# China's Industrialization path under ecological civilization strategy

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**Abstract:** Due to the intensifying conflict between resources, the environment, and industrialization, China must pursue a new industrialization path guided by the goal of building an ecological civilization. The strategy of ecological civilization imposes higher demands on new industrialization, calling for an increase in resource and environmental output levels, an enhancement of resource and environmental carrying capacity, and the promotion of coordinated development between resources and the environment. China should draw lessons from and learn the resource and environmental management experiences and technologies of post-industrialized regions and countries. It should vigorously advance scientific and technological progress to improve economic efficiency, reduce the negative environmental impacts of industrialization, and vigorously develop a green economy, circular economy, and low-carbon economy.

**Keywords:** ecological civilization, industrialization process, resource and environmental issues, new industrialization path

## 1. Introduction

Industrialization is a fundamental pathway for most nations and regions to achieve prosperity and strength. Its essence lies in the large-scale, rapid demand for resources and energy, coupled with an increasingly significant impact on the ecological environment. The process of industrialization is also one of technological advancement and improvement in ecological efficiency. How to navigate a path where industrialization, the progress of people's living standards, and friendly development with resources and the environment are coordinated is a policy and strategic choice for the vast majority of countries during their industrialization. This paper will first discuss the resource and environmental issues in the industrialization process, to clarify the current state of resources and the environment and their mechanisms of action during industrialization. On this basis, it will summarize and outline the key points of the new industrialization path under the ecological civilization strategy.

## 2. Resource and environmental issues in China's industrialization process

China's industrialization path, sustained for over 30 years with an average annual economic growth rate of around 10%, has seen the implementation of a series of measures in the exploration of coordinated development between resources, the environment, and industrialization. However, resource and environmental problems persist, primarily encompassing resource security, ecological and environmental health, and resource productivity.

### 2.1. The growing risk of resource security to economic and national security

Resource security is the material foundation for human survival and sustainable development, as well as the basis for China's economic and national defense security. China is currently in a period of accelerated industrialization and urbanization. Resource security issues are particularly prominent, including a low level of cultivated land security, water shortages, and high external dependence on energy and other mineral resources.

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China's cultivated land security is at a low level, with the scale of land used for industrialization expanding rapidly (as shown in Figures 1 and 2). Being in a stage of rapid industrialization, the continuous expansion of construction land poses a threat to cultivated and forest land security. As demands for food and ecology increase, and the state places greater emphasis on the red line for cultivated land and environmental quality, the occupation of cultivated and forest land by construction land has been somewhat mitigated, yet the pressure to protect cultivated land remains substantial. Many provinces in China face water shortage problems (Table 1). Water scarcity is not only a result of natural resource endowment but also stems from the increasing demand for water due to industrialization and the rising demand for domestic water as living standards improve.

China's demand for various mineral resources, including energy, iron ore, manganese ore, and copper ore, has exceeded domestic supply, leading to a high degree of external dependency. Energy, a critical factor supporting China's economic development, has become a major source of threat to both economic and national defense security due to its shortage. Among the 45 major proven mineral resources, only 5 were able to meet domestic demand in 2020. By 2030, with the exception of coal resources, the supply capacity of other mineral resources and energy sources, such as iron ore, copper, aluminum, oil, and gas, will face significant challenges. Rapid industrialization has driven substantial economic growth but has also widened the supply-demand gap for energy, iron ore, manganese ore, copper ore, and other mineral resources. China's proven reserves of petroleum, iron ore, manganese ore, copper ore, and other resources are critically insufficient, creating a severe supply-demand imbalance. Moreover, compared to Western nations, China's industrial technology exhibits weaker originality and higher transferability, failing to align with the country's resource endowment structure. This misalignment further exacerbates the supply constraints on energy and resources necessary for industrial development.

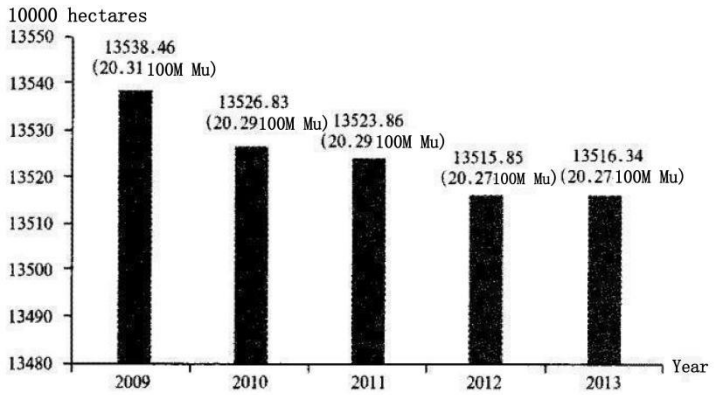


Figure 1. Trend of Changes in China's Cultivated Land Area (2009-2013)

