PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

PRCEE

GREEN TRANSFORMATION OF INDUSTRIAL PARKS IN CHINA'S JIANGSU PROVINCE

A SYNTHESIS REPORT

UN environment ILO UNDP UNIDO unitar United Nations Institute for Training and Research

Citation

PAGE (2019), Green Transformation of Industrial Parks in Jiangsu Province: A Synthesis Report

Disclaimer

This publication has been produced with the support of PAGE funding partners. The contents of this publication are the sole responsibility of PAGE and can in no way be taken to reflect the views of any Government. The boundaries and names shown, and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the PAGE partners, nor does citing of trade names or commercial processes constitute endorsement.

This document was produced with the financial assistance of the European Union, but the views expressed herein can in no way be taken to reflect the official opinion of the European Union.

The English version of the report is a synthesis version of the original report which was produced in Chinese.

Cover Photos

© Jiangsu Taixing Economic Development Zone: Running Technology
© Beibei Gu: Solar Power in Suzhou Industrial Park
© Changshu Economic and Technological Development Zone
© Changshu Economic and Technological Development Zone: South-east Bridge in High-tech Zone

GREEN TRANSFORMATION OF INDUSTRIAL PARKS IN CHINA'S JIANGSU PROVINCE

A SYNTHESIS REPORT (2019)

ACKNOWLEDGEMENTS

This report was led by the Policy Research Center for Environment and Economy (PRCEE) under the Chinese Ministry of Ecology and Environment (MEE). Yu Hai and Liu Yue are the principle authors with guidance from Wu Shunze, field research and editing support from Zhao Zijun and Li Haiying, and administrative support from Zhang Yan and Wang Yong.

From the PAGE partner agencies, the report was supervised by UN Environment's Economic and Fiscal Policy Unit led by Sheng Fulai. Gu Beibei has provided significant input to the report. Zhou Yimin and Karin Valverde Pedrique conducted additional research and provided editorial support. Credit also goes to the following colleagues for technical and policy guidance over the course of this study: Cristina Martinez, Zhang Xubiao (International Labour Organisation), Sarwat Chowdhury and Tim Scott (United Nations Development Programme), Claudia Assmann (UN Environment), Abu Saieed, Claudia Linke and Iti Ozunimi Lilian (United Nations Industrial Development Organisation).

This report has also benefited from invaluable comments and review from: Dong Zhanfeng (Chinese Academy for Environmental Planning), Qiao Qi (Chinese Research Academy of Environmental Sciences), Shi Han (City University of Hong Kong), Wang Ke (Beijing Institute of Technology), Yang Dongwei (the Chinese Ministry of Industry and Information Technology).

Huang Wei designed and laid out this report.

PAGE gratefully acknowledges the support of all its funding partners: European Union, Germany, Finland, Norway, Republic of Korea, Sweden, Switzerland and the United Arab Emirates.

PAGE is grateful to the European Union for providing the funding support to this project.

FOREWORD

World-wide large-scale industrialization is imposing a huge impact on the ecological environment. A major issue that governments are striving to address is the transition from the conventional industrial development that comes with an excessive price in resource and environmental terms towards a sustainable industrial development model, which is at the core of the United Nations Sustainable Development Goal 9 (Industry, Innovation and Infrastructure). China has a most complete industrial system of a scale amongst the top of the world and with a salient feature of industrial agglomeration. Green transformation of industrial parks, therefore, is a pivotal instrument for China in exploring the pathway towards green-oriented and high-quality development that gives priority to ecological conversation. The wisdom and solutions embedded in China's green transform of its industrial parks can contribute to sustainable industrialization not only at home but globally.

Jiangsu has an advanced economy with a strong industrial base and high productive capacity in China. At the same time, however, Jiangsu faces the challenges brought by high densities of industry, urban areas and population. Transforming Jiangsu's industry and industrial parks from "scale" to "quality" development, therefore, is to be addressed urgently.

In this context, the second phase of the United Nations Partnership for Action on Green Economy (PAGE) project was launched in September 2017, focusing on the green transformation of industrial parks in Jiangsu. As part of the key outcome of this project, this report, based on the assessment of the green transformation of industrial parks in Jiangsu, has identified the remaining problems and challenges, drawn experiences from case studies, and proposed the direction, pathways, and recommendations for furthering the transformation in the province. We hope that Jiangsu's experience will inspire other localities and countries and contribute to the development of green economies globally.

WU Shunze
Director General
Policy Research Center for Environment and Economy
Ministry of Ecology and Environment, P.R.China

LIST OF ACRONYMS

COD	Chemical Oxygen Demand
EDZ	Economic Development Zone
ETDZ	Economic and Technological Development Zone
FYP	Five-Year Plan
GGKP	Green Growth Knowledge Platform
GIS	Geographic Information System
HTZ	High-Tech Industrial Development Zone
ILO	International Labour Organization
MEE	Ministry of Ecology and Environment
MEP	Ministry of Environmental Protection
MIIT	Ministry of Industry and Information Technology
MoF	Ministry of Finance
MofCOM	Ministry of Commerce
MoST	Ministry of Science and Technology
NDRC	National Development and Reform Commission
NH_3-N	Ammonia Nitrogen
PRCEE	Policy Research Center for Environment and Economy
SO_2	Sulfur dioxide
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research

LIST OF FIGURES

LIST OF TABLES

CONTENTS

EXECUTIVE SUMMARY

The Chinese economy is transitioning from high-speed to high-quality development through optimizing economic structure and fostering new growth drivers. Meanwhile, China has attached strategic importance to the concept of "ecological civilization" under which green development is an integral part of China's economic modernization. In this context, the green transformation of industrial parks – the major carrier of industrial development in China - becomes an urgent task.

Situated at the lower reaches of the Yangtze River, Jiangsu – as the industrial powerhouse of the country, has been leading the development of industrial parks and has accumulated some experiences in the green transformation of the parks. Yet, as a region with high densities of industries, urban areas, and population, Jiangsu also faces challenges in the green transition, as do many other provinces. This report identifies these challenges, assesses the green transformation of industrial parks in Jiangsu based on three representative cases, and summarizes good practices and experiences.

In recent years, industrial parks in China have progressed in terms of industrial development, clean production, environmental protection, and scientific and technological achievements. However, many challenges exist: (1) differences across regions in China making it difficult to apply and scale up a single green model for industrial parks; (2) lack of an integrated and macro-level planning; (3) shortcomings in institutional arrangements; (4) inadequate park infrastructure; (5) lack of environmental awareness and enforcement contributing to the persistence of pollution; (6) inadequate application and diffusion of clean technology and inefficient use of energy and natural resources; and (7) strengthened international standards and norms on industrial parks making it necessary for Chinese parks to further raise their performance level.

This report assesses the green transformation of three representative industrial parks located in different regions of Jiangsu Province, namely, the Suzhou Industrial Park in southern Jiangsu, Taixing Economic Development Zone in central Jiangsu and Huai'an Economic & Technological Development Zone in northern Jiangsu. The evaluation framework consists of five primary dimensions (i.e., economic development, energy/resources efficiency, environmental protection, park management, and employment and social security) and 26 secondary indicators.

The assessment concludes that:

(1) The parks under consideration have progressed as a whole in their green transformation. Achievements in environmental protection have contributed strongly to the progress.

(2) In general, national-level industrial parks tend to perform better than provincial ones. Suzhou Industrial Park is in the lead for green transformation among the three parks, followed by Huai'an Economic & Technological Development Zone.

(3) Taixing Economic Development Zone faces more challenges due to its dependence on chemical industry, resulting in an undesirable energy structure and problems of pollution. These difficulties are common to chemical industrial parks across the country, pointing to the need for special attention to the green transformation of chemical industrial parks moving forward.

The report proposes a set of guidelines on the green transformation of industrial parks to inform future policy making concerning the development of industrial parks in Jiangsu and beyond.

© PRCEE 2017: PAGE Jiangsu Phase 2 Launch

1. BACKGROUND

In September 2014, the Chinese Ministry of Environmental Protection (MEP) (now re-named "Ministry of Ecology and Environment" or "MEE") expressed an interest in joining Partnership for Action on Green Economy (PAGE) [1], starting at the provincial level in Jiangsu. Designated by the MEE, the Policy Research Center for Environment and Economy (PRCEE) started working with PAGE in December 2014. The phase 1 of the PAGE Jiangsu project was launched in Nanjing in November, 2015 and concluded with a stocktaking report titled *"Transition to a green economy in China's Jiangsu Province"* launched in June 2016.

Following the priorities identified in the Stocktaking report and taking into account Jiangsu's role as an industrial powerhouse in China, the phase 2 of the PAGE Jiangsu project, launched in September 2017, focused on green transformation and policy coordination at the industrial park level. This report is prepared by PRCEE under the PAGE Phase 2 project in Jiangsu based on desk research, field surveys and expert consultations. The assessment in this report uses an index framework applied to three sample industrial parks in Jiangsu.

The PAGE Phase 2 project aims to achieve three objectives: 1) to identify and exemplify good practices of industrial parks in Jiangsu with a view to inspiring the parks in other provinces and countries; 2) to develop an index for evaluating the progress of Jiangsu' green industrial transformation and identifying challenges and gaps; 3) to suggest policy guidance on the green transformation of industrial parks. Through the engagement of stakeholders and knowledge-sharing networks, PAGE supports the dissemination of good practices and capacity building for Jiangsu to move further towards green industrial transformation.

The report targets at: (1) government agencies at the provincial and sub-provincial levels; (2) Park Management in Jiangsu; (3) local industrial associations, enterprises including Small and Medium Enterprises (SMEs), investors, and financial, research and training institutions. (4) PAGE partners in China and around the world interested in green transformation of industrial parks.

In the rest of the report, Chapter 2 summarizes the development of industrial parks in China over the past 40 years with a particular focus on Jiangsu. Chapter 3 details relevant policies and practices in China including, in particular, Jiangsu's strategies and goals. Chapter 4 evaluates the green transformation of three industrial parks across the southern, central and northern regions of Jiangsu, respectively. Chapter 5 is a case study Suzhou Industrial Park, which leads the three parks in green transformation. Based on the assessment, a set of policy recommendations for promoting the green transformation of the parks in Jiangsu have been developed.

2. INDUSTRIAL PARKS IN CHINA

This chapter covers the conceptual issues, characteristics and evolution of industrial parks in China and, in the context of which, highlights the salient features and trend of the parks in Jiangsu.

2.1 Concepts and characteristics

Industrial parks are carriers of industrial agglomeration and a pillar for sustainable industrialization (SDG 9). The term "industrial park", however, lacks a universally agreed definition. Common understanding among international organizations, research institutes and experts suggests that an "industrial park" has three characteristics: (1) located in an area with a clear boundary, making it easier to plan and manage; 2) a manufacturing hub, contributing to cost-saving, industrial symbiosis and economies of scale; 3) equipped with infrastructure systems and other supportive services, which in turn attract investment.

The industrial parks in China have developed rapidly over the past four decades with distinctive features. Firstly, industrial parks in China are managed by the government. Secondly, China has a vast number of industrial parks of vastly different sizes. As of June 2018, the country had 552 national-level industrial parks, 2,356 provincial-level parks that were equipped with wastewater management facilities, and more than 10,000 county- or lower-level industrial zones (China National Development and Reform Commission 2018). Thirdly, industrial parks in China consist of diverse types (Box 2-1) and administrative structures: the "Economic and Technological Development Zone" (hereinafter referred to as "ETDZ"), the "High-Tech Industrial Development Zone"("HTZ"), the "Export Processing Zone", the "Integrated Bonded Zone", the "Border Economic Cooperation Zone", etc. Despite the variety, industrial parks in China are predominately in the form of ETDZs and HTZs, to which the term "industrial parks" used in this report refers.

Multiple line ministries assume oversight of industrial parks in China, including the National Development and Reform Commission, the Ministry of Commerce (covering ETDZs), the Ministry of Science and Technology (covering HTZs), and the General Administration of Customs, among others.

Box 2-1. ETDZs and HTZs

The Economic and Technological Development Zones (ETDZs) are industrial parks based on knowledge-/technology-intensive manufacturing and processing industries, driven by foreign investment for generating regional output. In 1981, China's State Council approved ETDZs to be established in coastal cities. In 1984, 14 national-level ETDZs were set up in 12 cities. As of June 2018, China had 219 national-level ETDZs across 30 localities under the supervision by the Ministry of Commerce. ETDZs were initially set up to attract foreign investment in advanced manufacture industries. With their expansion into inland areas, ETDZs are increasingly important in promoting regional development.

Source: *official website of MofCOM*

The High-Tech Industrial Development Zones (HTZs) are industrial parks that rely on intelligence-/technology-intensive enterprises to learn advanced technologies and management experience from other countries and to maximize the commercialization of innovative technologies. The development of HTZs started in 1988. As of June 2018, China had 156+1 national-level HTZs ("1" represents the Suzhou Industrial Park, which is entitled to the same preferential policies enjoyed by national HTZs) across 30 localities, under the supervision by the Ministry of Science and Technology.

Source: *official website of MoST*

2.2 Evolution of industrial parks in China

2.2.1 History

Since China's t first industrial park - the Shekou Industrial Zone – was established in 1979, the country has witnessed a rapid and intensive growth of parks, driving China's industrialisation over the years. Six development phases of industrial parks can be identified (see Figure 2-1):

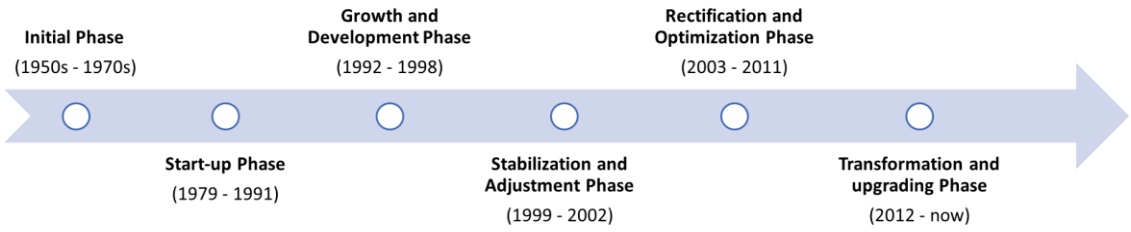


Figure 2-1. Industrial Park Development in China

Phase 1 Initiwal Stage (1950s-1970s): traditional, labour-/land-intensive industrial complexes in remote regions with limited infrastructure and a narrow range of industries; though primitive, did contribute to the early stage of China's industrialization and urbanization.

Phase 2 Start-up (1979-1991): emergence of policy-driven modern industrial parks attracting foreign investment and promoting export, though at a low scale, consisting of just a few labour-intensive sectors such as clothing, food and beverages.

Phase 3 Growth and Development (1992-1998): rapid development of industrial parks in terms of their number, diversity, administrative levels, geographic coverage, external orientation, and growth of high-tech industries, moving towards multi-functional parks hosting a comprehensive set of industries.

Phase 4 Stabilization and Adjustment (1999-2002): the growth of parks generally slowed down with a greater emphasis on quality rather than quantity in the aftermath of the global financial crisis and as the State was phasing out policy incentives, while some national-level parks grew into distinctive administrative districts within the respective cities.

Phase 5 Rectification and Optimization (2003-2011): consolidation of existing parks and suspension of approval for new parks in response to the problems of duplicated, wasteful, and low-quality development, with the number of parks reduced by 77 per cent and the related land use by 70 per cent, offering an opportunity for gearing the parks towards a sustainable pathway.

Phase 6 Transformation and Upgrading (2012 – present): transformation and upgrading of the parks in the context of the overall policy emphasis shifting towards productivity, quality, environmental management, and green, circular and low-carbon development.

2.2.2 Current status

From 1984 to 2018, 219 national-level ETDZs and 156 national-level HTZs were established (Figure 2-2). Their growth was concentrated during 1991~1994 and 2010~2017. Judging by the trend, HTZs are likely to be the dominate form of the parks in future.

