Sector Overview

Green Industries: China is conceptually supporting the circular economy (Tool GI 1: New energy approaches for carbon replacement). This includes co-generation of energy for industrial or non-industrial purposes, and the recycling and reuse of all resources required for industrial production (Tool GI 2: Energy efficiency and cogeneration). A growing number of industries have come into existence to demonstrate the viability of the concept of clean industrial production (Tool GI 3: Circular Economy). A serious pursuit of the green industries’ concept is urgent as part of the national campaign for cleaner air (Tool GI 4: Green Industries and urban renewal-revitalisation).

Old and abandoned industrial sites are a physical asset – an urban challenge: Cannon factory, Zhuhai

Green products are becoming prime concern of new and green industries – Toshiba in China

Source: F. Steinberg
Sector Profile of Green Industries

**Introduction.** Manufacturing and construction activities generate a lot of waste—as much as four times produced by households. One way to overcome this problem is to mimic nature, where waste produced by one organism is often reabsorbed by another as part of symbiosis. Industrial symbiosis offers the same kind of solution, whereby the waste or by-product of one enterprise becomes the resource or input of another. Green industrial complexes and eco-industrial parks have defined ambitious targets for reducing energy consumption, waste generation and carbon emissions. A more proactive and larger scale approach is being taken in ‘Circle Economy’ (CE) Cities in China.

State of Demand in China. Cities with effective recycling schemes can recycle up to 75% of household waste, but manufacturing and construction activities generate four times as much waste as households. One way to overcome this problem is to mimic nature, where waste produced by one organism often is reabsorbed by another. Industrial processes can follow a similar path, turning the waste or by-product of one enterprise into the resource or input of another. This is the approach being taken by “circle economy” cities in China. China’s rapid economic growth over the past decades has been accompanied by substantial depletion of natural resources and serious environmental pollution. The objective of the CE approach is to achieve the decoupling of economic growth from natural resource depletion and environ-
mental 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.

**Policy Directions.** The Government’s 13th Five-Year-Plan addresses these challenges through an ambition of achieving “green and inclusive growth” and specifically in the environmental area of promoting clean production, setting up green and low-carbon industry systems, promoting green finance, and establishing a green development fund. Key tasks mentioned include setting up a nationwide, real-time online environmental monitoring system and an emissions permit system that will cover companies with static pollution sources as well as including environmental protection in outgoing officials’ performance evaluation.¹

**Industrial policy framework.** Green industries form part of the general industrial policy framework, but have strong linkages to energy, housing, transport, land-use and resource policies as well. This paper looks at green industries from the perspective of urbanisation and how to promote sustainable urban development. The intention is thus not to cover all aspects of industrial policy, but to present the elements that are most relevant to city representatives, urban planners and developers in shaping an ecological and low-carbon urban development.

**Best Practices in Europe.** In January 2012, the rationale for a circular economy concept in Europe was articulated. It was the first of its kind to consider the economic and business opportunity for the transition to a restorative, circular model. The report details the potential for significant benefits across the EU. It argues that a subset of the EU manufacturing sector could realise 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.

**Best Practices in Europe:** European practices of green industries demonstrate a determination to switch to clean energy and an adaptation of the circular economy concept. Some of the examples can be found in the following cities and countries:

- **Jämtland County, Sweden: The fossil fuel-free region.** The county of Jämtland has implemented a long-term programme to become a “fossil fuel-free region”. The county claims to be the first European county to have all its operations certified with ISO 14001 and EMAS. This is mainly done by taking advantage of the regional assets to develop renewable energies, mainly wind power and biomass.²

- **Galicia, Spain: Business and Innovation Centre Tecnópole.** This science & technology park that was not originally conceived as an eco-park, but since 2009 it participated in the ECOMARK project and part of its activities focuses on eco-innovation.
The park includes a technologic centre, a business incubator, and consists of companies operating in various sectors including: automotive, electronics, ITC, services, renewable energies etc.  

- **Landskrona, Sweden: Industrial Symbiosis.** The project involved 21 businesses, mostly SMEs, covering various sectors such as agriculture, chemistry, metal works, auto parts, printing, packaging, waste management, recycling, transport and logistics. The intention is to establish “a collection of long-term, symbiotic relationships between and among regional activities involving physical exchanges or materials and energy carriers as well as the exchange of knowledge, human or technical resources, concurrently providing environmental and competitive benefits”.  

