

China aims for more sustainable development

CIRCULAR ECONOMY China is going to increase resource efficiency and lower environmental impacts through the circular economy, eco-industrial parks and cleaner production. A workshop in the framework of AchemAsia will focus on experiences, accomplishments and the future of the initiative.

China's target, according to the 11th Five-Year-Plan (2006-2010), is to reduce energy consumption per unit GDP by 20%, and the total amount of major pollutant discharges by 10%, by the end of 2010. Following the trends of previous years, China's economy grew by ca. 10% in 2006. Simultaneously, its energy consumption per unit GDP decreased by 1.23%, yet the goal of 4% was missed and total energy consumption continued to rise. The National Statistics Bureau of China reported that coal consumption increased by 9.6% to 2.37 Bio t, crude oil by 7.1% to 320 Mio t and natural gas by 19.9% to 55.6 Bio m³. The pattern for various raw materials was similar: the consumption of steel products rose by 17.2% to 450 Mio t, aluminium by 32.1% to 8.65 Mio t and ethylene by 23.9% to 9.39 Mio t.

Circular economy in motion

The explosive economic growth coupled with a rapid increase in resource consumption in the past decade has brought wealth and enhanced living standards in China's industrialized regions. In parallel, and in spite of the one child policy, the Chinese population has continued to grow whilst lacking a comprehensive sustainable development strategy. These factors have resulted in regional scarcities of raw materials, energy and water, and has had severe adverse environmental impacts, in the form water pollution, soil erosion, desertification, sandstorms and urban smog. The Chinese central government has acknowledged the problem and complementary to the goals of the 11th Five-Year-Plan the National Development and Reform Commission (NDRC), released the "Action Program for Sustainable Development in China in the Early 21st Century" in February 2007, to support the implementation of China's Agenda 21.

A significant role in this programme is dedicated to the circular economy that was officially approved as a new comprehensive development strategy in 2002. The aim of circular economy strategies is to enable sustainable economic growth through

increased resource productivity and eco-efficiency in both production and consumption. Although it was previously understood to be merely an approach for recycling, the emerging paradigm views circular economy as a strategy for more comprehensive industrial restructuring, development of new technological solutions, and reforming industrial policy.

Also the State Council indicated the importance of the circular economy in future economic development policies by transferring the main responsibility for the promotion of the circular economy from the State Environmental Protection Administration (SEPA) to the NDRC in 2004 [1]. The "Law on Circular Economy" is currently being drafted and likely to come into force in 2008. In addition to the launch of the circular economy initiative, the government has passed a number of environmental laws and regulations for companies and estates during the last decade, including Laws for Solid Waste and Air and Water Pollution Prevention and Control (1995-1996), a Law on Energy Saving (1998) and an Environmental Impact Assessment Law (2003). Nevertheless, the enforcement of laws and regulations is still partially ineffective, in particular the newer instruments, such as regional environmental impact assessments and total load control addressing the industrial zones and parks as a whole are still not being implemented sufficiently.

Eco-industrial parks as demonstration projects

The circular economy strategies are being implemented on three levels in China: 1) Micro or firm level, in the form of cleaner production (Cleaner Production Promotion Law 2003), 2) Meso or industrial park and zone level, in the form of eco-industrial parks (EIPs) and 3) Macro level in the form of eco-cities and -provinces [1]. The State Council and NDRC have already selected 42 companies across the country as national circular economy demonstration businesses, six cities (Beijing, Shanghai, Ningbo, Hebi,

Guiyang and Chongqing) as national demonstration cities for eco-cities, and three provinces (Liaoning, Shandong and Jiangsu) as national demonstration provinces for eco-provinces [2].

The total number of Chinese industrial parks and zones exceeded 6600 in 2006; 164 of which represent national development zones. At the industrial park and zone level, EIPs can be developed within a company group or for an industrial park or zone. In order to develop an EIP, a research institution in cooperation with an administrative committee of a park establishes an eco-plan for the park, taking into consideration local constraints and opportunities. These plans deal only with industrial production and cover the largest and environmentally relevant companies in a park. First, a baseline study concerning resource uses and environmental impacts of the companies is conducted, in cooperation with a zone environmental protection bureau, and if needed, the companies.

Based on the results, recommendations are made for technical solutions to individual companies and inter-firm groups, and the environmental and economic profits of the suggested measures are analyzed. Moreover, basic recommendations are formulated for supportive components, such as organizational structures, information exchange platforms and additional policies to carry out the measures. After SEPA has approved the plan, the zone or park obtains the status of a national EIP.

