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A Study on Circular Economy Implementation in China

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Abstract: As one of the most well-known concepts concern with sustainable development, circular economy (CE) has been implemented in many countries since the end of last century. As one of the biggest developing countries, China achieved rapid economical growth associated with significant natural resource consumption and environmental degradation. Recognizing nation's sustainable development needs a well coordinated economic growth and environment protection, China's top administration heightened attention on ecological modernization, green growth, and low carbon development with a national circular economy strategy.

In this research, with a purpose of better future practice of CE, we introduce the progress and status of CE implication in China, including introductions of CE supporting laws and regulations and a case study to provide readers a clearer view of the relevant issues in China.

Keywords: Circular Economy, Implementation, China

Résumé: L'un des concepts les plus connus du développement durable, l'économie circulaire (EC) a été mis en œuvre dans de nombreux pays depuis la fin du XXe siècle: Chine, Allemagne, France, Japon. La Chine particulièrement a connu une croissance économique rapide associée à la consommation importante des ressources naturelles et la dégradation de l'environnement. Reconnaissant que le développement durable de la nation requiert une gestion publique coordonnée de la croissance économique et de l'environnement, le gouvernement chinois a apporté une attention accrue à la modernisation écologique, à la croissance verte et au développement sobre en carbone. Une politique nationale fondée sur l'économie circulaire a été mise en œuvre. Cette communication a pour objectif d'identifier les meilleures pratiques futures de l'EC. Nous présentons l'état d'avancement de la mise en œuvre de l'EC en Chine, ainsi que l'introduction de lois et de règlements d'application. Une étude de cas, enfin, fournit une vision plus claire des questions actuelles à résoudre, en matière d'EC en Chine.

Mots clés: économie circulaire, Mise en œuvre, Chine.

1. Introduction

The traditional way of thinking on environmental protection was the terminal treatment system in the past. Since the Stockholm conference in 1972, governments have taken the way of end tackling operation. But the practical experiences of developed countries show that the traditional "end - treatment" is not an effectual method to control environment, and also caused great burden on economic development, like USA in 1911, its investment in environmental protection reached US $120bilions, accounting for the 2.8% of GDP, it has been overwhelmed. In China, investment in environmental protection were probably accounted for 0.63% and 0.79% during the 5^{th} and 6^{th} "5year Planning", and 1% during the 9^{th} "5year Planning" (SEPA, 2014). It's not too much, but the trend is becoming a large-scale investment on environmental issues while the environmental degradation becomes more and more serious, so this pattern must be changed. Sustainable development is the inevitable choice of human sociality, therefore, first the pollution prevention need to be shift from end of pipe to headstream prevention. Second important change is the traditional environmental protection and economic development must be well combined, to achieve win-win relationship between environmental protection and economic development. Thus, it is inevitable trend that a Circular Economy will take the place of traditional linear economy.

As the emergence of the idea, the generic Circular Economy label can be applied to, and claimed by, several different schools of thought, that all gravitate around the same basic principles which they have refined in different ways. The idea itself, which is centered on taking insights from living systems, is hardly a new one and hence cannot be traced back to one precise date or author, yet its practical applications to modern economic systems and industrial processes have gained momentum since the late 1970sThe idea of circular material flows as a model for the economy was presented in 1966 by Kenneth E. Boulding in his paper (Kenneth 1966).

In the run-up to the United Nations Conference on Sustainable Development (Rio+20) in June 2012, there has been a renewed focus on pursuing meaningful action to reduce resource and environmental pressures (Garcia 2012).

A CE is an industrial system focused on closing the loop for material and energy flows and contributing to long-term sustainability (EAF 2012). For a successful ecological transition and the change from a linear economy to a circular economy, many countries have taken actions for years. Germany and Japan were pioneers in CE like policies. Germany's 1996 CE Law sought to reduce land use for waste disposal by focusing on solid waste avoidance and closed-loop recycling. In 2000, Japan's

“Sound Material-Cycle Society” focused on solid waste management, land scarcity, and resource depletion because of concerns about shortages of land fill spaces and revitalizing local stagnating industries (Hashimoto 2010). CE in Japan includes “eco-towns” aimed at reducing landfill requirements (Berkel 2009) and product-specific recycling targets for waste categories to be reached through product stewardship schemes, levies, and voluntary regulatory initiatives for producers and consumers. France has reduced the quantity of waste produced and been promoting recycling (eMag 2013).