- **Kalundborg, Denmark: Sustainable city / symbiosis.** The scarcity of water was the motivation factor behind the project and led to cooperation among the different economic players. By using surface water from a nearby lake for a new oil refinery, the limited supplies of groundwater were saved. The reduction of costs led to even more innovative approaches. The focus was especially on how to income-produce uses for “waste” products.  

- **Barcelona, Spain: Industrial area 22@Barcelona.** This project was launched in 2000 to regenerate an industrial area inside Barcelona city by attracting new environmentally friendly businesses and foster sustainable urban and economic development. 22@Barcelona focuses on five knowledge-intensive economic clusters and sectors: ICT, media, biomedical, energy and design.  

- **Emmen, The Netherlands: Emmtec Industry & Business Park.** The companies at Emmtec Industry & Business Park use residual heat and cooling and process water is recycled. Besides, residual substances are used as raw material and packaging materials are taken back by the suppliers.  

- **Turin, Italy: Conversion of Incet Factory –Barriera di Milano.** This redevelopment takes place in the former headquarters of a company known as Incet, which made electric cables and was active until 1968. After acquiring the campus of giant white buildings, city authorities briefly used it as a pound for confiscated vehicles before letting it sit vacant for decades. Now, Turin is renovating the buildings into a hub of what officials here call “open innovation” — and perhaps, a spark plug for a new post-industrial economy.  

- **North-Rhine Westphalia, Germany: Converting a Coal Mine Into Giant Battery Storage for Surplus Solar and Wind Power.** The Prosper-Haniel coal mine in the German state of North-Rhine Westphalia will be converted into a 200 megawatt pumped-storage hydroelectric reservoir that acts like a giant battery. The capacity is enough to power more than 400,000 homes.  

**State of the art in green industries in Europe.** In July 2014, the European Commission adopted a Circular Economy Package including an overall paper: “Towards a circular economy: a zero waste programme for Europe” and communications on sustainable buildings, green employment, SMEs, and waste review. The package had a strong focus on waste management and in early 2015 the package was redrawn and the waste part was replaced by a more ambitious proposal to promote the circular economy, i.e. exploring synergies with other policies and how to address more concretely the country specific implementation issues. A hearing and consultation process in connection with the development of a
A white paper on Circular Economy was put in place from June to August 2015 with the aim of developing a comprehensive approach in the EU before the end of 2015. In December 2015 the Commission presented the new Circular Economy Package\textsuperscript{10} in the form of an EU Action Plan for the Circular Economy.\textsuperscript{10}

The CE package set long-term waste targets and presents a list of concrete actions to be carried out before 2020 management and recycling. Key elements of the revised package include:

- A common EU target for recycling 65% of municipal waste by 2030;
- A common EU target for recycling 75% of packaging waste by 2030;
- A binding landfill target to reduce landfill to maximum of 10% of all waste by 2030;
- A ban on landfilling of separately collected waste;
- Promotion of economic instruments to discourage landfilling;
- Simplified and improved definitions and harmonized calculation methods for recycling rates throughout the EU;
- Concrete measures to promote re-use and stimulate industrial symbiosis – turning one industry's by-product into another industry's raw material;
- Economic incentives for producers to put greener products on the market and support recovery and recycling schemes (e.g. for packaging, batteries, electric and electronic equipment, vehicles).

Successful CE implementation requires government involvement and effective institutional arrangements, but first it requires knowledge about practical solutions and benefits. Although introducing the CE approach initially imposes some increased costs, many CE solutions also turn out to be economically advantageous when the avoided cost of environmental damage and saved operational costs are taken into account. The legislation, policies, and pilot programs already in place demonstrate the potential of CE to make a difference. Such projects must according to the CE approach focus on improving the effectiveness and efficiency of CE policies:

- actively involving the production sector, local government, community groups, industrial associations, professional networks, and nongovernment organizations in establishing a CE;
- building capacity for CE implementation and monitoring through enhanced training and dissemination of local and international experience; and
- strengthening governance by establishing high-level leadership, coordinating CE efforts across sectors and ministries, and promoting and enforcing private CE activity rather than directly implementing such activity.\textsuperscript{11}

Promotion of green energy – renewable energy and energy efficiency - is a cornerstone of the EU climate change policy and prerequisite for the move towards a circular economy. The policy framework for EU for climate and energy therefore deals with three areas: Greenhouse gas emissions, renewable energy and energy efficiency.