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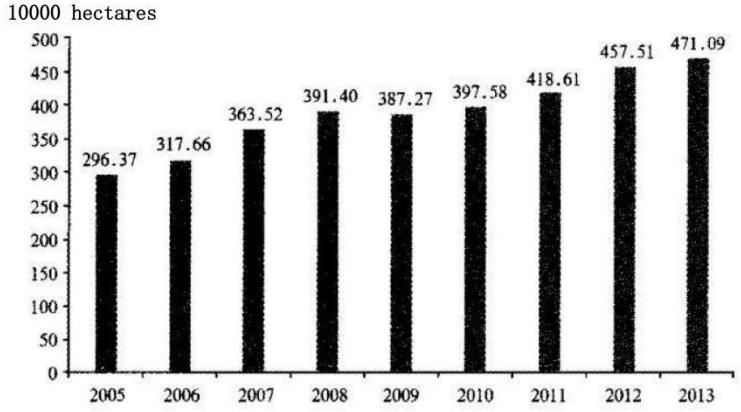


Figure 2. Trend of Changes in China's Construction Land Area (2005-2013)

Table 1. Water Scarcity Classification by Province in 2013

| Water Scarcity Level | Region |
|---|---|
| Extremely Water-Scarce | Jiangsu, Shanxi, Shandong, Hebei, Henan, Ningxia Hui Autonomous Region, Beijing, Shanghai, Tianjin |
| Severely Water-Scarce | Anhui, Shaanxi |
| Moderately Water-Scarce | Zhejiang, Chongqing, Hubei, Liaoning, Gansu |
| Slightly Water-Scarce | Hunan Province, Jilin Province, Guizhou Province, Guangdong Province |
| Not Water-Scarce | Tibet Autonomous Region, Qinghai Province, Hainan Province, Guangxi Zhuang Autonomous Region, Xinjiang Uygur Autonomous Region, Inner Mongolia Autonomous Region, Heilongjiang Province, Yunnan Province, Jiangxi Province, Fujian Province, Sichuan Province |

### 2.2. Ecological deterioration threatens socio- economic sustainability

The deterioration of the ecological environment has created substantial pressure on the sustainable development of the society and economy, which is specifically manifested in the following two aspects: First, ecological degradation has led to the mutation or even extinction of animal and plant species. Currently, due to climate change, environmental pollution, excessive hunting and fishing, and deforestation, mutations or extinctions of flora and fauna are occurring, such as three-legged frogs, fish poisoned by industrial waste, animals suffocating on plastic bags, and changes in animal sex ratios. Second, the deterioration of the ecological environment poses a threat to human health. Breathing fresh air, drinking safe water, eating secure food, and being free from viral infections are fundamental conditions for human health. The poor environment resulting from ecological damage is detrimental to human survival. The level of ecological and environmental health is influenced by factors such as capacity for investment attraction, technological level, and end-of-pipe treatment. However, core technologies and high-value-added segments of the industrial chain are largely held by industrial powers like the US, Europe, and Japan. This situation has resulted in China's industrialization exerting a significant impact on the ecological environment, thereby generating pressure on the sustainable development of the society and economy.

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### 2.3. The intensified negative environmental impact of energy utilization

The utilization of high-carbon energy has led to severe environmental problems. In 2006, China's total $CO_2$ emissions surpassed those of the United States, ranking first in the world and accounting for 22% of global emissions. This is closely related to China's long-standing extensive economic growth model and its coal-dominated energy consumption structure, while the inverted U-shaped curve of energy utilization is also associated with China's energy policies. This has also resulted in the continuous amplification of the adverse environmental impacts of energy use.

The negative impact of energy utilization on the atmospheric environment continues to intensify. Future industrialization and urbanization will still be accompanied by substantial coal consumption. Coal burning has become the most significant source of greenhouse gases and various environmental pollutants (such as sulfur dioxide and soot) in China. The coal-dominated energy structure has greatly exacerbated energy-related environmental pressures. The "energy trap" has created immense pressure on the ecological environment. In pursuit of quick and high profits, some scholars or enterprises support obtaining short-term gains from low-cost energy. Such behavior easily leads us into a long-term energy trap. For example, Shanxi Province is a typical region in China where excessive resource extraction has led to a decline in manufacturing and institutional weakening, with the energy trap constraining economic growth. The situation regarding pollution from residential energy use is worsening. The advancement of industrialization and urbanization has fundamentally changed people's living standards, shifting from pursuing basic sustenance to seeking comfort. More urban residents and even farmers are consuming private cars, taking taxis, etc., leading to a significant increase in emissions from residential energy pollutants.

