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Thinking on Strategic Research of Dual Carbon by High-end Sci-tech Think Tank

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Abstract

As the world's largest energy produce, consume, and carbon emission country, China's road map, construction map, and timetable for achieving the dual carbon goal, i.e., peaking carbon emission and achieving carbon neutrality, have attracted worldwide attention, and to achieve such goal, China has to strategically transform its energy system. This energy strategic transformation process is essentially a process for China to build its strength in manufacture, in science and technology, and in a strong economy. High-end sci-tech think tank should take the dual carbon strategic research as an important task to play the role of gathering wisdom and offering advices, and to propose comprehensive, strategic, and forward-looking consulting reports and policy recommendations, with adhering to demand-oriented and problem-oriented, science-oriented and frontier-oriented, goal-oriented and policy-oriented, and focusing on the implementation of ten actions to peak carbon emission. In such way, high-end sci-tech think tank would elevate its decision-making influence, academic influence, public influence, and international influence.

Keywords

high-end sci-tech think tank; energy strategic transformation; achieve dual carbon goal; ten research issues

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Thinking on Strategic Research of Dual Carbon by High-end Sci-tech Think Tank

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Abstract: As China is the largest energy producer, consumer, and carbon emitter, its road map, construction map, and timetable for achieving the dual carbon goal (carbon peak and carbon neutrality) have attracted worldwide attention, and to achieve such goal, China has to strategically transform its energy system. This energy strategic transformation process is in essence to build China's strength in manufacturing, science and technology, and economy. High-end sci-tech think tanks should take the dual carbon strategic research as an important task to play the role of gathering wisdom and offering advice and to propose comprehensive, strategic, and forward-looking consulting reports and policy recommendations, while adhering to demand-oriented and problem-oriented, science-oriented and frontier-oriented, goal-oriented and policy-oriented, and focusing on the implementation of "Ten Actions for Carbon Dioxide Peaking." In such way, high-end sci-tech think tanks would elevate their decision-making influence, academic influence, public influence, and international influence.

Keywords: high-end sci-tech think tank; energy strategic transformation; achieve dual carbon goal; ten research issues

Energy is a core strategic resource for economic and social development, and every energy revolution is accompanied by science & technology revolution, industrial revolution, and great power competition. In today's world, significant and profound changes have taken place in international political and economic structures and global governance mechanisms under the influence of unprecedented global changes and once-in-a-century pandemic. China-US relations have been in a stage with great difficulty since the establishment of diplomatic relations between the two countries. A new round of science & technology revolution and industrial transformation has entered a logarithmic growth phase. The world's economic system and the division of global industries have undergone significant adjustment. The digital and green transformations of the economy and society have shown synergetic development across countries. In this global context, China has proposed to strive to achieve carbon peak by 2030 and carbon neutrality by 2060 (hereinafter referred to as the dual carbon target). This is a major strategic decision made by the Communist Party of China and the State based on the great rejuvenation of the Chinese nation and the construction of a community with a shared future. This decision shows the responsibilities and the strategic will of China to cope with global climate change and promote green and low-carbon development. General Secretary Xi Jinping emphasized that "achieving carbon peak and carbon neutrality is a broad and profound systematic transformation in economy and society," which fundamentally explains the essential requirements and far-reaching significance of the dual carbon strategy. In September 2021, the Central Committee of the Communist Party of China and the State Council issued the *Opinions on Complete, Accurate, and Comprehensive Implementation of the New Development Philosophy to Achieve Carbon Peak and Carbon Neutrality*. In October 2021, the State Council issued the *Action Plan for Carbon Dioxide Peaking Before 2030* and proposed the "Ten Actions for Carbon Dioxide Peaking." These strategic arrangements point to the direction for China to welcome green revolution, accelerate green development, build a green society, and move towards a green civilization.

As the world's largest energy producer, consumer, and carbon emitter, China has attracted worldwide attention by establishing the "road map," "construction map," and "timetable" to achieve dual carbon. Achieving dual carbon in China will be the largest and most extensive transition of energy strategy in the world. It is essentially a process for China to build its strength in manufacturing, science and technology, and economy. In the next 30 years, China will take a road that no other countries have traveled, facing numerous tough challenges and battles. High-end sci-tech think tanks should take the strategic research of dual carbon as an important task of gathering wisdom, perfecting advice, and providing consultation. The research should be demand- and problem-oriented, science- and frontier-oriented, and goal- and policy-oriented, focusing on the implementation of the "Ten Actions for Carbon Dioxide Peaking". The think tanks should provide global, strategic, and forward-looking consultancy reports and policy recommendations, and continuously enhance their influence on decision-making, academy, public, and the global community.