The EU Directive on renewable energy sets a binding target of 20% of final energy consumption from renewables by 2020. All member states have adopted national renewable energy action plans that detail the actions they intend to take to meet their individual targets. The individual targets vary substantially between the member states from 10% in Malta to 49% in Sweden. In 2014, the share of renewable energy reached 15% and thereby reached the interim target towards 2020. The progress of the member states is assessed every two years.
As part of EU’s energy and climate goals for 2030, EU countries have agreed a new target for 2030 of at least 27%. To reach the 2030 target the Commission has identified that in sectors such as housing, other transport modes and electrical equipment there will be a need for a significant acceleration of current efforts to tap what the Commission calls ‘a significant unexploited potential’. It is foreseen that large investments will be needed in the building sector (leading to lower running costs), as well as framework conditions and information that encourage consumers to take up innovative products and services. Ambitious EU-wide Energy Efficiency Standards for appliances, equipment, buildings and CO₂ standards for vehicles will be needed. To avoid distorting energy prices and the market, EU has issued guidance on support schemes to help governments design and revise support schemes. The guide focuses on renewable energy for electricity generation.

A third area that is strongly related to the green industry agenda is the promotion of green growth or greening of the economy—green employment, promotion of green technologies, and development of new technologies and practices through innovative procurement. In 2014 the European Commission launched its Green Employment Initiative: Tapping into the job creation potential of the green economy. The Commission label the potential of employment creation linked to the production of energy from renewable sources, energy efficiency, waste and water management, air quality, restoring and preserving biodiversity and developing green infrastructure as significant and resilient to changes in the business cycle.

Small and medium-sized enterprises (SMEs) are the backbone of the European Union as the 20.7 million companies represent more than 99% of all European businesses. 85% of new jobs over the past 5 years were created by SMEs and they provide 67% of total employment. The European Commission promotes the growth of SMEs through the Small Business Act for Europe. The Act includes an initiative to raise SMEs awareness of environmental and energy-related issues and to assist them in implementing legislation, assessing their environmental and energy performance and upgrading their skills and qualifications. The European Commission has collected examples of good practice in various areas e.g. in “Enable SMEs to turn the environmental challenges into opportunities.”

State of the art in green industries in China. Industries form an integrated and important part of the fabric that cities are made of. At a national level, a country’s industrial sectors pay a crucial role in moving the national economic output and growth towards achieving the objectives of sustainable development. The behaviour and decisions made in and in relation to the industrial sector form the cities, the people living in them and conditions and environment in which they live. If managed well, urbanisation and industrialisation can bring important benefits for development. Cities are an efficient way of organising populations; they enable economies of scale and reduce the need for transportation, thereby making economic activity more environmentally friendly.

Negative externalities. Higher population density, however, also creates challenges in terms of negative externalities especially if urbanisation is rapid and poorly-planned. The availability and quality of infrastructure are at the core of many of the challenges faced by rapid developing cities. Further issues that are likely not to be able to keep pace with growth and expectations of cities include air pollution, access to sufficient and clean water and dealing with wastes.

Industries and environmental degradation. China’s rapid economic growth over the past decades has been accompanied by substantial exploitation of natural resources and serious environmental pollution. The increasing concern about environmental pollution in urban areas, especially air pollution from industry and energy generation, is leading to changes in the
approaches to planning and integration of industries. E.g. the promotion of high tech and light manufacturing in the East of China and relocation of heavy industries to the Mid and West China. The potential for improving the environmental conduct of the individual industries and clusters of industries remain, however, largely untapped.

Cities and high carbon emissions of carbon-based fuels. Cities in China are large procurers of materials, energy and infrastructure. The cost of materials for building construction is an increasing concern, as construction activities are taking place at a high pace and little experience exists in recycling of building materials. The energy demand for cement and metals production is enormous and the rapid developing housing sector thus has a direct impact on energy demand and emissions. Improving energy efficiency in the construction sector, especially in the production of building materials and recycling of materials, will have a significant positive impact on the environment.

Development choices. In the next 15 years, China will face a series of important choices, which will shape both China’s future and that of the world:

- China has the opportunity to become a high-income economy, but sustainable economic growth is needed over the next 20 years to avoid the middle-income trap.
- China has an opportunity to lead the world in developing new and renewable energy solutions, but will need major reform of the energy system to build safe, efficient, clean and low-carbon energy supply and consumption systems.
- China has the opportunity to play an important role in global low-carbon development and to move upstream in the industry chain, but will need to further limit greenhouse gas emissions and manage the risks of climate change.
- China has the opportunity to optimise economic growth through environmental improvement, but needs to improve environmental management.