### 2.4. Resource and environmental productivity lags behind developed countries

China's resource productivity shows a certain gap compared to the world average and lags far behind that of developed countries. In terms of China's water resource productivity, in 2013, it was 545,000 yuan of GDP per cubic meter, less than one-fifth of the world average, indicating a significant disparity compared to the average water productivity of developed countries (Figure 3). In China, each kilogram of oil equivalent generated 4.9 US dollars of GDP, whereas Denmark reached 14.3 US dollars per kilogram of oil equivalent in 2012, and Italy reached 13.4 US dollars. Focusing goals and attention on improving resource and environmental productivity is conducive to narrowing the gap between China and developed countries in terms of per-unit energy and resource output.

## 3. New industrialization under ecological civilization strategy

The new industrialization is a scientific path. Since 2002, China has made significant progress in areas such as environmental quality and human resource utilization, centered around new industrialization, the construction of a "Two-Oriented Society" (resource-saving and environment-friendly), and the building of an ecological civilization. Following the previous extensive traditional industrialization path, the existing resources and environment can no longer support the rapid advancement of China's industrialization and urbanization. It is imperative to chart a course for the coordinated development of new industrialization and ecological civilization. Guiding the advancement of the new industrialization path with the concept of ecological civilization, and enhancing the level and quality of ecological civilization construction through new industrialization, is the essential path for sustainable economic and social development under the new normal. Currently, following the new industrialization path under the strategy of ecological civilization should be carried out from the following five aspects.

### 3.1. Learn from post-industrialized countries' resource and environmental management

Learn from foreign ecological civilization systems and strengthen institutional innovation. A well-established resource and environmental management system is conducive to implementing the new industrialization strategy. China can draw lessons from foreign ecological civilization standards to expedite the revision of standards related to energy consumption, water usage, and environmental quality. For instance, establish a decreasing index system for energy and mineral consumption; enhance and refine construction standards for buildings, roads, and transportation, promoting the institutional development of ecological civilization through ecological consumption; formulate systems for the healthy development of

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emerging and manufacturing industries, prohibit the transfer of outdated production capacity to the central and western regions, and advocate for the relocation of high-pollution, high-consumption industries abroad; establish an environmental inspection mechanism, strictly implement reward and punishment mechanisms for ecological civilization, implement differentiated assessment systems for key functional zones such as restricted development zones, prohibited development zones, and ecologically fragile areas, and commend and reward regions, units, and individuals that achieve outstanding results in ecological civilization construction.

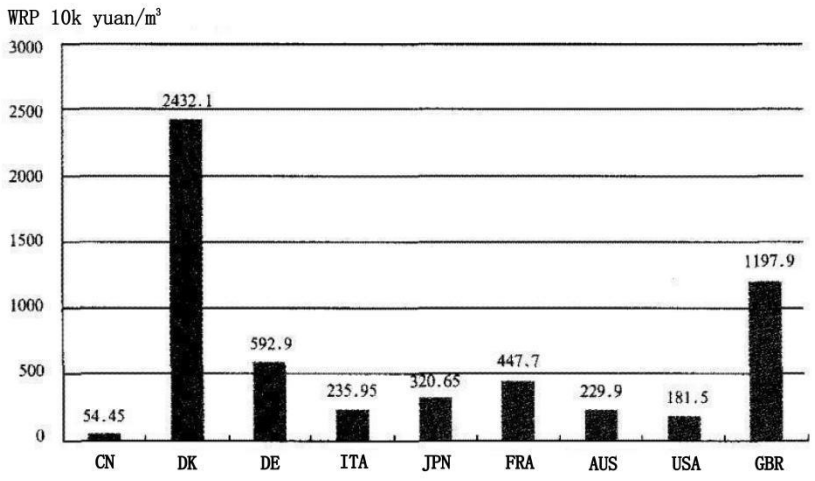


Figure 3. Comparison of Water Resource Productivity between China and Selected Developed Countries in 2013

Learn from advanced foreign technologies and vigorously promote China's scientific and technological progress. In conjunction with deepening reforms of the science and technology system, establish management systems and operational mechanisms in areas such as "government-application-industry-academia-research" that align with the characteristics of ecological civilization construction. Strengthen research and exploration of key scientific and technological issues, including the development of new energy sources and ecological environment restoration, striving to achieve breakthroughs in fundamental research and frontier technology R&D. Promote the large-scale application of advanced technologies such as green buildings, green transportation, and natural gas fuels to rapidly enhance economic efficiency.

