

Translation



The following document is China's plan for science and technology innovation during the years of the 13th Five-Year Plan (2016-2020). The first half of the plan details many of the specific technologies the PRC government identifies as near-term priorities for research and investment. The second half discusses proposed changes to China's S&T innovation infrastructure in areas such as S&T planning, infrastructure, organization, and investment, promotion of scientific literacy, and science popularization.

Title

State Council Notice on the Publication of the National 13th Five-Year Plan for S&T Innovation
国务院关于印发“十三五”国家科技创新规划的通知

Author

PRC State Council (国务院)

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The footnote on p. 5 is an addition by the translator; the source text contains no footnotes.

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Editor

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To the people's governments of all provinces, autonomous regions, and municipalities, and all ministries and commissions of the State Council and their respective agencies:

The *National 13th Five-Year Plan for S&T Innovation* is hereby printed and distributed. Please implement it meticulously.

State Council

July 28, 2016

(This circular is released publicly)

National 13th Five-Year Plan for S&T Innovation

The *National 13th Five-Year Plan for S&T Innovation* was formulated on the basis of the *13th Five-Year Plan for National Economic and Social Development of the People's Republic of China*,

the *Outline of the National Innovation-Driven Development Strategy*, and the *Outline of the National Medium- and Long-Term Science and Technology Development Plan (2006-2020)*. It primarily serves to clarify the overall thinking, development goals, main tasks, and major measures of science and technology innovation during the period of the 13th Five-Year Plan [2016-2020]. It is the country's key special plan in the field of S&T innovation and is an action plan to bring China into the ranks of innovation-oriented countries (创新型国家).

Part 1: Entering the Ranks of Innovation-Oriented Countries

The period of the 13th Five-Year Plan is a crucial period for forming a well-off society in an all-round way (全面建成小康社会) and for the entry of China into the ranks of innovation-oriented countries. It is a critical period for the in-depth implementation of the innovation-driven development strategy and the comprehensive deepening of S&T structural reform. During this period, it is necessary to conscientiously implement the decisions and deployments of the Party Central Committee and the State Council, face the global situation, take the overall situation into consideration, thoroughly understand and accurately grasp the new requirements of the new normal in economic development and the new trends of scientific and technological innovation at home and abroad, open up new areas of development, accelerate China's march into the ranks of innovation-oriented countries, and speed up the construction of a world S&T superpower (世界科技强国).

Chapter 1: Grasping New Trends in Scientific and Technological Innovation and Development

Since the adoption of the 12th Five-Year Plan, and especially since the 18th Party Congress, the Party Central Committee and the State Council have attached great importance to scientific and technological innovation and made major decisions and deployments to fully implement the innovation-driven development strategy. China's scientific and technological innovation has entered a new phase where the country is catching up in certain areas and keeping pace or taking in the lead in others. It is in an important period for the transition from quantitative accumulation to a qualitative leap and from breakthroughs at certain points to systemic capacity improvement. In overall national development, core positions have become more prominent, and the country's position in the global innovation landscape has further improved as China has become an influential S&T power (科技大国).

China continues to improve its scientific and technological innovation capabilities, make breakthroughs in strategic technologies, and significantly increase its international influence in basic research. Great achievements have been made in manned spaceflight and lunar exploration projects, manned deep diving, deep drilling, supercomputing, the quantum anomalous Hall effect, quantum communications, neutrino oscillation, and induced pluripotent stem cells. In 2015, total research and experimental development expenditures in China reached RMB142.2 billion, China ranked second in the world in the number of international scientific and technological papers published and rose to fourth in the number citations, the total value of national technology contracts reached RMB983.5 billion, and China ranked 18th in the world in national innovative capacity. The scientific and technological component of economic growth has continuously