In January 2012, a report was released by Ellen MacArthur Foundation, entitled Towards the Circular Economy: Economic and business rationale for an accelerated transition (EAF 2012). The report was the first of its kind to consider the economic and business opportunity for the transition to a restorative, circular model. Using product case studies and economy-wide analysis, the report details the potential for significant benefits across the EU. It argues that a subset of the EU manufacturing sector could realize net materials cost savings worth up to $630 billion p.a. towards 2025—stimulating economic activity in the areas of product development, remanufacturing and refurbishment. Towards the Circular Economy also identified the key building blocks in making the transition to a circular economy, namely in skills in circular design and production, new business models, skills in building cascades and reverse cycles, and cross-cycle/cross-sector collaboration.

Impact of CE in Europe is continuous. On 17 December 2012, the European Commission published a document entitled Manifesto for a Resource Efficient Europe (EUROPA 2012). This manifesto clearly stated that "In a world with growing pressures on resources and the environment, the EU has no choice but to go for the transition to a resource-efficient and ultimately regenerative circular economy." Furthermore, the document highlighted the importance of "a systemic change in the use and recovery of resources in the economy" in ensuring future jobs and competitiveness, and outlined potential pathways to a circular economy, in innovation and investment, regulation, tackling harmful subsidies, increasing opportunities for new business models, and setting clear targets.

In March 2014 the first large scale event for the circular economy is being held with over 6000 attendees and all the major stakeholders in attendance. The launch of such an event signals the rise of the topic and it will act as an enabler for business to transition towards more circular business models (UBM 2014).

When look back to China, in the past, the economic development in China was an extensive model, high input, high consumption mode of production brought negative impact to the environment. If it continues to follow the traditional mode of economic development, resources and environment capacity in China may not support

the future high-speed economic development. Recognizing nation's sustainable development needs a well coordinated economic growth and environment protection, China's top administration heightened attention on ecological modernization, green growth, and low carbon development with a national circular economy strategy.

The development of circular economy is an important way to implement the strategy of sustainable development, to achieve coordinated economy, social development and resource environment, which is also an important step of the economic structural adjustment, have important real significance and far-reaching historical significance to the Chinese economy and social development. At present, China government proposed the development of circular economy, promoting the sustainable development strategy, and carried out exploration and attempt in the process of developing circular economy.

This study is a preliminary overview on ideas and methods for the development of circular economy to seek better future performance of a CE model in China.

2. The Development of CE in China

When did the China government propose the development of circular economy?

During the 9th "5 year Planning" (1996-2000), the state has made efforts on pollution control

and could play a good effect. But when review at the process of environmental protection, the end of treatment was the main approach for environmental protection without control from the source, which should be the optimal way for pollution control. With the development of science and technology, circular economy has been greatly advocated and developed in the world. This facilitates China government, especially the State Council to clear out the overall train of thought during the middle of the 10th "5 year Planning" (2001-2005), starting environmental protection plans and industrial pollution control based on the concept of circular economy.

What exploration and experiment China has conducted for development of circular economy over the years? The Chinese initiative experiences on circular economy can be considered as following three levels:

i. Theoretical studies.

Research exploration and experiments in theory on circular economy were widely conducted at the beginning (Bi 2004a, 2004b,NDRC, Shi 2004, Zhao 2003, Zhu 2003, Yuan 2003), including the introduction and explanations of the advanced concepts, how to use foreign ideas of circular economy research, and apply it to our country, propose implementation framework (Feng 2007).

ii. A large number of pilots.

As promoting CE is considered as strategy choice for China's 21 century sustainable development, rather than as a short-term action; therefore, to develop CE is listed up in the 10th "5-year Plan", where the pilot projects of clean product in a manufacture level were clearly put forward. This requires firms to be engaged clean product inside manufacture, and reduce resource consumption from the very beginning. This can be considered as the first level of design and practice clean product based on a CE concept. Furthermore, at the second level, especially to implement pilots of constructing Eco-industry parks, a CE model collecting all of the potential manufactures where the waste/resource comprehensive utilization is promoted within inter-manufactures. The designs include the following basic ideas: waste is food, diversity is strength and systems thinking. In a larger scale, a CE pilot is implemented entire Liaoning province.

iii. Policy preparation and construction.