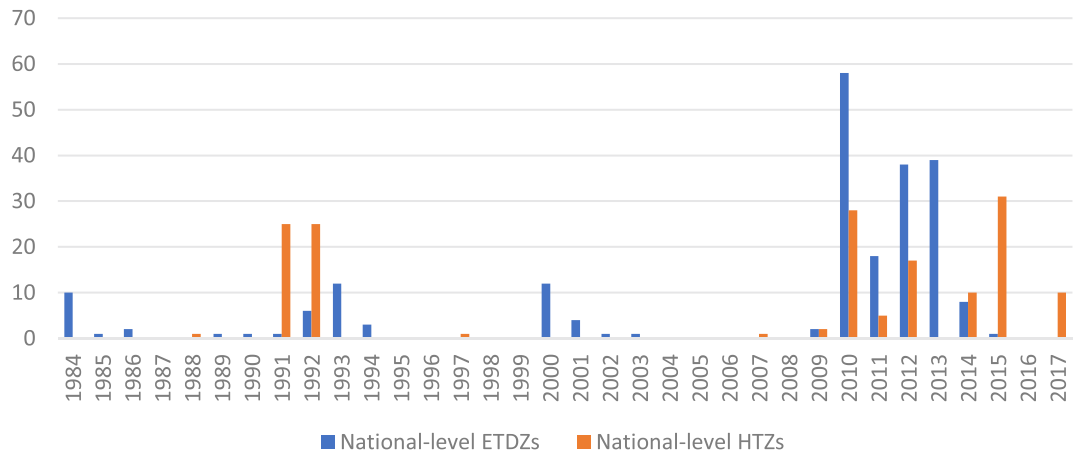
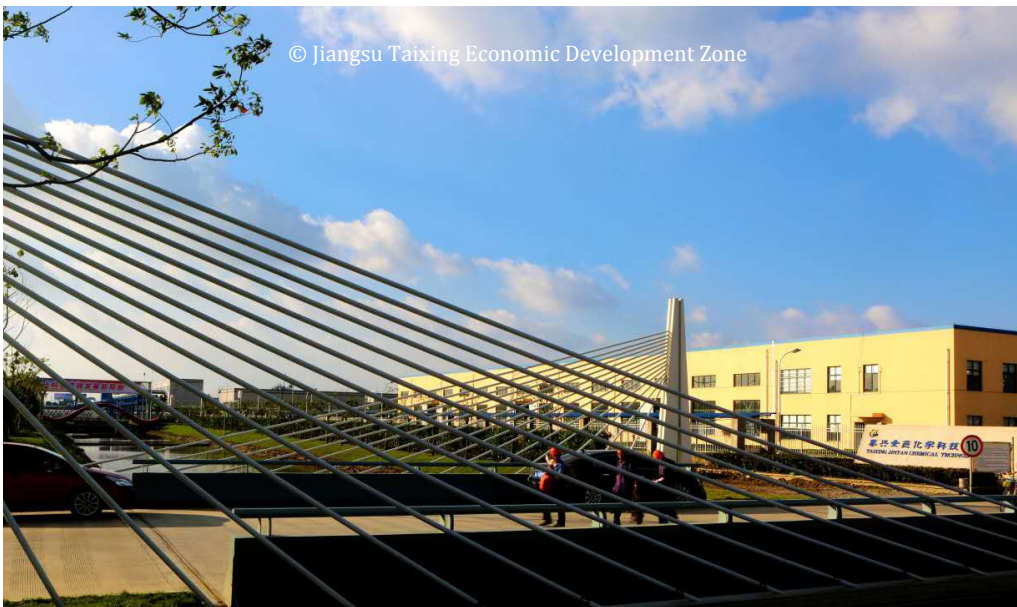


Figure 2-2 Numbers of approved national-level ETDZs and HTZs (1984-2017)

Source: *Ministry of Commerce 2018; Ministry of Science and Technology 2018*

Geographically (Figure 2-3), the ETDZs and HTZs are concentrated in the eastern and coastal regions (181 or 48.40% of the total national-level development zones as compared to 108 or 28.87% in central China and 85 or 22.73% in western China).



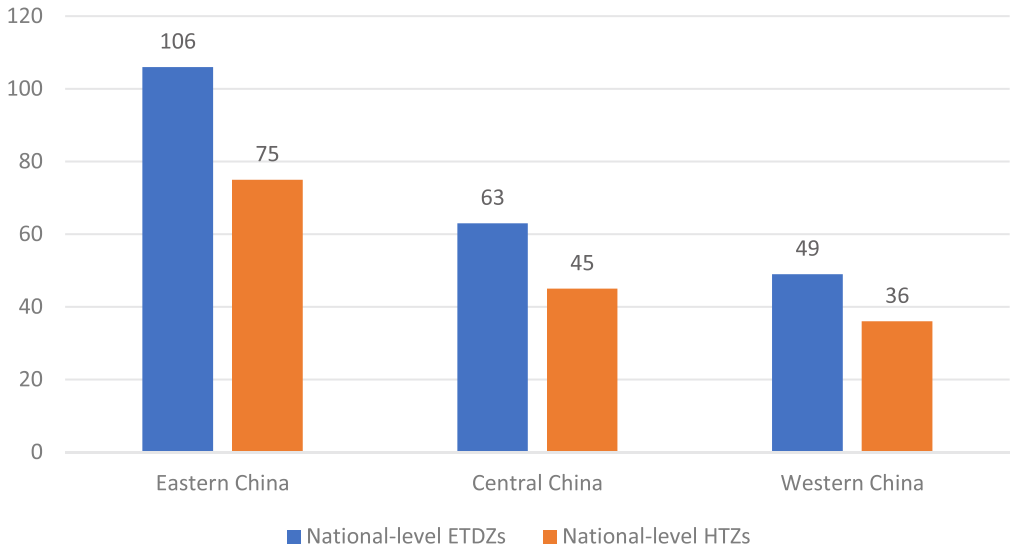


Figure 2-3 Numbers of approved national-level ETDZs and HTZs by region (1984-2017)

Source: *Ministry of Commerce 2018; Ministry of Science and Technology 2018*

2.3 Industrial parks in Jiangsu

2.3.1 Overview

Jiangsu is one of China's leading provinces in terms of economic growth, population and technological capability. In 2017, Jiangsu's per capita output reached US$ 15,968, its output from high-tech industries US$ 1,011 billion, and export worth US$ 186 billion (Statistics Bureau of Jiangsu Province 2017).

The province is split into southern, central and northern regions as detailed in Table 2-1.

Table 2-1. Sub-regional overview of Jiangsu Province (2017)

Regions	Key Prefectural Cities	Area（km^2）	Population (million)	Per capita output (US$)
Southern Jiangsu	Nanjing / Suzhou Wuxi / Zhengjiang Changzhou	52,300	33.48	22,384.50
Central Jiangsu	Taizhou Yangzhou Nantong	20,900	16.47	15,892.25
Northern Jiangsu	Huai'an / Xuzhou Yancheng Lianyungang Suqian	52,300	30.35	9,081.52

Jiangsu has over a hundred industrial parks – the highest in China - including 26 ETDZs and 17 HTZs at the national level that are concentrated in the rich southern part of the province, with the rest at the provincial level across all the sub-regions (Figure 2-4 and 2-5), suggesting a close linkage between the development of industrial parks and Jiangsu' overall economic development.

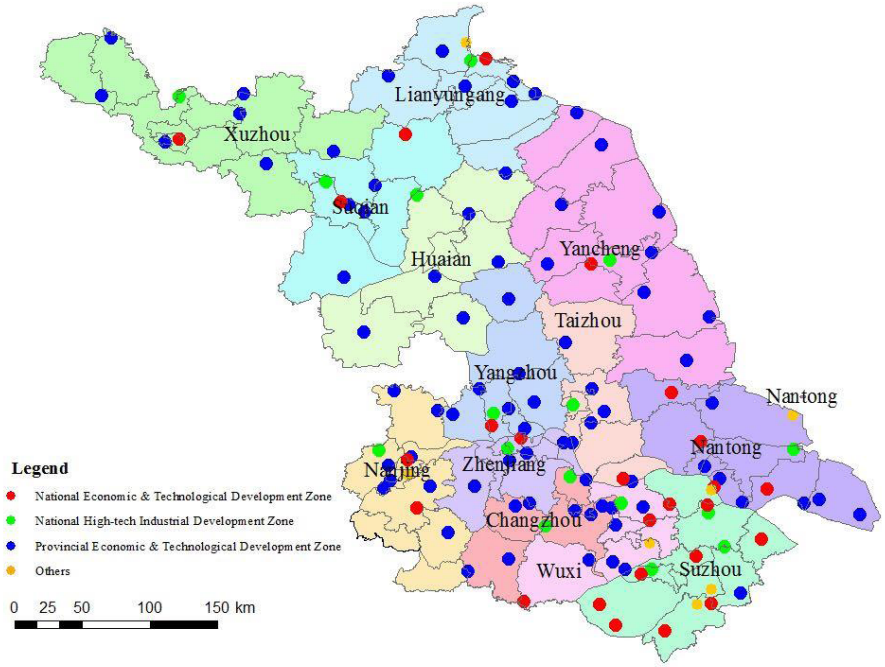


Figure 2-4 Distribution of industrial parks in Jiangsu [2]

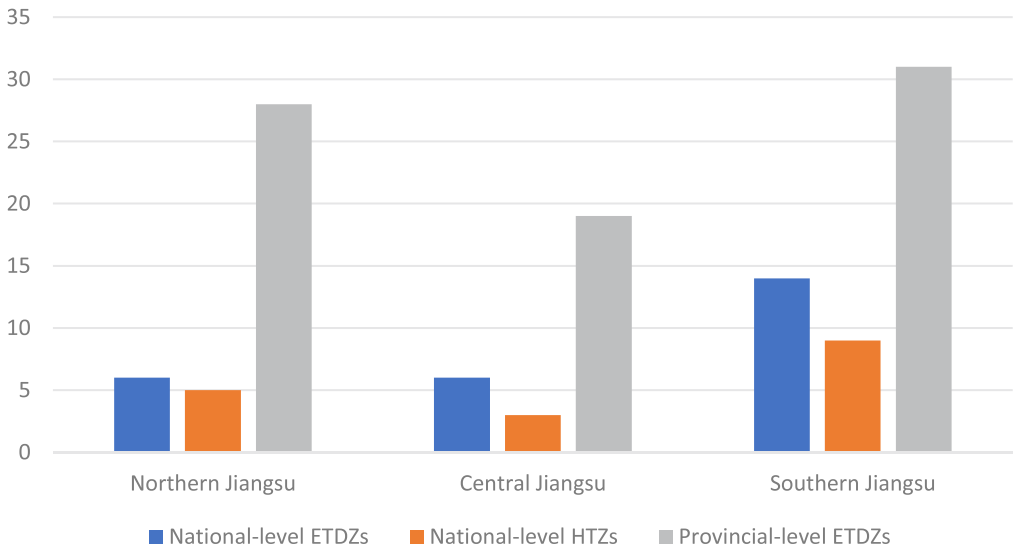


Figure 2-5 Numbers of industrial parks in Jiangsu (by sub-region, by type) [3]

70% of Jiangsu' national-level industrial parks were established before 1995, each occupying around 100 km^2, generating an average output of US$ 9 billion (more than 60 percent of which from knowledge-/technology-intensive industries) and collectively contributing US$ 800 million in tax revenue [4]. Of these, Suzhou Industrial Park is in the lead in terms of output and tax contribution.

2.3.2 Industrial characteristics

According to the *Classification and Codes of National Economic Sectori* [5], the top five sectors in Jiangsu's national-level industrial parks (Figure 2-7) are Equipment Manufacturing (17%), Electricity and Thermal Energy Production and Supply (12%, including electricity from renewable energy), Computer, Communication and Other Electronic Equipment Manufacturing (11%), Pharmaceutical Manufacturing (10%) and Automobile Manufacturing (8%). Going by the classification of high-tech industries [6], the top five sectors in Jiangsu's national-level industrial parks (Figure 2-8) include Advanced Manufacturing and Automation (31%), Electronic Information (20%), New Energies and Energy Conservation (13%), High-tech Services (13%) and Biology and New Medicine (12%), with varied distribution across the province (Figure 2-9). The sectors such as New Materials, Resources and Environment, Aerospace and other high-tech sectors, however, account for smaller proportions.

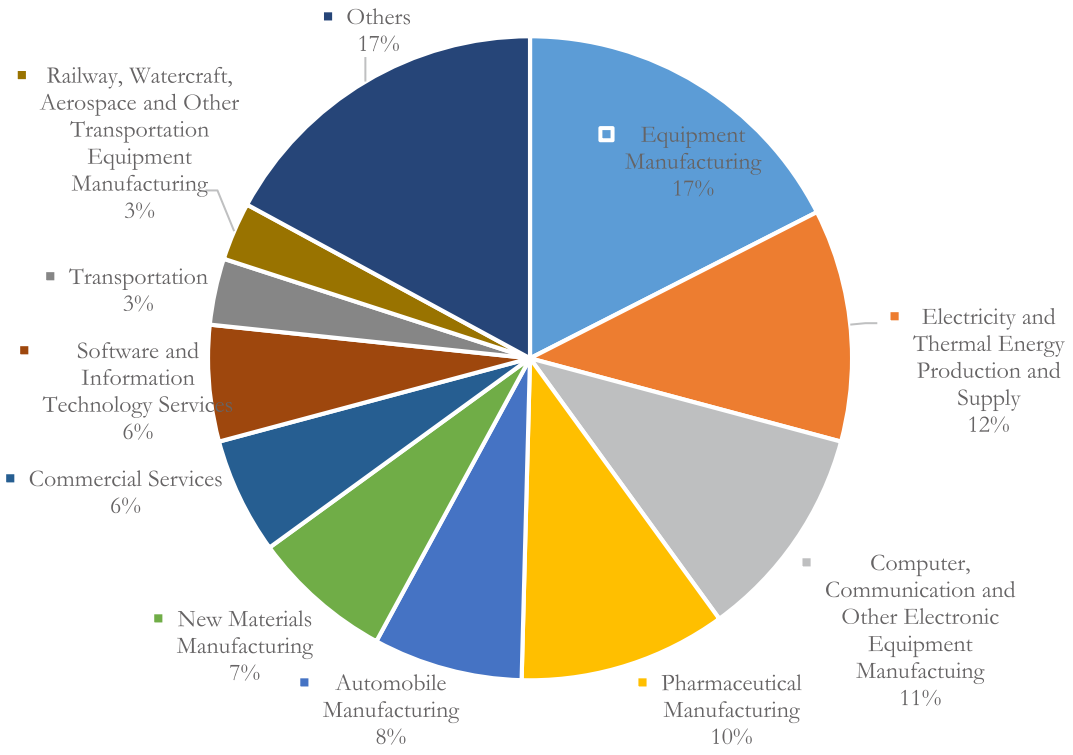


Figure 2-6 Key industrial sectors in Jiangsu's industrial parks [7]

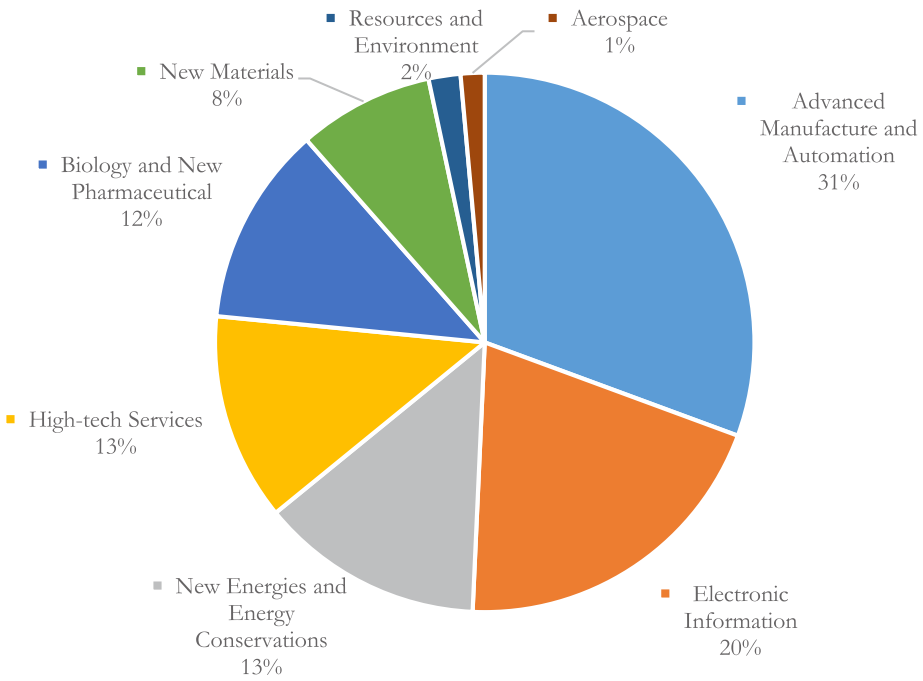
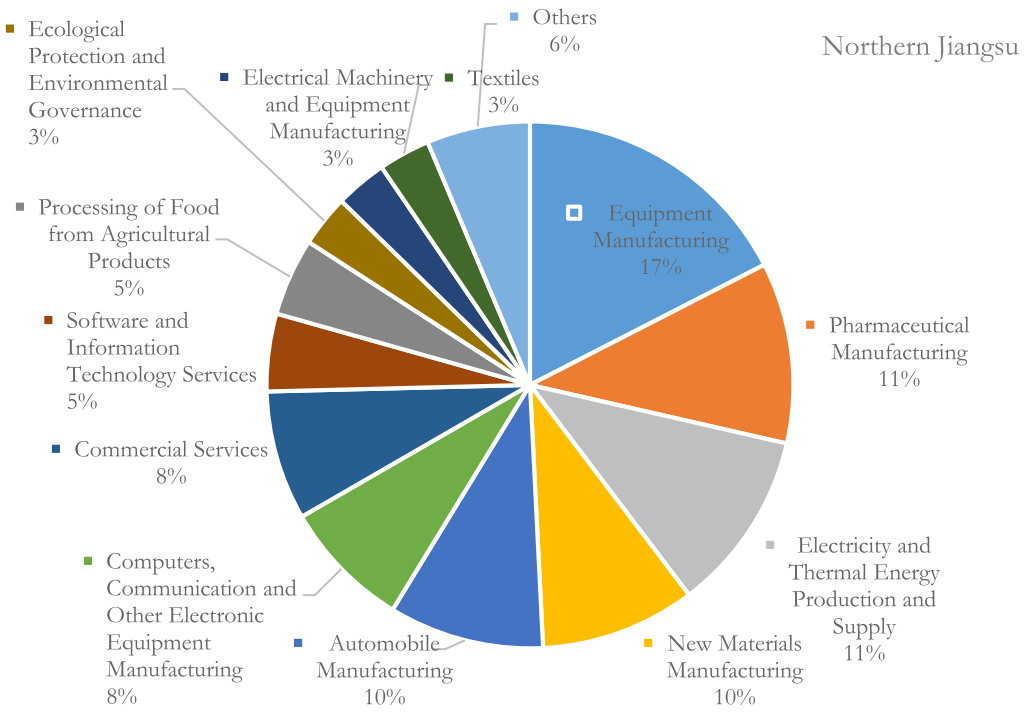
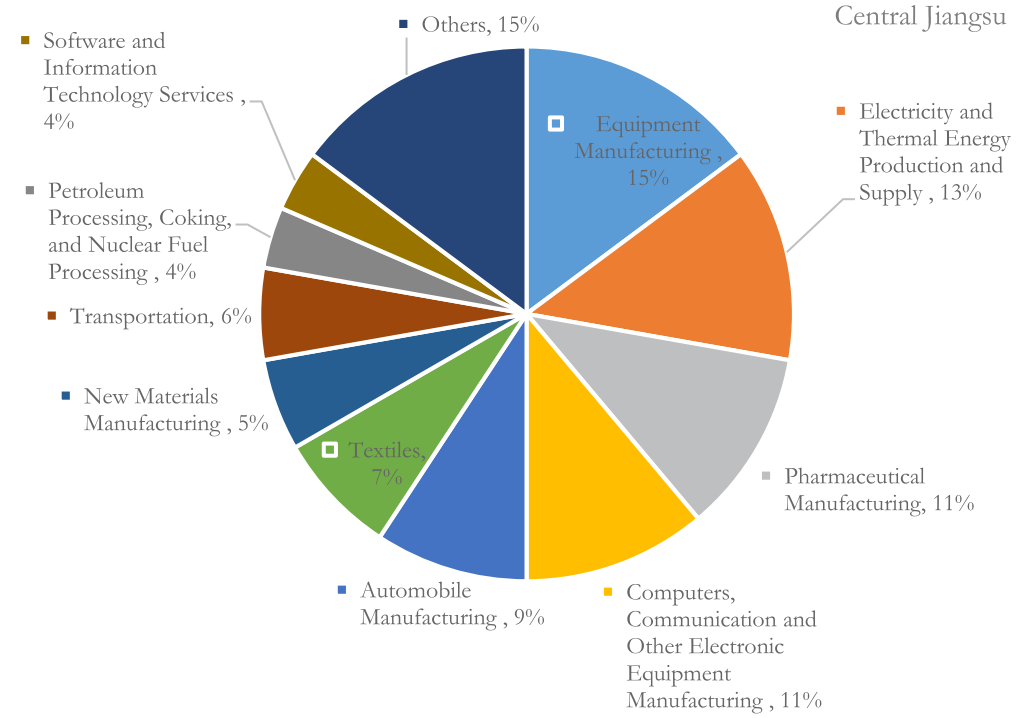