improved and the contribution rate of scientific and technological progress increased from 50.9% in 2010 to 55.3% in 2015. Major breakthroughs have been made in major equipment and strategic products such as high-speed rail, hydropower equipment, UHV transmission and transformation, hybrid rice, fourth-generation mobile communications (4G), ground observation satellites, the Beidou Navigation Satellite System, and electric vehicles. Some of these products and technologies are now being exported to other countries. S&T structural reform has progressed systematically and intensively. Substantial progress has been made in the management reform for central government science and technology financing plans (special projects, funds, etc.), the overall coordination of scientific and technological resources has been further strengthened, market-oriented technological innovation mechanisms have been gradually improved, and the status of corporate technological innovation has continued to strengthen. The level of internationalization of scientific and technological innovation has been greatly enhanced, international scientific and technological cooperation has been carried out in depth, the accumulation of high-end innovative resources (such as top international scientific and technological talent and research and development institutions) has accelerated, and scientific and technological diplomacy plays an increasingly prominent role in the country's overall diplomacy. The innovation and entrepreneurial ecosystem of the whole society has been continuously optimized. National independent innovation demonstration zones and high-tech industrial development zones have become important vehicles for innovation and entrepreneurship. The *Law of the People's Republic of China on the Promotion of the Transformation of S&T Achievements into Commercial Products* has been revised and implemented, and the implementation of policies such as corporate R&D deductions has achieved significant results. Science and technology have been more closely integrated with finance, the scientific skills of citizens have been steadily improved, and the whole society's awareness of and activeness in innovation have been significantly enhanced.

During the 13th Five-Year Plan period, global scientific and technological innovation has shown new trends, and economic and social development in China has entered a new normal.

The world is currently poised for a new round of technological change and industrial transformation. Science and technology have evolved from the microscopic to the macroscopic scale, and the trend of multi-disciplinary breakthroughs and cross-integration has become increasingly apparent. Material breakthroughs, the evolution of the universe, the origin of life, the nature of consciousness, and other major scientific issues are opening up new frontiers and new directions. Information networks, artificial intelligence, biotechnology, clean energy, new materials, advanced manufacturing, and other fields are progressing by leaps and bounds. Disruptive technologies continue to emerge, giving birth to a new economy, new industries, new types of business, and new models, which will have unprecedented and profound impacts on human production methods, lifestyles, and even ways of thinking. Scientific and technological innovation plays an increasingly important role in meeting the common challenges of mankind and achieving sustainable development. Global innovation and entrepreneurship have entered a highly intensive and active period, and the speed, scope and scale of global flows of innovative resources such as talent, knowledge, technology, and capital have reached unprecedented levels. Models of innovation have undergone significant changes and the networking and globalization of innovation activities have become more prominent. The restructuring of the global innovation landscape is accelerating and the trend toward multipolar innovation is becoming increasingly

apparent. Scientific and technological innovation has become the core lever by which countries can rebalance their economies and create new national competitive advantages. Such trends are profoundly changing the way national power is measured and reshaping the global economic structure and pattern of international competition.

China's economic development has entered a new normal of changing speed, structural optimization, and engine conversion. To promote supply-side structural reforms and promote increased economic quality and efficiency and economic transformations and upgrades, China urgently requires scientific and technological innovation to cultivate new driving forces for development. To coordinate and advance new industrialization, informatization (信息化), urbanization, agricultural modernization, and environmental improvement and build an ecological civilization, China urgently requires scientific and technological innovation to break through the bottlenecks of resources and the environment. To cope with the aging population, eradicate poverty, enhance people's health, and innovate in social governance, China urgently requires scientific and technological innovation to support the improvement of people's livelihoods. To implement the overall national security vision and safeguard national security and strategic interests, China urgently requires scientific and technological innovation to provide strong safeguards. At the same time, China's national income has steadily increased, market demand has accelerated, the industrial system has become more complete, the vitality of the system has increased significantly, the level of education and human capital has continued to improve, and the economy has great potential for sustainable development, resilience, and room for maneuver. Bringing comprehensive national power to a new level will surely provide a solid foundation for the acceleration of breakthroughs in scientific and technological innovation.

At the same time, we must clearly understand that, compared with the requirements for entering the ranks of innovation-oriented countries and building a world power in science and technology, there are still some weak links and deep-seated problems in China's science and technology innovation. The most important of these are: the scientific and technological foundation is still weak, there is still a large gap in scientific and technological innovation capabilities and especially in original innovation capabilities, the situation in which key technologies in key areas are controlled by others has not fundamentally changed, many industries are still at the low-end of the global value chain, and the contribution rate of science and technology to economic growth is not high enough. Obstacles in ideological concepts (思想观念) and deep-seated institutional mechanisms that restrict innovation and development still exist, and the overall efficiency of the innovation system is not high. Leading talent and highly-skilled talent are in short supply and the ranks of innovative entrepreneurs must be developed and enlarged. The environment for stimulating innovation needs to be improved, the implementation of policies and measures needs to be further strengthened, the openness and sharing of innovation resources need to be improved, and the scientific spirit and culture of innovation need to be further promoted.