Commitment to reduction of fossil fuels. China’s commitment to increase the share of non-fossil fuels in primary energy consumption is strong and has been confirmed through several important agreements. The principal commitment is to increase non-fossil fuels to around 20% by 2030. One of the measures is promotion of trade in green goods through e.g. encouraging trade in sustainable environmental goods and clean energy technologies; focus on smart low-carbon cities and smart low-carbon growth technologies.

China’s new normal. The notion “China’s new normal” was introduced in June 2015 to describe the Chinese shift in strategy towards structural change, better growth and peak emissions. A good example of the shift is seen in international cooperation efforts in the promotion of renewable energy that is now receiving increased attention, e.g. the cooperation agreement between China State Grid Energy Research Institute and the US Department of Energy’s National Renewable Energy Department (NREL) in relation to developing mechanisms to ensure achieving the full benefits of the large investments in renewable energy already made, e.g. integration of fluctuating renewable energy sources into the grid.
**Circular Economy.** Circular Economy (CE) is a relatively recent economic concept, seeking to ultimately decouple global economic development from finite resource consumption. It enables key policy objectives such as generating economic growth, creating jobs, and reducing environmental impacts, including carbon emissions. The CE model is developed as a reaction to the linear ‘take, make, dispose’ model that relies on large quantities of easily accessible resources and energy. The model acknowledges that working towards efficiency – a reduction of resources and fossil energy consumed per unit of economic output – will not alter the finite nature of their stocks, but can only delay the inevitable depletion, wherefore a deeper change of the operating system is needed.

**Circular Economy for China.** Promoting a circular economy was identified as national policy in China’s 11th five-year plan starting in 2006 and China’s Circular Economy Promotion Law came into force in January 2009 with the purpose of promoting CE, raising the resources utilization rate, protecting and improving environment and realizing sustained development. The use of the terminology CE in China is close to the use in the EU of ‘green economy’ or ‘sustainable development.’ The CE Promotion Law aimed to decouple economic growth from resource consumption and pollution and also shifted the traditional view on solid waste treatment to the idea of closed-loop materials flows addressing reuse and recycling. Finally, the law introduced policies and instruments for controlling the total quantities of resource consumption and pollutant discharge.

**The circular economy cycle.** The CE is perceived as a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows. In its more comprehensive version the CE is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.

**Principles.** The Circular Economy rests on three key principles:

1. Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows—for example, replacing fossil fuels with renewable energy or using the maximum sustainable yield method to preserve fish stocks.

2. Optimise resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles – for example, sharing or looping products and extending product lifetimes.

3. Foster system effectiveness by revealing and designing out negative externalities, such as water, air, soil, and noise pollution; climate change; toxins; congestion; and negative health effects related to resource use.
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<td>__ % of hazardous waste treated</td>
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Sources:

Outlook and future sector agenda. China’s pathway to a green economy is about (i) waste recycling and reutilization; (ii) clean technologies; and (iii) renewable energy. With its huge public investment, China’s environmental protection industry is expected to continue growing at an average of 15-20 per cent per year. These investments come to consolidate a massive fiscal stimulus that China committed in response to the economic and financial crisis. In absolute terms, China’s green stimulus of US$ 218 billion was the largest in the world. China is taking considerable steps to shift to a low-carbon growth strategy based on the development of renewable energy sources. But one would be wrong to think that improving air quality, creating jobs and reducing carbon-dioxide output are the main drivers of the pursuit of clean energy. It’s really about energy security. China realizes it can (literally) manufacture its own energy security in wind-vane and solar-panel factories or it can trapse around the world competing with other energy-thirsty countries for oil, gas and coal. China’s pursuit of clean energy is really about energy security. China is the world’s second-biggest economy and its phenomenal growth has been driven almost entirely by the “black” fuels. As long this fuel is not replaced, one cannot yet speak of a real greening of the industries. Thus, green industries, which represent the circular economy approach, will need to replace carbon-based technologies, and seek more energy efficiency. The retrofitting and refurbishment of old industrial complexes and their conversion to new functions opens an opportunity to develop projects of green industries which are low carbon-based, such as creative and cultural
industries. Such industrial redevelopment activities represent also a form of urban renewal and revitalisation.

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Editor: Kosta Mathé

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