

# China's carbon neutrality faces the challenges of “three highs and one short”, and requires “five carbon implementations” to achieve dual carbon goals

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**D**ual carbon goals are closely related to high-quality green development. The government has required that dual carbon goals be included in ecological civilization construction's overall layout. Achieving carbon peak and carbon neutrality is a broad and profound systemic economic and social transformation. China is facing the “three highs and one short” challenges and requires the “five carbon implementations” to achieve dual carbon goals. The core of dual carbon goals is a new round of industrial competition, and the world is laying out dual carbon goals as the starting point and competing for a new round of technological high ground.

## 1 “Three highs and one short” challenges

**High-carbon energy structure.** In 2019, fossil energy accounted for 50% to 85% in the energy structure of major countries, and China accounted for about 85%. However, in Europe and the United States, coal accounts for only 3% to 17% of fossil energy, while in China, it is as high as 57%.

**High-carbon industrial structure.** The world recognizes the high-carbon and difficult-to-reduce industries, such as steel, petrochemicals, cement, etc., and the proportion of these industries in China's industrial structure is still relatively high.

**High energy consumption.** Thirdly, China is the world's largest developing country and is still in the process of medium-to-high-speed industrialization and urbanization. Many regions still need energy consumption increment.

**Short period for carbon neutrality.** Fourthly, from carbon peak to carbon neutrality, China has only a short period of thirty years, Europe has sixty to seventy years, and the United States has forty to fifty years.

## 2 Three major significances

**Climate commitment.** As of the end of last year, more than 130 countries in the world have proposed carbon neutrality targets, covering more than 70% of global GDP and more than 65% of carbon dioxide emissions.

**Industrial competition.** The world's economic development will shift from resource-dependent to technology-dependent. Under the condition of sufficient resource utilization, whoever has better technology and can use it economically and effectively will succeed. Nowadays, the world is laying out with “dual carbon” as the starting point and competing for a new round of technological high ground. The signal of industrial competition is apparent.

**Ecological civilization.** Promoting the dual carbon goals will

make a significant adjustment to the energy and transportation industries, which can fundamentally solve atmospheric pollution problems such as PM<sub>2.5</sub> and ozone pollution. In China, carbon neutrality is closely related to high-quality green development, and the central government has required that “dual carbon” be included in the overall layout of ecological civilization construction.

## 3 “Five carbon implementations”

**Reduce carbon by energy conservation and efficiency improvement.** Firstly, resource efficiency and carbon reduction through energy conservation and efficiency improvement. Emphasis is placed on the core of the entire life cycle of material circulation and the practice of comprehensive management thinking, with “zero waste” construction being vital and sustainable.

**Reduce carbon by energy structure transition.** Research and development of renewable energy generation technology, energy storage technology, etc., significantly increase the proportion of non-fossil energy use and establish a new power system mainly based on renewable energy as early as possible.

**Storage carbon in geological spaces.** Solve some of the carbon dioxides through carbon capture, utilization, and storage (CCUS) technology.

**Sequester carbon in ecosystems.** Consolidate and increase the carbon sink capacity of carbon dioxide through ecological construction means such as reducing emissions and increasing absorption in agriculture and forestry, ecological engineering, and biological carbon capture, storage, and utilization.

**Trade carbon in the market.** Promote the more rational and effective application of various technologies through carbon market mechanisms.

## 4 Three global concerns

**Key-core technological innovation.** The demand for technological innovation is particularly urgent to move towards a technology-dependent economic development model, but the technology gap is still relatively large. The International Energy Agency's (IEA) latest report in 2021 shows that 50% of the key technologies for achieving net-zero emissions in the global energy industry by 2050 are immature and need further research and development. Much future energy supply and energy-saving and emission-reducing technologies require continuous improvement, and they also need to be closely integrated with information technology (such as artificial intelligence, the Internet, and communication technology) to form an integrated system to solve relevant issues.

**New energy industry supply chain–key materials.** From the perspective of the industrial chain, the materials used to manufacture photovoltaic cells include key rare elements such as indium and tellurium. With the rapid expansion of installation scale in the future, the cumulative demand for these scarce elements will increase significantly, and their value will continue to rise.

**Support system for dual carbon goals.** Global major economies such as Europe, the United States, and Japan have formulated carbon neutrality strategies and paths, and global climate investment and financing have grown rapidly. China has also established a “1+N” policy system and has established the “four pillars and eight beams” to implement the “dual-carbon” goal.

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### **Declaration of competing interest**

The author has no competing interests to declare that are relevant to the content of this article.