Looking at the overall situation, China's scientific and technological innovation faces a period of important strategic opportunity where it can achieve a great deal of progress, but it is also facing the risk that the gap will grow wider. We must firmly grasp the opportunities, establish self-confidence in innovation, enhance the awareness of hardship and the courage to overcome difficulties, take the initiative to adapt to and take the lead in current trends, place scientific and technological innovation in a more important position, optimize the overall layout of science and

technology development, and make innovation the national will and the common aim of the entire society. Proceeding from a new historical starting point, a new situation of national innovation and development will be created, and a new journey of building a world S&T superpower will begin.

Chapter 2: Establishing a New Blueprint for Scientific and Technological Innovation and Development

I. Guiding Ideology

The guiding ideology of the 13th Five-Year Plan for S&T Innovation is: hold high the great banner of socialism with Chinese characteristics; fully implement the spirit of the 18th Party Congress and the 3rd, 4th, and 5th plenums of the 18th CPC Central Committee; take Marxism-Leninism, Mao Zedong Thought, Deng Xiaoping Theory, the important thinking of the "Three Represents," and the scientific development concept as the guide; thoroughly implement the spirit of General Secretary Xi Jinping's series of important speeches; conscientiously implement the decisions and arrangements of the Party Central Committee and the State Council; adhere to the "Five in One" [economic, political, cultural, social, and ecological civilization development] overall layout and the "Four Comprehensively" [comprehensively build a well-off society in an all-round way, comprehensively deepen reform, comprehensively govern the country according to law, comprehensively govern the party strictly] strategic layout; adhere to the concepts of innovation, coordination, environmental protection, openness, and shared development; adhere to the guidelines of independent innovation, leapfrog development in key areas, support for development, and leadership of the future; adhere to innovation as the first driving force (第一动力) for development; place innovation at the core of the overall national development situation; make in-depth implementation of the innovation-driven development strategy and support for supply-side structural reforms the main theme; comprehensively deepen S&T structural reform; vigorously promote comprehensive innovation centered on scientific and technological innovation; focus on enhancing independent innovation capability, focus on building an innovative talent team, focus on expanding open cooperation in science and technology, and focus on promoting mass entrepreneurship and innovation; shape forward-leading development (引领型发展) that relies more on innovation-driven and first-mover advantages; ensure that China enters the ranks of innovation-oriented countries as scheduled; lay a solid foundation for building a world S&T superpower; and provide a powerful impetus for achieving the "two centennial" objectives ("两个一百年" 奋斗目标) [establish a well-off society in an all-round way by the centennial (2021) of the founding of the Communist Party of China (CPC); establish a rich, strong, democratic, civilized, harmonious, modernized socialist nation by the centennial (2049) of the founding of the PRC]¹ and the Chinese dream of the great rejuvenation of the Chinese nation.

¹ The above definition of the "two centennial" objectives is as of the publication of this *Outline* (July 2016). In his report to the 19th Party Congress on October 18, 2017, CPC General Secretary Xi Jinping redefined the second "centennial" as follows: "Build China into a rich, strong, democratic, civilized, harmonious, *beautiful* modernized socialist *superpower*" (emphases added by translator).

II. Basic principles

—Insist on supporting major national needs as a strategic task. Focus on national strategies and major needs for economic and social development and define the main directions of attack and breakthroughs; strengthen R&D for key core and general-purpose technology and the conversion of research results into practical applications; give full play to scientific and technological innovation in cultivating and developing strategic emerging industries, promoting economic upgrades and improvements in efficiency, shaping leading development, and playing an important role in the maintenance of national security.

—Insist on making catching up and taking the lead faster the focus of development. Grasp the development trends of cutting-edge science and technology, make advance plans and layouts in basic cutting-edge areas related to long-term development, implement asymmetric strategies, strengthen original innovation, strengthen basic research, work hard to achieve originality and uniqueness, comprehensively enhance independent innovation capabilities, achieve leapfrog development in important scientific and technological fields, keep up with and even take the lead in new directions in global science and technology development, and take the strategic initiative in a new round of global science and technology competition.

