Chapter 7

Circular Economy Policies in China

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Chapter 7

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1. Circular Economy Development in China

1.1. Background of Circular Economy

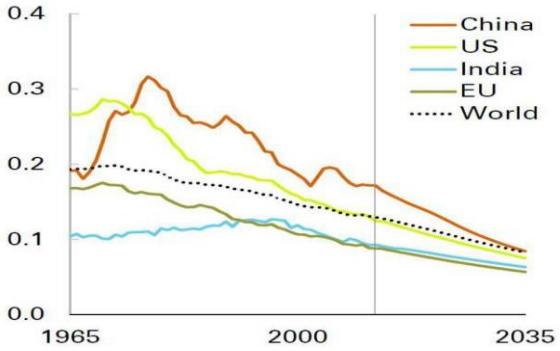
Since reforming and opening up, China's economy has developed rapidly with its GDP increasing significantly. However, its traditional extensive economic growth mode, with industrial production at the core, has relied on high investment and high consumption of resources, resulting in contradiction between limited environmental resources and economic development. The contradiction mainly includes the following aspects.

Firstly, China's resources per capita are scarce and its resource-utilisation efficiency is relatively low. China's major resources per capita are far below the world's average level and its extensive economic growth mode has rapidly increased the demand for resources (Figure 7.1). In 2012, China's gross domestic product (GDP) accounted for 11.6 percent of the total global GDP, but the country consumed 21.3 percent of energy, 54 percent of cement, and 45 percent of steel in the world.

Emissions of major pollutants are high and environmental pollution is still serious in China. In recent years, the country's environmental situation has continued to deteriorate. Pollution of its key waters is serious, with the proportion of Grade-V water increasing from 10 percent to 30 percent. Air pollutant emissions are in the overall rise and air pollution is very serious (Figure 7.2). One of the main reasons for the environment deterioration in China is the significant emissions of three industrial wastes. According to statistical data, economic losses caused by environmental pollution in the country account for 2.1–7.7 percent of GDP and economic losses caused by ecological destruction account for 5–13 percent of GDP (You and Qi, 2004).

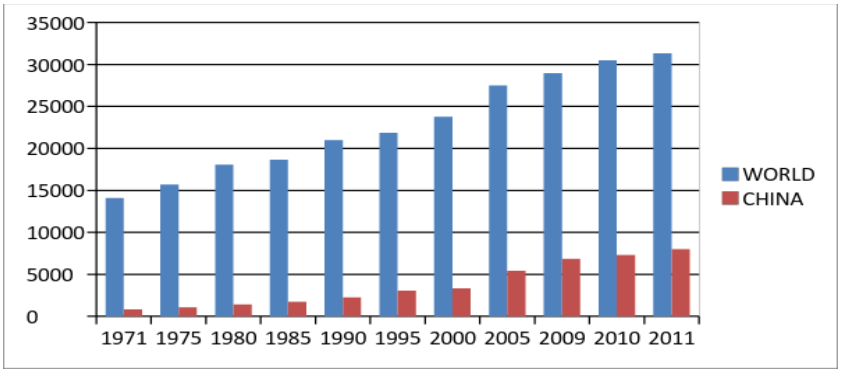
Since 1978, with rapid industrial development, total energy consumption in China has increased five times while its greenhouse gas emissions have risen rapidly.

Figure 7.1. Energy Intensity
(TOE per thousand $ 2012 GDP)



EU = European Union, GDP = gross domestic product, TOE = tonne of oil equivalent, US = United States.
Source: BP.

Figure 7.2. CO_2 Emissions in China (million tonnes)



CO_2 = carbon dioxide.
Source: International Energy Agency.

Under pressure of limited environmental resources, China must change its traditional economic growth mode and optimise its industrial structure. With circular economy as a new economic development model, China can reduce its energy consumption and pollution emissions, improve resource-utilisation efficiency, and solve the development bottleneck in resources and environment.

1.2. The Development Process of Circular Economy in China

In the Circular Economy Promotion Law issued by China in 2008, circular economy refers to the reduction, reuse, and recycling (3R) activities in the production, circulation, and consumption of products. The first of the 3R refers to the reduction of resource consumption and waste generation while reuse and recycling mainly involve wastes. Circular economy in China has two purposes. Firstly, scarcity of resources should be partly solved by improving

energy efficiency and reducing the consumption of resources and energy. Secondly, emissions of pollutants and greenhouse gas should be reduced by mitigating pollution caused by rapid industrial development.

Driven by strong policy, the development of circular economy in China has experienced the following four stages.

The first stage (before 1992) was characterised by the comprehensive utilisation of resources. China had accumulated abundant experiences in establishing a system of waste recycling and comprehensive utilisation of waste gas, waste water, and waste solid (three wastes). At this stage, the main purpose of the comprehensive resource utilisation was to remedy the shortage of various products and indirectly increase resource supplies. In 1985, the government issued Interim Provisions on Several Issues of Comprehensive Utilization of Resources Approved by State Council and Transferred to National Economic Commission and proposed the Directories of Sources for Comprehensive Utilization. The comprehensive utilisation of three wastes was encouraged through a series of preferential policies. For example, in 1986, the output value, profit, and retention profit of the products in the comprehensive utilisation of three wastes in the metallurgical industry were 34.6 percent, 38.2 percent, and 97 percent higher than the corresponding values in 1985, respectively. The average annual recycling rate of industrial waste water in 1986 was 2.74 percent higher than that in 1985. Also, the amount of recycled gas increased threefold and the rate of fly ash utilisation increased by 9 percent.