Figure 2-7 Key High-tech industries in Jiangsu' industrial parks [8]


Northern Jiangsu
Others 6%
Ecological Protection and Environmental Governance 3%
Electrical Machinery and Equipment Manufacturing 3%
Textiles 3%
Equipment Manufacturing 17%
Processing of Food from Agricultural Products 5%
Pharmaceutical Manufacturing 11%
Software and Information Technology Services 5%
Commercial Services 8%
Electricity and Thermal Energy Production and Supply 11%
Computers, Communication and Other Electronic Equipment Manufacturing 8%
Automobile Manufacturing 10%
New Materials Manufacturing 10%


Central Jiangsu
Others, 15%
Software and Information Technology Services , 4%
Equipment Manufacturing , 15%
Electricity and Thermal Energy Production and Supply , 13%
Petroleum Processing, Coking, and Nuclear Fuel Processing , 4%
Transportation, 6%
New Materials Manufacturing , 5%
Textiles, 7%
Pharmaceutical Manufacturing, 11%
Automobile Manufacturing , 9%
Computers, Communication and Other Electronic Equipment Manufacturing , 11%

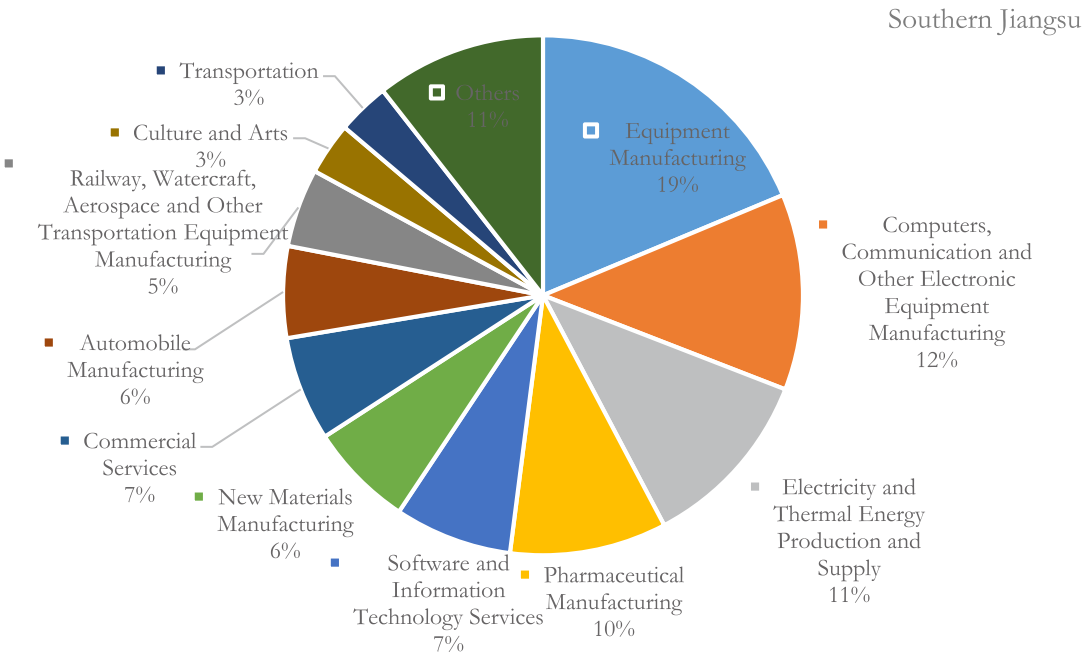


Figure 2-8 Industrial sector of Jiangsu' industrial parks by geographic locations [9]

2.3.3 National ranking of Jiangsu's Industrial Parks

In 2017, the Chinese Ministry of Commerce assessed 219 national-level ETDZs taking into account their industrial base, technological innovation, role in regional development, environmental protection and administrative efficiency. All of the 26 national-level ETDZs in Jiangsu were shown to have progressed significantly from the previous year, with four of these ranked among the Top 10 with the Suzhou Industrial Park topped the overall ranking.

Similarly, in 2017, the Chinese Ministry of Science and Technology assessed national-level HTZs. Jiangsu's 16 national HTZs were shown to have moved up in their rankings over the previous year (Provincial People's Government of Jiangsu 2018).

3. GREEN TRANSFORMATION OF INDUSTRIAL PARKS IN CHINA

In the context of the Chinese economy shifting towards quality growth and embracing green development, the green transformation of China's industrial parks is inevitable. This chapter reviews the policies and practices of this transformation at both national and Jiangsu provincial levels.

3.1 Defining green transformation

Although lacking a standard definition, the concept of "green transformation of industrial parks" is generally understood as a process in which parks achieve the efficient use of energy and resources, reduced pollution and environmental impacts, increased labour productivity and enhanced capacity for sustainable development.

In general, green transformation of industrial parks can be viewed at three levels: (1) adjusting parks' industrial structure towards agglomeration so as to increase the overall resource use efficiency (including that of land) while reducing production cost through technological innovation; (2) developing closed-loop supply chains through tiered use of energy and circular use of waste and by-products, enabled by the industrial symbiosis and the shared use of infrastructure; (3) achieving integrated and coordinated development of economy, environment and employment through integrated planning and rigorous management.

3.2 Greening industrial parks: a policy perspective

Industrial parks have contributed significantly to China's industrialization and urbanization, which have – unfortunately – also been accompanied by environmental challenges. Green transformation of industrial parks is a response to the challenges, guided by a policy framework from the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Ecology and Environment, the Ministry of Science and Technology and the Ministry of Commerce. Key policy schemes include the "Circular Transformation", the "Low-Carbon Industrial Parks", the "Eco-Industrial Parks" and the "Green Industrial Parks" (see Table 3-1).

Table 3-1 Key National Policy Schemes on the Green Transformation of Industrial Parks in China

Policy Schemes	Dates issued	Led by	Policy Objectives	Evaluation Criteria
National Standard on Eco-Industrial Demonstration Parks	December 2015	MEE	• Reduced pollution emission • Improved energy and resources efficiency • Industrial symbiosis established • Institutionalized mechanism for promoting Eco-industrial park through demonstration	23 Indicators in Five dimensions: • Economic Development (4 indicators) • Industrial Symbiosis (3 indicators) • Resources Conservation and Efficiency (9 indicators) • Environmental Protection (13 indicators) • Information Transparency (3 indicators)

Policy Schemes	Dates issued	Led by	Policy Objectives	Evaluation Criteria
Circular Transformation Program of Industrial Parks	March 2012	NDRC, MoF	• Improved resources efficiency and land use efficiency • Improved recycling rates of water, solid wastes and municipal wastes, • Reduced emission of key pollutants to "near-zero" level	• Optimized spatial layout • Improved industrial structure • Closed material loop • Efficient use of resources • Integrated pollution treatment facilities • Standardized operational and management processes
National Pilot Program of Low-carbon Industrial Parks	October 2013	MIIT, NDRC	• Reduced carbon intensity per unit of industrial output • Low-carbon transition in both conventional and green sectors	• Low-carbon infrastructure • Low-carbon technology innovation and application • Innovative management • International cooperation
Evaluation Criteria on Green Industrial Parks	September 2016	MIIT	• Enhanced land-use efficiency and productivity • Shared use of park infrastructure with improved recycling rates of water, head and waste • Smart infrastructure (i.e smart micro-grid) • Certification of Green product and Green factory • Green supply chain	24 Indicators in Six dimensions: • Energy Efficiency (3 indicators) • Resources Efficiency (3 indicators) • Infrastructure (5 indicators) • Industry structure (3 indicators) • Environmental Protection (8 indicators) • Operation and management (3 indicators)

3.2.1 National eco-industrial parks demonstration scheme

China's eco-industrial parks started piloting in 2000. These are the parks that are designed and established based on the principles of clean production, circular economy and industrial ecology. hey link up factories or enterprises through logistics and energy flows to form industrial symbiosis where resources are shared and by-products/wastes exchanged, thereby minimizing waste and facilitating tiered use of energy and closed-loop circularity.

In 2015, the Ministry of Environmental Protection, the Ministry of Commerce and the Ministry of Science and Technology issued the *Measures for the Administration of National Demonstration Eco-Industrial Parks and the Standard for National Demonstration Eco-industrial Parks,* which came into force in 2016.

As of March 30, 2018, the development plans for 93 national demonstration eco-industrial parks had been approved, and 51 of these officially accredited. Jiangsu has 21 accredited national demonstration eco-industrial parks and 7 more under construction, accounting for 30% of these parks in China (MEE 2017)

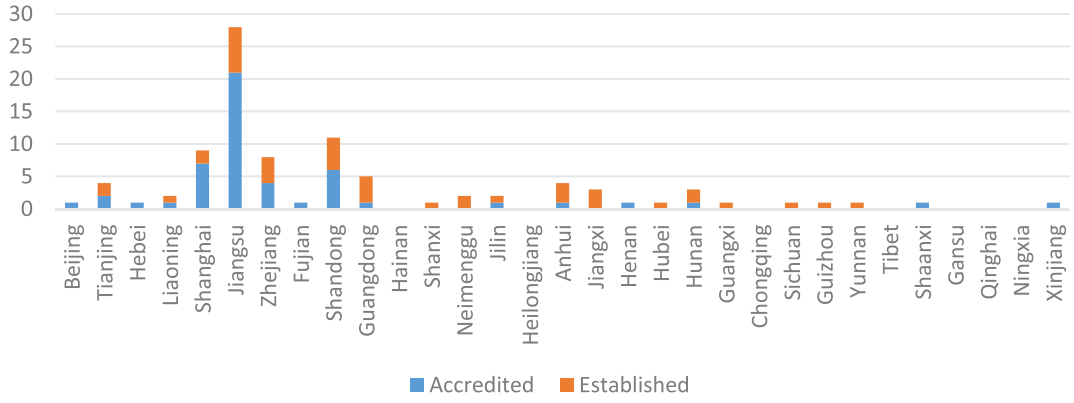


Figure 3-1 Number of national demonstration eco-industrial parks accredited and established by localities

Source: *MEE 2017*

3.2.2 Circular transformation of industrial parks

Circular transformation departs from the traditional linear production model at the industrial park level. It requires efficient and circular use of resources as well as safe disposal of wastes within parks to achieve economic efficiency and environmental benefits.

China's 13th Five-Year Plan for the National Economic and Social Development (hereinafter referred to as "13th FYP") requires 75% of the national-level industrial parks and 50% of the provincial-level industrial parks to undertake circular transformation. During the "12th Five-Year Plan" period (2011-2015), the government set the target of 100 parks for demonstration purpose. As of June 2018, another 50 parks were included for demonstration, while four were revoked (NDRC 2017). Jiangsu has a total of 10 demonstrations parks (see Figure 3-2).

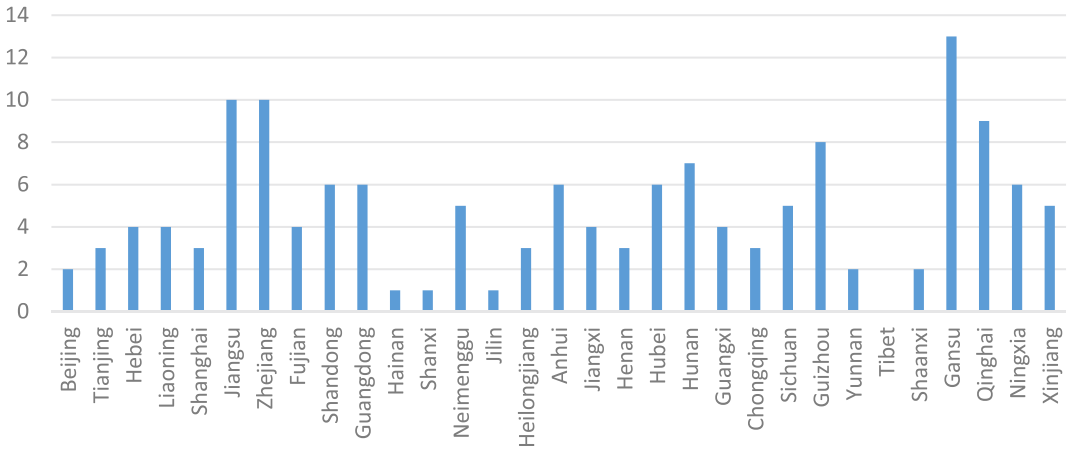


Figure 3-2 Number of "circular transformation demonstration parks" by localities

Source: *NDRC 2017*

3.2.3 National low-carbon industrial parks

In October 2013, the Ministry of Industry and Information Technology and the *National Development and Reform Commission issued the Notice on Organizing the Pilot Work of National Low-carbon Industrial Parks.* Since 2014, two batches of parks have been approved for piloting low-carbon strategies over a three-year period, of which Jiangsu has three parks under the first batch (see Figure 3-3).

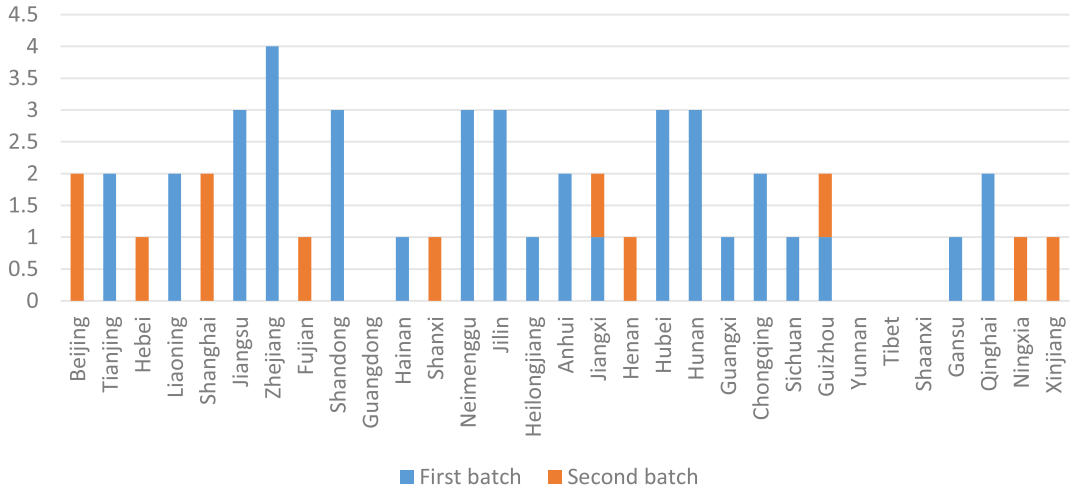


Figure 3-3 Number of pilot national Low-Carbon Industrial Parks by localities

Source: *MIIT 2014; MIIT 2017*

3.2.4 National green industrial parks

In May 2015, the "*Made in China 2025*" initiative proposed the development of green manufacturing systems focusing on "developing green industrial parks, promoting industrial synergies among parks and achieving 'near-zero' emission". The initiative also sets a national target of having 100 "Green Industrial Parks" for demonstration by 2020.

In July 2016, the Ministry of Industry and Information Technology issued the *Plan for Industrial Green Development (2016-2020)*, which covers the development of green industrial parks.