—Insist that the fundamental purpose of science and technology is to serve the people. Closely focus on the people's immediate interests and urgent needs, combine scientific and technological innovation with the improvement of people's lives, and use scientific and technological innovation to improve people's living standards, enhance the scientific culture and health of society as a whole, promote high-quality employment and entrepreneurship, help the poor and alleviate poverty, and build a resource-saving and environment-friendly society. In this way, more of the results of innovation can be shared by the people and they will have a greater sense that these efforts are benefiting them.

—Insist on deepening reforms to serve as a powerful driving force. Adhere to the simultaneous development of S&T structural reform and reforms in the economic and social fields, give full play to the decisive role of the market in allocating innovative resources and allow government to play a better role, strengthen the market-oriented mechanisms of technological innovation, remove the institutional obstacles to the deep integration of science and technology, stimulate original breakthroughs and the transformation of S&T achievements into commercial products (成果转化) effectively improve the efficiency of science and technology investment, form dynamic science and technology management and operation mechanisms, and provide continuous impetus for innovation and development.

—Insist on talent-driven innovation as an essential requirement. Implement a strategy of talent-first development, prioritize the development of talent resources in scientific and technological innovation, discover talent while practicing innovation, cultivate talent through innovative activities, bring together talent in innovative undertakings, reform the mechanisms for talent cultivation and deployment, and cultivate a large-scale team of high-quality talent with a rational structure.

—Insist on adopting a global vision as an important guide. Proactively integrate into the global innovation network, optimize the allocation of innovation resources globally, combine scientific and technological innovation with national diplomatic strategy, promote the establishment of a broad innovation community, carry out cooperative scientific and technological innovation at higher levels, strive to become a leader in several important areas

and a contributor to important rules, and improve China's influence in global innovation governance.

III. Development Goals

The overall goals of the 13th Five-Year Plan for scientific and technological innovation are: sharply increase the country's scientific and technological strength and innovation capacity, achieve outstanding results in innovation-driven development, improve the country's comprehensive innovation capacity so it ranks among the top 15 countries in the world, bring China into the ranks of innovation-oriented countries, and provide strong support to achieve the goal of forming a well-off society in an all-round way.

- Comprehensively increase independent innovation (自主创新) capabilities. Make significant breakthroughs in basic research and strategic advanced technology, significantly improve original innovation capabilities and international competitiveness, and transition from playing catch-up in overall independent innovation capabilities to keeping pace or taking the lead. Increase the intensity of investments in research and experimental development funding to 2.5%, significantly increase the share of basic research in nationwide R&D investments, and increase the proportion of R&D expenditures by industrial enterprises above a certain size to 1.1% of main business revenue; raise China to 2nd in the world in terms of scientific and technological paper citations; and increase the number of invention patents per 10,000 people to 12 and double the number of patent applications filed through the Patent Cooperation Treaty (PCT) compared to 2015.

- Significantly enhance the support and leadership roles played by scientific and technological innovation. As an important aspect of economic work, allow scientific and technological innovation to play a more prominent role in promoting economic balance, inclusiveness, and sustainable development and increase the contribution rate of scientific and technological progress to economic development to 60%. Bring the operating income of high-tech enterprises to RMB34 trillion, raise the added value of the knowledge-intensive service industry to 20% of GDP, and increase the total amount of national technology contracts to RMB2 trillion. Promote the growth of a number of world-leading innovative enterprises, brands, and standards, with several companies entering the top 100 innovative companies worldwide, and form a group of regional poles of innovative growth with strong influence. New industries and the new economy will become new driving forces for creating national wealth and high-quality employment, with more of the benefits of innovation shared by the people.

- Simultaneously improve the scale and quality of innovative talent. Take the first steps to form a large-scale team of high-quality innovative scientific and technological talent with a rational structure. Foster the emergence of a group of strategic scientific and technological talent, leading scientific and technological talent, innovative entrepreneurs, and highly skilled talent, further expand the team of young scientific and technological talent, significantly improve the human resource structure and employment structure, and raise the number of R&D personnel to 60 per 10,000 employees. Further improve the talent evaluation, mobility, and incentive mechanisms and fully stimulate the innovative vitality of professionals with varied talent.