The second stage (1991–2002) was characterised by cleaner production. In 1992, the Chinese State Council formulated the Top 10 Strategies for Environment and Development and formally proposed cleaner production. In 1993, the Chinese State Environmental Protection Administration, supported by the World Bank, started the B-4 Demonstration Project, the first systematic cleaner production project in China. Through the project, the government audited the cleaner production plans of 27 companies and 29 projects. Results of the audit showed many companies achieving cleaner production through rectification. For example, after investing CNY68,500 and implementing 10 programmes, Yantai No. 2 Brewery gained CNY2.89 million economic benefit and reduced its use of coal to 810 tonnes (21 percent), power to 134,000 kWh (18 percent), food to 3.56 tonnes (18 percent), water to 98,000 tonnes (28 percent), and discharge waste stillage to 20,000 tonnes (27 percent). Subsequently, a number of Sino–Foreign cooperative cleaner production projects were successively carried out, thus effectively promoting the development of clean production. In 2002, with the implementation of the Cleaner Production Promotion Law of the People's Republic of China, cleaner production entered a new era. Environmental pollution control mode has gradually shifted from end treatment to source prevention, thus greatly promoting the increase in resource utilisation rate and reduction in pollutant emissions in industrial sectors and laying the foundation for the development of circular economy.

The third stage (2002–2008) was the pilot stage of circular economy. In 2002, the State Environmental Protection Administration launched the circular economy programme, and Guiyang City and Liaoning Province were selected as China's first circular economy pilot city and province, respectively. In 2005, the Chinese State Council issued The Opinions of State Council on Accelerating the Development of Circular Economy, indicating circular economy as the new development model. In 2005 and 2007, the Chinese State Council launched the first and second sets of circular economy pilot projects in targeted provinces and cities, sectors, areas, and industrial parks.

The fourth stage (from 2009 to the present) is the rapid development of circular economy. On 1 January 2009, the Circular Economy Promotion Law of People's Republic of China was implemented, indicating the entry of China's economic development into the legislation process. With the rapid increase in the number of pilot projects and scope, circular economy has covered 27 provinces and numerous industries, indicating a widespread trend in implementation (Ren and Zhou, 2009).

1.3. Practices of Circular Economy in China

China's circular economy practices are primarily implemented at the enterprise, regional, and social levels. At the enterprise level, cleaner production is promoted to reduce the consumption of materials and energy in products and services. In this way, resource-utilisation efficiency is improved and emissions are minimised. At the regional level, in eco-industrial parks, as eco-industrial chains are established, industrial metabolism and symbiosis relationship are formed among enterprises. At the social level, the recycling and reuse of various industrial wastes promote the recycling of waste materials.

China has also launched circular economy pilot projects in provinces and cities, industries, fields, and industrial parks. In 2005 and 2007, the National Development and Reform Commission and other six ministries jointly organised the first and second sets of circular economy pilot projects (Table 7.1).

Table 7.1. Pilot List of China's Circular Economy

Key industries	Steel, nonferrous metals, coal, electricity, chemicals, building materials, light industry, papermaking, textile, machinery manufacturing, agro-processing, agriculture (forestry), and processing and utilisation base of renewable resources
Main fields	Renewable resource–recycling system, remanufacturing, scrap metal recycling, recycled metal utilisation, recycling of waste household appliances, recycling of electronic wastes, tyres, batteries, and packaging recycling
Industrial parks	20 eco-industrial parks over the country
Provinces (or cities)	27 provinces (or cities) in China.

Source: Qi Jianguo et al. (2010).

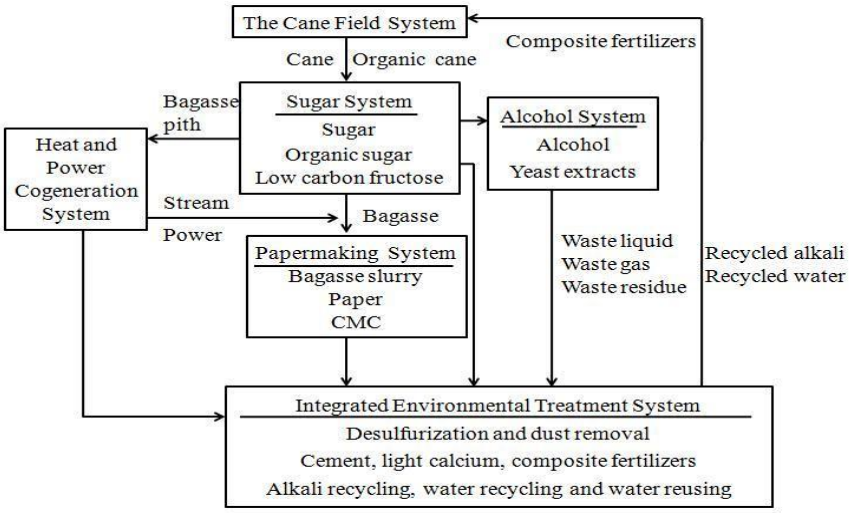
Box 1. Guigang Eco-Industrial Park in Guangxi Zhuang Autonomous Region

Guigang City is the major sugar production city in Guangxi Province. Since 1990, Guigang's annual sugar production has always been above 200,000 tonnes and ranks first in Guangxi Province. Sugar, papermaking, and alcohol production constitute the pillar economic industries in Guigang. However, these three industries are also the major pollution-causing industries. To solve the longstanding serious structural and regional pollution in the sugar industry in Guigang, the Guigang National Eco-Industrial (Sugar) Demonstration Park was constructed in 2001.