There were 16 EIPs with varying industrial focus by the end of May 2006 in China. In 2006, SEPA also released the "Standards for EIPs in China". The standards were established for three different categories of industrial parks: 1) Standards for sector specific EIPs, 2) Standards for multiple sector EIPs and 3) Standards for recycling industry-oriented EIPs. In each category indicators are defined for economic development, reduction, re-use and recycling, pollution control and park management. Indicators for reduction, re-use and recycling include: energy

and water uses per unit of industrial value added; waste production per unit of industrial value added; and re-use and recycling rates for wastewater and different waste fractions. Indicators for pollution control address the environmental impacts of a park and the availability of centralized systems for waste collection, sewage and waste treatment, as well as environmental management. In terms of park management, the indicators focus on existing communication systems, eco-industrial awareness, the skills of park employees, and the satisfaction of surrounding communities. Currently the standards are being tested to assess the implementation stage of the approved eco-plans [3].

On October 22-23, 2006, the 3rd International Conference on the Circular Economy was organized in Tianjin. Besides the prominent participation of Chinese circular econ-

and eco-design) and the technological support for the circular economy. The major goal of the Center is to enhance the connections between government, industries and academics.

The TEDA Administration Committee has taken on the role of providing policy guidance e.g. in the form preferential resource pricing and capacity building, and promoting public awareness of the circular economy. Furthermore, a Waste Minimization Club, founded by the TEDA Environmental Protection Bureau in 2004, is planned to function as an information platform for integrated waste management. The participation of companies in the Club is voluntary, and the activities of the Club are slowly evolving. In terms of technical measures, the TEDA aims to enhance intra- and inter-firm product chains, and water and waste recycling networks. In this respect, the

overall rate of established product chains and recycling networks in the TEDA is still low. Similar problems have also been encountered by many other Chinese EIP initiatives. Factors identified as barriers for further development include: the fragmented regulation system providing unsatisfactory support for innovations, the lack of sufficient technical capability, financial resources, information systems and human capacity to encourage public participation [2]. A factor given less attention is the insufficient participation of different stakeholders, especially industry, in the EIP development process.

This poses a big challenge in Chinese industrial parks, where the share of international investors often exceeds 70%, creating a very complex mixture of corporate cultures. Furthermore, the circular economy initiatives mainly address company resource strategies, and these are often embedded at the corporate level in multinational corporations, due to the high price of energy and raw materials. Thus, the headquarters of the business units also add to the mixture of stakeholders. However, the success of eco-industrial initiatives largely depends on making them a functioning business case. The top-down approaches for developing network solutions across the world have mostly failed and there is a strong need for active public-private cooperation.

Exchange of experiences

The latest news on the circular economy in China, and current experiences in the development of eco-industrial initiatives in industrial zones and parks, will be presented and discussed in the 2nd International Chinese – German Workshop on Sustainable Development of Industrial Parks. The workshop will be held from May 14 to 16, 2007, as a guest event of AchemAsia 2007 in Beijing, in cooperation with the Dalian University of Technology (PRC), Chinese Research Academy of Environmental Science (PRC) and the University of Leipzig (GER). The aim of the workshop is to promote the exchange of experiences between industry, civil authorities and academics.

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The international conference on Circular Economy in Tianjin attracted high ranking delegates from all over the world.

omy experts, the event attracted international experts from research institutions in Europe, U.S., Canada, Korea and Japan. In the framework of the conference the circular economy plan of the Tianjin Economic-Technological Development Area (TEDA) was presented. In order to support circular economy components, the TEDA Circular Economy Promotion Center was founded in 2005, co-financed by the TEDA Administrative Committee and Nankai University. It acts as a service institution for the circular economy and its major tasks comprise: the establishment of a comprehensive TEDA circular economy information system, the provision of consultancy services to companies in regard to the circular economy (for example, cleaner production audits, ISO 14001 environmental management system

role of the subsidiaries of TEDA Investment Holdings is the construction and operation of centralized utilities and sewage treatment plants.

One example of successful intra- and inter-firm recycling projects is Tianjin Novozymes: its wastewater is re-used for public irrigation and the residues of its enzyme products as fertilizers. Another is Tianjin Toyota, who re-use their waste steel after it has been processed by a recycling company. Recycling industries promoting the circular economy development in TEDA are also present at TEDA Chemical Industrial Park. They include Tianjin Toho Lead Recycling Co. Ltd. and Taiding (Tianjin) Environment Technology Co., Ltd. which specializes in the recycling of electronic waste. Despite these successful pilot proj-

[1] Yuan, Z., Bi, J. & Moriguchi, Y. 2006. The Circular Economy - A New Development Strategy in China. *Journal of Industrial Ecology*, Vol. 10, No. 1-2. pp. 4-8.

[2] Geng (2006): Presentation at the 3rd International Conference on Circular Economy in Tianjin

[3] Salonen (2006) according to the data in Chinese at www.sepa.org.cn