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1 Scientific layout of energy

We should thoroughly study the overall trend of profound changes in global energy strategy and energy production/consumption structure, analyze China's layout of clean, low-carbon, safe, and efficient energy system to achieve the goal of dual carbon, and support the effective supply and scientific utilization of energy and resources at all stages of China's modernization.

The key study areas include (1) adhering to the rules of economy, science, and energy development, and coordinating the construction of a modern energy system, a comprehensive development and utilization system for energy and mineral resources, and a system for the protection and efficient utilization of water resources with Chinese characteristics; (2) analyzing the energy transition hierarchy and association of resource-, labor-, capital-, and technology-intensive industries according to the regional distribution and resource advantages of energy industry in terms of category, factors, division, and supply chain; (3) establishing appropriate positioning and objectives, directions and focuses, and paths and measures for the development of energy industry, and finding a new way of green, low-carbon, and circular development in the new stage of development; (4) optimizing regional layout, spatial structure, resource allocation, economic scale, construction time sequence, and input/output; preventing irrational decision-making, me-too investment, repeated construction, and ecological destruction in the development of energy economy [1,2].

2 Green structure of energy

In essence, non-fossil energy accounting for 20% of energy consumption by 2025 is the foundation for achieving dual carbon. Therefore, we should not only promote the clean use of high-carbon energy but also accelerate the scaling-up of low-carbon energy. Green, standardized, reduced, resourced, and recycled use of energy should be implemented across the life cycle of a product, in order to actively and orderly replace fossil energy with green energy.

Key study areas for clean use of high-carbon energy: vigorously promoting the clean and efficient use of fossil energy, especially the reduction, substitution, transformation, and efficient utilization of coal; tracking and promoting the research and development of technologies coupling coal chemistry and petroleum chemistry and the large-scale utilization of carbon dioxide; improving the technologies of supercritical and ultra-supercritical coal-fired power generation, coal gasification combined cycle power generation, energy-saving and carbon reduction in key industries, and energy consumption quotas for key products.

Key study areas for scaling-up of low-carbon energy: research/development, demonstration, and promotion of key technologies related to hydrogen energy production, storage, and application; promoting technological breakthroughs in renewable energy, large-capacity energy storage, shale oil and gas exploration, energy internet, and advanced/safe nuclear energy; developing renewable energy complemented with fossil energy and integrated with modern power grids; improving centralized power generation, multi-energy complementation, efficient energy storage, and distributed energy utilization efficiency [2–4].

3 Diversified supply of energy

We should comprehensively understand the trends and take measures to build a diversified energy supply system including coal, crude oil, natural gas, nuclear energy, new energy, and renewable energy. At present, the self-sufficiency rate of primary energy in China is roughly 80%, but the high proportion of coal in primary energy consumption and the high dependence of imported crude oil and natural gas may not be alleviated in the short term. Therefore, the availability and safety of oil and gas resources will continue to be a priority for China. Due to the constantly changing political, economic, and military situations in the world, it is particularly important to coordinate and address the four major risks of oil/gas source, international oil price, transportation channel, and energy diplomacy. It is necessary to enhance the capacity of global oil and gas resource allocation and emergency response while guaranteeing localized energy supply in China.

The key study areas include (1) securing energy supply in the context of reshaping global political, economic, and oil/gas market landscape; (2) promoting the exploration of oil/gas resources in the South China Sea and the East China Sea, and the construction of a number of long-term reliable overseas energy bases to secure energy supply; (3) enhancing the pricing power and voice to match the oil and gas consumption of China and to secure energy supply; (4) improving the national strategic reserve system for crude oil, natural gas, and coal to secure energy supply; (5) constructing a maritime logistics corridor between China and Myanmar to break the bottleneck at the Malacca Strait and to secure energy supply [2,9].

4 Low-carbon consumption of energy

We should pay attention to green manufacturing, green lifestyle, and green ecological development, improve the efficiency of energy utilization, the effect of energy conservation and emission reduction, and the benefit of circular economy, and construct a circular, and sustainable national economic system that facilitates low input, high output, low energy consumption, and low emission. At present, industry, transportation, and construction account for more than 90% of China's energy consumption, and we must constantly

develop green manufacturing, green transportation, and green construction.

The key study areas include (1) shaping resource-saving, environment-friendly, and ecologically-safe economic and social structures; promoting the development of green economy, low-carbon economy, and circular economy in urban and rural construction; (2) applying innovative green technology, clean production technology, energy-saving and environmental protection technology, recycling technology, remanufacturing technology, and contaminant purification technology; creating low-carbon industrial chains, venous industrial chains, and green supply chains in key industries and fields; (3) establishing the long-term mechanisms of energy-saving standard system, energy efficiency labeling system, and "frontrunner" system for energy efficiency, and completely changing the traditional linear industrial model and energy consumption model of "take–make–dispose"; (4) improving the comprehensive utilization efficiency of coal as chemical materials and promoting the high-end, diversified, and low-carbon chemical processing of coal [4–6].