As shown in Figure 3, the Guigang National Eco-Industrial (Sugar) Demonstration Park is composed of cane field system, sugar system, alcohol system, papermaking system, heat and power cogeneration system, and integrated environmental treatment system (Wu, 2007). Through optimisation and combination, the interface between input and output of various systems has been connected to realise optimal resource configuration and efficient waste utilisation and reduce environmental pollution. Through this, the relatively complete combined ecological system of industry and farming has been established to form an efficient, safe, and stable sugar industrial park.

Source: Liu Hongci (2011).

Figure 7.3. Overall Circular Economy Structure in Guigang Eco-Industrial Park



Source: Wu (2007) and Liu Hongci (2011).

About 93 percent of molasses production in Guangxi Province is consumed in the demonstration park to produce alcohol. Moreover, waste alcohol solution is utilised to produce compound fertilisers. Waste alcohol solution discharge in Guangxi Province has decreased by about 93 percent. Annual organic pollutant reduction in waters has reached 134,000 tonnes.

2. Analysis of China's Circular Economy Policy

Since the 1980s, China has successively issued a series of laws and regulations, comprehensive policies, industrial policies, economic policies, and related environmental policies on circular economy. Laws and regulations are legal protection and play supporting role in the development of circular economy. These include the Cleaner Production Promotion Law, the Energy Conservation Law, the Circular Economy Promotion Law, etc. The Circular Economy Promotion Law focuses on development plans, extended producer responsibilities, supervision management systems for key enterprises with high energy and water consumptions, circular economy indices, statistics, and other management systems. In the Circular Economy Promotion Law, the requirements for circular economy development are proposed, covering production techniques, equipment, resource exploitation, recycling of waste materials, comprehensive resource utilisation, reduction, and other aspects. As proposed in the law to stimulate circular economy, the government shall encourage circular economy through special funds, technical support, tax incentives, investment, finance, price, government procurement, and other aspects.

Comprehensive policies play the general guiding role and include action plans, programmes, and opinions such as the Opinions on Accelerating the Implementation of Cleaner Production, the Notice on Building a Conservation-Oriented Society by the State Council, the Opinions on Accelerating the Development of Circular Economy, the Comprehensive Energy Reduction Program, and the Notice of the State Council on Issuing the Circular Economy Development Strategy and Near-Term Action Plan.

Box 2. Notice of the State Council on Issuing the Circular Economy Development Strategy and the Near-Term Action Plan

The Circular Economy Development Strategy and the Near-Term Action Plan issued in 2013 provides the development target and the detailed explanation of circular economy development. The development target of circular economy in the 12th Five-Year Plan is described as follows. The main resource productivity should be 15 percent higher than that in the 11th Five-Year Plan and total output value resource of the recycling industry should reach CNY1.8 trillion. Meanwhile, the detailed guidance for the development and safeguard measures of circular economy is proposed for key sectors and fields. In the policies on circular economy, the coal industry should be improved on five aspects: green mining, comprehensive exploitation and utilisation of coal and associated minerals, energy-saving and consumption reduction, ecological environment protection, and construction of industrial chains. The following targets should be realised by 2015: 60 percent higher coal washing rate, 75 percent comprehensive utilisation rate of coal gangue, 60 percent coal bed methane extraction rate, 2.85 million kWh power-generation capacity obtained through the utilisation of coal bed; 76 million kWh power-generation capacity obtained through comprehensive utilisation of coal of low calorific value, 75 percent comprehensive utilisation rate of mine water, and 60 percent land reclamation rate.

Source: The State Council of the People's Republic of China.

Environmental policies are mainly to promote the development of circular economy through the reverse transmission pressure mechanism. For example, China's Environmental Protection Ministry has developed pollutant emission standards for different industries. For those industries, pollutants should be treated according to the emission standards before being discharged, so that enterprises would be forced to develop strategies for low material consumption and low emissions.

Industrial and economic policies are to promote the development of circular economy. Economic policies can be roughly divided into tax, fiscal, monetary, and price policies. The following key economic and industrial policies may promote the development of circular economy (Table 7.2).

