

# Paving the Ecological Foundation of New Industrialization with Green and Low-Carbon Development

Dongyan Ma, Hongbo Zhang, Lijuan Shi, Qi Meng, Yongrui Su, Jueyu Zhao \*

China Industrial Control Systems Cyber Emergency Response Team, Beijing, China

**Abstract.** Since its inception, the new industrialization has incorporated green and low-carbon into its characteristics. Against the backdrop of the interweaving of global economic development and environmental protection, green development is an inevitable choice for China to break through resource and environmental constraints and promote the development of new industrialization. This article first analyzes the connotation and characteristics of new industrialization and green low-carbon, and then introduces the practical experience of green development in the European Union, the United States, and China. The European Union focuses on transforming energy structure and promoting innovation in green technologies, the United States focuses on supporting green low-carbon development through legislation and building market mechanisms, while China actively explores from top to bottom through policy guidance, industrial transformation, and energy system optimization. Based on domestic and foreign experiences, this article proposes to strengthen the division of responsibilities, improve supply levels, optimize energy structure, and other aspects to cultivate a green background for new industrialization.

**Keywords:** The new industrialization, green development, low-carbon, domestic and foreign experiences.

## 1. Introduction

The concept of new industrialization has incorporated green and low-carbon characteristics since its inception. The 16th National Congress of the Communist Party of China in 2002 first proposed "new industrialization," explicitly stating the need to "persist in driving industrialization through informatization, promote informatization through industrialization, and forge a path of new industrialization characterized by high technological content, good economic benefits, low resource consumption, minimal environmental pollution, and fully leveraged human resources." Subsequently, the 17th, 18th, 19th, and 20th National Congresses reiterated the emphasis on new industrialization. China's commitment to promoting new industrialization must unwaveringly follow a green and low-carbon development path, which is not only essential for addressing global climate change but also an intrinsic requirement for achieving high-quality economic development. In the context of the new trends in global economic and social development, green and low-carbon development is not only an inevitable choice for environmental protection but also an essential option for advancing new industrialization.

## 2. The Intrinsic Requirements of New Industrialization

Currently, the wave of the global new industrial revolution is accelerating, with technological advancements, particularly in digital technologies, profoundly and disruptively impacting traditional industries, economic rules, and division of labor patterns. Meanwhile, there is a global consensus on emission reduction, which not only forms the basic constraints of the industrialization process but also generates a massive demand for green development. Compared to some developed countries, China starts from a relatively lower development level on the road to digital and green transformation. Only by firmly pursuing the path of new industrialization can we effectively respond to successive challenges and seize unprecedented strategic opportunities.

Digital technology empowerment is the intrinsic driving force of new industrialization. In the wave of the new industrial revolution, the rapid advancement of science and technology is driving profound changes in the techno-economic paradigm. Numerous disruptive innovations are emerging in the

digital field, giving rise to new industries and business models and nurturing new production factors, thereby reshaping the form of production organization. An important manifestation of new industrialization is the change in production functions, with digital elements increasingly replacing labor, impacting the comparative advantage of labor, and weakening the position of developing countries in the global industrial chain. This also affects China's competitiveness in labor-intensive industries and related segments. The core of new industrialization lies in leveraging advanced production factors such as knowledge, technology, human capital, and data to reconstruct and enhance China's competitiveness. Simultaneously, digital technology has become a key lever to elevate technological levels and control over global value chains. To play the role of a significant participant and leader in the new industrial revolution, China must advance new industrialization by deepening the integration of digital technology with manufacturing and other real economies, achieving digital and real economic integration across all industrial fields, value chains, product life cycles, supply chains, and commercial ecosystems.

Green and low-carbon development is an inevitable choice for new industrialization. Achieving the grand goals of carbon peaking and carbon neutrality is not only China's firm commitment to the international community but also a profound systemic transformation of the economy and society. Facing the incremental greenhouse gas emissions brought by the industrialization process, China, along with other countries, shoulders the responsibility of emission reduction. The Paris Agreement urges countries to set clear timelines for carbon peaking and neutrality, to which China has responded positively by establishing the "dual carbon" strategic goals. Essentially, new industrialization is an industrialization process promoted on a low-carbon development trajectory. It presents new challenges and constraints, but also new development opportunities and competitive fields. Technological innovation, product upgrading, service optimization, and industrial transformation that can meet these new challenges will become powerful growth engines in the process of new industrialization. The development and utilization of new energy, breakthroughs in carbon capture technology, and the enhancement of ecological restoration capabilities will become key areas of competition among major countries. To shift China's industrial competitiveness from demographic dividends to green and low-carbon advantages, it is necessary not only to promote low-carbon transformation within the industry but also to use the opportunity of new industrialization to build a world-leading green industry system. This will lay a solid material foundation for the green and low-carbon transformation of the entire economy and society and provide ample low-carbon technologies, products, and services to achieve the "dual carbon" goals.