- Mature and shape institutions and mechanisms conducive to innovation. Basically form the basic system and policy structure of science and technology innovation, significantly enhance

the rule of law (法治化) in science and technology innovation management, and achieve significant progress in the construction of innovation governance capacity. Enhance the robustness of market-oriented technology innovation systems with enterprises as the primary entities, make the governance structure and development mechanisms of higher education institutions and research institutes more scientific, improve mechanisms for military-civil fusion (军民融合) innovation, and significantly improve the overall efficiency of the national innovation system.

– Further optimize the innovation and entrepreneurship ecosystem. Continuously improve scientific and technological innovation policies and regulations and effectively protect intellectual property. More closely integrate science and technology with finance and make innovation and entrepreneurship services more efficient and convenient. Make the flow of innovation factors such as talent, technology, and capital smoother and take the first steps to form a comprehensive and open pattern of technological innovation. Further promote the scientific spirit, strengthen the atmosphere of innovation and entrepreneurship, significantly raise the scientific culture of society as a whole, and increase the proportion of citizens with scientific capabilities to over 10%.

Box 1 Main Indicators of the 13th Five-year Plan for Scientific and Technological Innovation			
Indicator		Value in 2015	Target for 2020
1	World ranking in national comprehensive innovation capacity (rank)	18	15
2	Contribution rate of scientific and technological progress to economic development (%)	55.3	60
3	Research and experimental development funding investment intensity (%)	2.1	2.5
4	R&D personnel per 10,000 employed persons (person-year)	48.5	60
5	Operating revenue of high-tech enterprises (trillion RMB)	22.2	34
6	Value added in knowledge-intensive service industries as a proportion of GDP (%)	15.6	20
7	R&D expenditures by industrial enterprises above a certain size as a proportion of main business revenue (%)	0.9	1.1
8	World ranking by the number of international scientific and technological paper citations (rank)	4	2
9	PCT patent applications (10,000 applications)	3.05	Double
10	Invention patents held per 10,000 people (patents)	6.3	12
11	National technology contract amount (100 million RMB)	9835	20000
12	Proportion of citizens with scientific capabilities (%)	6.2	10

IV. Overall Deployment

In the next five years, China's scientific and technological innovation work will closely focus on the in-depth implementation of the national 13th Five-Year Plan and the Outline of the National Innovation-Driven Development Strategy. It will provide strong support for "Made in China 2025", "Internet+", the Cyber Superpower, Maritime Superpower, and Space Superpower

strategies, Healthy China construction, military-civil fusion development, "Belt and Road" [the Silk Road Economic Belt and the 21st Century Maritime Silk Road] construction, Beijing-Tianjin-Hebei coordinated development, and the development of the Yangtze River Economic Belt. Full play will be given to the core leading role scientific and technological innovation plays in advancing Chinese industry to the mid-to-high end, creating new momentum for development, opening up new spaces for development, and improving the quality and benefits of development.

First, we will focus on building up the nation's first-mover advantages and strengthen its major strategic layout from both the current and long-term perspectives. Accelerate the implementation of major national science and technology projects and start "Science and Technology Innovation 2030—Major Projects"; build an industrial technology system with international competitiveness, strengthen the integration of modern agriculture, new generation information technology, smart manufacturing, energy, and other fields, promote innovation in disruptive technologies, and accelerate changes in leading industries; strengthen the technical systems that support improvements in people's lives and sustainable development and break through bottlenecks in resources and the environment, population health, public safety, and other fields; and establish a technical system that guarantees national security and strategic interests and develop advanced strategic technologies with deep-sea, deep earth, deep space, and deep blue applications.

Second, we will focus on enhancing innovative capabilities and cultivate innovative strength for important strategies. Continue to strengthen basic research, comprehensive layout, and forward-looking deployment, focus on major scientific issues, propose and lead the organization of major international scientific plans and major scientific projects, strive to lead the world's scientific direction in more basic and cutting-edge areas, and achieve breakthroughs in more strategic areas; and improve the construction of innovation bases led by national laboratories and promote the optimization and integration of scientific research bases according to their functional positioning and classifications. Cultivate a number of world-class scientists, leading science and technology talent, highly skilled talent, and high-level innovation teams, help young scientific and technological talent distinguish themselves, and strengthen and expand a team of innovative entrepreneurs.