### 3.2. Advance technology to boost efficiency and resource output

At the national level, formulate and improve relevant laws and regulations to restrict the scope and technology of resource and energy utilization, thereby enhancing resource use efficiency. Across the nation, vigorously promote energy-saving and environmentally friendly technologies, mandate the use of desulfurization technologies in high-pollution industries, and implement certain reward and punishment measures for enterprises. By limiting the scope and technology of resource and energy utilization, improve resource use efficiency.

At the industrial level, phase out outdated production capacity and enhance industrial economic efficiency. Accelerate the elimination of outdated production capacity, gradually raise elimination standards, and prohibit the transfer of outdated capacity in industries such as electricity, coal, steel, cement, and non-ferrous metals to the central and western regions. While phasing out outdated capacity, proper arrangements must be made for employees of related enterprises, with a focus on the upgrading and transformation of businesses.

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At the enterprise level, strengthen technological transformation and management innovation. Continuously reinforce the primary role of enterprises in technological innovation, establish mechanisms for investment in technological innovation, and set up R&D institutions with national and international influence, such as national key laboratories and national engineering research centers. Continuously advance the industrialization of major scientific and technological achievements in new technologies, new materials, and new processes. Strengthen the development of innovative talent teams within enterprises through initiatives like the overseas high-level talent recruitment program and innovation talent programs.

### 3.3. Promote green growth for sustainable resource and environmental harmony

Vigorously develop green industries to accelerate the formation of a green economy. On one hand, traditional industries should be transformed and upgraded to achieve greening and ecologicalization. Examples include the application of new materials and the development of green transportation characterized by low-carbon development, which are manifestations of enhancing traditional industries, and China should strongly promote these efforts. On the other hand, China should develop industries that have minimal environmental impact or contribute to environmental improvement, such as eco-tourism and eco-agriculture. Optimize the industrial structure and let the market play a decisive role in guiding the direction of green industry development. Increase technological investment and supporting infrastructure construction in seven emerging strategic industries, including energy conservation and environmental protection, new-generation information technology, and biotechnology.

Accelerate the establishment of a circular economy system for industry, agriculture, and services to promote the development of a circular economy. Leverage the synergistic effects of energy conservation and emission reduction. Deepen energy conservation and emission reduction across society by implementing key industrial energy efficiency improvement plans and promoting energy-saving and new-energy transportation equipment. Establish a circular economy system in the industrial, agricultural, and service sectors respectively. Encourage the recycling and utilization of renewable resources, promote effective linkage between production and living, and realize a circular economy at all stages of production, distribution, and consumption. In the industrial sector, guide key industries such as metallurgy, machinery, and petroleum to conduct clean production audits, enhance clean production technology, and implement energy cascade utilization. In the agricultural sector, reduce the use of fertilizers that heavily pollute water and soil, implement cleaner production processes, intensify efforts to improve the rural ecological environment, and increase overall agricultural efficiency. In the service sector, promote the "Clean Plate" campaign in the catering industry and avoid the phenomenon of "ghost cities" in the real estate sector.

Implement key industrial energy efficiency improvement plans to achieve a low-carbon economy as soon as possible. The key to addressing carbon emissions lies in properly managing energy utilization. Strictly limit the expansion of high-energy-consumption industries such as chemical raw material manufacturing and non-metallic mineral products. Accelerate the advancement of ten major energy-saving projects, including the renovation of coal-fired industrial boilers, building energy efficiency projects, and green lighting projects, to materialize low-carbon actions.

Strengthen the statistical monitoring of resource and environmental utilization and enhance law enforcement supervision. Utilize advanced technological means such as satellite remote sensing to accelerate the development of statistical monitoring and accounting capabilities for resources and the environment. During law enforcement, adopt a "zero tolerance" approach towards all types of illegal activities involving resource and environmental utilization, and impose severe penalties on those who illegally use resources and harm the environment.

## 4. Conclusion

In summary, both the new industrialization path and the construction of an ecological civilization are inevitable choices for China to pursue sustained, healthy, and coordinated economic development, and to promote the harmonious coexistence between humanity and nature, under the increasing constraints of resources and the environment. The ecological civilization strategy imposes higher demands on new industrialization, calling for an increase in resource and environmental output levels, an enhancement of resource and environmental carrying capacity, and the promotion of coordinated development between

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resources and the environment. Therefore, China should learn from and draw upon the resource and environmental management experiences and technologies of post-industrialized countries and regions; vigorously advance scientific and technological progress to improve economic efficiency; reduce the negative environmental impacts of industrialization; and vigorously develop a green economy, circular economy, and low-carbon economy.

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