To promote CE development, policy solutions are very important support. Therefore, besides pilot, SEPA explored policy studies on CE implementation, including policies on waste disposal and waste recycling. Those policies have been developed particularly after 2000. The primary laws and regulations support for CE implementation in China is introduced in the next part of this article.

3. Laws and Regulations Support for CE Implementation in China

How to achieve a Circular Economy? Though promoting a circular economy was identified as national policy in China's 11th five-year plan starting in 2006 (Feng 2007), the development of circular economy is a very large system engineering, involves various aspects of the society, it's inevitable needs of laws, regulations and policy support, which guide the implementation recycling economy effectively.

The National Development and Reform Commission (NDRC) in China is leading the Circular Economy strategy at the national level. Under the NDRC's guidance, a circular economy will be achieved through a score of legislative, political, technical and financial measures. Many of these are powerful policy instruments, such as law, government regulations, subsidies and tax breaks. Among those policy instruments, the related laws and government regulations play the most important roles.

The document, "The Interim Provisions on The Development of Resources Comprehensive Utilization" issued by The State Council of China in 1985 is a programmatic document guiding the development of resources comprehensive

utilization in China. Since 1985, the State Council approved the State Economic Commission "The Interim Provisions on The Development of Resources Comprehensive Utilization" (No.117,1985) especially after issued "The Views on Further Development of Resources Comprehensive Utilization" (No.36,1996), the state has formulated a series of preferential policies encouraging the development of comprehensive utilization of resources, especially the tax relief policy, which greatly aroused the enthusiasm of enterprises to carry out comprehensive utilization of resources. These indicate that the government has put "Resources Comprehensive Utilization" into nation's plan as a long term development strategy.

The key Laws and Regulations for CE Implementation in China is summarized as Table1 below.

Table 1: Primary Laws and Regulations for CE Implementation in China

Date of Issue	Law And Regulations	Authority for Issue
1985	The Interim Provisions on The Development of Resources Comprehensive Utilization	The State Council of China (No.117,1985)
1996	The Views on Further Development of Resources Comprehensive Utilization	The State Council of China (No.36,1996)
2003.12.17	The Views on Speeding up The Clean Production	State Environmental Protection Administration (China SEPA), The National Development and Reform Commission (NDRC), etc., 9 sectors.
2004.01.12	The Catalog of Comprehensive Utilization of Resources	The National Development and Reform Commission (NDRC), Ministry of Finance, State Bureau of Taxation
2004.12.29	Law of the People's Republic of China on the Prevention and Control of Solid Waste Inducing Environmental Pollution	the Standing Committee of the National People's Congress (NPC)
2006.11.27	The National Key Industry Clean Production Technology Oriented Directory	The National Development and Reform Commission (NDRC); State Environmental Protection Administration (China SEPA)
2008.08.29	Circular Economy Law of The People's Republic of China	the Standing Committee of the National People's Congress (NPC)
2012.02.29	The Cleaner Production Promotion Law of the People's Republic of China (2012 Revised)	the Standing Committee of the National People's Congress (NPC)
2013.01.23	Circular Economy Development Strategy and the Recent Action Plan	The State Council of China
2004.09.24	The Ordinance on Construction of Ecological City Based on Circular Economy in Guiyang City（The first regulation issued by a municipal government in China）	the Standing Committee of Guiyang People's Congress (NPC)

Source: Based on governmental websites

"Circular Economy Law of the People's Republic of China" issued by the Standing Committee of the National People's Congress (NPC) on 29 Aug. 2008

formalized aspects of the Circular Economy concept but fails to express the vision of multi-factor reduction in resource use, a critical loss. When first conceived, proponents argued that the Chinese economy had to achieve an increase between seven and ten times in efficiency of resource use. This seemed a realistic goal, given the depletion of global nonrenewable resources and the relatively low efficiency of much of Chinese industry. The Law states no goals whatsoever and tends to rely on incremental improvements. .

While the CE Law will be managed by the powerful National Development and Reform Commission, actual implementation and enforcement will be delegated to Local Authorities. This further weakens the power of the legislation, since these authorities are often corrupt and reluctant to act against powerful businesses.

