank

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Environmental and natural resources management issues are an integral part of the development challenge in the East Asia and Pacific (EAP) Region. The World Bank’s Environment Strategy in the East Asia and Pacific Region has provided the conceptual framework for setting priorities, strengthening the policy and institutional frameworks for sustainable development, and addressing key environmental and social development challenges through projects, programs, policy dialogue, non-lending services, and partnerships. This study provides a forum for discussions on good practices and policy issues within the development community and with client countries.

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SUMMARY

China's rapid economic growth over the past decades has been accompanied by substantial depletion of natural resources and serious environmental pollution which are characterized as follows.

China's resource utilization efficiency (defined as resource consumption per unit of GDP) is low in relation to international standards. Accounting for 14.5 percent of the world's economy (on a PPP basis), China, in 2005, used 15.8 percent of the world's freshwater, 26 percent of steel, 25 percent of aluminum, and 47 percent of cement. Although part of this "inefficiency" is due to the present structure of the economy (manufacturing and exporting resource intensive goods), there is still much that can be done to improve resource utilization efficiency. In addition, as China grows, the structure of its economy will also shift and efficiency gains in resource use will help China grow into a more sustainable, and environmentally friendly future.

The combination of growing raw materials consumption and low efficiency of resource use results in massive generation of waste products, and underinvestment in waste treatment. Although production of economic goods as well as waste has increased dramatically in recent years, waste treatment rates are still modest, largely due to inadequate investment. For example, only 56 percent of urban domestic wastewater and 54 percent of solid waste were treated in 2006.

As a result of the rapid economic growth coupled with increasing use of natural resources the natural environment has been

seriously polluted. The serious level of air and water pollution has resulted in high environmental and health costs. For example, the government estimates that the economic cost of environmental pollution was about 512 billion RMB in 2004, equivalent to 3.05 percent of GDP.

Institutional and policy failures are a major cause of these environmental and resource-use problems. Pervasive market and policy failures, including subsidies for raw materials, weak enforcement of anti-pollution regulations, and low waste disposal fees result in low resource productivity and severe pollution. Institutional and policy reforms to remedy such failures are urgent and deserve the full attention of the government.

To its credit, China's government fully recognizes that such trends cannot continue indefinitely and therefore is committed to building a resource-saving and environmentally friendly society as a stated national policy. It has adopted the Circular Economy (CE) approach as a core component of its sustainable development strategy and has passed legislation to support this. CE is a general term covering activities that reduce, reuse, and recycle materials (referred to as the 3R approach) in production, distribution, and, consumption processes. Basically, this 3R approach strives to reduce harmful impacts of economic activities on the environment by minimizing impacts throughout the production life cycle. The ultimate objective of the CE approach is to achieve the decoupling of economic growth from natural resource

depletion and environmental degradation. Successful implementation requires government involvement and effective institutional arrangements.

Although introducing the CE approach initially imposes some increased costs and often requires substantial investments from both government and private entities, many of the CE solutions also turn out to be economically advantageous when the costs of environmental externalities that are avoided are fully taken into account. The legislation, policies, and pilot programs already in place demonstrate the potential of CE to make a real difference.

This report, based on findings from World Bank-supported studies and lessons learned from on-going government programs, gives special emphasis to the following four themes:

Improving the effectiveness and efficiency of CE policies through a balanced mix of policy instruments, including establishing the appropriate regulatory framework, achieving the correct policy mix between command-and-control and market-based incentives, working towards “getting the prices right” and harmonizing economic policies. In some cases government incentives may be required to promote adoption of CE measures, always remembering that the cost-effectiveness of any policies must be key criteria in the design and implementation of the CE approach.

Enhancing industry and community participation by actively involving the production sector, local government, community groups, industrial associations and professional networks, and NGOs in the process of establishing

a CE. An expanded use of the “extended producer responsibility” (EPR) system shows promise on the production side, and enhanced community involvement in implementing the CE approach is another key element to creating “buy-in” to the CE approach.

Building capacity for CE implementation via enhanced training of those responsible for implementation (including representatives of government, industrial groups, and local communities) and disseminating local and international experience with CE and best-practice examples. Successful implementation requires systematic monitoring of progress (including the use of indicators), as well as creating mechanisms for learning and adjusting policies to respond to new information or modify policies if existing ones are not effective.

Clarifying the role of government and strengthening governance through establishing high-level leadership for the CE approach, ensuring organizational harmonization of CE efforts across sectors and ministries, and enhancing the accountability of government programs. Given the growing role of the private sector in China’s economic growth, the government needs to remember that its key function is as a promoter of and an enforcer for CE, rather than as a direct implementer. While all levels of government continue to have a major role, the government needs to be able to clearly distinguish between cases when it needs to step in with regulation, and when it is both more effective and cheaper to support market-based solutions.

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1. INTRODUCTION

China's rapid economic growth over the past decades has been accompanied by substantial depletion of natural resources, degradation of major ecosystems, and serious environmental pollution with adverse impacts on human health. China's government fully recognizes that such trends cannot continue indefinitely and therefore is committed to building a resource-saving and environmentally-friendly society as a stated national policy. It has adopted the Circular Economy (CE) approach (sometimes also translated as "recycling economy"), where CE can be translated as an economy that maximizes reduce/reuse/recycle strategies (referred to as the 3R approach) to reduce resource inputs and pollution discharges per unit of production. CE is becoming a core component of its sustainable development strategy.

The ultimate objective of the CE approach is to achieve the decoupling of economic growth from natural resource depletion and environmental degradation. The Chinese government has been promoting CE on a number of fronts — legislation, policy reform, pilot projects, and monitoring and evaluation activities. The World Bank, with funding from Italian and British trust funds, has supported policy and legal studies for some of these activities, including the preparation for the Circular Economy Promotion Law that was promulgated by China's National People's Congress in August 2008.

Over a dozen studies were completed by Chinese and other experts examining various aspects of the Circular Economy approach and its application in China.

The background papers are grouped in four categories: legislation and policies, indicators, pilot studies by sector, and developing an eco-friendly industrial park. Preparation of these papers was followed by an extensive consultation process in China. The background papers are listed at the end of this note.

This briefing note highlights and recommends further actions the government should take into consideration to enhance the effectiveness of its efforts to develop a circular economy.

Based on the findings and results from the World Bank-supported CE studies, the note focuses on four key areas that deserve greater attention:

- a balanced mix of policy instruments,
- participation by both industry and the public in the CE approach,
- capacity building, and
- the role of the government and governance.

A set of recommendations are provided under each topic.