In September 2016, four Ministries including the Ministry of Industry and Information Technology, the National Development and Reform Commission, the Ministry of Science and Technology and the Ministry of Finance issued the *Guide to the Implementation of Green Manufacturing Projects (2016-2020),* which clarifies the concept of green industrial parks as platforms for green-minded enterprises to congregate for integrated management and coordinated linkages in the areas of park planning, spatial layout, design of industry chains, energy and resource use, infrastructure, ecological environment, operation, and management. The *Guide also* proposed that some parks be selected for demonstration, to be assessed against the criteria issued by the Ministry of Industry and Information Technology. In addition, in May 2018, national standards were issued for assessing green factories including those within industrial parks.

Between September 2017 and November 2018, the Ministry of Industry and Information Technology publicised 81 parks and 800 factories for green parks/factories demonstration, respectively, of which 10 parks and 97 factories are located in Jiangsu, more than any other localities (see Figure 3-4).

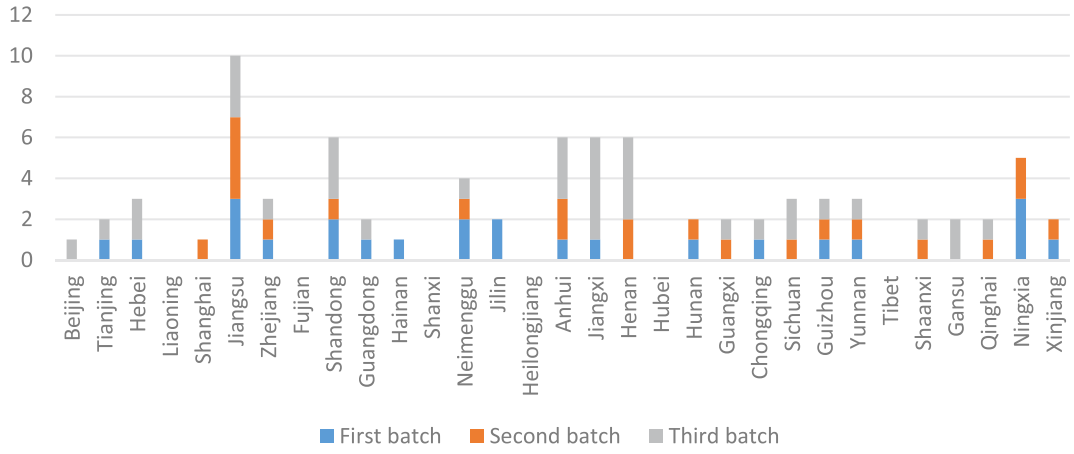


Figure 3-4 Number of national green industrial parks by localities

Source: *MIIT, 2017; MIIT, 2018a; MIIT, 2018b*

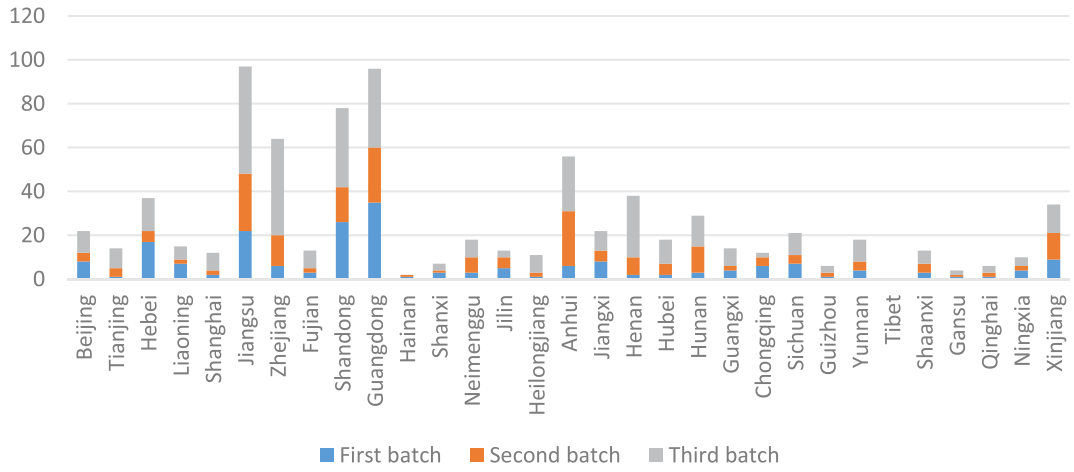


Figure 3-5 Number of national green factories by localities

Source: *MIIT, 2017; MIIT, 2018a; MIIT, 2018b*

3.3 Progress and challenges

More than 20% of China's Gross Domestic Product (GDP) comes from its national-level industrial parks (MofCOM 2016; Xinhua Net 2016; National Bureau of Statistics 2016). And more than half of China's manufacturing takes place in industrial parks and export processing zones (Mathews & Tan 2016). As such, green transformation of China's industrial parks has a decisive effect on the country's overall resources use and environmental performance.

3.3.1 Achievement [10]

Increased efficiency in energy and resource use

Over the past decade, China's industrial parks have increased the efficiency in using land, energy and water resources. As Figure 3-6 shows, during 2006-2015, national eco-industrial parks under the demonstration scheme (see 3.2.1 for description) improved its land-use efficiency (in terms of industrial value added per square kilometres of industrial land) by 109.52%. Over the same period, water intensity (cubic meter over 10,000 RMB) fell by 65.98%, and energy intensity (tonne of coal equivalent or TCE per 10,000 RMB), by 66.02%.

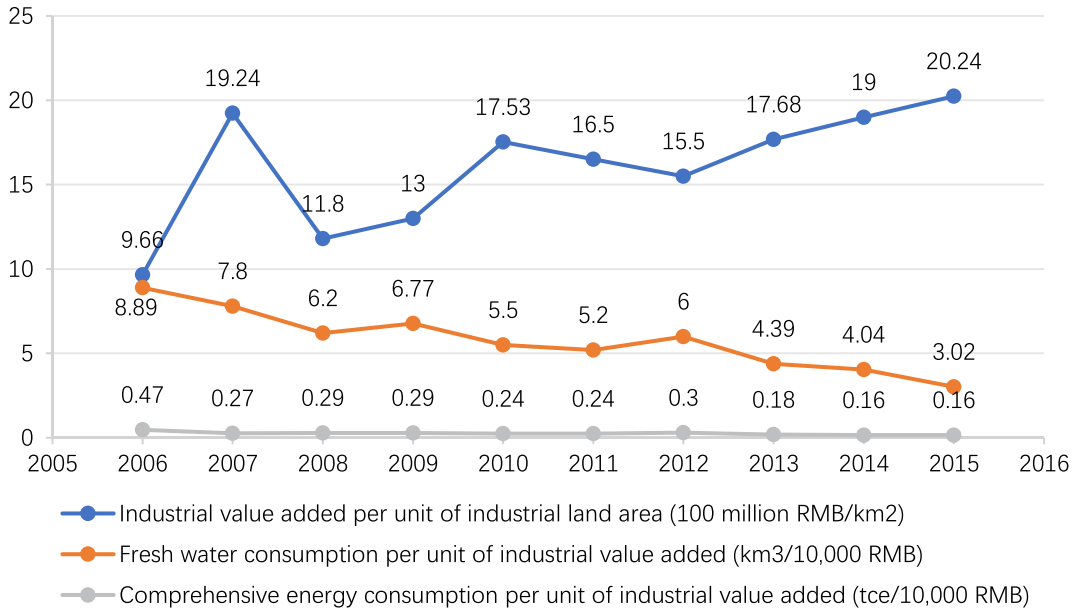


Figure 3-6 Energy efficiency in national demonstration eco-industrial parks in 2006-2015

Reduced pollution

The national eco-industrial parks under the demonstration scheme achieved significant reduction in the emission of Chemical Oxygen Demand (COD) and Sulphur Dioxide (SO_2) (kilogramme per 10,000 RMB industrial value added). Between 2006-2015, these parks' COD and SO_2 emissions both fell by 81.48%

For industrial parks under the "Circular Transformation" scheme (see 3.2.2 for description), during 2010-2013, the discharge of wastewater and industrial solid waste was cut 37.53% and 49.45%, respectively (Figure 3-7). NH_3-N (Ammonia Nitrogen), SO_2 and COD per unit of industrial output dropped by 28.57%, 25.8% and 34.01%, respectively. Although the absolute volume of COD emission increased somewhat, it declined by 25.3 % per unit of industrial value added.

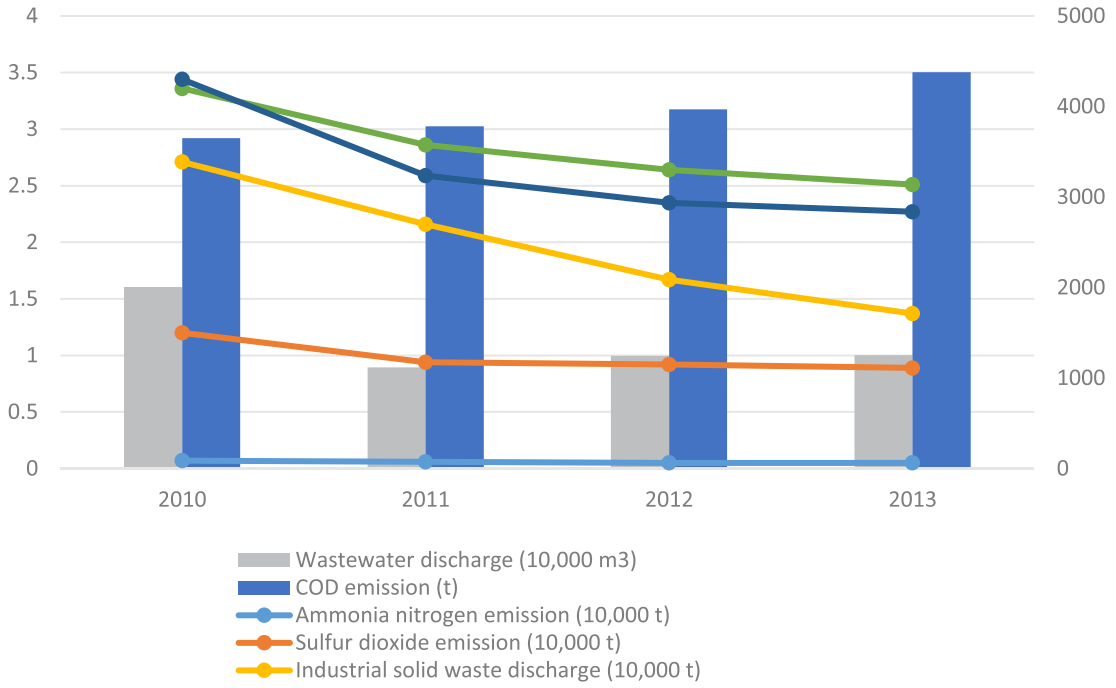


Figure. 3-7 Pollutant level in industrial parks undergoing circular transformation in 2010-2013 [11]

Structural transformation

Green transformation of industrial parks has contributed to the structural transformation of Chinese industries. The parks have pioneered the ecological industrial systems covering iron and steel, non-ferrous metals, power supply, chemicals, automobile, and machinery manufacture. The green transformation has also contributed to the phasing out of obsolete industrial capacity and pollution-/energy-intensive industries, enabling the transition towards a clean and circular production mode, new sources of energy, industries of high added value and high-end manufacturing industrial clusters.

Technological innovation

A major pathway for Chinese industrial parks to achieve green transformation is technological innovation. They have improved their clean production capability by introducing advanced technologies and equipment, upgraded technologies within traditional industries through investing in Research and Development, and cultivated new drivers of growth by focusing on innovation in sectors such as environmental industry, new source of energy and information technology.

Environmental management

The national "Eco-Industrial Parks" under the demonstration scheme are required to improve their environmental management capacity. Specifically, each park is required to set up an environment department with clear roles and responsibilities, and the parks' management is held accountable for environmental performance under its jurisdiction. In addition, with a dedicated team or staff responsible for implementing the demonstration project, each park should establish

an environmental risk prevention and control system including an online platform facilitating environmental information disclosure of key enterprises.

Similarly, under the national "Green Industrial Parks" scheme (see 3.2.4 for description), parks are required to put in place standards, plans, and information platforms.

3.3.2 Challenges

Despite the progress made, China still faces challenges in greening its industrial parks.

Scaling up. It is difficult to scale up good examples, given the diversity of China's industrial parks. The demonstration programs have been effective, but on the national level, different parks located in different regions make it impossible to have a standard model for green industrial parks. How to replicate the demonstration schemes nationally remains a challenge. China has accumulated and shared experiences mostly on the level of individual parks. It would be helpful to translate these experiences into a systematic and comprehensive guidance on nation-wide green transformation of industrial park.

Integrated and macro-level planning. Industrial agglomeration is, to a large extent, triggered by market forces. However, the government also plays a role in guiding and supporting industrial development through integrated and macro-level planning. At present, most park management authorities focus on the development of their respective parks, giving rise to duplication and disorderly competition. The lack of integrated planning at the macro-level might also leads to an undesirable industrial mix, making it difficult to implement a circular economy. A national sustainable development masterplan for industrial parks, therefore, is needed to strengthen coordination among relevant government departments.

Institutional and management arrangements. Many parks are not able to attract the financing necessary for green transformation. The current fiscal arrangement characterized by tax burden on the parks and lengthy waiting periods for parks to receive from the local government their share of the rents (based on land leased to enterprises) does not serve the needs of park development. The Park Administrative Committee, the top decision-making authority at the industrial park level, is sometimes constrained by bureaucratic procedures at higher levels, resulting in low efficiency in project approvals and insufficient oversight on enterprise performance.

Infrastructure. Business expansion can overwhelm the capacity of infrastructure within the parks. Some parks are experiencing increasing pressure on their transportation, logistics and auxiliary infrastructure systems. The lack of an upstream and integrated infrastructure planning also heightens the pollution crisis in some parks, calling for improved environmental infrastructure including centralized drainage systems and wastewater treatment pipelines and facilities.

Industrial pollution. In some cases, businesses are found to illegally discharge untreated industrial wastewater. The lack of proper management and treatment of hazardous wastes by some enterprises has caused significant environmental hazards and risks. Those behaviours reflect the general lack of corporate social responsibility and suggest an inadequate supervision by the park authority, which fails to have a full grasp of accumulated pollution issues and a dedicated and specialized inspection team.

Technological innovation. This is central to achieving the green transformation of industrial parks. Although R&D capability in China has improved over time, there are still obstacles to technological innovation. Efforts are needed to

reduce the costs of clean technologies, match the supply with demand, and remove the bottleneck in the commercialization and scaling-up of clean technologies.

Standards and norms. At the international level, eco-industrial parks have increasingly been recognized as an effective tool to overcome the challenges of inclusive and sustainable industrial development (UNIDO 2018). In this context, greening the industrial parks in China and measuring their performance need to take into account international standards and norms. Under PAGE, UNIDO is piloting the International Framework for Eco-Industrial Park in selected industrial parks in Jiangsu. Meanwhile, with the growing exchange and cooperation among industrial parks in different countries, China's industrial parks are facing close international scrutiny for their management and technological capability.

3.4 Green transformation of industrial parks in Jiangsu

In 2000, Jiangsu announced the ambition to turn itself into an "Ecological Province". In the following year, it issued an action plan on "*Ecological Civilization*" followed by a detailed programme covering *2013-2022.* The focus has been on industrial development with strategic spatial planning.

The green transformation of industrial parks initially focused on the provincial level parks.

Since 2008, Jiangsu has put forward a large number of policies and implementation plans that contribute to the green transformation of various types of parks: eco-industrial parks, development zones, chemical industrial parks, and logistics parks (see Table 3-1). It is clear that industrial parks have become a major arena for industrial development and environmental protection. The provincial government has placed a strong emphasis on the role of green industrial demonstration parks and established environmental targets (see Table 3-2).