An effective market and proactive government are essential guarantees for new industrialization. The report of the 20th National Congress of the Communist Party of China points out, "We should give full play to the decisive role of the market in resource allocation and better play the role of the government," establishing the basic positioning of the relationship between the market and the government. Achieving the positive interaction between an effective market and a proactive government is a theoretical and practical issue that needs to be addressed in the process of promoting new industrialization. As the industrialization process deepens, the potential risk to high-quality development lies in the lag of economic system reform, which may struggle to keep pace with the rapid advancement of industrialization. Overcoming this obstacle hinges on optimizing the dynamic relationship between the government and the market. Market mechanisms play a crucial regulatory role at the micro level; however, at the macro and meso levels, government guidance and regulation are equally indispensable. Furthermore, with the rapid development of digital technologies, the market environment is becoming increasingly complex and volatile, with significant enhancements in uncertainty and interaction, posing higher demands on the quality and efficiency of government services. Promoting the organic combination of an effective market and a proactive government is a fundamental cornerstone for ensuring the smooth advancement of new industrialization.

### **3. Domestic and International Experiences in Promoting Green and Low-Carbon Development**

#### **3.1. International Models of Green and Low-Carbon Development**

##### **3.1.1. European Practices in Green and Low-Carbon Development**

Europe embarked on the path of green and low-carbon development in the 1960s, driven by environmental protection movements. Initially advocated by environmental professionals, these movements gradually garnered public support, ultimately forming a societal consensus that laid the foundation for Europe's sustainable development. As a pioneer in green development, Europe has accumulated rich experience in environmental governance.

In terms of top-level deployment, Europe employs various means such as policy formulation, evaluation, legal constraints, and more to establish a coherent policy transmission system from the top down. Since the implementation of the Kyoto Protocol, the EU and its major member states have progressively refined domestic regulations, integrating them into the EU's low-carbon policy framework. This has created a policy transmission mechanism from the EU to national and local levels and clarified the division of labor among departments. A dynamic execution mechanism encompassing execution, evaluation, supervision, feedback, and revision has been established. Europe also uses diverse policy tools to ensure a complete implementation cycle. For example, Sweden has developed tools such as Environmental Load Profile (ELP), Environmental Systems Analysis (ESA), and Life Cycle Assessment (LCA) to ensure the fairness and precision of various low-carbon incentive policies. The EU has implemented strict energy efficiency standards like the Fuel Quality Directive, Automobile Emissions Regulations, and Building Energy Efficiency Directive, promoting low-carbon development in major energy-consuming sectors.

In energy transition, Europe has supported renewable energy sources like solar, biofuel, wind, and nuclear energy since the 1980s. The proportion of renewable energy in total energy consumption increased from 9.02% in 2005 to 21.8% in 2021, with a target of 45% by 2030 set by the Renewable Energy Directive Amendment passed in October 2023. Germany, the UK, and Denmark have established wind farms in the North Sea, achieving local manufacturing of offshore wind equipment. France's Areva has integrated carbon capture and storage technology to develop low-carbon nuclear reactors. Additionally, the EU's research framework program has funded new-generation high-efficiency solar cell technologies, achieving a photovoltaic conversion efficiency of over 28%. In 2014, the Netherlands built the world's first solar-powered bike path, and in 2016, France created the first solar highway, pioneering new ways of using sustainable energy.

In industry, Europe promotes technology iteration and upgrades, aiming for deep integration of renewable energy and industrial technology to form a "zero-carbon" green industrial chain. Germany, leveraging its industrial and automotive strengths, is developing hydrogen energy transport tools and new energy vehicles while applying low-carbon technologies in steel, chemical, and machinery manufacturing to achieve green development. France focuses on the hydrogen energy industry chain, with Air Liquide leading in hydrogen production and storage, and companies like EDF and Engie prominent in hydrogen supply. Equipment manufacturers like McPhy are leaders in hydrogen production and distribution equipment. Airbus aims to launch zero-emission hydrogen-powered aircraft by 2035, and SNCF is developing hydrogen trains, while brands like Renault and Peugeot have introduced hydrogen vehicles.

##### **3.1.2. American Practices in Green and Low-Carbon Development**

Though the U.S. industrialized later than European nations, it quickly rose to a global economic and political power during the Second Industrial Revolution. However, this rapid expansion led to severe environmental issues by the 1970s. Starting in 1970, the U.S. government began addressing these problems through various measures to promote green and low-carbon development.