2. OVERVIEW OF THE PRESENT ENVIRONMENTAL SITUATION AND ON-GOING EFFORTS TO DEVELOP A CIRCULAR ECONOMY

Since its opening up in 1978, China's economy has grown at the remarkably high average rate of 9.6 percent per year. Per capita GDP has also increased significantly, leading to rising affluence and consumption and improvements in the quality of life. Rapid growth, however, has also been coupled with inefficient natural resource utilization, serious pollution, declining environmental quality, and increasing health damage costs. Even if China's economic structure changes in the future (with less emphasis on resource-intensive manufacturing and exports) the current development trend is not sustainable and is characterized by the following characteristics:

China's resource utilization efficiency (defined as resource consumption per unit of GDP) is low in relation to international standards. Accounting for 14.5 percent of the world's economy (on a PPP basis, UNDP 2007), in 2005 China used 15.8 percent of the world's freshwater (World Bank, 2007), 26 percent of steel, 25 percent of aluminum, and 47 percent of cement (Worldwatch Institute 2006). Consumption of steel, copper, aluminum, lead and zinc per unit of GDP is 5.6, 4.8, 4.9, 4.9, and 4.4 times the world average. Although part of the cause of these patterns is the structure of the Chinese economy – dominated by heavy industries that naturally are resource-intensive – a major contributing factor is low efficiency of resource use, often promoted by inappropriate policies. Partly due to low

energy prices, China's energy consumption per unit output (whether measured on an exchange rate basis or on a purchasing power parity basis) is substantially higher than almost all competing nations, except for Russia.

In addition to mineral and energy inputs, water is also often used inefficiently. For example, despite water scarcity in many parts of China, the efficiency of water use remains low. China's water productivity, at \$3.60/m³ (on a PPP basis), is considerably lower than the average of middle-income (\$4.80/m³) and much lower than that of high-income countries (\$35.80/m³) (World Bank 2007b).

(ii) *The combination of growing raw materials consumption and low efficiency of resource use naturally results in massive amounts of waste being generated each year.* For instance, total wastewater and COD discharges in China rose to 53.7 billion tons and 14.3 million tons respectively in 2006, up by 2.4 percent and 1.0 percent compared with 2005 (SEPA 2007a). In the same year, industrial solid waste was 1.5 billion tons, up by 13.1 percent from 2005, and SO₂, soot, and industrial dust emissions amounted to 25.9 million tons, 10.8 million tons, and 8.1 million tons respectively. (SO₂ emissions were over double the 12 million tons permitted by national standards.) Waste treatment rates, however, are still modest, largely due to inadequate investment. For example, only 56 percent of urban domestic wastewater and 54 percent of solid

waste were treated in 2006 (NDRC 2007).

(iii) As a result of the rapid economic growth (to a great extent much attributable to manufacturing and exporting resource intensive goods) coupled with increasing use of natural resources the natural environment has been seriously polluted. According to the most recent State of the Environment report (SEPA 2007a), in 2006, 28 percent of all 745 monitored river sections reported water quality worse than Grade V—that is, unsafe for any use. 30 percent of major city drinking water sources do not meet the Grade III quality standard – that is, they are unsafe for human consumption after treatment. Almost half, or 46 percent, of cities above county level do not meet the official Grade II air quality standard that is required for urban areas. This serious level of air and water pollution is associated with high environmental and health costs. As estimated by the government, the economic cost of environmental pollution was about 512 billion RMB in 2004, equivalent to 3.05 percent of GDP (SEPA and NBS 2006). Thus, inefficient resource use and serious pollution are both very costly today and have begun to undermine the sustainability of China’s development.

(iv) Institutional and policy failures are a major cause of these environmental and resource-use problems. It is well known that market failures under a free market economy, i.e., a failure to internalize external costs in decision making about production and consumption, cause environmental pollution and resource depletion. But, speaking more broadly, market failures are often created by institutional failures that result in low resource productivity and severe pollution. Even with continuing

economic growth and structural changes in the economy, China needs to address institutional and policy failures – growth by itself will not produce the desired result of a more sustainable economy. An obvious example of policy failure is the case of low fees for wastewater discharge which fail to reflect downstream costs. These low fees result in excessive wastewater being generated and discharged untreated into water bodies thereby imposing negative environmental impacts (water pollution, water shortages, and public health problems) on downstream communities. The low wastewater discharge fees also mean that polluters have little incentive to invest in costly water treatment. In addition, the fact that effluent fees are often not collected, and that excessive discharges are not monitored and sanctioned, further exacerbates the institutional failure. Other examples of poor policies include subsidies for the production and consumption of agrochemicals (fertilizers and pesticides,) that are a major cause of nonpoint source pollution in rural areas. Institutional and policy reforms to remedy such failures are urgent and deserve the full attention of the government.

TOWARDS A MORE SUSTAINABLE GROWTH PATH

Concerns over the unsustainability of China’s resource and pollution intensive growth path led to the search for an alternative model for more sustainable development. The concept of circular economy (CE) first became known and popular in China in the late 1990s. Aiming to decouple economic growth from increasing resource use and environmental degradation, the CE approach is an economic growth model

designed to enhance the efficiency of raw material use through the adoption of reduce/reuse/recycle strategies (referred to as the 3R approach) that translate into sharply reduced resource inputs and pollution discharges per unit of production.

The circular economy approach focuses on the life-cycle of economy-environment interactions. It builds on the industrial ecology tradition which promotes the restructuring of industrial processes along the lines of ecosystems, whereby the waste of one manufacturer becomes the input of another (Frosch and Gallopoulos 1989). The term "circular economy" was first used in the Western literature in 1980s (Pearce and Turner 1990) to describe a closed system of economy-environment interactions. In Germany and Japan the interpretation of CE is based on the management of waste through 3R. The underlying vision is that the present linear flow of materials (resource → product → waste) needs to be transformed into a circular flow (resource → product → recycled resource).

It must be recognized that the CE approach often costs money up-front and normally requires increased expenses on the part of manufacturers, both government-owned and private firms. If a recycling activity was privately profitable it would already be practiced. In fact, the most economic or profitable recycling options from a purely private perspective have already been "cherry picked." China has one of the world's largest recycling industries, particularly for electronic waste, industrial solid waste, and paper. The economic justification for broader and expanded CE, however, is that when

one examines the total costs of implementing CE, and compares this to the total benefits of its implementation, the benefits should exceed the costs. Since many of the benefits of the CE approach accrue to the wider public or society (e.g. less waste generated, reduced pollution, reduced environmental impacts) but the costs of implementing CE do fall on industry and/or consumers, government involvement and incentives are normally required to implement CE.