© Jiangsu Taixing Economic Development Zone

Table 3-2 Jiangsu's policies on green transformation of industrial parks

Type	Title of policy document	Issued by
Plans/ Opinions	Notice on Deepening the Construction of Eco-industrial Parks	2008
	Master Plan of Jiangsu Province for Ecological Civilization Construction (2013-2022)	2013
	Opinions on Effectively Strengthening the Administration of Chemical Industrial Parks in Jiangsu Province (Draft)	2013
	Development Plan of Logistics Parks in Jiangsu Province (2014-2020)	2015
	"13th FYP" Development Plan for Green Industrial Development in Jiangsu Province	2016
	"13th FYP" Development Plan for the Development of a Modernized Industrial System in Jiangsu Province	2017
	Implementation Opinions on Promoting the Reform and Innovative Development of Development Zones in Jiangsu Province	2017
	Guiding Opinions of Jiangsu Province on Accelerating the Cultivation of Advanced Manufacturing Industry Clusters	2018
Measures/ Action plans	Measures for the Administration of Provincial Eco-industrial Parks in Jiangsu Province (for Trial Implementation)	2008
	Notice on Effectively Strengthening Environmental Protection in Chemical Industrial Parks (Clusters)	2011
	Notice on Issuing the Planning and Layout of the Petrochemical Industry in Jiangsu Province	2015
	Implementation Plan of Jiangsu Province for the Development of Green Manufacturing System	2016
	"13th FYP" Comprehensive Implementation Plan for Energy Conservation and Emission Reduction in Jiangsu Province	2017
	Notice of Jiangsu Province on the Pilot Work Plan for Replacing Project-based Energy Conservation Assessment and Environmental Impact Assessment with "Regional Energy Conservation Assessment and Environmental Impact Assessment + Block Energy Consumption and Environmental Standards" (for Trial Implementation)	2017
	Notice on Issuing the Interim Regulations of Jiangsu Province on the Recognition and Administration of Smart Industrial Parks in Jiangsu	2017
	Notice on the Implementation Plan for the Establishment of National Demonstration Zones for the Technology Transfer and Commercialization in Southern Jiangsu Province	2017
	Opinions on Accelerating the Innovative Development of Provincial Demonstration Logistics Parks	2017
	Notice on Developing the Innovative (Industrial) Demonstration Parks in Jiangsu Province	2018
	Notice of Jiangsu Province on the Interim Measures for Replacing the Total Emission Reduction Quota of Major Water Pollutants in Construction Projects in the Taihu Lake Basin	2018
	Implementation Opinions on Accelerating the Establishment of Provincial Technology Transfer System	2018
	Administrative Regulation of Provincial Development Zones in Jiangsu	2018
	Notice of the Work Plan for Rectifying Coastal Chemical Industrial Parks (Clusters) in Jiangsu Province	2018

Table 3-3 "13th FYP" Targets for green transformation of industrial parks in Jiangsu

Category	Targets by 2020
Green Industrial Development	Reduction on energy consumption per unit of industrial value added by industrial-scalei enterprises: 18%
	Reduction on CO2 emission per unit of industrial value added: 19%
	Reduction on water consumption per unit of industrial value added: 20%
	Reduction on discharge of major pollutants: 10%
	Comprehensive utilization rate of industrial solid wastes: above 95%
	Level of land conservation and integrated land use, output per mu: significant improvement
	Value added of service industry per regional GDP: 57% (by 2022)
	Output value of high-tech industries per total output value of industrial-scale enterprises: 45% (by 2022)
Green Transformation of Industrial Parks	The planning, construction and operation of Green Industrial parks
	Energy-intensive and highly polluting enterprises and projects excluded from industrial parks
	A component of circular upgrading/transformation included in the masterplan of industrial parks
	Application of new and renewable energies accelerated in the industrial parks
	Solid waste sorting, recycling and disposal system, and sewage pipe network and treatment facilities built and improved in the industrial parks
	Green and circular transformation of transport, water supply, power supply, lighting, tele-communication and other infrastructure systems undertaken in industrial parks
	Continuous improvement of overall industry structure, infrastructure, production process and management mechanisms in national and provincial-level industrial parks
	Pilot accreditation programme of green industrial parks initiated at the prefecture-level cities in Jiangsu
	An evaluation indicator framework developed for the promotion of green industrial demonstration zones
	Industrial Park Economy 2.0 conceptualized
	A deeper integration and co-development of industrial parks and its urban surroundings
	Development of industrial parks under joint partnerships enhanced
	100 green demonstration factories and 10 green demonstration industrial parks established
	Rectification objectives and tasks of the chemical industry parks and the chemical industry enterprises in the parks completed

4. GREEN TRANSFORMATION PERFORMANCE

This chapter proposes a framework for assessing the three sample industrials parks in Jiangsu for their green transformation performance and provides the assessment results.

4.1 Assessment framework

4.1.1 Principles

Based on expert opinions, six principles are applied in this assessment.

Comprehensiveness: Green transformation encompasses economic development, energy and resource use, environmental protection, park management, etc. and, therefore, requires comprehensive assessment.

Scientific: the selection of indicators should reflect the main characteristics of issues to be assessed in a scientific manner, supported by a tiered analytical structure and reliable data sources.

A tiered structure: overall assessment is based on assessment at disaggregate levels

Static and dynamic analysis: assessment should cover not only the status but also trend of green transformation, which is a dynamic process.

System Thinking: indicators should be assessed not only individually but also in connection with each other to provide a full picture.

Practicability: assessment should take into account data availability and quantifiably of certain dimensions, combining the use of quantitative and qualitative approaches and ensuring that each indicator can be monitored, measured and compared (across the parks).

4.1.2 Indicators

Based on the government's relevant requirements, the assessment of the parks in Jiangsu relies on two levels of indicators: primary and secondary. There are five primary indicators: Economic Development (ED), Energy and Resources Efficiency (ES), Environmental Protection (EE), Park Management (CM), and Employment and Social Security (SI). Each primary indicator is weighted by an average of 5 secondary indicators (except the primary indicator of EE, which has 6 secondary indicators to reflect the greater importance given to environmental protection). Secondary indicators are normalized, i.e. converted from absolute values to relative ones for comparability purpose.

4.1.3 Methodology

The index for parks' green transformation measures the distance between actual and target values, a methodology adopted in the government's *Requirements for Assessment of Green Industrial Parks*:

$$\text{Index} = \frac{1}{n_1 + n_2 + n_3 + n_4 + n_5}\left[\sum_{i=1}^{n_1}\frac{ED_i}{ED^b{}_i} + \sum_{j=1}^{n_2}\frac{ES_j}{ES^b{}_j} + \sum_{f=1}^{n_3}\frac{EE_f}{EE^b{}_f} + \sum_{p=1}^{n_4}\frac{CM_p}{CM^b{}_p} + \sum_{m=1}^{n_5}\frac{SI_m}{SI^b{}_m}\right]$$

where *i, j, f, p* and *m* represent the i^{th}, j^{th}, f^{th}, p^{th} and m^{th} items of Economic Development (ED), Energy Resource Utilization (ES), Eco-Environment (EE), Park Management (CM) and Employment and Social Security (SI), respectively; *n1, n2, n3, n4* and *n5* represent the numbers of their secondary indicators, respectively; *b* represents the target value of each indicator.

The standardization of all indicators are achieved by the formula of "actual value/target value" for positive indicators (that is, the larger the value, the better the results) and the formula of "target value/actual value" for negative indicators (that is, the larger the value, the better the results).

The target values for indicators are based on Jiangsu's "13th FYP" and other related plans. When a provincial target value is absent, the related national-level target is used. Target values for Employment and Social Security (SI) are based on existing literatures. The entire index system is shown in Table 4-1.

Table 4-1 The index framework of Jiangsu industrial parks' green transformation

Primary Indicator	Secondary Indicator	Remark	Unit	Target Value	Type	Reference sources
Economic Development (ED)	Proportion of the output value of high-tech industries to total industrial output by enterprises with industrial-scale [13]	Ratio of the industrial output value of high-tech enterprises to total industrial output by enterprises with industrial-scale located in the industrial park	%	45	Expected/ Indicative	13th FYP of Jiangsu Province
	Proportion of the output value of emerging industries [14] to total industrial output by enterprises with industrial-scale	Ratio of the industrial output value of emerging enterprises to total industrial output by enterprises with industrial-scale located in the industrial park	%	31	Expected/ Indicative	13th FYP for Emerging and Strategic Industries of Jiangsu Province
	Per capita industrial value added	Ratio of the industrial value added of an industrial park to the number employed by industrial enterprises in the industrial park by end of a calendar year	10,000 RMB /person	15	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks and Green Industrial Parks
	Average annual growth rate of industrial value added (three-year annual average)	$\left[\left(\frac{\text{Industrial value added of current year}}{\text{Industrial value added of the past three years}}^{\frac{1}{3}}\right)-1\right]$ x 100%	%	15	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	Patents ownership per 10,000 persons	Ratio of the number of invention patents to total population of the industrial park by end of a calendar year	Patents/ 10,000 persons	22.5	Expected/ Indicative	Jiangsu Statistical Bulletin of National Economy and Social Development
Energy Resource Utilization (ES)	Comprehensive energy consumption per unit of industrial value added	Ratio of the total comprehensive energy consumed in the industrial park to the total industrial value added of the industrial park	tce/ 10,000 RMB	0.5	Binding	National Standard on Eco-industrial Demonstration Parks
	Proportion of non-fossil energy consumption in total energy consumption	Ratio of non-fossil energy consumption to total energy consumption in the industrial park	%	11	Expected/ Indicative	13th FYP for Energy Development of Jiangsu Province
	Proportion of natural gas consumption in fossil energy consumption	Ratio of natural gas consumption to total fossil energy consumption in the industrial park	%	10	Expected/ Indicative	13th FYP for Energy Development of Jiangsu Province

Primary Indicator	Secondary Indicator	Remark	Unit	Target Value	Type	Reference sources
	Industrial value added per unit of industrial land area	Ratio of the industrial value added of an industrial park to the industrial land area of the industrial park	100 million RMB/ km2	9	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	Fresh water consumption per unit of industrial value added	Ratio of the total fresh water consumption by industries in an industrial park to the total industrial value added of the industrial park	km3/ 10,000 RMB	8	Binding	National Standard on Eco-industrial Demonstration Parks
Eco-Environment (EE)	COD emission per unit of industrial value added	Ratio of the industrial COD emission in an industrial park to the total industrial value added of the industrial park	Kg /10,000 RMB	1	Binding	Comprehensive standard on eco-industrial parks
	Sulfur dioxide emission per unit of industrial value added	Ratio of the industrial sulfur dioxide emission in an industrial park to the total industrial value added of the industrial park	Kg /10,000 RMB	1	Binding	Comprehensive standard on eco-industrial parks
	Green coverage ratio	Ratio of the total area of green space in an industrial park to the total land use area within the scope of park planning	%	30	Expected/ Indicative	Standard on Green Industrial Parks
	Proportion of park enterprises ISO14001 certified	Ratio of the number of enterprises certified to ISO14001 standard to the total number of enterprises in the industrial park	%	100	Expected/ Indicative	Comprehensive Assessment Framework for the Scientific Development of ETDZs in Jiangsu Province
	Utilization rate of industrial solid wastes	Ratio of the utilized volume of industrial solid wastes to the total combined volume of industrial solid wastes generated by current year and that of stored from previous years	%	70	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	Utilization rate of reclaimed water	Ratio of the amount of recycled water to the total industrial water consumption in the industrial park	%	30	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks

Primary Indicator	Secondary Indicator	Remark	Unit	Target Value	Type	Reference sources
Park Management (CM)	Environmental management capacity	Encompassing four requirements with a weight of 25% for each: 1) A dedicated environmental protection department in place; 2) with clearly defined functions and a governance structure; 3) environmental protection be included in the performance assessment of park leadership and management with corresponding evaluation mechanism in place; 4) a specialized agency or person responsible for the construction of national or provincial demonstration parks in place.	%	100	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	Implementation rate of cleaner production program by key enterprises	Ratio of the number of key enterprises passing the audit of cleaner production program to the total number of key enterprises in the industrial park	%	100	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	The establishment of environmental risk management system	Encompassing five requirements with a weight of 20% for each: practice of environmental risk assessment; 1) Environmental Risk Assessment of the industrial park conducted; 2) A sound environmental risk contingency plan established for the park; 3) integrate emergency resources within the park an establish a professional environmental emergency response team with necessary stockpiles; 4) specialized training on contingency plan organized; 5) Environmental risk monitoring and reporting platform established.	%	100	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
	Environmental information disclosure rate of key enterprises	Ratio of the number of enterprises and public institutions disclosing environmental information as required by the *Measures for Environmental Information Disclosure by Enterprises and Public Institutions* to the number of key emission enterprises in the park	%	100	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks

Primary Indicator	Secondary Indicator	Remark	Unit	Target Value	Type	Reference sources
	The Establishment of the Eco-industrial information platform	Encompassing five requirements with a weight of 20% for each: 1) regularly reporting on the progress and annual assessment result of green transformation of the industrial park 2) release economic and environmental data including environmental compliance information of the industrial park 3) publish progress of the industrial park on advanced technologies adoption and good practices on cleaner production, resource utilization and so forth; 4) release the data of energy and waste flow (generated, supplied, discharged or stored) within the industrial park; 5) regular disclosure on related information of major pollutant emitter in the industrial park.	%	100	Expected/ Indicative	National Standard on Eco-industrial Demonstration Parks
Employment and Social Security (SI)	Proportion of female employees	Ratio of end-of-term number of female employees to the total number of employees in the industrial park	%	50	Expected/ Indicative	Literature
	Proportion of employees with college degree or above	Ratio of end-of-term number of employees with college degree or above to the total number of employees in the industrial park	%	100	Expected/ Indicative	Literature
	Proportion of managerial staffs	Ratio of end-of-term number of managers to the total number of employees in the industrial park	%	30	Expected/ Indicative	Literature
	Proportion of engineers and technicians	Ratio of end-of-term number of engineers and technicians to the total number of employees in the industrial park	%	35	Expected/ Indicative	Literature
	Social insurance coverage of park employees	Ratio of end-of-term number of employees covered by social insurance program to the total number of employees in the industrial park	%	100	Expected/ Indicative	Literature

4.2 Assessment results [15]

Based on the approach described above, this study assesses Suzhou Industrial Park (hereafter either "Suzhou" or the "Suzhou Park" for simplification) in southern Jiangsu, Taixing EDZ (hereafter either "Taixing" or the "Taixing Park" for simplification) in central Jiangsu and Huai'an Economic & Technological Development Zone (hereafter either "Huai'an" or the "Huai'an Park" for simplification) in northern Jiangsu, each representing different stages of social and economic development. The assessment consists of a composite index covering the five primary indicators, which are in turn supported by the 5-6 secondary indicators as described earlier.

4.2.1 Suzhou Industrial Park

Established in 1994, the Suzhou Park – a cooperation project between China and Singapore, covers 278 km2 and hosts a population of about 800,000. In 2016, the park's GDP amounted to US$ 32 billion and its industrial value added of US$ 16.9 billion.

Accredited as both a national-level ETDZ and a high-tech zone, the Suzhou Park has enjoyed the preferential policies under the two national schemes and has seen a continuous development over the past two decades. It currently tops the list of national development zones in the areas of overall development, agglomeration rate, quality, and efficiency. Structure-wise, the park's conventional sectors include information technology and electric and machinery manufacturing industry joined by new industries such as biomedicine industry, nanotechnology, and artificial intelligence in recent years in the context of the establishing a green, circular and low-carbon industrial symbiotic system.

The assessment results are shown in Fig. 4-1. The park's composite index of green transformation was 1.78 in 2015 compared to 1.67 in 2015. The progress was driven by three of the five primary indicators (ED, ES and EE), pointing to the potential for improving park management (CM) and employment and social security (SI) measures.

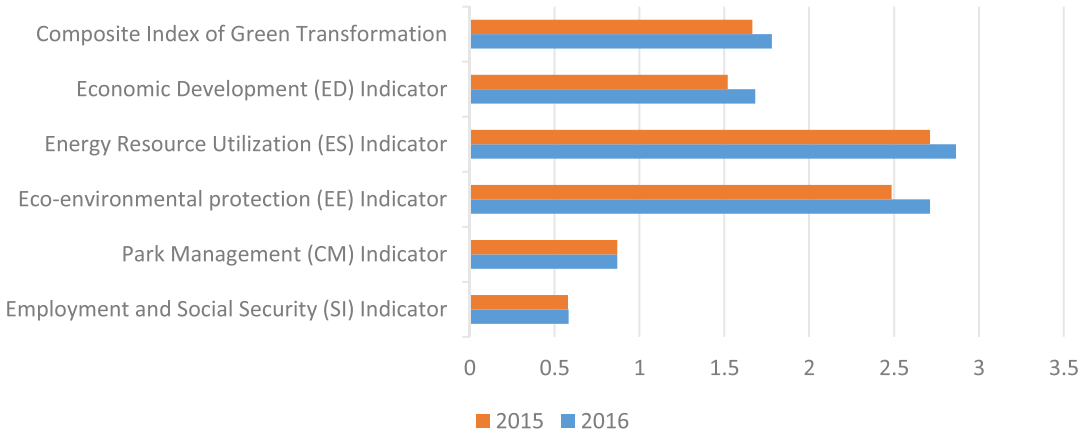


Figure 4-1 Composite index of green transformation for Suzhou Industrial Park and results of primary indicators

(1) Economic Development (ED)

The secondary Economic Development (ED) indicators are used to show changes in a park's industrial structure, output and innovation (Table 4-2). All five secondary indicators exceeded their respective target values.

Table 4-2 Economic Development (ED) Indicators of Suzhou Industrial Park

Secondary Indicator	2015	2016	Target Value
Proportion of the output value of high-tech industries to total industrial output by enterprises with industrial-scale %	66.97	66.20	45
Proportion of the output value of emerging industries to total industrial output by enterprises with industrial-scale %	59	60.20	31
Per capita industrial value added (10,000 RMB/person)	25.98	25.52	15
Average annual growth rate of industrial value added (three-year annual average) %	16.28	27.70	15
Patents ownership per 10,000 persons	31.37	32.57	22.5

(2) Energy and Resource Efficiency (ES)

The secondary Energy and Resource Efficiency (ES) indicators measure green transformation in terms of energy structure and energy/resources efficiency. Of the five indicators, energy intensity and water intensity have mandatory targets whereas the other three are suggested targets (Table 4-3).

Table 4-3 Energy and Resource Efficiency (ES) Indicators of Suzhou Industrial Park

Secondary Indicator	2015	2016	Target Value
Proportion of non-fossil energy consumption in total energy consumption (%)	73.9	77.34	11
Proportion of natural gas consumption in fossil energy consumption (%)	26.51	28.25	10
Comprehensive energy consumption per unit of industrial value added (tce/10,000 RMB)	0.48	0.5	0.5
Industrial value added per unit of industrial land area (100 million RMB/km2)	18.96	19.21	9
Fresh water consumption per unit of industrial value added (km^3/10,000 RMB)	7.69	5.99	8

In terms of energy structure, the share of non-fossil energy in total energy use was getting close to 80% while that of natural gas within fossil-energy approaching 30%, far exceeding the suggested target of 11% and 10%, respectively. When it comes to energy intensity, however, it reached the upper limit of the mandatory target in 2016, pointing to the importance for the park to improve energy efficiency. As far as land and water resource efficiency is concerned, the park exceeded the respective targets, with water to a less extend.