Some key provisions of the CE law can be summarized as below (NPC 2008):

i. The government to closely monitor energy consumption and pollution emissions in heavy consuming and polluting industries including the steel and non-ferrous metal production, power generation, oil refining, construction, and printing industries;
ii. Government departments to promote recycling and improve energy-saving and waste-reutilization standards and develop policies to divert capital into environment friendly industries;
iii. Industrial enterprises to introduce water-saving technologies, strengthen management, and install water-saving equipment in new buildings and projects;
iv. Crude oil refining, power generation, steel and iron production plants to stop using oil-fired fuel generators and boilers, in favor of clean energy, such as natural gas and alternative fuels;
v. Enterprises and government departments to adopt renewable products in new buildings, such as solar and geothermal energies;
vi. Enterprises to recycle and make comprehensive use of coal mine waste, coal ash, and other waste materials; and
vii. Encourages farmers and rural administrators to recycle straw, livestock waste, and farming by-products to produce methane.

The World Bank in 2009 issued a report recommending upgrades to the CE Law "Developing a Circular Economy in China: Highlights and Recommendations" (2009) as below:

"This policy note highlights and recommends further actions the government should take to enhance the effectiveness of its efforts to develop a circular economy. It focuses on four key areas that deserve greater attention: (i) a balanced mix of policy instruments, (ii) participation by both industry and the public in the

CE approach, (iii) capacity building, and (iv) the role of the government and governance."

"Circular Economy Development Strategy and the Recent Action Plan" issued by The State Council of China on 23 Jan, 2013 is the latest important guidance for the implement CE in a large scope of Chinese social and industrial sectors.

4. The Chinese CE Strategy

The Chinese circular economy strategy is deployed at three levels: the enterprise-wide promotion of clean production; in industrial zones to implement industrial ecology (Eco-Industrial Parks); and at the region level to develop eco-cities. According to Jean Claude Levy, Special Advisor to the Commissioner for external action of local communities in France, this strategy was tested in seven industrial sectors and implemented in 13 industrial parks, and since 2005, in 10 eco-cities and eco-provinces (Beijing, Shanghai, Chongqing, Guiyang, Ningbo, Hebei, Tongling, Liaoning, Shandong, and Jiangsu) under the leadership of the National Development and Reform Commission.

The construction of an eco-city essentially comprises the three following key aspects of the circular economy:

i. The industrial system of the circular economy (ecological industry, ecological agriculture and service sector);

ii. The construction of urban infrastructure, which highlights the circular use of water, energy and solid waste;

iv. The ecological security that implies the presence of non-polluting buildings, and the high quality of the habitat and the protection of the environment.

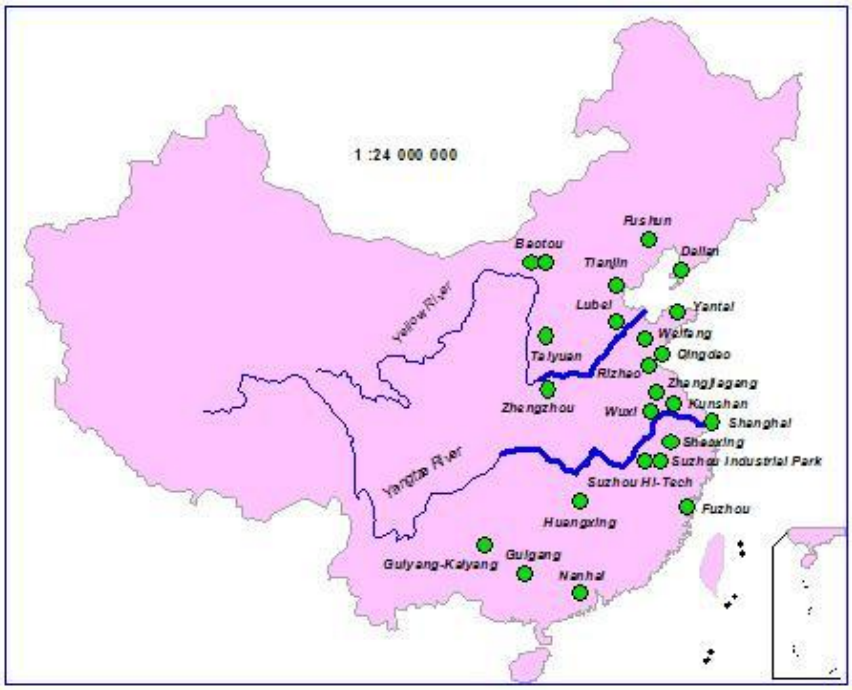
5. Case of CE implementation in China (Eco-Industrial Parks)

As represent above in "The Chinese CE Strategy", the Chinese circular economy strategy is deployed at three levels: clean production, Eco-Industrial Parks and eco-cities. The following introduction on Eco-Industrial Parks provides an insight into how circular economy practices are being implemented on the ground in China (HKGC, 2010).