5 Coordination of energy science and technology

Efforts can be made to investigate and establish a complete, self-controllable, and advanced energy science and technology innovation system, capture the main trends and hold the high ground of future science and technology development in the major fields of energy transformation.

The key study areas include (1) developing key common technologies, cutting-edge technologies, modern engineering technologies, and disruptive technologies related to energy, in order to fully support the reform of energy resource, energy production, energy transportation, energy consumption, energy materials, energy equipment, and energy system integration; (2) advancing the innovation and supply of energy science and technology to meet the major needs, and tracking the breakthroughs in cutting-edge technologies such as hydrogen energy, energy storage, nuclear fusion, combustible ice, and wireless energy transmission; (3) building an energy technology innovation ecosystem characterized by multiple disciplines, multiple technologies, as well as the crossover, integration, and synergy of multiple fields; accelerating the integration of scientific discovery, technological invention, project construction, and industrial development in energy economy; (4) developing industry-research alliances, venture capital funds, technology transfer services, and intellectual property protection in the construction of leading science and technology enterprises, new R&D institutions, and open source innovation platforms in the energy industry; (5) improving the connection of innovation in the whole process of energy transformation and the joint efforts of enterprises, universities, and research institutes to promote knowledge innovation, technological innovation, regional innovation, national defense innovation, and civil-military innovation [7,9].

6 Marketization of energy finance

Focuses should be put on green finance to achieve the optimization and aggregation of energy industrial capital and financial capital through market mechanisms. We should promote financial innovation activities that facilitate the integration of industry and finance, beneficial interaction, and coordinated development in energy transformation. In particular, we should remain alert to the risk of excessive financialization in the development of new energy finance.

The key study areas include (1) giving play to the resource allocation, risk management, and market pricing functions of finance in support of green and low-carbon development; (2) establishing green financial standards, financial institution supervision and information disclosure mechanisms, incentive and restraint mechanisms, green financial product and market systems, and international cooperation in green finance; (3) practicing green investment and financing management in energy conservation and environmental protection, clean manufacturing, clean energy, ecological environment, green upgrading of infrastructure, and green service; (4) supporting green transformation of economy by green financial system and tools such as green credit, green bonds, green development funds, and green insurance; (5) preventing environmental risk, technical risk, behavioral risk, and interventional risk in energy finance, effectively reducing the leverage of energy transaction, and regulating the derivatives; (6) investigating and conducting the evaluation of green technology maturity, green manufacturing maturity, green product maturity, green market maturity, and green industry maturity [4].

7 Intelligentization of energy system

We should systematically summarize the role of "Internet+" smart energy as a new technology, new mode, and new form of energy transformation in promoting energy production and consumption revolution, energy market expansion and opening up, and energy industry optimization and upgrading.

The key study areas include (1) solving the problems in building an intelligent system of energy production and consumption, an integrated energy network with synergized multi-energy supply, and communication infrastructure for energy industry; (2) building an open and shared platform for optimal allocation of clean energy; developing distributed energy resources, microgrids, energy storage, electric vehicle, smart energy use, value-added services, flexible trading of green energy, and energy big data service; (3) promoting the development of energy internet key technologies, the

research on core equipment, the construction of standard system, and the breakthroughs in international application and cooperation of energy internet technologies, standards, and modes; (4) expanding comprehensive energy services such as energy consumption diagnosis, energy efficiency improvement, and multi-energy supply; improving the efficiency of final energy consumption in the whole society and guiding users to actively save energy; coordinating the development of energy/power and the achievement of energy conservation and carbon reduction through market mechanisms; (5) making use of the differences in resource, time zone, seasonal, and electricity price in global energy internet to promote the scientific and rational development and efficient allocation of clean energy in the world [2,7].

8 Localization of energy equipment

It is necessary to track and analyze the advances and localization of complete sets of energy technology and equipment, energy-saving and environmental protection equipment, and green manufacturing equipment. The proportion of equipment manufactured in China should be gradually increased in strategic fields and core industries.