(3) Environmental Protection (EE)

The six secondary Environmental Protection (EE) Indicators cover the emission of major pollutants, green space, environmental management systems, and circularity in resource use. The emission intensity of key pollutants is subject to mandatory targets.

Table 4-4 Environmental Protection (EE) Indicators of Suzhou Industrial Park

Secondary Indicator	2015	2016	Target Value
COD emission per unit of industrial value added (Kg/10,000 RMB)	0.326	0.246	1
sulfur dioxide emission per unit of industrial value added (Kg/10,000 RMB)	0.127	0.122	1
Green space coverage (%)	45	45	30
Proportion of enterprises ISO14001 certified (%)	50.99	53.25	100
Comprehensive utilization ratio of industrial solid wastes (%)	98.11	98.11	70
Utilization rate of reclaimed water (%)	16.7	17.17	30

As the results shown (Table 4-4), the Suzhou Park is well ahead in meeting the emission intensity targets for key pollutants, the target for green space coverage and the target for utilizing industrial solid waste (closing to 100%), although the progress of implementing a park-wide ISO14001 standard system is half way through and the utilization of recycled water has a large room for improvement.

(4) Park Management (CM)

The Park Management (CM) indicators cover environmental management capacity, auditing of key enterprises' clean production, environmental risk management system, key enterprises' environmental information disclosure, and eco-industrial information platforms. The related indicators are all suggested by the *National Standard on Demonstration Eco-industrial Parks.*

Figure 4-2 points to the need for the Suzhou Park to include environmental protection in the performance evaluation of the park's management team and publicize green transformation indicators and information on the generation, supply of, demand for, and flow of waste as well as surplus energy.

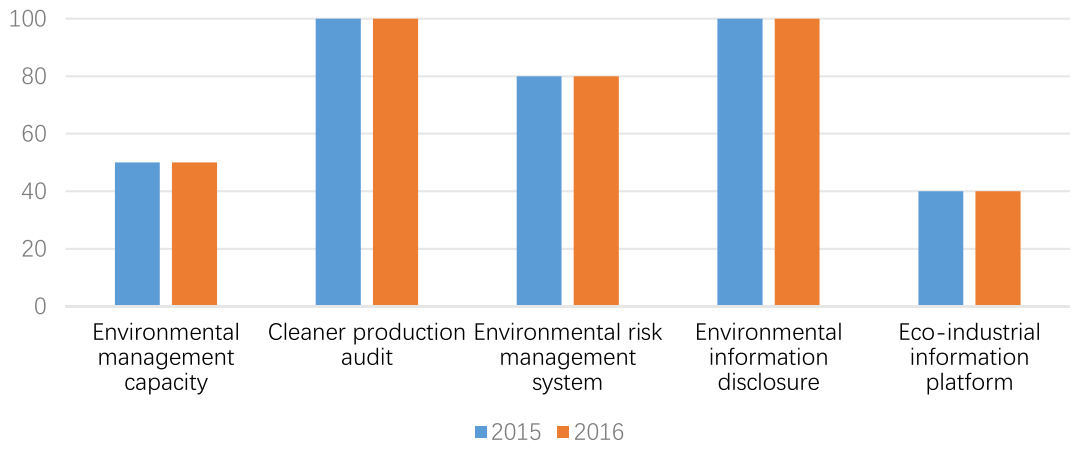


Figure 4-2 Park Management (CM) indicators of Suzhou Industrial Park

(5) Employment and Social Security (SI)

Employment and Social Security are integral to green transformation of industrial parks in accordance with the concept of inclusiveness embedded in the Sustainable Development Goals. The secondary Employment and Social Security (SI) indicators include the proportion of female employees, proportion of employees with college degree or above, proportion of managers, proportion of engineers and technicians, and social security coverage of employees, though there are overlaps across some of these categories.

Figure 4-3 provides the respective scores for each indicator. Social security was close to full coverage and female participation in labor force was more than 40%, but other indicators are difficult to interpret without their respective target values.

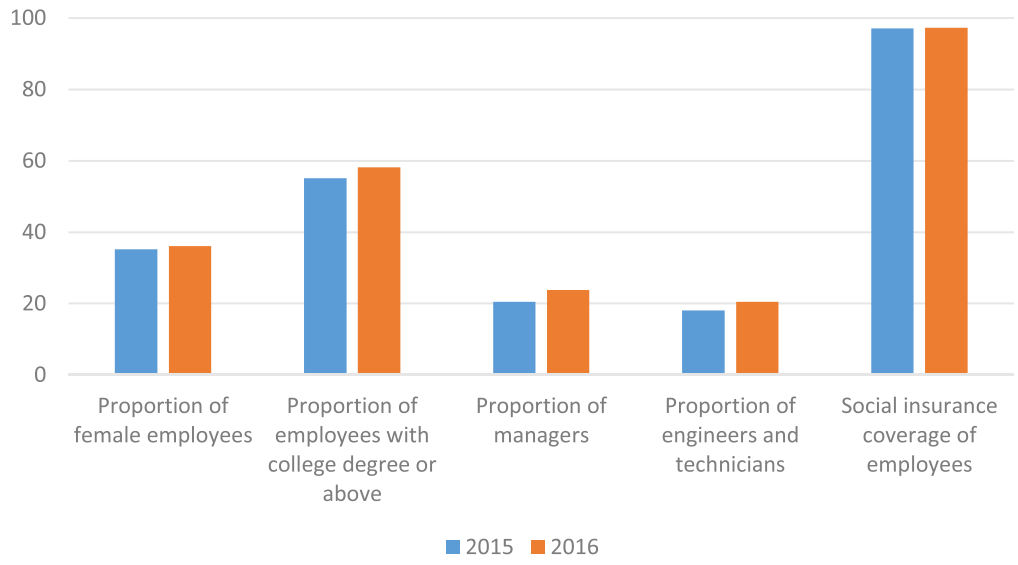


Figure 4-3 Employment and Social Security (SI) indicators of Suzhou Industrial Park

4.2.2 Taixing Economic Development Zone

Established in 1991, the provincial level Taixing Park covers an area of 59.8 km^2, of which 25.8 km^2 is dedicated to the chemical industry. The park is specialized in manufacturing industrial materials and advanced chemical products. In 2002, the park was named as the China Fine Chemicals (Taixing) Development Zone, with the aim of becoming a global hub for fine chemicals industry and a key national circular transformation park.

As shown in Figure 4-4, the Taixing EDZ made progress overall during 2015-2016, as measured by the index, with the most significant contribution from environmental protection (EE).

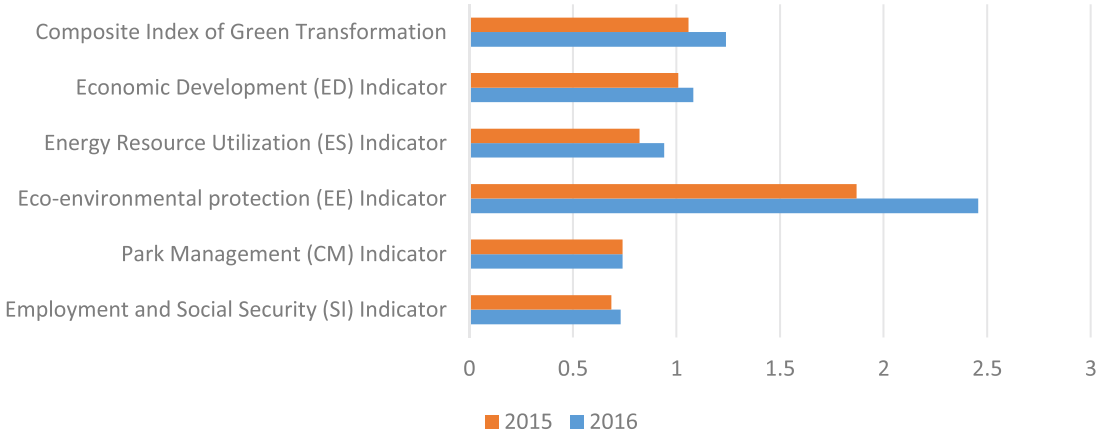


Figure 4-4 Composite Index of green transformation for Taixing EDZ and results of primary indicators

(1) Economic Development (ED)

Table 4-5 Economic Development (ED) indicators of Taixing EDZ

Secondary Indicator	2015	2016	Target Value
Proportion of the output value of high-tech industries to total industrial output by enterprises with industrial-scale %	21.8	22.1	45
Proportion of the output value of emerging industries to total industrial output by enterprises with industrial-scale %	73.2	75.6	31
Per capita industrial value added (10,000 RMB/person)	8.94	9.27	15
Average annual growth rate of industrial value added (three-year annual average) %	19.4	21.7	15
Patents ownership per 10,000 persons	7	9.3	22.5

Given Taixing Park's focus on fine chemicals and new materials, which are classified as emerging industries under the *National Industry Catalogue* (NRDC 2016) the proportion of its emerging industries accounts for 70% of the total industrial output, far exceeding the target value. The share of its high-tech industries as well as its growth of industrial value added also surpassed the targets, but the park lagged behind in terms of per capita industrial value added and innovation.

(2) Energy and Resource Utilization (ES)

Table 4-6 Energy and Resource Utilization (ES) indicators of Taixing EDZ

Secondary Indicator	2015	2016	Target Value
Proportion of non-fossil energy consumption in total energy consumption (%)	1	1	11
Proportion of natural gas consumption in fossil energy consumption (%)	5	4.2	10
Comprehensive energy consumption per unit of industrial value added (tce/10,000 RMB)	0.6	0.42	0.5
Industrial value added per unit of industrial land area (100 million RMB/km2)	18.2	19.5	9
Fresh water consumption per unit of industrial value added (km3/10,000 RMB)	12	9.6	8

The Taixing Park's energy almost entirely depends on fossil fuels within which natural gas accounts for a minor share. Energy efficiency, however, managed to meet the mandatory target by a small margin in 2016. In terms of resource efficiency, water intensity, industrial value added per unit of land was twice better than the target value but water efficiency remained behind.

(3) Environmental protection (EE)

Table 4-7 Environmental protection (EE) indicators of Taixing EDZ

Secondary Indicator	2015	2016	Target Value
COD emission per unit of industrial value added (Kg/10,000 RMB)	0.132	0.093	1
sulfur dioxide emission per unit of industrial value added (Kg/10,000 RMB)	1.071	0.804	1
Green space coverage (%)	12.35	12.6	30
Proportion of enterprises ISO14001 certified (%)	26.7	28.9	100
Comprehensive utilization ratio of industrial solid wastes (%)	88.21	89.03	70
Utilization rate of reclaimed water (%)	23.08	23.08	30

On the whole, the Taixing Park did well in reducing industrial pollution and increasing the re-use of industrial solid waste. Yet, efforts need to be made in areas of green space coverage, the adoption of ISO14001 and the use of reclaimed water.

(4) Park Management (CM)

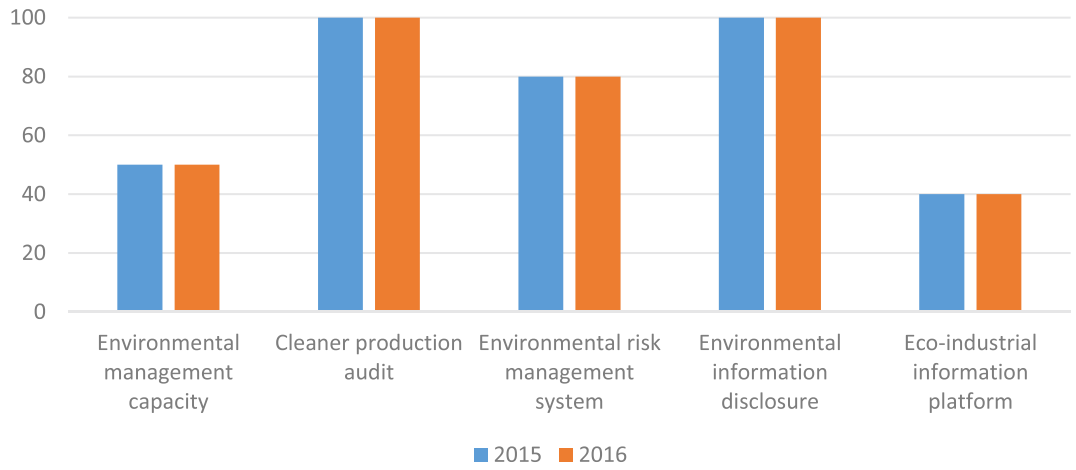


Figure 4-5 Park Management (CM) index of Taixing EDZ

As shown in Figure 4-5, major shortcomings are in environmental management capacity, ecological information platform and environmental risk management systems, similar to the performance of the Suzhou Park, calling for the inclusion of environmental protection in the performance evaluation of the park's management team and annual publication of green transformation indicators and information on the generation, supply of, demand for, and flow of waste as well as surplus energy.

(5) Employment and Social Security (SI)

Figure 4-6 provides the respective scores for each secondary indicator. Female employees in Taixing Park accounted for 36.1% of the total workforce, while employees with college degree or above accounted for 58.2% by the end of 2016. The social insurance coverage of employees in Taixing EDZ was above 97% for both years.

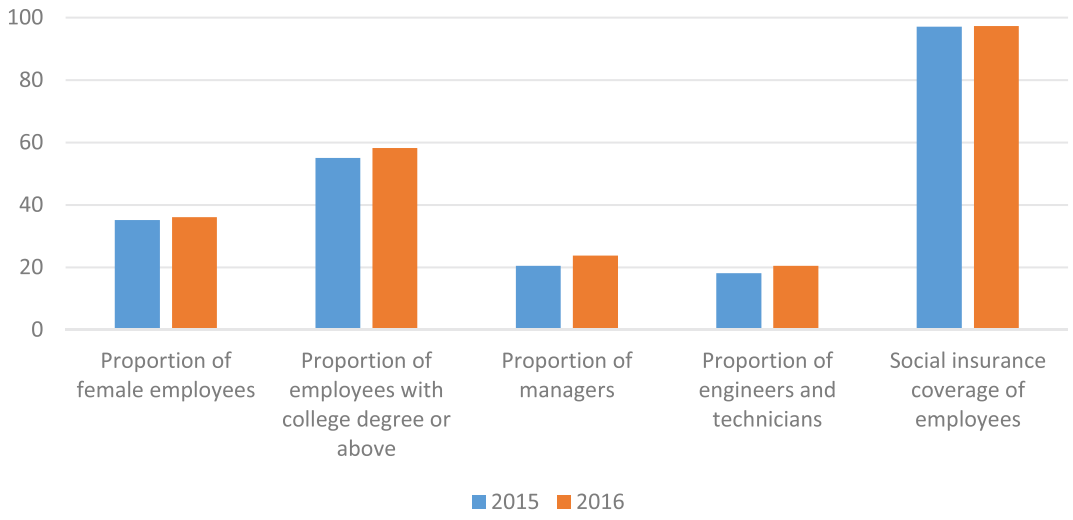


Figure 4-6 Employment and social security (SI) index of Taixing EDZ

4.2.3 Huai'an Economic & Technological Development Zone

The Huai'an Park in northern Jiangsu was established in 1992, approved as a provincial-level development zone in 1993, and upgraded to the national level in 2010. The Huai'an park, which covers 166 km2 with a population of 300,000, is the only national demonstration zone designated for hosting enterprises from Taiwan. As of November 2016, the Huai'an Park was included as an Eco-Industrial Park under a national demonstration scheme (China Huai'an Economic & Technological Development Zone 2017).

Figure 4-7 shows slight progress in overall performance between 2015 and 2016, with contribution mostly from environmental protection, somewhat offset by regression in energy and resource efficiency.

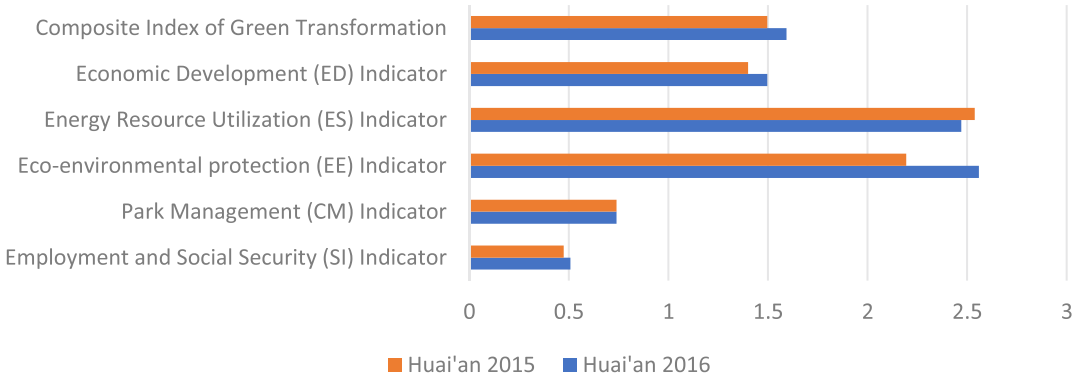


Figure 4-7 Composite Index of green transformation for Huai'an ETDZ and results of primary indicators

Source: *China Huai'an Economic & Technological Development Zone 2017*

At the level of primary indicators, the Huai'an Park showed stronger performance in Energy and Resource Utilization (ES) and Eco-environmental Protection (EE), but less strong in Employment and Social Security (SI) and Park Management (CM).