To promote the development of EIPs, the State Environmental Protection Administration of China constructed demonstration parks in 1999 and established a Standard for the Construction and Management of Eco-Industrial Parks in 2006. Currently, 24 national EIPs have been set up throughout the country. In terms of industry composition, most of the parks are primarily made up of manufacturing industries. Chemicals, coal, metals, electronics, composite materials, machinery,

and bio-pharmaceutical industries are relatively common; a handful is related to agriculture, animal husbandry and tourism.

Figure 3.1: EIPs in China



Source: State Environmental Protection Administration of China

There are two types of EIPs: those that are converted from existing industrial parks and those that are newly built. The latter tend to be fewer in number due to the high capital costs of construction involved; conversion of an existing park into an eco-industrial park supported by enterprises and designated as a development zone, on the other hand, is more the norm. A development zone is a special location where a geographic area is selected to attract capital, technology or other external production elements with the aim of promoting economic development through new policies or reforms in this target area. In general, EIPs which are under government management have diversified types of industry and operate on a larger scale compared to parks under enterprise management which are relatively simple and concentrated.

Examples of the diversified industries within government-managed EIPs are:

i. Nanhai - environmental protection, plastic, plate, and ceramic equipment manufacturing;

ii. Huangxing - electronics & information, new materials, bio-pharmacy,

and environmental protection industries;

iii. Tianjin - electronics, communication, pharmaceuticals, machinery, food manufacturing, utilization of waste paper, coal ash and domestic waste, and electroplating industry;

iv. Suzhou - electronics & information, precision instruments, bio-pharmaceuticals and new materials.

Through this approach, these parks are able to take advantage of:

i. Material integration - waste recycling and treatment centers, byproduct/waste exchanges;

ii. Water integration - wastewater reduction , recovery of valuable material from wastewater, and central wastewater treatment;

iii. Energy integration - central heating systems, energy cascading usage, energy saving technologies, and cleaner energy usage;

iv. Information integration -web capability, management information systems, environmental management and technology services

v. Harmony with the local environment - maintenance of local ecosystems, park landscape design, and green buildings.

China's potential to create a circular economy is immense. Driven by the fact that its development is unsustainable in its current form, the central government has embraced the concept of the circular economy as one of the strategic measures for the nation's growth. Like Japan, China's internal manufacturing capacity – whether re-used into primary production or recycled into secondary production - is a key factor in providing the means with which to absorb the materials from spent products.

6. Discussion and Future Perspectives

In this research, a preliminary overview on CE implementation in China is conducted from 4 aspects, which are the development of CE in China, supporting laws and regulations for CE Implementation, the Chinese CE strategy and case introduction.

Though China has been moving to practice CE in different levels following the country's strategy for years, there are still barriers for better implementation. The main considerations concern the issues are:

i. Lack of wide understood by international society. International cooperation is important for progress on the CE because trade in waste and resources is rising and supply chains for many products today involve multiple countries.

ii. Lack of an appropriate measurement for CE (Geng 2012, 2013, Zhu 2006,

Feng 2007, Stahel 2011). This makes difficult to develop an effective incentive tools to courage individuals take follow-up action towards CE. To solve this problem, using the measurement for low carbon economy is a practical way, because all resource, including energy and material consumption can be calculated though the coefficient of carbon emissions.

iii. Lack of citizens' cooperation (zhou 2011, 2012a,b). This needs build citizens' high environmental awareness, including environmental knowledge help citizens understanding on environmental issues and how CE can contribute to solve the problems. Droved by command and control approach, or market approach, firms may have more desires to implement CE in their production process. But for citizens, if not droved by their environmental awareness, it may difficult for them to follow the idea of CE, this won't lead them to take action for a CE idea-based consumption. Therefore, for citizens, to improve their environmental awareness is most important to implement CE in an individual level.

For future research, varies of issues for better practice of CE are facing challenges including measurement of CE, public involvement of CE, ect., which we mentioned above. As next step, it's considered to view the development of CE in EU countries, which would be the leading countries of CE implementation, such as France; then based on those observation and reference to conduct comprehensive study for further analysis.

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