At the top level, the U.S. has passed numerous energy and emissions-related laws, gradually building a comprehensive carbon reduction policy framework. Under the Obama administration,

significant emphasis was placed on low-carbon development. The 2009 Clean Energy and Security Act outlined pathways to improve energy efficiency and established mechanisms for carbon trading and renewable energy promotion. The 2014 Clean Power Plan set a goal to reduce power plant CO<sub>2</sub> emissions by at least 30% from 2005 levels by 2030. In 2015, the U.S. committed to a 26%-28% reduction in greenhouse gas emissions by 2025 compared to 2005 levels. Despite withdrawing from the Paris Agreement in 2017, the Biden administration rejoined in 2021 and implemented measures to advance carbon neutrality.

In optimizing energy structures, the U.S. has improved its energy consumption mix and promoted renewable energy through institutional adjustments. The Department of Energy established the Office of Energy Efficiency and Renewable Energy to guide communities, governments, and businesses in adopting renewable energy. The Environmental Protection Agency leads the Green Power Partnership, with over 1300 entities voluntarily using billions of kilowatt-hours of green power annually. Federal agencies collaborate on the E3 (Energy, Economy, and Environment) program to enhance competitiveness, increase profits, and reduce energy consumption. Advances in nuclear and clean energy, like corn ethanol and biodiesel, have diversified energy supplies. In 2010, renewable energy accounted for 8.2% of total energy consumption, rising to 21% in 2022.

In industry, the U.S. promotes voluntary emission reductions by companies, encouraging R&D and restructuring. The USCAR collaborates on vehicle electrification and other technologies, and the American Chemistry Council supports energy efficiency and innovative climate solutions. Companies like Steel Dynamics and Apple finance green projects, reducing the share of high-energy, high-emission industries and developing high-value, low-consumption sectors like automotive and biotechnology.

### **3.2. Domestic Green and Low-Carbon Development Practices**

Since the 18th National Congress, under Xi Jinping's guidance, China has firmly pursued ecological priority and green development, achieving significant progress in ecological civilization and green development.

At the top level, China has issued several policy documents to guide industrial green and low-carbon transformation, such as the "Industrial Green Development Plan (2016-2020)" and "Green Manufacturing Engineering Implementation Guide (2016-2020)." In September 2020, President Xi announced China's goals to peak carbon emissions by 2030 and achieve carbon neutrality by 2060, which have been integrated into the 14th Five-Year Plan. The "1+N" policy system includes the "Opinions on Complete, Accurate, and Comprehensive Implementation of the New Development Concept for Carbon Peaking and Carbon Neutrality," "Action Plan for Carbon Peaking Before 2030," and sector-specific plans, supported by financial, pricing, tax, land, and government procurement measures. The State Council and various departments have issued policies to accelerate the green and low-carbon circular economy and the carbon peaking implementation plan for key industries.

In energy structure optimization, China aims to improve industrial energy efficiency and optimize energy consumption. Policies like the "Industrial Energy Efficiency Improvement Action Plan" and various efficiency enhancement programs promote high-efficiency energy-using equipment. Efforts to diversify energy consumption include green microgrids, distributed photovoltaics, and intelligent energy management systems. In 2023, green electricity transactions reached 31 billion kWh, doubling from the previous year. The application of electric boilers and other technologies in key industries is expanding. In 2023, China's new renewable energy capacity was 293 GW, with wind and photovoltaic power significantly contributing.

In industry, China focuses on increasing green low-carbon product supply, transitioning transport tools, and developing renewable energy equipment. Green design and sustainable materials are promoted, with over 20,000 green products and numerous green design demonstration enterprises established. The push for new energy vehicles and green ships and aircraft continues, with significant growth in electric vehicle ownership. The renewable energy equipment industry is expanding, with

thousands of green factories contributing to a substantial portion of manufacturing output and the environmental equipment manufacturing industry expected to reach significant output value.

### **3.3. Comparative Analysis of Domestic and International Practices**

Both Europe, the U.S., and China emphasize green and low-carbon development, showing significant progress in policy, industrial adjustment, and energy transition. However, their focuses and paths vary. Europe prioritizes energy structure conversion and green technology innovation through regulations and international cooperation. The U.S. relies on legislation and market mechanisms to support green development, promoting clean energy and energy management policies. China employs top-down policy guidance, industrial transformation, and energy system optimization, exploring paths for green and low-carbon development.