Third, we will focus on opening up spaces for innovative development and coordinate the overall Chinese and international layouts. Support the construction of science and technology innovation centers with global influence in Beijing and Shanghai, build a group of innovative provinces and municipalities and regional innovation centers to serve as major driving forces, promote the innovative development of national independent innovation demonstration zones and high-tech zones, and systematically promote comprehensive innovation and reform pilot projects; improve the mechanisms for regional collaborative innovation, increase science- and technology-driven poverty alleviation, and stimulate the vitality of grassroots innovation; and build a Belt and Road collaborative innovation community, improve the capabilities of global innovation resource allocation, participate in global innovation governance in depth, and promote two-way openness and the flow of innovation resources.

Fourth, we will focus on promoting mass innovation and entrepreneurship and construct a good ecosystem for innovation and entrepreneurship. Vigorously develop the science and technology service industry, establish a unified and open technology trading market system, and enhance service capabilities for the entire chain of innovation; strengthen the construction of a

comprehensive vehicle for innovation and entrepreneurship, develop makerspaces (众创空间), support crowd innovation, crowdsourcing, crowdfunding, and crowd support, and serve the transformation and upgrading of the real economy; and implement intellectual property and technology standards strategies in depth. Improve the mechanisms for the integration of science and technology with finance and vigorously develop venture capital and multi-level capital markets.

Fifth, we will focus on removing the institutional barriers that hinder innovation and the transformation of S&T achievements into commercial products and comprehensively deepen S&T structural reform. Accelerate management reform for central government science and technology financing plans (special projects, funds, etc.) and strengthen the overall coordination of science and technology resources; implement national technology innovation projects in depth, build national technology innovation centers, and improve the innovation capacity of enterprises; promote and improve the modern university system and research institute system, foster new market-oriented R&D institutions, and build a more efficient scientific research organization system; and take actions to promote the transfer and conversion of S&T achievements into commercial products, improve the mechanisms for the transfer and conversion of S&T achievements into commercial products, and vigorously promote military-civil fusion technological innovation.

Sixth, we will focus on consolidating the foundation for an innovative population and society and strengthen the popularization of scientific knowledge and the construction of a culture of innovation. Implement national scientific capability action plans in depth and comprehensively promote the improvement of overall scientific capabilities of society as a whole; strengthen the construction of science popularization infrastructure, vigorously promote information-driven science popularization, and develop a science popularization industry; encourage colleges, universities, scientific research institutes, and enterprises to open their various scientific research facilities to the public; carry forward the scientific spirit, strengthen the integrity of scientific research, strengthen interaction with the public, and cultivate an entrepreneurial spirit and culture of innovation that respects knowledge, advocates creativity, and pursues excellence.

Chapter 3: Constructing an Efficient and Collaborative National Innovation System

To further implement the innovation-driven development strategy and support supply-side structural reforms, we must coordinate and promote the construction of an efficient and collaborative national innovation system, promote the collaborative interaction of various types of innovation entities and the smooth flow and efficient allocation of innovative elements, and form practical vehicles, institutional arrangements, and environmental safeguards for innovation-driven development.

I. Cultivate Vibrant Innovative Entities

Further clarify the functional positioning of various types of innovation entities, highlight the core driving role of innovative talent, enhance the status of enterprises as the mainstay and guiding force of innovation, allow national scientific research institutions to act as the backbone and leaders in innovation, and allow higher education institutions to serve as the foundation and vital force of innovation, encourage and guide the development of new types of R&D institutions,

give full play to the role of scientific and technological social organizations, stimulate the vitality of various types of innovation entities, and systematically enhance the capabilities of innovation subjects.

II. Systematically Lay Out High-level Innovation Bases

Aim at internationally advanced science and technology and the trends of industrial change, focus on national strategic needs, strengthen the system integration layout in accordance with the innovation chain and production chain, use national laboratories as guides to form a complete and interconnected innovation base, gather first-class talent, strengthen innovation reserves, enhance the support capacity of the whole innovation chain, and lay an important foundation for achieving major innovative breakthroughs and cultivating high-end industries.