(1) Economic Development (ED)

Table 4-8 Economic Development (ED) indicators of Huai'an ETDZ

Secondary Indicator	2015	2016	Target Value
Proportion of the output value of high-tech industries to total industrial output by enterprises with industrial-scale %	62.5	62.3	45
Proportion of the output value of emerging industries to total industrial output by enterprises with industrial-scale %	61.8	75	31
Per capita industrial value added (10,000 RMB/person)	32	32	15
Average annual growth rate of industrial value added (three-year annual average) %	15.1	15.3	15
Patents ownership per 10,000 persons	10.8	11.9	22.5

Structure-wise, the Huai'an Park's shares of high-tech and emerging industries in the overall industry portfolio both exceeded the respective targets. Per capita industrial value added was more than twice better than the target value. As far as industrial growth is concerned, the Huai'an Park kept pace with the target. A major area for improvement is innovative capacity.

(2) Energy and Resources Utilization (ES)

Table 4-9 Energy and Resources Utilization (ES) indicators of Huai'an ETDZ

Secondary Indicator	2015	2016	Target Value
Proportion of non-fossil energy consumption in total energy consumption (%)	84.4	75.7	11
Proportion of natural gas consumption in fossil energy consumption (%)	2.1	2.1	10
Comprehensive energy consumption per unit of industrial value added (tce/10,000 RMB)	0.48	0.41	0.5
Industrial value added per unit of industrial land area (100 million RMB/km^2)	23.1	24.3	9
Fresh water consumption per unit of industrial value added (km^3/10,000 RMB)	6.7	5.97	8

Non-fossil fuel accounted for a significant share of the Huai'an Park's energy consumption, far exceeding the target value, although the share of natural gas within fossil fuels remained below the target. All energy and resources efficiency indicators were in line with the respective targets, most notably the land-use efficiency.

(3) Environmental Protection (EE)

Table 4-10 Environmental Protection (EE) indicators of Huai'an ETDZ

Secondary Indicator	2015	2016	Target Value
COD emission per unit of industrial value added (Kg/10,000 RMB)	0.28	0.21	1
sulfur dioxide emission per unit of industrial value added (Kg/10,000 RMB)	0.17	0.15	1
Green coverage (%)	39.1	39.4	30
Proportion of enterprises ISO14001 certified (%)	57.6	74.6	100
Comprehensive utilization ratio of industrial solid wastes (%)	96.3	97.5	70
Utilization rate of reclaimed water (%)	12.8	13.1	30

As the results shown, the Huai'an Park was well ahead in meeting the targets for emission intensity, green space coverage, and re-use of industrial solid waste. Progress was also made in adopting the ISO14001. A major shortcoming was in the utilization of recycled water.

(4) Park Management (CM)

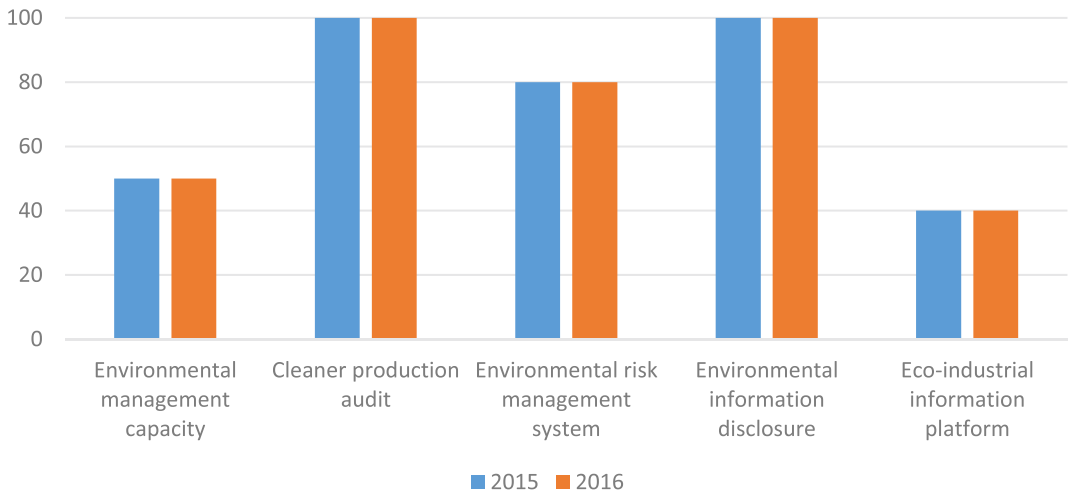


Figure 4-8 Park Management (CM) index composition of Huai'an ETDZ

Figure 4-8 shows the full implementation of clean production audit and environmental information disclosure. Improvements, however, are needed in the areas of environmental management capacity, environmental risk management system, and ecological information platform. In particular, the Park should include environmental protection in the performance evaluation of the management team, organize training on environmental emergency responses, and publicize information on the generation, supply of, demand for, and flow of waste and surplus energy.

(5) Employment and Social Security (SI)

Figure 4-9 provides the respective scores for each secondary indicator. Female employees in Huai'an Park accounted for 44.2% of the total workforce, while employees with college degree or above accounted for 20.6% by the end of 2016. The social insurance coverage of employees in Huai'an ETDZ was above 99% for both years. Compared to the other two parks, the proportion of more educated employees appears relatively lower in the park.

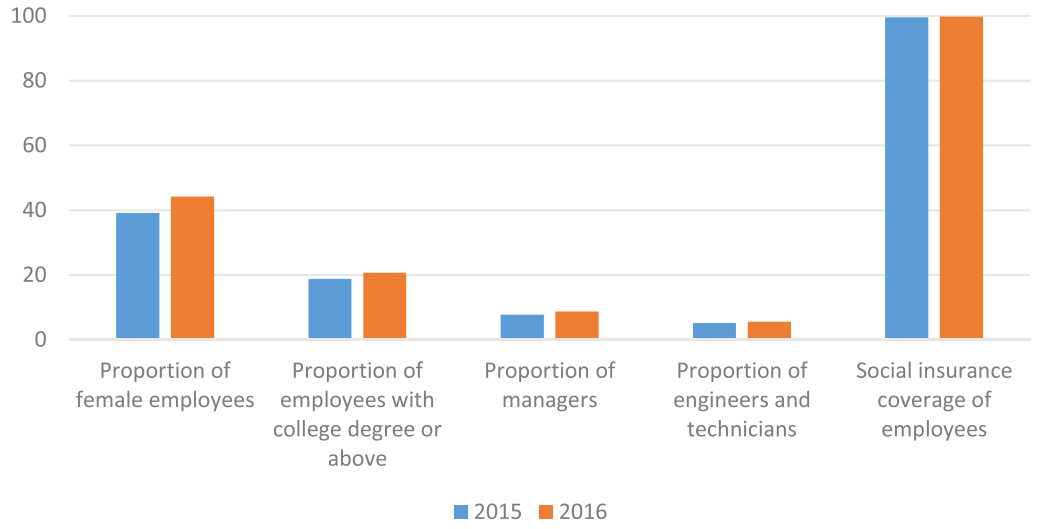


Figure 4-9 Employment and Social Security (SI) indicators of Huai'an ETDZ

4.2.4 Comparative analysis

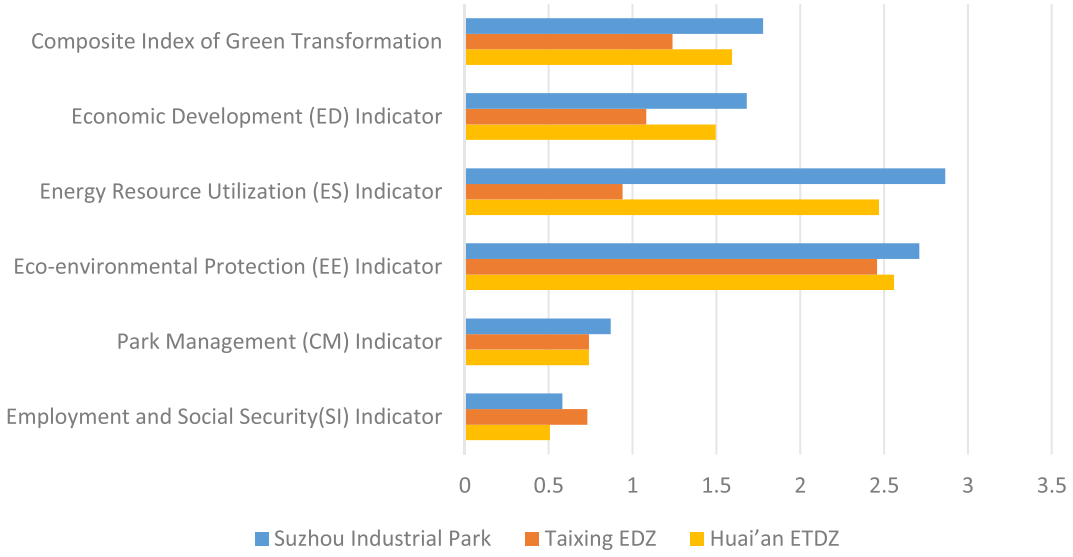


Figure 4-10 Comparison by overall green transformation index (2016)

In terms of overall green transformation, the Suzhou Park ranked the first, followed by Huai'an and Taixing (Figure 4-10). In terms of economic development (see Figure 4-11), Suzhou exceeded the relevant targets and was ahead of the other two in innovation and growth rate. Huai'an performed better in per capita output and emerging/high-tech sectors compared to its innovation capability and growth rate. As for Taixing, it was strong in emerging industries and growth rate but weak in high-tech industries, innovation capacity and per capita output, which all failed to meet the respective targets.

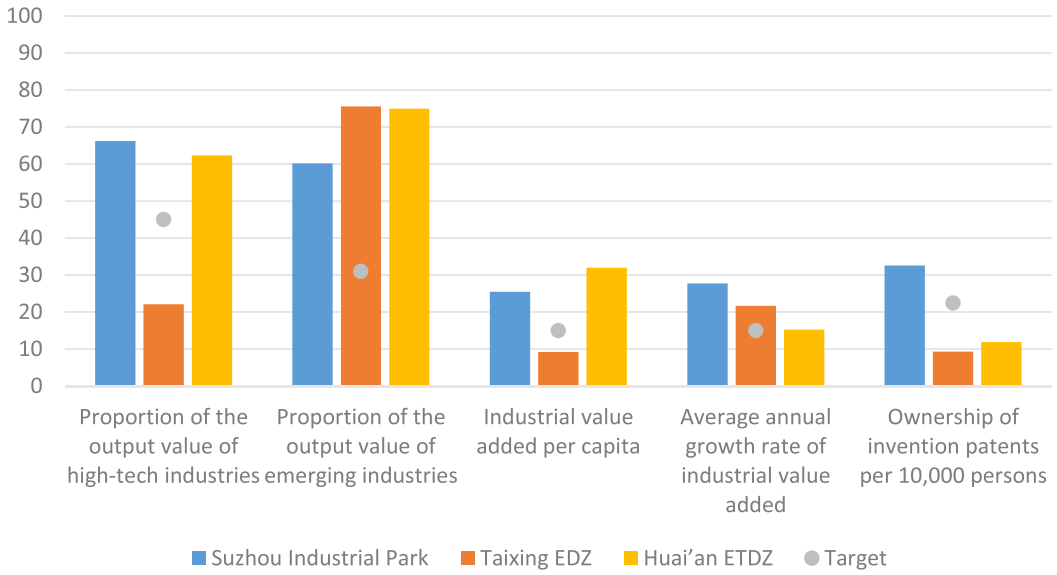


Figure 4-11 Comparison by Economic Development (ED) index

In the area of energy and resource efficiency (Table 4-11), Suzhou outperformed its peer parks in energy structure but not energy efficiency. Taixing with its dominant chemical industry lagged far behind its peers in transiting towards low-carbon energy and water efficiency. Huai'an did well in land use efficiency though its share of natural gas within the fossil fuel sector failed to meet the target.

Table 4-11 Comparison of parks by Energy and Resource Utilization (ES) indicators

Secondary Indicator (ES)	Suzhou Industrial Park	Taixing EDZ	Huai'an ETDZ	Target Value
Comprehensive energy consumption per unit of industrial value added (tce/10,000 RMB)	0.5	0.42	0.41	0.5
Proportion of non-fossil energy consumption in total energy consumption (%)	77.34	1	75.7	11
Proportion of natural gas consumption in fossil energy consumption (%)	28.25	4.2	2.1	10
Industrial value added per unit of industrial land area (100 million RMB/km2)	19.21	19.5	24.32	9
Fresh water consumption per unit of industrial value added (km3/10,000 RMB)	5.99	9.6	5.97	8

In the area of environmental protection (Table 4-12), Taixing did better than Jiangsu in COD emission and re-use of recycled water, but lagged far behind Jiangsu in SO_2 emission, green space and adoption of ISO14001. Huai'an excelled in the adoption of ISO14001 though its use of recycled water left much to be desired. As far as management is concerned (Figure 4-12), all three failed to

achieve the targets of environmental management capacity and eco-industrial information platform. Additionally, Taixing and Huai'an need to improve environmental risk management.

Table 4-12 Comparison of parks by Environmental Protection (EE) indicators in 2016

Secondary Indicators (EE)	Suzhou Industrial Park	Taixing EDZ	Huai'an ETDZ	Target Value
COD emission per unit of industrial value added (Kg/10,000 RMB)	0.246	0.093	0.206	1
Sulfur dioxide emission per unit of industrial value added (Kg/10,000 RMB)	0.122	0.804	0.151	1
Green space coverage (%)	45	12.6	39.4	30
Proportion of enterprises ISO14001 certified (%)	53.25	28.9	74.6	100
Comprehensive utilization ratio of industrial solid wastes (%)	98.11	89.03	97.46	70
Utilization rate of reclaimed water (%)	17.17	23.08	13.07	30

© Jiangsu Taixing Economic Development Zone

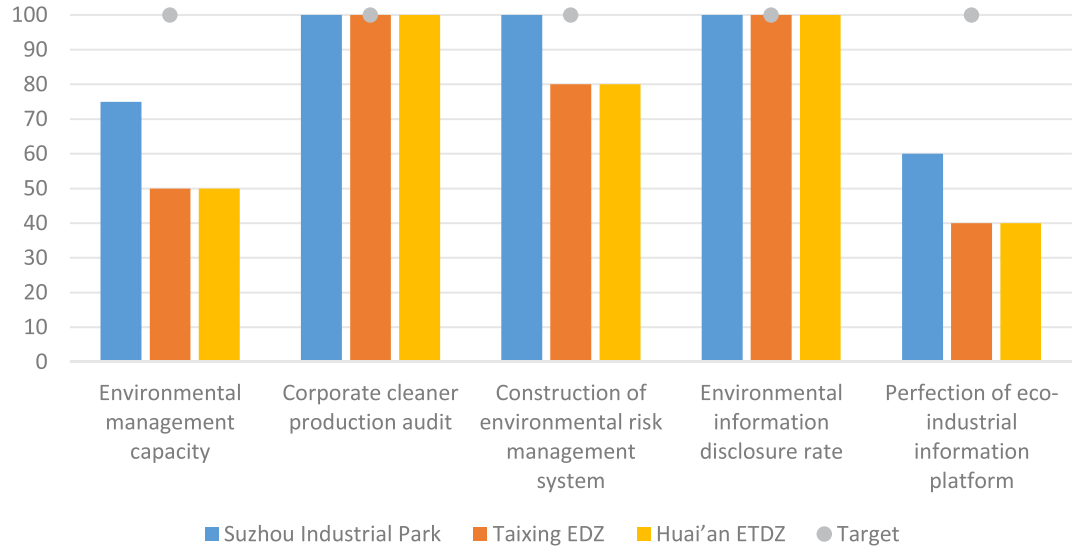


Figure 4-12 Comparison by Park Management (CM) Index

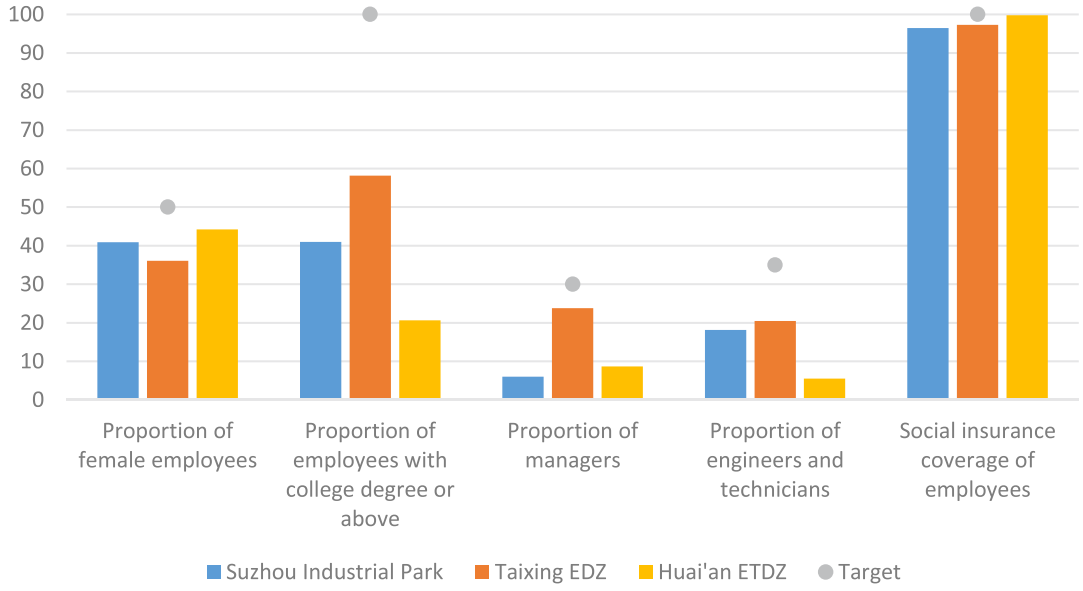


Figure 4-13 Comparison by Employment and Social Security (SI) Index

Figure 4-13 shows the breakdown of SI secondary indicators across the three parks. Taixing demonstrated the highest level of technical expertise in its labor force among the three whereas Suzhou and Huai'an had higher percentages of female employees. As far as social security is concerned, all three achieved nearly full coverage.