Table 7.2. Analysis of Major Industrial and Economic Policies

Policy Classification	Policy	Policy Measure	Main Points of the Policy
Upgrading industrial structure	Lists of Backward Production Capabilities, Processes, and Products to Be Eliminated (the First, Second, and Third Batches in 1999, 2000, and 2002)	Command-control	Backward production capabilities, processes, and products to be eliminated have the following features: violation of national regulations, backward production methods, poor product quality, serious environmental pollution, and high consumption of materials and energy.
	Interim Regulation for Promoting Industrial Structure Upgrade and Guiding Lists for Upgrading Industries (2005)	Command-control	Encourage and support key technologies, devices, and products beneficial to environmental protection and energy saving; gradually eliminate backward technologies that consume too much resources and energy and pollute the environment.
	Notice of the State Council on Accelerating the Structural Upgrading of the Industries with Excessive Production Capability (2006)	Command-control	Legally close small enterprises that destroy resources, pollute environment, and have no safe production conditions; eliminate backward production capabilities; dispose devices to be eliminated; improve policies and measures restricting resource products with high energy consumption and high pollution.
	Notice on Accelerating the Structure Adjustment of the Steel Industry via Controlling Total Production Capability and Eliminating Backward Production Capability (2006)	Command-control	Close enterprises with backward production capability and high resource consumption, serious environmental pollution, and unqualified production conditions; eliminate, before 2007, a series of backward devices including blast furnaces with capacity below 200 m^3 and converter furnaces with capacity below 20 tonnes; eliminate, before 2010, backward devices including blast furnaces with capacity below 300 m^3.
	Notice on Accelerating the Structure Adjustment of Power Generation Industry for Healthy and Smooth Development (2006)	Command-control	Gradually close, according to local situation, thermal power units with high energy consumption; restrict power generation of units with high energy consumption and serious consumption.
	Guiding Advices on Improving and Enhancing Financial Services for Environmental Protection Industries (2007)	Financial measures	Simplify the lending procedure for projects that encourage investment according to the Guiding Lists of the Industries to Be Adjusted; stop lending credit and withdraw loans to projects to be eliminated.
	Guiding Advices on Financial Services for Supporting and Promoting Key Industrial Adjustments and Suppressing Excessive Production Capability (2009)	Financial measures	Do not provide loans to projects not consistent with the policies on supporting and promoting key industrial adjustments or relevant industrial policies, especially backward projects for elimination by related regulations and laws.
	Advices on Financial Services for Supporting Energy Saving and Emission Reduction and	Financial measures	Do not provide loans to projects under construction and not consistent with the policies on energy-saving and emissions reductions or are for elimination; do not provide additional

	Eliminating Backward Production Capability (2010)		loans for illegally constructed projects.
	Management Method of the Central Financial Rewarding Fund for Eliminating Backward Production Capability (2011)	Fiscal measures	Reward enterprises that eliminate their backward production capability for resettlement of laid-off workers, production conversion, and debt payment.
Cleaner production	Interim Method for Auditing Cleaner Production Projects (2004)	Command-control	Perform compulsory audit on enterprises that violate local or national emission standards, use poisonous materials, or discharge poisonous matters.
	Preferential Income Tax Lists of the Enterprises for Producing Special Safety Production Devices (2008)	Tax measures	If an enterprise purchases and utilises special equipment for environmental protection, energy- and water-saving, and safety production, related equipment purchase cost may be deducted from income tax.
	Interim Management Method of the Central Financial Rewarding Fund for Energy-Saving Technologies (2011)	Fiscal measures	In East China, after the construction of energy-saving projects, the reward standard is CNY240 per tonne of standard coal, and in Middle and West China, it is CNY300 per tonne of standard coal.
Comprehen-sive resource utilisation	Notice on Comprehensive Resource Utilization Measures Approved by the State Council and Transferred to State Economic Trade Commission (1996)		**The scopes of comprehensive resource utilisation and preferential policies are clarified to enhance comprehensive resource utilisation and prevent resource waste and environment pollution for the purpose of supporting the comprehensive utilisation of thermal energy and power in power-generation plants and promoting the recovery of waste materials.
	Notice on the Policy of Preferential Income Tax of Enterprises (1994)	Tax measures	For enterprises that use waste water, waste gas, and waste solid as main production materials, income tax may be decreased or waived for 5 years.
	Notice on the Interpretation of Regulation Tax Rating of Fixed Asset Investment for Comprehensive Resource Utilization and Warehouse Facilities (1994)	Tax measures	The regulation tax rate for fixed asset investment consistent with the requirements of comprehensive resource utilisation is zero.
	Notice on Exemption of VAT for Partial Products of Comprehensive Resource Utilization Projects (1995)	Tax measures	Enterprises that use materials containing more than 30 percent waste solids (coal gangue, limestone coal, fine coal dust, and boiler slags) or waste liquids to produce construction products may be exempted from VAT until 1995.
	Notice on Consumption Tax Policy of Soap and Tires (2000)	Tax measures	Exemption from consumption tax for radial tyres or retread tyres.
	Notice on Preferential VAT Policy for the Products Produced through the Comprehensive Utilization of Three Residues or Secondary Woods (2001)	Tax measures	Enterprises which use the three residues or secondary woods as materials should be exempted from VAT immediately after taxation.
	Notice on the VAT Policy for the Business of Waste Recovery (2001)	Tax measures	Enterprises of waste materials should be exempted from VAT.
	Notice on the VAT Policy for Comprehensive Resource Utilization and Related Products (2008)	Tax measures	Enterprises that sell reclaimed waste water, retread tyres, or produce rubber powder with the material of waste tyres or produce construction products with material containing more than 30 percent waste solid, should be exempted from VAT; enterprises on waste water treatment should be exempted from VAT; enterprises that sell CO_2 of high purity produced with industrial waste gas, power, or heat generated with the garbage fuel, and regenerated asphalt cement produced with waste asphalt should be exempted from VAT immediately after taxation; enterprises that sell power or heat generated with coal gangue, silt coal, limestone coal, and bituminous shale should be exempted from 50 percent VAT immediately after taxation; enterprises that sell biodiesel generated through comprehensive