In China, the CE concept was adopted by the government as a new paradigm for economic and industrial development -- a paradigm that improves resource use efficiency and protects the environment. China's 11th Five-year Plan for Economic and Social Development describes CE as combining economic development with resource conservation in accordance with the principle of 3R. It proposes a closed loop of resource development, production, consumption, waste generation, and recycling. The CE Promotion Law defines CE as "a general term covering activities that reduce, reuse, and recycle materials in production, distribution, and consumption processes". Basically, the 3R principle is prescribed for the full life cycle of products to reduce the harmful impact of economic activities on the environment.

ON-GOING INITIATIVES FOR CE PROMOTION

Recognizing that a full and comprehensive CE will not develop by itself and it will require both government encouragement and increased investment, beginning in the early 2000s the Chinese government has

launched a series of programs to promote the CE approach. These efforts are guided by the State Council's "Guidance of the State Council on Promoting the Development of Circular Economy" issued in 2005. This document sets targets for establishing legal, policy, and institutional systems for a circular economy.

LEGISLATION. Recognizing that appropriate laws and rules are essential for promoting the CE, the government undertook a major effort to develop a supportive legal and regulatory framework. A study on the drafting of the China CE Promotion Law was carried out in 2005–07. The study evaluated existing Chinese laws and regulations related to resource conservation and waste management, reviewed international experience, and examined options to improve the current legal system for the promotion of CE. The China CE Promotion Law was promulgated by the National People's Congress of China (NPC) in August 2008 and became effective on January 1, 2009. It is among the first, if not the first, such law in a developing country and reflects the commitment of the Government of China to "growing" a more sustainable future.

POLICY. As suggested by China's low efficiency of resource use and serious environmental pollution, existing policies have proven inadequate for solving environmental and natural resource management problems. A number of studies were conducted to identify priorities for strengthening the policy framework and provide recommendations for the promotion of CE. For example, recent work carried out by the Ministry of Environmental Protection (MEP) focused on (i) eco-

efficiency improvement in cement and paper making; (ii) recycling, reuse, and harmless disposal of electronic waste; and (iii) CE development in regions and industrial parks. Some of the findings have been reflected in the CE Promotion Law and recent policy decisions.

PILOT PROJECTS. In 2005 the Chinese government launched the first round of CE pilot projects in seven key industrial sectors with the participation of forty-two leading enterprises, four waste recycling and reuse areas, thirteen industrial parks, and ten provinces or cities. In 2007, a second round of pilot projects expanded the coverage of sectors and regions. As of 2008 most of the pilot projects are still under implementation, and additional enterprises, industrial parks, cities and provinces have expressed an interest in participating.

INDICATORS FOR MONITORING AND EVALUATION. To enhance the accountability of local officials and corporate managers, the Chinese government introduced a trial Circular Economy Evaluation Indicators System in 2007. The system has two levels of indicators—those at the level of the industrial park, and a second set of more macro level indicators. For each level, four types of indicators were identified: (a) resource output indicators (GDP volume produced per unit of resource consumed, (b) resource consumption indicators (resource consumption per unit output of products or GDP), (c) resource use indicators, and (d) waste emission indicators.

These indicators have been introduced in some recent CE programs. For the second round of CE pilot projects, all

participants (enterprises, industrial parks, and cities) were asked to establish their CE targets for 2010 and 2012 based on this indicator system, and monitor and report their progress.

MORE EFFORTS ARE NEEDED

While the above initiatives point in the right direction and early results are encouraging, developing a circular economy is a tremendous task. The rapid economic growth of China presents a major challenge: overall resource consumption in China since the introduction of initial CE measures has continued to grow. The effects of increasing growth on resource use were not offset by improvements in resource use efficiency. Even with increased use of the 3R principle, total net resource use continued to grow. In some cases, puzzlingly, recycling rates even declined. For example, while the world average steel recycling rate in 2004 was 42.3 per cent, in China it actually declined from 23.49 per cent in 2000 to 20.1 per cent in 2004. (Wu 2006).

Implementing the CE approach faces many challenges. At the local level governments weigh the benefits and costs, and then decide whether to adopt it. For example, a CE awareness survey of local government officials conducted in 2006 in Suzhou (Li 2008), one of the pilot cities, found that while the majority of those interviewed strongly supported and agreed that the CE approach was important for sustainable development, about one-third of respondents were unsure about whether the nation should put every effort into developing the CE. One-third of the survey respondents argued that the CE approach cannot be adopted unless it can generate economic benefits in

addition to external environmental and social benefits.

Overall, given the CE goal of changing the model of economic growth by radically increasing materials use efficiency and sharply reducing pollution discharges, it is clear that government involvement and effective institutional arrangements are needed. Based on findings from the Bank-supported studies and lessons learned from on-going government programs, special attention needs to be given to the following four topics:

- Improving the effectiveness and efficiency of CE policies through a balanced mix of policy instruments;
- Enhancing industry and community participation;
- Building capacity for CE implementation; and
- Clarifying the role of government and strengthening governance.

These points are discussed in the following sections, respectively.

3. STRENGTHENING THE REGULATORY AND POLICY FRAMEWORK AND INCREASING THE USE OF MARKET-BASED INSTRUMENTS

As seen in international examples and from China's own experience, the government has at its disposal a wide range of legislative, policy and administrative tools to advance the CE. It is important that the government balances the combination of these instruments for maximum effect. It is also important that the government recognizes that its main role is to set the rules and provide incentives and oversight so that enterprises and civil society will take the lead in implementing their own CE programs.

CREATING A CLEAR AND STRONGLY ENFORCED LEGISLATIVE AND REGULATORY FRAMEWORK FOR THE CE

In terms of legislative measures, China's new CE Promotion Law is the most prominent legal instrument related to the CE, and China is one of the first countries to embrace the CE approach as a national policy. Beyond the CE Promotion Law, however, the government will also need to develop a full legal and policy system in support of CE development and also advance legislative harmonization, ensuring that the principles of the CE are reflected in a wider range of legislative and policy instruments, including those that regulate the system of incentives and disincentives that influence resource consumption and pollution. The CE Promotion Law already calls for establishing a set of regulations and standards for recycling, reuse, and waste reduction -- for example, administrative methods of mandatory

collection of packing materials and products; standards for energy, water and materials saving, standards for recycle and reuse; a list of out-of-date technologies, equipment, materials and products to be banned or phased out; the ban on the use of toxic materials in electronic products; etc. Efforts need to be made to formulate a spectrum of economic policies that will provide incentives for self-initiated behavioral change instead of purely relying on administrative measures.