4.3 Conclusions

Through measuring and analysing the green transformation of the three industrial parks in southern, central and northern Jiangsu Province, respectively, the study came to the following conclusions and suggestions.

The parks under consideration have progressed as a whole in their green transformation. Achievements in environmental protection have contributed strongly to the progress. All three parks scored higher in the green transformation composite index of 2016 than that of 2015. Areas for improvement include: environmental infrastructure, law enforcement, governance and management, and environmental awareness.

Suzhou is in the lead for green transformation, but with imbalances across dimensions. It does better than the other two in all dimensions (especially economic, energy/resource use, and environmental protection), exceeding the relevant national and provincial targets. Within the Park, however, efforts should be made to increase the proportion of emerging industries, conserve land including by using it in a more compact manner, improve wastewater treatment and recycling, and strengthen its industrial specialisation.

Taixing has shown a tendency towards green transformation, but challenges remain pronounced. Compared with Suzhou and measured against relevant targets, it has difficulties in the following areas: emission of major pollutants, green space, energy structure, and technological innovation. These difficulties are common to chemical industrial parks across the country. Building on the tendency towards green transformation, Taixing should strengthen environmental protection and, in particular, seriously address the already exposed problems with a stronger sense of risk prevention.

Huai'an has steadily progressed on green transformation, though showing both strengths and weaknesses. It is in-between Suzhou and Taixing in green transformation performance, closer to the former. Major strengths are reflected in the development of emerging industries, per capita output, land-use efficiency, and gender-balance in workforce. Nevertheless, Huai'an needs to catch up with Suzhou in technological innovation and energy restructuring. It should sharpen its orientation, gear its industrial structure towards finer specialization and smart sectors, attract talents and top-notch research institutes, and grow its economy on the basis of environmental protection.

In sum, the three parks have moved towards green transformation to varying degrees, but no one has been able to transform across all relevant indicators and to the fullest extent. Problems are particularly concentrated in Taixing, which is dominated by chemical industry. Generally speaking, national-level industrial parks tend to perform better than provincial ones. Of the three, Suzhou, accredited as a national-level park, is the top performer thanks to its strong economic foundation and capacity for technological innovation. Next comes the national-level Huai'an park, which has adjusted its industrial structure and improved its environmental performance apart from attending to gender equality in its labor force. The one lagging behind is the provincial-level Taixing park whose green transformation is constrained by its energy structure and problems of pollution, pointing to the need for special attention to the green transformation of chemical industrial parks moving forward.

5. SUZHOU INDUSTRIAL PARK – A CASE STUDY

Of the three parks assessed, Suzhou is in the lead on overall green transformation. This case study provides more details on its good practices in order to inspire other industrial parks in China and other countries.

5.1 Park Management

The Suzhou Park is co-managed by a government body "administrative committee" (consisting of 8 departments), which oversees general social and economic affairs within the park and the developer (a joint-venture of Chinese and Singaporean consortiums) which responsible for infrastructure development, investment promotion, property management. Under this structure, the number of civil servants in the park is only one-third of an equivalent jurisdiction in China (Ren el al 2017).

5.2 Park planning

In developing the park, Suzhou gives priorities to planning in accordance with designated land-use functions and policy targets, with adequate room for future adjustment (e.g. anticipating the land-use implications of new transport modes). It also uses competitive bidding in contracting infrastructure projects and public services, subject to the review by professional planners. In addition, Suzhou has been adjusting its industrial mix in response to changing circumstances, from the initial focus on manufacturing to the current emphasis on electric information, equipment manufacturing, bio-medicinal industry, nanotechnology, artificial intelligence, and modern services.

5.3 Smart Management Platform

Suzhou is an early runner in applying information technology to park planning and management. Its public information platform applies a standard, high-definition coding system for roads, land plots, buildings, property units and other urban components. The platform connects with the systems of more than 20 departments in the park (e.g. park management, environmental protection, and transportation), and serves as a comprehensive database in supporting park planning, development and management. In addition, Suzhou has developed a mobile office system that allows real-time access to all relevant data and information (China Development Zone Network 2017). It is leading the emergence of "smart parks" contributing also to the growth of e-commerce, linkages among industries, and overall urban management.

5.4 Energy Efficiency

Suzhou has taken three actions to improve energy efficiency. First, it has put in place a Three-Year Action Plan to phase out energy intensive industries including 41 enterprises, thereby contributing to structural transformation efficiency performance as well as a greener industrial structure mix.

© Jiangsu Changshu High-Tech Industrial Development Zone

Second, it has signed agreements with large coal users to enforce a cap on coal consumption.

Third, it has launched a low-carbon energy management platform, currently capable of uploading energy consumption data from 13 public buildings and over 200 enterprises.

5.5 Environmental protection

Each year the Jiangsu Park implements a number of environmental projects. In 2016, for example, it initiated 51 projects covering environmental infrastructure, green buildings, clean energy, ecological restoration, and environmental management capacity. One example is a factory established in November 2018 to process biodegradable waste within the park. At a later stage, the factory is also expected to connect with related projects surrounding the park area for circular flow of resources, turning itself into a demonstrative “city mine” in China.

6. GUIDELINES ON THE GREEN TRANSFORMATION OF INDUSTRIAL PARKS IN JIANGSU

Based on the assessment of the three parks in Jiangsu, a set of general guidelines are proposed to inform the green transformation of all industrial parks in the province.

The guidelines cover nine areas: 1) general principles; 2) park management; 3) strategic planning; 4) industrial policy; 5) energy and resource efficiency; 6) environmental protection; 7) environmental risk management; 8) social security; and 9) capacity building.

1. General principles

Green transformation of industrial parks is not only about enhancing environmental protection, but also raising the quality of industrial activities and leading the optimization of overall industrial structure beyond the parks.

Green transformation, therefore, covers both environmental protection and innovative development, guided by the principles of innovative management, scientific planning, industrial clustering, compact land use, habitable environment, inclusive growth, openness, and win-win cooperation.

2. Park management

To promote green transformation of industrial parks throughout the province, Jiangsu may consider setting up a dedicated committee (e.g. "Committee for Green Transformation of Industrial Parks") and assigning senior provincial government officials to lead the committee overseeing related activities including conducting performance evaluation of parks at the provincial and all sub-provincial levels.

3. Strategic planning

The Committee can be tasked to lead the formulation of a provincial development plan for the green transformation of industrial parks in Jiangsu, on the basis of which the management of all industrial parks in Jiangsu can make plans specific to their respective parks, including a focus on adjustment to sectoral mix, infrastructure design, construction or re-purpose in line with green industrial development, and various platforms facilitating industrial agglomeration, cooperation among enterprises, and technological innovation.

4. Industrial Policies

In guiding the structural transformation of industrial parks, Jiangsu may consider incentivizing the parks to develop quality green products with high value addition and apply clean technologies to the production of traditional products. In addition, the province may consider raising the bar for the entry of enterprise and projects, especially in the case of chemical industry.

5. Energy and Resources Efficiency

Jiangsu may further promote land-use efficiency, focusing on compact and vertical spatial design

and redeploying under-utilized space. In addition, the province may consider raising the proportion of renewable energy in total energy consumption while reducing the use of coal across all parks in Jiangsu.

6. Environmental Protection

There are 6 areas where Jiangsu can strengthen its environmental protection: 1) incentivizing the scaling up of clean production; 2) facilitating circular flow of resources; 3) investing in environmental infrastructure; 4) strengthening environmental governance with a special attention to the inspection and monitoring of pollution and waste including in particular hazardous waste; 5) raising environmental awareness; and 6) improving green space coverage including specifying relevant targets and setting up professional maintenance systems.

7. Environmental Risk Management

A major approach to managing environmental risks is the disclosure of information on the performance of parks and the enterprises therein. Jiangsu may consider various ways of making relevant data and information publicly available, accessible and verifiable. In addition, the province needs to strengthen the ability of the parks and their enterprises to respond to environmental emergencies, including close monitoring of potential sources of major pollution and risks.

8. Social Security

Social inclusion is an integral part of green transformation. A dedicated department may be established within each park in charge of vocational training and social security affairs. In addition, the department can be tasked to harmonize labour relations, promote job creation, facilitate re-employment, and ensure equitable treatment of women in recruitment and promotion practices.

9. Capacity building

Green transformation of industrial parks cannot be achieved without innovative talents and entrepreneurship. Parks in Jiangsu are advised to put in place flexible and service-oriented systems to attract and facilitate the flow of talents. In addition, to incentivize enterprises to embrace green transformation, parks could set up funds ear-marked for eligible activities. Finally, it is important that park departments responsible for green transformation be adequately staffed with competent professionals, subject to regular training and evaluation.

© Jiangsu Changshu High-Tech Industrial Development Zone

NOTES

1. PAGE is a UN inter-agency mechanism to support countries interested in green economy. More information is available at: www.un-page.org.

2. "Other" represents three national development zones (i.e., Zhangjiagang Free Trade Zone, Wuxi Taihu National Tourist Resort Zone, and Suzhou Taihu National Tourism and Vacation Zone) and four provincial development zones (i.e., Nanjing Baixia High-Tech Industrial Park, FOHO New & High-tech Industrial Development Zone, Ganyu Marine Economic Development Zone and Nantong Export-oriented Agricultural Comprehensive Development Zone). The data adopted here is from the provincial and municipal government websites collected by the authors of this study.

3. The data adopted here is from the provincial and municipal government websites collected by the authors of this study.

4. Data here is mostly collected from promotional materials and media sources of various industry parks. Subject to data availability and validity period, the data in this section is not of any statistical value.

5. The industrial classification in this report is based on the *Classification and Codes of National Economic Sectors*. To be specific, "New Materials" correspond to many multiple national economic sectors, so they are collectively referred to as "Manufacture of New Materials"; the manufacture of various machinery and equipment is collectively referred to as "Manufacture of Equipment"; manufacture of new energy automobile is included in "Manufacture of Automobile"; photovoltaics, wind power and other new energies are included in "Production and Supply of Electric Power and Heat Power". Incomplete data or data that cannot be classified are not included.

6. State-certified high-tech sectors include Electronic Information, Biology and New Medicine, Aerospace, New Materials, High-tech Services, New Energies and Energy Saving, Resources and Environment, and Advanced Manufacture and Automation.

7. Listed in the chart are the top ten industries in percentage terms, and other industries are collectively referred to as "Other". The data adopted here is from the provincial and municipal government websites collected by the authors of this study.

8. The data adopted here is from the provincial and municipal government websites collected by the authors of this study.

9. The data adopted here is from the provincial and municipal government websites collected by the authors of this study.

10. Data and information adopted in section 3.3.1 Achievements is collected by Qi Qiao from China Academy of Environmental Science under MEE in 2018.

11. Data and information adopted here is collected by Qi Qiao from China Academy of Environmental Science under MEE in 2018.

12. Industrial-scale enterprises refer to those with an annual revenue of US$ 3 million or higher.

13. Industrial-scale enterprises refer to those with an annual revenue of US$ 3 million or higher.

14. Overlap may exist between the industry categories of "high-tech industries" and "emerging industries". The definition and detailed categories of latter can be found in *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*, pp.66-68, published in 2016. Available at: http://en.ndrc.gov.cn/newsrelease/

15. Majority of the data used in this assessment is obtained through: (1) field surveys and consultation meetings with selected park management. (2) the economic development (ED) indicator and employment and social security (SI) indicator of Suzhou Industrial Park are derived from the *Monthly Bulletin of Statistics of Suzhou Industrial Park* (2015-2016).

REFERENCE

China Huai'an Economic & Technological Development Zone (2017). *Report on the construction evaluation of huaian economic and technological development zone national eco-industrial demonstration zone in 2016.* 2017. 2 November. http://www.hadz.gov.cn/col/875_726475/art/8714c2217a874babb365046fb637d707.html.

China Development Zone Network (2017). *Park surveying and mapping: intellectual planning management on the big data platform.* 2017. 16 October. http://www.sohu.com/a/198316663_740456

Mathews, JA & Tan, H 2016, 'Circular economy: Lessons from China' *Nature*, vol. 531, no. 7595, pp. 440-442. https://doi.org/10.1038/531440a

Ministry of Commerce (2016). *Main economic indicators of national economic and technological development zones in 2016.* 2017. 16 June. http://ezone.mofcom.gov.cn/article/n/201706/20170602594167.shtml.

Ministry of Commerce (2018). National economic and technological development zone and border economic cooperation zone. http://www.mofcom.gov.cn/xglj/kaifaqu.shtml. Accessed 10 April 2019.

Ministry of Ecology and Environment (2017). *Notice on publishing list of national eco-industrial demonstration parks*. 2017. 24 January. http://www.mee.gov.cn/gkml/hbb/bwj/201702/t20170206_395446.htm.

Ministry of Industry and Information Technology (2014). *Circular on the issuance of the pilot list of national low-carbon industrial parks (the first batch)*. 2014. 7 July. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057542/n3057544/c3865293/content.html.

Ministry of Industry and Information Technology (2017). *Notice on the publication of the first batch of green manufacturing demonstration lists in 2017*. 2017. 23 August. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057542/n3057545/c5777819/content.html

Ministry of Industry and Information Technology (2018a). *Notice on the publication of the second batch of green manufacturing demonstration lists.* 2018. 18 January. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057542/n5920352/c6018056/content.html.

Ministry of Industry and Information Technology (2018b). *Notice on publishing the third batch of green manufacturing lists.* 2018. 29 October. http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057542/n5920352/c6470916/content.html.

Ministry of Science and Technology (2018). High-tech industrial development zones. http://www.most.gov.cn/gxjscykfq/. Accessed 10 April 2019.

National Bureau of Statistics (2018). *Announcement of the National Bureau of Statistics on the Final Verification of Gross Domestic Product (GDP) in 2016*. 2018. 5 January. http://www.stats.gov.cn/tjsj/zxfb/201801/t20180105_1569933.html.

National Development and Reform Commission (2016). *The 13th FYP for Economic and Social Development of the People's Republic of China*. Beijng. http://en.ndrc.gov.cn/newsrelease/201612/P020161207645765233498.pdf

National Development and Reform Commission (2017). *Announcement of the National Development and Reform Commission and Ministry of Finance on the Acceptance and Acceptance Results of the Recycling Reform of the Park and the "Urban Mineral" Demonstration Base in 2017*. 2017. 2 June. http://www.ndrc.gov.cn/gzdt/201706/t20170602_849890.html.

National Development and Reform Commission (2018). *Announcement of the National Development Zones* 2018. 26 February. http://www.ndrc.gov.cn/gzdt/201803/t20180302_878800.html.

PAGE (2018). Green industrial policy trilogy. https://www.un-page.org/greenindustrialpolicy. Accessed XX XX 2018.

Provincial People's Government of Jiangsu (2018). *Jiangsu's national-level HTZS achieved all-round progress in the national evaluation and ranking.* 2018.18 January. http://www.jiangsu.gov.cn/art/2018/1/18/art_48870_7413663.html.

Ren, H., Zhen, J., Ye, J., Zhong, D., Liu, B., Qu, Y. et al. (2017). *Blue Book on Continuous Development of Industrial Parks in China*. Shanghai: Tongji University Press.

Statistics Bureau of Jiangsu Province (2017). *Statistical Bulletin on National Economic and Social Development of Jiangsu Province* 2018. 22 February. http://tj.jiangsu.gov.cn/art/2018/2/22/art_4031_7491654.html.

Xinhua Net (2017). *The gross domestic product of 46 national high-tech zones accounted for 11.8% of the national GDP in 2016*. 2017. 20 September. http://www.xinhuanet.com//2017-09/20/c_1121697360.htm.

PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

The Partnership for Action on Green Economy (PAGE) was launched in 2013 as a response to the call to action following the Rio +20 Sustainable Development Conference. PAGE brings together the expertise, convening power and networks of five UN agencies – UN Environment, International Labour Organization, UN Development Programme, UN Industrial Development Organization, and UN Institute for Training and Research – to support countries in addressing one of the most pressing challenges of the 21st century: transforming their economies and financial system into drivers of sustainability and social equity.

PAGE seeks to put sustainability at the heart of economic policies and practices to advance the 2030 Agenda for Sustainable Development and supports nations and regions in reframing economic policies and practices around sustainability to foster economic growth, create income and jobs, reduce poverty and inequality, and strengthen the ecological foundations of their economies. As of 2018, PAGE provides technical and financial assistance in 18 countries.

In 2015, the Chinese Government expressed its interest to join PAGE, starting at the provincial level in Jiangsu. Designated by the Ministry of Ecology and Environment, the Policy and Research Center for Environment and Economy (PRCEE) started working with PAGE to promote knowledge and best practices to support the transition to a green economy in Jiangsu. Following a Jiangsu Green Economy Stocktaking report in 2016, the second phase of PAGE China was launched in 2017 with a focus on the green transformation of industrial parks in Jiangsu. This report is part of the project output.

The report assesses the green transformation of Jiangsu industrial parks based on three representative cases, identifies the remaining problems and challenges, summarizes good practices, and proposes recommendations for furthering the green transformation in the Jiangsu Province and beyond.

For More Information:

PAGE Secretariat
UN Environment
Resources and Market Branch
11-13 Chemin des Anémones
CH-1219 Chatelaine-Geneva
Switzerland
page@un.org

www.un-page.org

twitter.com/PAGEXchange

facebook.com/greeneconomyunep

Job No: DTI/2240/GE