			resource utilisation should be exempted from VAT after taxation.
	Notice on Preferential Income Tax for the Catalogue of Materials of Comprehensive Resource Utilization (2008)	Tax measures	After 1 January 2008, the revenue of enterprises that sell products generated with the materials in the catalogue and included in the catalogue should be deducted by 10 percent during income calculation.
	Notice on the VAT Policy for the Products Produced with Agricultural And Forestry Residues (2009)	Tax measures	Products produced with four types of agricultural and forestry residues (three residues, secondary woods, crop stalks, and bagasse) should be exempted from VAT immediately after taxation. Tax ratio exemption was 100 percent in 2009 and 80 percent in 2010.
	Notice on Exemption of Consumption Tax for Biodiesel Produced with Waste Animal and Vegetable Oils (2010)	Tax measures	Biodiesel produced with waste animal and vegetable oils are exempted from consumption tax.
Exploitation and utilisation of resources and energy	Notice on Further Implementation of the Policy on Differential Power Pricing and Charging Issues Related to Own Power Plants (2004)	Price measures	Based on basic industrial power price, the prices of power for enterprises to be restricted or to be eliminated should be increased by CNY0.02/kWh and CNY0.05/kWh, respectively. These enterprises are mainly concentrated in the electrolytic aluminium, ferroalloy, calcium carbide, caustic soda, cement, and steel industries.
	Opinions on Improving the Differential Power Pricing Policy (2006)	Price measures	Based on basic industrial power price, the prices of power for the yellow phosphorus and zinc smelting industries should be increased by CNY0.05/kWh and CNY0.2/kWh, respectively, for the enterprises to be restricted or to be eliminated.
	Pilot Scheme of Pricing and Cost-Sharing Management of Power Generation with Renewable Energy (2006)	Price measures	For renewable energy-generation projects, the amount exceeding the electricity purchase price of local coal-fired power generation plants may be compensated through additional power price fee from power users in China.
Composite	Catalogue of Encouraged Technologies, Processes, and Equipment of Circular Economy (the First Batch) (2012)		The catalogue covers reduction, reuse and remanufacture, recycling, and industrial symbiosis and linkage, and includes 42 key circular economy technologies, processes, and devices.
	Interim Management Method Circular Economy Development Funds (2012)	Fiscal measures	Special funds should support national urban minerals demonstration bases, kitchen waste recycling and safe disposal, circular transformation in parks, remanufacture, and demonstration and promotion of cleaner production technologies. Taking cleaner production as an example on the basis of verification by experts, the government should freely promote mature and advanced cleaner production technologies by purchasing the technology.
	Notice on Opinions of Supporting Policies and Measures of Circular Economic Development Investment and Financing (2010)	Financial measures	Circular economy-related projects should receive credit support. No additional credit should be provided and original credit should be reduced or withdrawn for enterprises that adopt technologies, processes, equipment, materials, or products in the catalogue to be eliminated.
	Interim Management Method of Energy Conservation and Emission Reduction Funds (2015)	Fiscal measures	The allocation of energy-conservation and emission-reduction funds should be based on properties, objectives, investment costs, energy-saving and emission-reduction effects, energy and resource utilisation levels, and other factors of the projects. Fund support mainly includes subsidies, rewards, discounts, and true settlements. Rewards are mainly allocated based on energy conservation performance. In truly settled projects, funds are first disbursed and settled later.

VAT = value-added tax.

Source: Zhang Lu (2013) and Xie Haiyan (2010).

Circular economy policies mainly include command-control, tax, fiscal, financial, and pricing measures, and focus on upgrading industrial structures, cleaner production, recycling and comprehensive utilisation of waste materials, and exploitation and utilisation of resources and energy.

Upgrading industrial structures is mainly based on command-control measures aimed at compulsory elimination of backward production capability, process, and products in violation of national regulations, backward production modes, poor quality, serious environmental pollution, and extensive consumption of materials and energy under financial and fiscal measures. Cleaner production is mainly based on the Interim Method for Auditing Cleaner Production Projects and implemented through command-control measures. Moreover, preferential tax and financial incentives are also adopted to stimulate the development of cleaner production in enterprises. Preferential tax rating is implemented in enterprises dedicated to waste material recycling and comprehensive resource utilisation. Price measures are adopted to regulate industries with high-energy consumption for utilisation of resources and energy.

3. Implementation Effects of Circular Economy Policies in China

Based on the background and purpose of circular economy development, the effects of implementing circular economy policies in China can be divided into the following.