BALANCING THE POLICY MIX

The creation of an enabling environment to promote CE in China will depend on the adoption of policy measures that provide strong incentives to increase resource efficiency and reduce the discharge of wastes. To achieve this, government needs to have a balanced mix of administrative and market-based instruments, as well as increased direct investments.

In China, the government tends to rely on administrative regulations (i.e., command-and-control measures such as rules, quotas, standards, and bans) for environmental and natural resource management. The importance of market-based instruments is gradually being recognized. This new approach is reflected in official Government documents promoting the CE, such as the 2005 "Guidance of the State Council on Promoting the Development of the Circular Economy" or the 11th Five-Year Plan.

A balance of administrative and market based mechanisms have been successfully used by countries such as Germany and Japan, both pioneers in systematic efforts to implement the CE. Japan's SOx emission tax, for example, is believed to have played a key role in cutting emissions and achieving significant environmental improvement since the 1970s. Applying a pollution tax can be effective in cases where pollution can be measured and verified, and payments can be adjusted accordingly. It is particularly suitable to tackle point-source pollution from industrial sources. For non-point sources, excise taxes on pollution-causing products, such as the weight-based tax for motor vehicles, have been effective in guiding consumers towards environmentally sound choices and behaviors.

GETTING THE PRICES RIGHT AND HARMONIZING ECONOMIC POLICIES

Market failures are often associated with inadequate pricing of resource values and externalities. A recent study on water scarcity in China by the World Bank (2009) illustrates that the low levels of water tariffs and sewerage discharge fees in many parts of China have contributed to pervasive water scarcity and pollution problems. When effluent fees are set at too low a level, they provide an obvious incentive to pay the fees rather than reduce pollution, regardless of the social cost imposed on the rest of society.

Exactly how much effluent fees have to be increased will depend on the industry and the available technology. Since it is very likely that increasing fees can go "too high" just as easily as "too low" to have the desired impact, changing fees has to be done in a

carefully monitored and responsive manner. A "correct" fee level will be such that many polluters have an incentive to reduce pollution, but not so high that firms are forced out of business.

In some cases it has been observed that even if an appropriate fee is determined, if it becomes "locked in place" over time then its impact will diminish as the general price level rises. Water supply prices in China, for example, used to be set at one price and did not change as the economy grew or prices of other things rose. Not surprisingly the impacts of pricing water fell over time, leading to waste and overuse.

Market failures have been widely observed in environmental management and resource utilization of industrial sectors such as water extraction and waste collection and recycling. Given disincentives or even distorted incentives, it is not surprising that administrative efforts to enforce emission limits have not been very effective, and national rates for waste water treatment and recycling remain below targets.

Beyond setting prices and incentives correctly, it is necessary to carry out a thorough review of existing policies and their impact on resource use and pollution. For example, energy subsidies to the fertilizer industry allow fertilizer to be sold at an artificially low price and contribute to their excessive use. China's oil subsidies have not only led to low fuel efficiency and over consumption of fossil fuels, but also impeded the adoption of fuel-saving technologies. Restructuring such policies not only frees up resources for sustainable development, but also reduces

pollution. In theory “full cost pricing” of any natural resource or process includes all the true costs of production including the costs of any associated environmental damages. For many years in China the price of coal, for example, was set below actual production costs and did not include any charge for the environmental damage costs associated with either production or consumption. As a result coal was the preferred energy source as it was considered very “cheap” even if it actually was much more expensive once all the costs associated with production and use were included. When coal prices started to rise to more fully reflect their costs to society, consumers decreased use and used remaining supplies more efficiently. A similar story can be told in the case of water, especially irrigation water supplies: low perceived price leads to excess and inefficient use and rising demand.

Unless policies are harmonized so that a consistent message is sent, the positive effects of laws and policy measures focused on implementing the CE may be neutralized by other policies that discourage resource conservation or recycling through artificially low prices.

INTRODUCING NEW MARKET-BASED INSTRUMENTS

In addition to pricing and taxation, another set of market-based instruments worth considering are cap-and-trade schemes to reduce emission of pollution. Such schemes illustrate the potential efficiency of market based instruments when compared to traditional regulation. Under a cap-and-trade system the government establishes an overall emission target and defines the rules of trade, but emission quotas are

sold and bought by individual emitters. Emitters are thus given the choice to select the least costly methods to meet the quota, either by reducing the pollution themselves or purchasing quota from someone else. As a result, the market will favour the most cost effective solution for complying with the overall emissions cap. Cap and trade schemes also can usually be implemented at lower administrative cost. Emission trading related to SO₂ has been introduced at the national level in the United States through the 1990 Clean Air Act, and played a key role in reducing acid rain in a cost-effective manner. Fortunately China has already begun to introduce emissions and pollution trading in some sectors; for example, the pilots of MEP and local EPBs in trading water pollution discharge permits by industries in Shanghai and SO₂ emission permits by power plants in northern China. It can further build on this experience.

A recent simulation of selected market-based instruments promoting CE in China has concluded that a balanced mix of economic policies can significantly improve the efficiency of resource use and reduce pollutant emissions in China while raising revenues for the government. For example, the introduction of a 20 percent tax on fossil energy (to nominally reflect the impact of climate change) would reduce coal consumption by 8.9 percent, oil consumption by 10.2 percent and GDP by only 0.1 percent. Thus, the economy’s overall energy efficiency would be improved by 10 percent, while increasing tax revenues by about 125 billion RMB (Circular Economy Policy Study Project Team. 2007).

COST-EFFECTIVE ACTION-PLANNING

The success of CE development relies on cost-effective policies and programs. In recent years, various government agencies have committed financially to support CE programs. For instance, the National Development and Reform Commission (NDRC) committed RMB 1.12 billion in 2005 for key projects of CE development, including investments in eco-industrial parks, financial support for technology R&D, subsidies for development of relevant industries such as waste recycle and wastewater treatment, or knowledge dissemination¹. In 2008 an additional RMB 2.5 billion (out of the increased investment of RMB100 billion for mitigating the impacts of the global financial crisis) were allocated for energy conservation and CE development projects². In addition, the Ministry of Science and Technology committed RMB 4 billion in technology R&D for CE development for the first three years of the 11th Five-year Plan period³. Even so, these investments are far below what is required for full CE implementation. More funding from the governments, both central and local, and industrial enterprises is expected in the years ahead.

Although a CE investment should be economically viable because of its external benefits, the effectiveness of CE investments can vary and funding resources are limited relative to the huge demand for them. To help mobilize greater resources for CE development and ensure maximum

results from investments, more attention needs to be given to the cost-effectiveness of CE activities in their design and implementation process. A successful CE program should be adopted and promoted on the basis of the analysis of its economic benefits/costs in relation to the traditional approaches.