The key study areas include (1) establishing a complete supply chain for the manufacturing of clean energy equipment for hydropower, nuclear power, wind power, and solar power generation in China; accumulating experience in successful development of technologies and equipment in shale oil and gas exploration, green, efficient, and intelligent coal mining, industrialization of coal-to-oil/gas, and ultra-high voltage remote power transmission; (2) comparing the paths and gaps in high-end equipment manufacturing industry development in the US, Japan, and Germany; proposing measures to address the problems of low industry concentration, weak technological innovation, poor equipment integration, and few internationally recognized brands; (3) improving integrated, systematic, localized, and international energy equipment in key fields; increasing the ability of product upgrading, international cooperation, and independent innovation; enhancing the export of products to generate foreign exchange, the localization rate, and the international market share; (4) breaking the bottlenecks of key technologies, key equipment, key components, key processes, and key raw materials in the development of China's energy equipment manufacturing industry towards the middle- and high-end market; promoting demonstration enterprises with integrated development of innovation chain and industrial chain to reduce energy consumption and emission while increasing the quality, yield, and efficiency of production [9].

9 Intensification of energy bases

Great importance should be attached to the intensive, large-scale, and efficient utilization of energy resources, thereby effectively solving the problems of over-development, decentralized production, extensive management, and energy waste. These are essential requirements for implementing the new development philosophy and achieving high-quality economic development in China.

The key study areas include (1) further optimizing the structure of energy and mineral exploration, planning and building a number of centralized energy and mineral exploration zones, and promoting the spatial clustering and intensive exploration of energy and mineral resources, in order to change the "numerous, small, and scattered" exploration of energy and mineral resources; (2) promoting the safe, green, and intelligent exploration as well as clean, efficient, low-carbon, and intensive use of coal, building ecological mines, developing circular economy, and constructing a modern coal economic system; (3) planning and constructing multi-energy, clean energy, complementary energy, and intensive energy production bases with integration of "wind/photovoltaic/energy storage and transmission" at tens of millions of kilowatt scale; (4) transforming enterprises from traditional manufacturing to green manufacturing, service manufacturing, and intelligent manufacturing; achieving intensive management that minimizes manufacturing costs, optimizes product quality, and maximizes labor efficiency; (5) intensive, comprehensive, innovative, and efficient development and utilization of biomass energy in rural areas, and development of plants for the production of "green petroleum" [4–6].

10 Digitization of energy industry

We should make full use of integrated innovation with digital technology in promoting energy transformation and achieving the goal of dual carbon, and accelerate the technology, production, management, and system reforms in the energy industry.

The key study areas include (1) promoting the application of intelligent technology clusters such as 5G communication, artificial intelligence, Internet of Things, cloud computing, blockchain, and digital twins, in order to provide technical services with high scientificity, economy, operability, and reliability for energy transformation; (2) promoting the digital transformation of energy industry by innovative digital infrastructure construction, innovative digital technology application, innovative digital product/service, and innovative digital market cultivation; (3) constructing "digital factory," "digital logistics," and "digital network" to promote the digitization of product design, lean production, process reconstruction, market development, after-sales service, and business decisions; (4) promoting the application of "data + computing power + algorithm" for profound integration and innovation of energy, resource, and environment, and for

precise measurement and prediction of carbon emissions, carbon capture, carbon peak, and carbon neutralization; (5) using digital technology to improve the calculation of green gross domestic product and industrial added value, and to perform quantitative analysis for the measurement of the real growth and development of countries, regions, and industries [7,8].

Achieving dual carbon is not only a national strategy of China but also a common action of the world. High-end sci-tech think tanks should contribute Chinese wisdom and Chinese power by following the principles of equity, common but differentiated responsibilities, and respective capabilities. In-depth research should be conducted to strengthen international green economy/trade and technical/financial cooperation, to break technical, trade, and financial barriers, and to establish an international law system to address climate change as soon as possible. It should be noted that existing clean energy technologies are far from meeting the needs of green and low-carbon transformation, and high-end sci-tech think tanks should focus on the progress of international green and low-carbon technologies. According to the International Energy Agency, of the 38 key clean-energy technologies to limit the global temperature increase to 2 °C by the end of the 21st century proposed by the *Paris Agreement*, only 4 technologies (solar cell, biomass energy, electric vehicle, and lighting) are on track, 23 technologies are in need of improvement (offshore wind power, smart grid, bioenergy, nuclear power, hydrogen energy, and cement production, etc.), and 11 technologies are not on track, such as carbon capture, utilization, and storage (CCUS), geothermal energy, ocean energy, and refrigeration [1]. Therefore, the leading countries should make clear and predictable medium- and long-term goals for green and low-carbon development, and meanwhile continue to promote the low-carbon transformation of energy, industry, construction, transportation, and city. It is important to focus on the research and development of key technologies, promote the application of mature technologies, expand investment in emerging technologies, and improve technology transfer systems, thereby providing science/technology support to the global transition to green, low-carbon, and sustainable development. We should pay special attention to avoiding the "lock-in effect" of backward high-emission technologies in the post-epidemic era, and fully leverage the achievements of green and low-carbon innovation as the driving force for economic recovery and a new round of growth. The international community should join together to build a community with a shared future and a green global village.

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