3.1. Improvements in the Comprehensive Utilisation Rate of Resources

In implementing circular economy policies in China, the rate of comprehensive utilisation of resources is mainly improved in three aspects: (i) the rates of resource mining and comprehensive recovery in the mining of mineral resources, (ii) the utilisation rates of three wastes, and (iii) recycling waste materials. The total amount of recycled renewable resources increased from 52.38 million tonnes in 2001 to 148.899 million tonnes in 2010. In the 10th Five-Year Period, the total amount of recycled renewable resource was more than 400 million tonnes with an average annual growth above 12 percent. Gross output value of primary recycled renewable resource was more than CNY650 billion. In the 11th Five-Year Period, the total amount and gross output value of recycled renewable resource increased further. At the same time, renewable resource recycling brought ecological benefits to China. From 2001 to 2009, renewable resource recycling was equivalent to 915,708,500 tonnes of the accumulated savings of standard coal; 51,222,440 tonnes of waste water–emission reduction; 13,454,990,000 tonnes of solid waste reduction; 20,646,500 tonnes of sulphur dioxide–emission reduction; and 2,866,380,300 tonnes of carbon dioxide–emission reduction. Statistics of renewable resource recycling and energy conservation from 2011 to 2012 are provided in Table 7.3.

Table 7.3. Statistics of Renewable Resource Recycling and Energy Conservation in China (2011–2012)

Waste	Recycled amount (10,000 tonnes)		Saved energy (10,000 tonnes of standard coal)		Waste water–discharge reduction (10,000 tonnes)	
	2011	2012	2011	2012	2011	2012
Scrap steel	9100,0	8400,0	3194,2	2948,5	79853,9	73711,3
Scrap ferrous metals	455,0	530,0	4734,5	5514,9	305667,5	356052,3
Waste plastics	1350,0	1600,0	442,1	524,0	122812,9	145556,0
Wastepaper	4347,0	4472,0	6866,9	7064,4	508655,8	523282,4
Waste tyres	329,0	370,3	74,0	83,3	6163,6	6937,3
Waste electrical and electronic utensils	370,6	190,7	730,1	375,7	8980,8	4621,3
Disposed cars	285,0	249,0	191,5	167,3	10260,0	8964,0
Disposed ships	225,2	255,0	239,9	271,6	6877,2	7787,2
Total	16461,8	16067,0	16473,1	16949,7	1049271,7	1126911,8

Waste	Emission Reduction (10,000 tonnes)					
	Waste solid		Sulphur dioxide		Carbon dioxide	
	2011	2012	2011	2012	2011	2012
Scrap steel	26617,6	24570,1	177,4	163,8	7666,0	7076,3
Scrap ferrous metals	245794,4	286310,0	80,6	93,9	11362,9	13235,9
Waste plastics	3779,0	4478,8	58,5	69,3	1061,2	1257,7
Waste paper	9838,8	10121,7	12,1	12,4	16480,6	16954,5
Waste tyres	369,9	416,3	4,5	5,1	177,6	199,9
Waste electrical and electronic utensils	5043,2	2595,1	17,1	8,8	1752,4	901,7
Disposed cars	7695,0	6723,0	7,3	6,4	459,7	401,6
Disposed ship	3365,1	3810,4	13,2	14,9	575,7	651,9
Total	302503,0	339025,4	370,7	374,6	39536,1	40679,5

Source: Xie Zhenhua (2013).

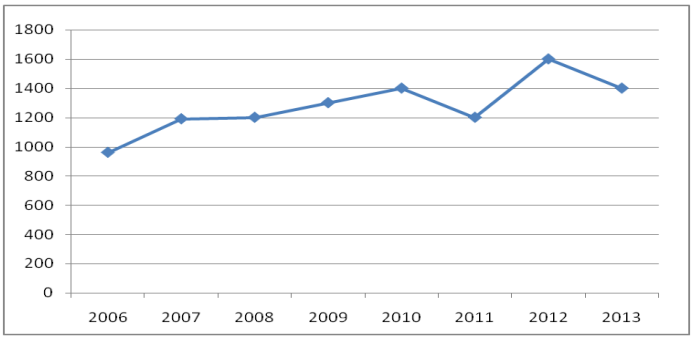
Box 3. Waste Tyre Recycling in China

With the rapid development of the automotive and the transportation industries in China, the volume of scrap tyres has also increased. The annual average growth rate of scrap tyres in 2001–2006 reached 18 percent. Daily production of waste tyres in 2013 reached about 10 million tonnes.

To promote the recycling of scrap tyres, the Ministry of Industry and Information Technology in 2011 developed the Opinions on the Guidance of Comprehensive Utilization of Waste Tires, the first industrial policy for the comprehensive utilisation of waste tyres specifically issued by the Government of the People's Republic of China. In 2012, the government issued the Conditions for the Access to Tire Retreading Industry and the Conditions for the Access to Comprehensive Utilization Industry of Waste Tires. Industrial policies play a guiding and leading role in the development of comprehensive utilisation of waste tyres. The Notice on the VAT Policy for Comprehensive Resource Utilization and Related Products (2008) requires that enterprises retreading tyres or producing rubber powder from waste tyres be exempted from VAT. Until 2013 more than 1,000 enterprises were dedicated to the comprehensive utilisation of waste tyres (Figure 7.4). The established comprehensive utilisation system is mainly composed of the tyre retreading industry and the production industry of rubber and rubber powder from waste tyres (Figure 7.5).