RECOMMENDATIONS

In light of the opportunity provided by the CE Promotion Law, the government needs to consider rebalancing the current mix of policy instruments for promoting CE by reviewing the following actions:

PURSUE LEGISLATIVE HARMONIZATION.

The government needs to pay particular attention to ensure that the CE Promotion Law is carefully integrated into the existing legal and administrative framework and measures at both the national and local level. This would require a careful review and, if necessary, revision of those frameworks and measures to ensure their objectives are in line with that of the CE Promotion Law regarding resource use efficiency and pollution reduction.

BALANCE THE MIX OF POLICIES AND ENHANCE THE ROLE OF MARKET-BASED INSTRUMENTS. Instead of heavily relying on use of command-and-control measures, the government can expand the piloting and implementation of market based instruments such as emissions trading, deposit-refund schemes, environmental taxes, and resource fees that can be designed to address specific market failures.

¹ China Township and Village Enterprises News. Nov. 14, 2005.

² Xinhua.net, Dec 25, 2008

³ People's Daily (Overseas Version). Dec. 24, 2008.

ADJUST RESOURCE PRICES TO REFLECT THEIR SCARCITY VALUE. The government can ensure that resource prices and taxes more fully reflect the scarcity value of the resource and the environmental externalities of production and consumption (as mentioned in the cases of coal and water). This will provide incentives for producers and consumers to make the best use of their resources. While China's resource prices and taxes on minerals, energy, and water, have recently been adjusted, more needs to be done to get the prices right. Effluent fees have also been adjusted, but are still far below the social costs caused by pollution.

INCREASE THE USE OF COST-BENEFITS ANALYSIS IN DECISION MAKING. There is significant potential in using full cost/benefit analysis to include the economic benefits from CE measures that are sometimes neglected in standard financial analyses. The explicit inclusion of the benefits of environmental externalities and resource conservation will often serve to demonstrate the economic benefits of the CE approach and facilitate its adoption by decision makers and the public.

4. ENHANCING PARTICIPATION BY INDUSTRY AND THE COMMUNITY

Despite the government's major role in promoting a circular economy, the successful implementation of CE requires active participation of all productive sectors as well as the consuming public.

PARTICIPATION OF PRODUCTIVE SECTORS

A central task of CE is to make sure that productive sectors comply with all the environmental and resource efficiency requirements and fully participate in waste reduction, recycling and reuse in their production processes and take further responsibilities in collecting and recycling of their products following their disposal by consumers. To achieve such level of participation in industrial sectors, the government should, as part of its CER incentive policies, expand the use of “extended producer responsibility” systems (EPR). EPR requires producers to bear the responsibility for collection and recycling of their products at the end of their useful life. EPR can be adopted as one of the major tools, in addition to tight emission standards, to help enforce CE requirements.

In developed countries, EPR has been a major driver for the industrial sector's participation in product recycling and reuse. It has led producers and distributors to design their products in such a way as to allow the recovery of raw materials and reduce the generation of waste. In Germany, mandatory EPR was put in place in 1996 and since then, it has become the country with the

highest materials recovery and recycling rates in the world. Almost 60 percent of municipal wastes and more than 40 percent of production wastes are recovered and recycled, respectively. For certain types of wastes, the recycling rates are even higher, e.g. construction waste 86 percent, packaging 81 percent, batteries 77 percent, and paper 82 percent. The success of the EPR in Germany has led to its rapid diffusion, most commonly in the form of deposit-refund schemes, to most European countries, as well as to Japan, Taiwan, South Korea and Canada (Walls 2006).

EPR, as recently required in the CE Promotion Law, can potentially, given the right incentives, be implemented in collaboration between industry and government—or even by industry alone. There are already interesting initiatives underway, on more than a pilot basis; for instance, in the consumer electronics sector China Telecom participated in a program to recycle used mobile phones. It should be pointed out that establishing EPR systems requires the introduction of multiple policy measures and the establishment of a rigorous monitoring scheme so that the effects of the system can be evaluated.

Attention should be also given to protect and upgrade the recycling industry in China. At present, China already has a big and growing waste recycling industry, with about 5000 enterprises, 160,000 waste collection centers and a labor force of nearly 10

million⁴. While their recovery rates are fairly high, a large portion of the industry consists of small enterprises that rely on large numbers of informal laborers and waste collectors that operate with outdated and environmentally unsafe technologies, with attendant pollution and health and safety hazards. They are also very vulnerable to the fluctuation of the global market as shown by the recent sharp downturn due to the global economic recession. The introduction of EPR-based CE instruments would allow the collection process and the waste exchange markets to be organized and regulated for higher technical and environmental performance, maximize the scope for reuse and recycling, and reduce the hazards faced by its labor force. The current global economic crisis may provide an opportunity to the government for the restructuring and modernization of China's recycling industry.

CONSUMERS AND NGOS

While environmental protection and CE development are among the government's top priorities, making real progress will require more active participation by consumers. The consumers are the final driver of CE development. In order to engage the average consumer, the government can provide increased support for awareness raising and the introduction of practical incentive measures that help ordinary people engage in waste reduction, reuse or recycling.

According to the result of a national survey conducted in 2007 by the China

Environmental Awareness Program (CEAP, 2008), 10.2 per cent of the population ranked the environment as their top priority; 10.2 per cent as second; and 9.1 per cent as third. The survey further revealed that 66 per cent of people had "heard of" recycling; 50 per cent had heard of reducing the use of plastic bags; and 41 per cent knew that greenhouse gas emissions are a threat to the environment. However, while some of these numbers may appear encouraging, the survey also found that most people are only passive recipients of environmental information through the mass media. Only small fractions participate directly and consciously in environmental activities.

In many countries, increased consumer participation has been promoted through information and education measures to raise awareness on the concept, methods and potential benefits of CE, and appealing to their sense of responsibility. Consumer awareness has also been raised through such instruments as environmental and energy efficiency labeling of products, and green certification of services. Enhanced citizen awareness of resource management and waste disposal standards and regulations would also enable them to better monitor and assist the government in environmental management and the enforcement of environmental regulations.