## **4. Green and Low-Carbon Development Strategies in the New Industrialization Process**

As China advances towards carbon peaking and neutrality and modern industrialization, industrial green and low-carbon development is crucial. This is essential for overcoming resource and environmental constraints and aligning with technological progress. Key strategies include strengthening responsibility division, improving industrial structures, and optimizing energy structures.

**Strengthen Responsibility Division and Promote Coordinated Development.** Governments should implement policy plans, improve laws and regulations, and integrate tasks and goals into medium and long-term plans. Companies should actively participate, with leading enterprises driving upstream and downstream supply chains to reduce carbon emissions. Encouraging SMEs to follow suit is vital for broadening green development pathways and accumulating valuable low-carbon transition experiences.

**Enhance Supply Levels and Promote Low-Carbon Applications.** Accelerating the promotion of green technologies and tapping into existing energy-saving potential is crucial. Coordinating resources to tackle key technologies in green industries and expanding the supply of green products are essential. Developing comprehensive green manufacturing solutions can foster a new model of green manufacturing and service integration.

**Optimize Production Structure and Promote Industrial Green Development.** Traditional manufacturing sectors should explore new technologies and industries, eliminate outdated capacities, and prevent unchecked development of high-energy, high-emission projects. Improving management systems and refining management directories for high-energy projects can avoid blanket approaches to industrial management. Key industries should focus on energy-saving and emission-reducing innovations and promote green transformations across the entire production chain.

## **5. Conclusion**

Against the backdrop of intertwined global economic development and environmental protection, green development has become an inevitable choice to address resource and environmental constraints and promote high-quality economic development. It not only concerns the long-term layout of ecological civilization construction but also embodies a country's competitiveness. In recent years, China has vigorously promoted green development in the industrial sector, achieving certain results through policy guidance, technological innovation, and other means. However, compared with foreign development experiences, China still faces numerous challenges and issues.

In the next step, China will strengthen policy support and incentive mechanisms, improve the legal and regulatory system for green development, enhance enterprises' willingness and capability for green transformation, optimize industrial and energy structures, eliminate outdated production capacities, promote green and low-carbon production methods, and drive industries toward high-end,

intelligent, and green transformation. This aims to ensure that carbon emissions in the industrial sector peak before 2030.

## References

- [1] Yang Chengyu. Practice and Challenges of EU Green Development—Analysis from the Perspective of Carbon Neutrality. *German Studies*, 2021, 36(03): 79-97+154-155.
- [2] Chen Xin, Yang Chengyu. Motivation, Implementation Paths, and Prospects of European Energy Transition. *Eurasian Economy*, 2022(04): 55-74+126.
- [3] Li Qiang. EU Launches "Green Pact Industry Plan". *People's Daily*, 2023-02-07(017). DOI: 10.28655/n.cnki.nrmrb.2023.001200.
- [4] Lv Xiaobei, Chen Ting, Ding Jiefang. Enlightenment of Green and Low-Carbon Policy Mechanisms in European Countries on China. *Journal of Urban Planning*, 2022(S1): 272-278. DOI: 10.16361/j.upf.202207039.
- [5] Liu Xiaofang, Zhang Xiangqian. Implications of the US Green Economy for High-Quality Development of Shanghai's Green Economy. *Science and Technology and Industry*, 2022, 22(10): 301-306.
- [6] Mei Yuqian. Comparative Study on Clean Energy Transformation Paths between Germany and the United States under the Background of Global Energy Transition. East China Normal University, 2023. DOI: 10.27149/d.cnki.ghdsu.2023.002334.
- [7] Hong Qunlian. Research on Green and Low-Carbon Transformation of China's Industrial Chain Supply Chain. *Economic Observer*, 2023(09): 56-66. DOI: 10.16528/j.cnki.22-1054/f.202309056.
- [8] Wang Dawei, Meng Hao, Zeng Wen, et al. Study on Green Development Strategies of Europe, America, and Japan from the Perspective of "Dual Carbon". *Global Science and Technology Economy Outlook*, 2022, 37(05): 61-66+76.
- [9] Guiding Opinions on Accelerating the Transformation and Upgrading of Traditional Manufacturing Industry (MIIT Joint Regulations [2023] No. 258).
- [10] Comprehensive Promotion of Green Manufacturing, Accelerating Green and Low-Carbon Development of Industry — Series of Reviews on Promoting High-Quality Development of Industry and Informatization in 2024; *China Electronics News*. (<https://www.cena.com.cn/industrynews/20240116/122633.html>)
- [11] Li Jifeng, Chang Jiwen. Foundation, Paths, and Policies for Low-Carbon Transformation of China's Industry — Historical Review and Future Thinking. *Urban and Environmental Studies*, 2023(02): 56-71.