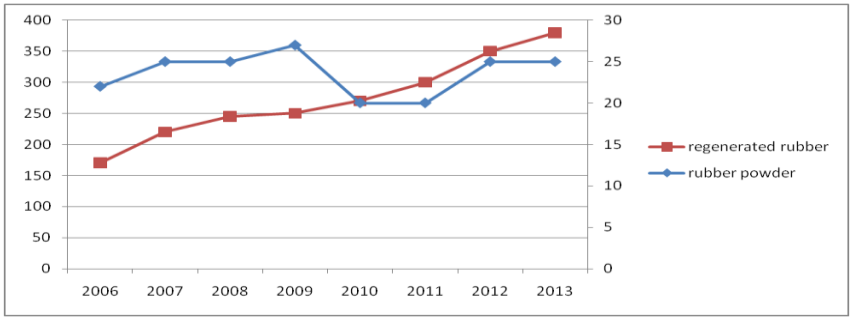
Source: National Development and Reform Commission.

Figure 7.4. Retreaded Tyre Quantity in China (10,000 pcs)



Source: National Development and Reform Commission (2014).

Figure 7.5. Comprehensive Utilisation Production of Waste Tyres in China (10,000 tonnes)



Source: National Development and Reform Commission (2014).

3.2. Promoting Energy Saving and Emission Reduction

In implementing circular economy policies in China, upgrading industrial structures and cleaner production in enterprises have played a major role in energy conservation. The environmental benefits of implementing cleaner production from 2007 to 2010 are shown in Table 7.4. With the scope of cleaner production and technological innovation continuously expanding, energy-saving and emission-reduction effects and economic benefits will further increase.

Table 7.4. Environmental Benefits of Cleaner Production

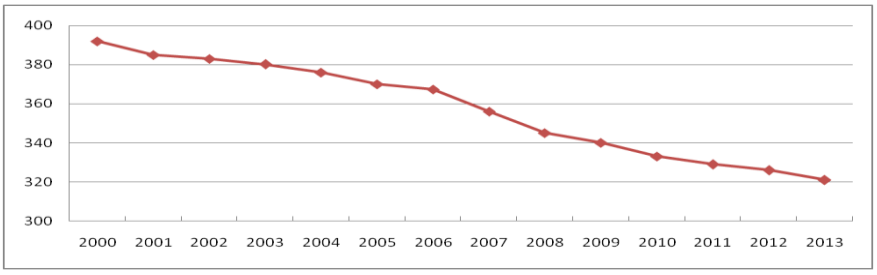
Year	COD reduction (10,000 tonnes)	SO_2 emission reduction (10,000 tonnes)	Water savings (10^8 tonnes)	Power savings (10^8 kWh)	Economic profits (CNY10^8)
2007	9.5	7.1	3.8	36.9	58.9
2008	7.3	32.3	15.2	43.1	102.2
2009	6.4	27.7	4.1	26.2	115.3
2010	6.2	14.0	10.2	37.2	128.0

COD = chemical oxygen demand; kWh = kilowatt-hour; SO_2 = sulphur dioxide.
Source: Ministry of Environmental Protection of the People's Republic of China.

3.3. Reducing Greenhouse Gas Emissions

In circular economy, carbon emissions are mainly reduced through improvement of utilisation efficiency of energy and resources. According to the International Energy Agency, CO_2 emissions are still rising in China. Although per capita CO_2 emissions in China in 2011 were only about 60 percent of the OECD average level, these were still three times of the 1990 level. The electricity industry is the largest contributor for the rise of CO_2 emissions. Therefore, to reduce carbon emissions it is necessary to further improve energy efficiency especially in the power industry.

Figure 7.6. Coal Consumption of Thermal Power–Generation Units (g/kWh)



g = gram kWh = kilowatt hour.
Source: Qi Jianguo et al. (2010).

Box 4. Circular Economy Policies of the Thermal Power Industry and their Effects in China

China's power industry is dominated by thermal power-generation units (PGUs) which account for more than 70 percent of the country's total installed capacity in 2011. Coal consumption in thermal power plants accounts for more than 50 percent of total coal consumption. The power industry has the biggest energy consumption and the biggest SO_2 and CO_2 emissions. CO_2 emissions in the electricity and heat-generation industries accounted for 50 percent of total CO_2 emissions in 2011 in China.

The Notice on Accelerating the Structure Adjustment of Power Generation Industry for Healthy and Smooth Development, promulgated in 2006, requires that thermal power units with high energy consumption be gradually closed down. Moreover, the government is striving to shut down small coal-fired condensing steam PGUs with below 50,000 kW (15 million kW in total) capacity and fuel PGUs with 7 million kW capacity. The Opinions on Accelerating Shutting Down Small Thermal Power Generation Units promulgated in 2007 calls for the shutting down of small thermal PGUs. These mainly include thermal PGUs with capacity below 50,000 kW and/or those with high coal consumption; conventional thermal PGUs with capacity below 100,000 kW; and those operating for more than 20 years. Through the command control of industrial policies, small thermal PGUs with high energy consumption and high pollution emissions should be eliminated to save efficient energy and reduce emissions. Until the end of 2009, the total capacity of closed thermal PGUs reached 55.45 million kW.