NGOs can play an important role in raising public awareness and increasing participation in CE development. According to recent reports, the number of environmental NGOs in China was 3,539 in October 2008, an increase of 771

⁴ China Recycling Resource Network, 2006-10-24. Available at: <http://www.bj3r.com/Front/content.jsp?id=247>

since 2005⁵. However, China's environmental NGOs face a number of institutional barriers, including weak organizational abilities, limited funding, insufficient cooperation and a lack of staff. The government can facilitate the role of NGOs by providing secure, long-term operating funds to NGOs focused on environmental and CE matters. A stable funding base could be created through a tax related to the consumption of a particular product or effluent, with the revenue deposited in a special fund to provide, on a competitive basis, support for NGOs projects dealing with CE issues and the environment. Similar systems have been established in several countries including in Eastern Europe after 1990⁶. For instance, in the Canadian Province of Manitoba the government established a Sustainable Development Innovation Fund financed by a tax imposed on car tires that provides, on a competitive basis, funding for partnerships, community development and environmental education⁷. As long as these mechanisms function in a transparent way and award funding is based on clear and objective criteria, they can contribute to strengthening

civil society organizations and their activities related to the CE.

INDUSTRIAL ASSOCIATIONS AND PROFESSIONAL NETWORKS

For CE to achieve its goal of radically increasing the economy's resource use efficiency and sharply reducing the generation of waste, implementation of the concept needs to rapidly spread beyond the boundaries of individual enterprises, industrial parks and cities to encompass the full lifecycle of production, consumption and waste reuse/recycling sector wide and economy wide. It will require the establishment and participation of region- and economy-wide, multi-agent networks connecting multiple materials- and energy streams.

At present, however, CE is still a new concept in China. Most CE promotion activities have been government-initiated and led, with limited awareness and dissemination beyond immediate participants. There are few institutions such as industrial associations, professional networks, and community-based groups involved in promoting CE at the enterprise and consumer levels. Enterprise participation in the small number of pilot projects has been limited. For example, when the pilot program of voluntary agreements for energy conservation was initiated in Shandong Province, only two enterprises signed up (Hu 2007).

A recent evaluation of CE pilot projects in the iron and steel and nonferrous metals sectors (Zhou 2007) identified a number of barriers for CE implementation. Among them are low awareness of and weak participation in

⁵ Natural Resources Defense Council. 2008. New Report Shows Chinese environmental NGOs and Civil Society Expanding. Beijing: NRDC China Program. <http://www.greenlaw.org.cn/enblog/?p=258>

⁶ REC. (1994) NGO Funding. What your government can do for you. The Bulletin, A quarterly of the Regional Environmental Center for Central and Eastern Europe. Vol. 4, No. 4. <<http://greenhorizon.rec.org/bulletin/Bull44/funding.html>>

⁷ Manitoba Conservation. (2009) Sustainable Development Innovations Fund. Winnipeg MB: Pollution Prevention Branch, Manitoba Conservation. <<http://www.gov.mb.ca/conservation/pollutionprevention/sdif/>>

CE development by industries and the community. There is also a lack of mechanisms for information exchange and knowledge and technology sharing related to resource saving, waste reduction, and environmental protection activities.

International experience suggests that industrial associations can play an important role as networks for information and knowledge sharing. In the UK, for example, the implementation of the government's climate change agreements (CCA) program has effectively relied on industrial associations to reach the over 5000 enterprises and 10,000 sites that needed to be involved. Industrial associations play a role in representing enterprises and signing voluntary CCAs with governments. They offer enterprises a way to participate in a cost-effective manner. Across most of Europe, industrial associations have formed a network of "Eco-efficiency Agencies" that has played an important role in disseminating good practices, as a clearinghouse between professional consultants and firms, and as a mechanism for increasing knowledge on sustainable resource management. Progress in recent years has demonstrated that this approach has been successful.

In China, industrial associations and professional networks could also be fully involved in promoting CE participation by industrial sectors and enterprises. They could play an important role through the collection and sharing of information and data, e.g. on intensity of energy and raw materials use, that would be critical for disseminating the identification and

adoption of good CE technologies and practices.

In May 2007, the State Council issued "Several Opinions of the General Office of the State Council on Promoting the Reform and Development of Sector Associations and Business Associations". The opinions raised in this document include: (i) governments at different levels can transfer or entrust some of their duties to industrial associations; (ii) the comments from industrial associations should be considered before important policies are issued; (iii) industrial associations could carry out sector statistics, information disclosure, training and other services based on their mandate.

RECOMMENDATIONS

Overall, while the government's CE initiatives have begun to move in the right direction, more needs to be done to effectively engage the industrial sector and the consuming public in the promotion and implementation of CE. Recommended actions are:

INCREASE THE COMPLIANCE AND PARTICIPATION OF INDUSTRIAL SECTORS THROUGH IMPLEMENTING EXTENDED PRODUCER RESPONSIBILITY (EPR). As a first step towards the implementation of EPR mechanisms, the government can consider the introduction of deposit-refund schemes for batteries and other products containing hazardous chemicals, as well as consumer electronics (e.g. cell phones, TV sets, computers) that can be broken down into their component materials (plastic, glass, toxic metals) and recycled or disposed of safely. This program would encourage consumers to return the products to designated recycling

stations and avoid them being treated as waste.

BROADEN COMMUNITY AND NGO PARTICIPATION. A major effort is needed to increase awareness of the meaning and potential benefits of CE among all stakeholders. Examples include environmental and energy efficiency labeling, and education and training programs on resource management and waste disposal standards and regulations. The objective is to encourage consumer participation in resource saving and waste recycling activities, as well as in monitoring and enforcement of unsound resource management and waste disposal practices.

INVOLVE INDUSTRY ASSOCIATIONS. A study is needed to follow-up on the State Council's "Several Opinions of the General Office of the State Council on Promoting the Reform and Development of Sector Associations and Business Associations" and review the potential role and constraints of industrial associations in the promotion of CE. The study needs to identify government mandates and functions that could be transferred to industrial associations. They could organize CE dissemination and outreach activities, organize circular economy industrial chains and eco-industrial parks; manage a special fund for waste collection, dismantling, reuse and recycle activities, facilitate technology transfer, information exchange and training. The study would support the drafting of legislation that would clearly define the role of industrial associations in the promotion of CE.

5. BUILDING CAPACITY FOR IMPLEMENTATION

Achieving the goals of CE development and ensuring implementation of CE in China will depend on whether the key actors involved -- the government, enterprises, and the general public -- have the required understanding and capacity:

- Government will need adequate capacity to formulate sound policies and enforce them;
- Enterprises will need capacity to innovate and apply the knowledge and technology for CE, and
- The public will need capacity to act in an environmentally-friendly way as consumers and participate in CE policy making and implementation as policy advocates and monitors.

Indications are that the current capacity of the key actors is far below what is required for China to fulfill its promise in CE development.