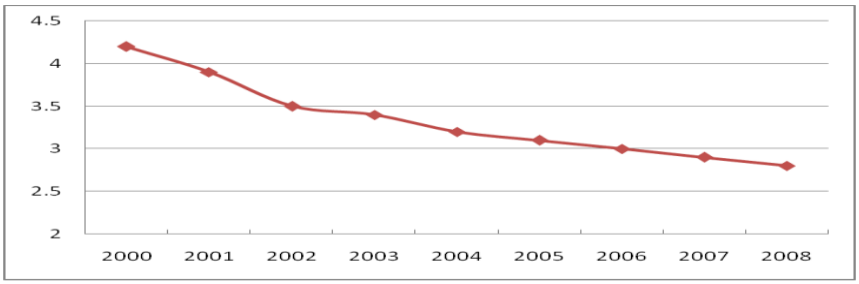
The Notice on Cutting Down Pool Purchase Price of Small Thermal Power Generation Units to Shut Down Small Thermal Power Generation Units (2007) requires that electricity purchase price of small thermal PGUs be decreased. Moreover, the quota of small thermal PGUs may be transferred to large thermal PGUs at a price not higher than its original price after small thermal PGUs are shut down. After quota is transferred and small thermal PGUs are shut down, the electricity purchase price of small thermal PGUs will no longer be cut down. Economic measures are adopted to promote the closing of small thermal PGUs. Moreover, the Interim Management Method of Electricity Purchase Price and Desulphurization Facilities of Coal-Fired Power Generation Units (2007) requires that CNY0.015 per kWh be added to the electricity purchase price of coal-fired PGUs after desulphurisation upgrading to encourage the desulphurisation transformation of thermal power plants.

The Ministry of Environmental Protection also promulgated the Emission Standard of Air Pollutants for Thermal Power Plants (2011), an improvement over the 2003 standard. For newly constructed coal-fired boilers, the SO_2 emissions standard was improved from 400 mg/m^3 to 100 mg/m^3; and for existing boilers, from 2100 mg/m^3 to 200 mg/m^3. Under the new pollutant emissions standard, power-generation enterprises are forced to find ways to reduce emissions.

With industrial economic and environmental policies synergized, the circular economy of the power industry has achieved considerable effects. In 2001–2012, coal consumption, water consumption, dust emissions, and SO_2 emissions of thermal PGUs decreased by 15.3 percent, 28.2 percent, 85.6 percent, and 66.3 percent, respectively (Figures 6–8). In 2006–2012, the total CO_2-emissions reduction was 3.56 billion tonnes. Although total CO_2 emissions are rising, emission intensity is declining.

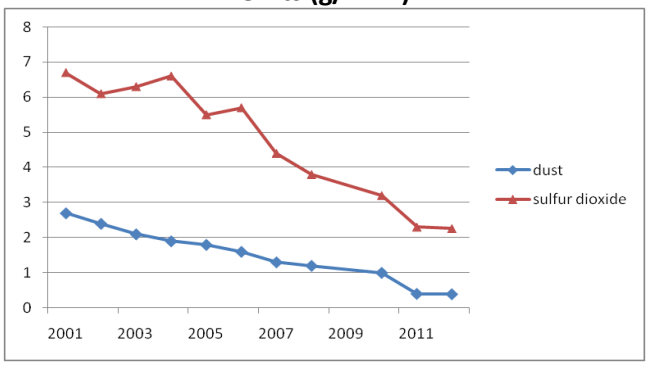
Source: Qi Jianguo et al. (2010).

Figure 7.7. Water Consumption of Thermal Power-Generation Units (kg/kWh)



kg = kilogram; kWh = kilowatt hour.
Source: Qi Jianguo et al. (2010).

Figure 7.8. Dust and Sulphur Dioxide–Emission Performance of Thermal Power–Generation Units (g/kWh)



g = gram kWh = kilowatt hour.
Source: Qi Jianguo et al. (2010).

Based on laws and regulations led by industrial policies, pushed by environment policies, and mobilised by economic policies, circular economy has gained significant developments in China and has positively promoted the improvement of resource-utilisation rate, emission reduction of major pollutants, and greenhouse gas-emissions reduction. At the same time, fiscal, financial, and investment policies have been developed to support the development of circular economy.

4. Implications for Policy and Practices

4.1. Construction of Related Systems

Related systems such as laws, regulations, and standards are the fundamental requirements of circular economy. Laws and regulations legally protect and support the development of circular economy. Comprehensive policies, such as action plans, programmes, and opinions, mainly play the general guiding role. Construction of related systems can provide a long-term mechanism to promote circular economy.

4.2. Composite Policies

Composite policies may drive the development of circular economy through the synergistic mechanism of industrial policies, reverse promotion of environmental policies, and the excitation of economic policies.

4.3. Pilot Projects in Multiple Levels

Pilot project demonstration is one of the most important practices of circular economy in China. Pilot projects should focus on enterprises, sectors, industrial parks, and areas which have development potential and could play a leading role in the development of circular economy. It is important for policymakers to recognise the characters of circular economy and set separate target policies for those levels.

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