GOVERNMENT CAPACITY

Since the government is by far the most important player for CE development in China, its capacity is crucial to achievement of the CE development goals. At present, however, the capacity of the government for CE development is quite weak, both in policy making and implementation. Weak government capacity is reflected in lack of adequate policy research to assist the government in making sophisticated CE policies. Many public policies to promote CE are poorly developed and not well implemented. As indicated in section 5, China has applied more regulatory or administrative instruments than market-based and public participatory ones. In

many cases, regulatory instruments entail higher cost and in some cases they are not very effective given poor monitoring and supervision. In addition, as pointed out by some researchers (e.g., Qin and Zhang 2005), some policies are not enforceable. The central government is also promoting eco-industrial parks nationwide as one of the important approaches to CE development. However, local officials and industrial park managers rarely find relevant information about planning and designing such parks.

It is known that the country's environmental protection agencies are understaffed and underfunded, resulting in weak environmental enforcement. According to a survey in 2004 (Lu, et al. 2006), the total staff for environmental inspection and management in China amounted to 50,040, with an average of 24 in each provincial agency, 32 in each municipal agency, and 35 in each county agency. Given the growing numbers of polluters to be monitored and inspected, staff size is too small. Analysis of the data collected in the survey also shows that agencies responsible for environmental enforcement are short of funds and inadequately equipped, which is regarded by respondents as the most important barrier to fair and effective enforcement (Lu, et al. 2006). In terms of promoting and developing a circular economy, the staffing situation is even worse.

ENTERPRISE AND COMMUNITY CAPACITY

The capacity of enterprises as both producers and consumers is a key to CE implementation. Although awareness of CE has grown in recent years, most enterprises do not have adequate knowledge and relevant technologies for implementing CE in their business operation. The lack of funds is another factor contributing to weak implementation of CE by Chinese enterprises. For most firms used to relatively low standards of technology and processing, small scale production, and the long tradition of operating in a resource- and pollution-intensive mode, the costs of CE-oriented business reengineering are too high to afford.

INTERNATIONAL EXPERIENCE

The experiences of other countries can provide useful guidance for China. In Japan, for example, the government cooperates with research institutions and enterprises establishing ecological industrial parks and supports joint R&D on technologies for waste disposal/reuse and pollution control.

Another international lesson is the importance of strengthening laws and regulations. In the US the Office of Enforcement and Compliance of EPA takes on fewer responsibilities than the Environmental Inspection Agency of MEP, China, but its staff size is much larger (with more than 3,000 staff), and its annual budget amounts to US\$713 million. To ensure achievement of environmental goals, EPA has set up 10 regional offices across the US to supervise local governments and enterprises, and deal with interstate disputes on pollution (Qin and Zhang 2005).

Finally, information disclosure and environmental education promote greater awareness and knowledge by both the public and enterprises. All developed countries have legal requirements about the disclosure of environmental information by enterprises and governmental organizations. For example, in the European Union the Århus Convention and the new Directive on Public Access to Environmental Information support this. In the US, such laws and policies such as the Clean Water Act, the Resource Conservation and Recovery Act, and Public Involvement Policy have stipulations on the disclosure of environmental information (World Bank 2007b). The governments of these countries also work together with civil society to disseminate knowledge on environmental protection in general and CE in particular.

RECOMMENDATIONS

To improve the capacity for CE implementation and achieve goals of CE development as stated in the CE Promotion Law and other government plans, the following actions are recommended:

STRENGTHEN CE TRAINING AND EDUCATION. China should strengthen training and education for three groups of participants: officials, business managers, and the general public. For officials, besides general knowledge of CE, training should be focused on policy development, including legislation, use of policy instruments, and planning.

STRENGTHEN ENFORCEMENT. To ensure that laws and regulations for CE are fully implemented, China needs to enhance the capacity of regulation and

enforcement organizations by appropriating more budgetary funds, adding more staff, strengthening performance management, and involving the public.

PROMOTE CE TECHNOLOGY R&D. China could set up a center for CE technology R&D and dissemination. Its main missions include collecting data on technologies for CE, technology R&D to reduce the cost of implementing the CE approach, especially for small and medium-sized enterprises, and exchanging information on technology and best practice for CE activities.

6. CLARIFYING THE ROLE OF GOVERNMENT AND STRENGTHENING GOVERNANCE

Since the introduction of the idea of pursuing a circular economy in China in the late 1990s, the Chinese government has been playing a leading role. As shown, however, CE development requires the full support and participation of the business community and the general public as well. Thus, the government's proper role is that of a promoter and enforcer rather than a leading actor. In addition to continuously demonstrating a high level of political commitment, the government needs to focus its attention on defining a legal and policy framework that provides adequate incentives for CE development. These steps include prioritizing government programs based on cost-effectiveness, strengthening governance, and enhancing accountability of all parties, including the government itself, through the use of performance monitoring and evaluation.

ESTABLISHING HIGH-LEVEL LEADERSHIP

Developing a CE will need sustained commitment from the top leadership to set clear targets; put in place implementation measures that ensure targets can be met; and to ensure government accountability. International experience suggests that sustainable development strategies and instruments tend to have stronger impact if they are directly supported by high-level government offices, such as the Prime Minister's Office (Swanson et al., 2004). In China, although CE development has been highlighted in the 11th Five-Year Plan and senior officials have all vowed to support this endeavor in their speeches, there is the risk of diminishing

commitment to CE activities because the global financial crisis may divert their attention. Continued interest from the State Council and relevant high-level government bodies such as NDRC, the Ministry of Finance (MOF), and Provincial leaders will help maintain momentum and translate national CE targets into sectoral, provincial and local-level programs and measures.

ENSURING ORGANIZATIONAL HARMONIZATION

At present, the institutional arrangement for CE promotion is weak and *ad hoc* (with only a division in NDRC dedicated to the task while many other government agencies get involved selectively). CE-related policies (or those broadly related to environment and natural resource management) made by different government organizations at different levels are not all consistent with each other and counterproductive in some cases.

Unclear distribution of responsibilities and weak coordination among various government organizations is becoming an issue undermining the effective implementation of CE development strategies and plans. For example, seven government or quasi-government organs at the central government level -- NDRC, MEP, Ministry of Housing and Urban and Rural Construction, Ministry of Commerce, Ministry of Science and Technology, National Patriotic Health Campaign Committee, and All China Federation of Supply and Marketing Cooperatives -- share some

responsibilities for solid waste recycling and reuse (Circular Economy Policy Study Team, 2007). There are both overlapping and neglected areas due to lack of a clear division of responsibilities. This situation calls for clearer definition and allocation of responsibility and better coordination among agencies.

ENHANCING THE ACCOUNTABILITY OF GOVERNMENT PROGRAMS

Establishing strong accountability mechanisms will be particularly important to ensure CE successes and failures are clearly recognized and adaptive actions are taken as needed. Accountability mechanisms have been shown to be a critical factor for the successful implementation of sustainable development strategies and strategic initiatives of government (Swanson and Pintér 2006). The specific mechanisms involve setting clear goals and targets, identifying relevant performance indicators, assigning responsibility for making progress towards targets, systematically tracking and reporting performance, and finally, holding organizations and individuals accountable.

Accountability mechanisms are often emphasized in public finance, where spending is tracked and results are demonstrated in financial terms. In implementing CE the same level of accountability needs to be extended to non-financial performance criteria, such as pollution reduction and resource use efficiency targets. There are an increasing number of examples of how this can be done. In the United States, for example, the state of Oregon has developed Oregon Benchmarks, a system of overarching goals that are used to inform government spending and policy making (Oregon

Progress Board 2006). The goals are accompanied by a set of high level, outcome-focused indicators covering socio-economic and environmental priorities. These indicators are reported to government and the public on a regular basis to ensure transparency and clarity about overall progress and performance. A similar system has been established in the province of Alberta, Canada (Barg et al. 2006).

In those cases where strong accountability systems have been introduced for sustainable development it is important that the responsibility for achieving sustainability outcomes is vested not only with sectors but also with central government ministries, particularly departments of Planning and Finance. Innovations such as outcome based budgeting can help allocate resources based on specific performance objectives and outcomes (Manitoba Treasury Board Secretariat 2006).

ADOPTING AN ADAPTIVE APPROACH

Policies are typically designed to operate within a certain range of conditions, but when these conditions change, so do policy outcomes. Therefore, no combination of CE policy instruments would always work well in the constantly changing world situation. Policy making needs to take an adaptive approach. The adaptive policy approach is not new to China: it is the essence of Deng Xiaoping's well-known statement characterizing China's transition as "crossing the river by touching the stones." An adaptive approach would involve the design and implementation of CE policies with an explicit recognition of uncertainties, systematic monitoring of progress and built-in mechanisms for learning and adjustment as new knowledge becomes

available or if the existing policy is proving unsatisfactory.

Adaptive policy making recognizes that policy change is often needed to reach desired goals. For instance, China introduced a tax on luxury cars to reduce pollution. Having little effect on actual air quality, the policy was recently revised and on January 1, 2009, a new system was introduced, replacing road maintenance fees with increased taxes on fuel. While this by itself represents an adjustment to the fuel tax regime, the new policy would be a good candidate for testing an adaptive policy regime, with close monitoring of both economic and environmental effects and the response from China's rapidly growing number of private car owners.

Allowing for flexibility and adaptation in CE policy mechanisms means that mid-course policy corrections are often needed. The government may need to intervene when, due to external forces, CE policy measures are at risk of breaking down. The collapse of commodity prices due to the global economic crisis in 2008 and the subsequent pressure on the recycling industry are examples of stress caused by external forces, calling for an adaptation of earlier policy measures to ensure China's recycling industry remains viable.

RECOMMENDATIONS

Transforming China's economy along the lines of the Circular Economy is an urgent task. To carry it out successfully, the Chinese government has to be mindful in choosing focus areas and designing policy instruments. Thus, we suggest the following actions for the government to consider:

SHIFTING THE ROLE OF THE GOVERNMENT FROM AN ACTOR TO A PROMOTER AND ENFORCER. The state-owned industries' direct role in production is substantial but certainly not the biggest part of the economy. If the CE approach is to be successfully implemented, the private sector must be involved. Although implementing the CE approach will require additional investments, the Government will have to shift from direct interventions in production processes to setting the stage for the broader economy. The Government's most important role will be as a facilitator of change, establishing the appropriate targets and incentives, and enforcing CE requirements, rather than as a direct implementer and investor.

MAINTAINING HIGH-LEVEL LEADERSHIP. Even if many of the implementation measures are carried out by line departments and local governments, the overall leadership and responsibility for the CE should be retained by a central government body such as the State Council or through NDRC or MOF. This high level of political backing is essential if CE measures are to be introduced and enforced.

IMPROVING ORGANIZATIONAL HARMONIZATION. It is very difficult to implement the CE approach if different arms of Government send conflicting signals. Harmonization of policies and messages across different parts of Government (and at the national and provincial levels) is required to implement CE ideas.

ENHANCING GOVERNMENT ACCOUNTABILITY. Government must be held accountable for implementing CE approaches in the public and state-owned sector through monitoring and

evaluation, information disclosure, and public participation and supervision. It is not convincing when a CE approach is promoted for private investments and while the same standards are not applied to government agencies and state-owned enterprises.

ADOPTING AN ADAPTIVE APPROACH.

Considering the complexity of the task and the potential consequences of failure, the government needs to promote the CE with an adaptive approach as the late Chinese leader Deng Xiaoping used to say “crossing the river by touching the stones”. This requires a feedback loop based on close and frequent monitoring of the performance of CE programs, openly identifying and discussing problems, and allowing sufficient flexibility to modify implementation mechanisms.

7. CONCLUDING REMARKS

China is at an environmental crossroads; finding effective ways to deal with its serious environmental and natural resource management challenges is imperative. As China became the primary manufacturing plant for the world, its total material and energy consumptions increased, leading to unsustainable levels of natural resource consumption and pollution discharges greatly in excess of the carrying capacity of the environment. The failure to meet national targets for pollution reduction and the staggering costs associated with pollution indicate that a new, more effective approach is needed.

CE has become a central element of China's sustainable development strategy and can offer systems-based, practical solutions to promote improved efficiency in material and energy use, which in turn should translate into major environmental quality and resource security improvements. Although introducing the CE approach initially imposes some increased costs, many of the CE solutions also turn out to be economically advantageous when the costs of environmental externalities that are avoided are fully taken into account. A functioning CE system produces the dual benefits of reducing physical material consumption and reducing pollution.

The legislation, policies, and pilot programs already in place demonstrate the potential of CE to make a real difference. These are, however, only initial steps. In order for CE to realize its potential in addressing resource and pollution concerns, the CE approach needs to be expanded to wider segments of the Chinese economy and supported by

more effective public policies and economic instruments.

CE measures need to be designed to address both policy and market failures, and use, as appropriate, both market-based and strict regulatory measures. While all levels of government continue to play a major role, the government needs to be able to distinguish between cases when it needs to step in with regulation, and when it is both more effective and cheaper to support market-based solutions. The Chinese government has a central role in introducing and supporting the development of the CE approach. Given the growing role of the private sector in China's economic growth, the Government must always remember that its key function is as a promoter of and an enforcer for CE, rather than the direct implementer.

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