III. Create Poles to Drive High-End Innovation Growth

Following the regularities of highly concentrated innovation regions combined with regional innovation development needs, guide high-end innovation elements to accelerate toward and aggregate around regional productive capacity layouts. Based on national independent innovation demonstration zones and high-tech zones, with regional innovation centers and cross-regional innovation platforms playing the leading roles, encourage advantageous areas to create innovative highlands with significant leadership and global influence, form a stepwise layout of regional innovation development, and promote the overall improvement of regional innovation.

IV. Create Open and Collaborative Innovation Networks

Focusing on opening up the channel between technology and economy, use technology markets, capital markets, and talent markets as links and use resource openness and sharing as the means. Focusing on deploying innovation chains around the production chain (产业链) and improving capital chains around the innovation chains, strengthen cooperation among various innovation entities, promote the close integration of production, education, research, and users, advance the development of science and education integration, deepen military-civil fusion innovation, improve the innovation and entrepreneurship service system, and build an open and efficient innovation network that integrates multi-entity collaboration and interaction with mass innovation and entrepreneurship.

V. Establish Modern Innovation Governance Structures

Further clarify the division of labor between governments and markets, continue to streamline administration, delegate power, strengthen regulation, and improve service reforms and promote the transformation of government functions from R&D management to innovative services; clarify and improve the division of labor between the central and local governments and strengthen top-down linkage and overall coordination; strengthen the construction of high-tech think tanks and improve the major decision-making mechanisms for scientific and technological innovation; and reform and improve the resource allocation mechanisms, guide the concentration of social resources for innovation, improve the efficiency of resource allocation, and form an innovation-driven institutional arrangement that combines the government's guiding role with the market's decisive role.

VI. Create an Environment Conducive to Innovation

Strengthen legal protections for innovation and actively create an environment characterized by the rule of law and conducive to the creation and protection of intellectual property; continue to optimize the supply of innovation policies, build a policy system for inclusive innovation, strengthen policy reserves, and strengthen the implementation of key policies; and stimulate the creative vitality of society as a whole and create a cultural environment that advocates innovation and entrepreneurship.

Part 2: Building National First-Mover Advantages

Focusing on the strategic needs of improving industrial competitiveness, improving the people's livelihoods, and ensuring national security, we will strengthen system deployment in key areas and provide strong support for shaping more forward-leading development that relies on innovation-driven and first-mover advantages.

Chapter 4: Implementing Major Science and Technology Projects that are Relevant to the Country's Overall Situation and Long-Term Goals

Major science and technology projects are important starting points that reflect national strategic goals, integrate scientific and technological resources, and achieve leapfrog development in key areas. During the 13th Five-Year Plan period, based on the implementation of major national science and technology projects, looking toward 2030 we will deploy a number of major scientific and technological projects that reflect the national strategic intentions and explore a new national system of scientific and technological innovation under the socialist market economy. This is done to improve the organizational model of major projects, seize future commanding positions in strategically contested areas, open up new directions for industrial development, cultivate new economic growth points, drive the development of productive forces, and provide strong support for improving the country's overall competitiveness and ensuring national security.

I. In-Depth Implementation of Major National Science and Technology Projects

In accordance with the requirements of focusing on targets, highlighting priorities, and accelerating progress, accelerate the implementation of major national science and technology projects that have already been deployed, promote the application and industrialization of the project results, improve the effectiveness of project implementation, and ensure that the special project goals are achieved. Continue to overcome the key issues in core, high-end, and basic areas (core electronic devices, high-end general-purpose chips, and basic software), integrated circuit equipment, broadband mobile communications, CNC machines (数控机床), oil and gas development, nuclear power, water pollution control, genetic modification, new drug creation, prevention of infectious diseases, and other core technologies, and focus on solving major scientific and technological issues that restrict economic and social development and national security; research and develop major strategic products with international competitiveness, build high-level major demonstration projects, and play an influential role in improving people's livelihoods and developing national pillar industries; gather and train a group of leading scientific

and technological talent and high-level innovation and entrepreneurship teams, build a group of leading innovation platforms and industrial bases with international influence, and create a group of innovative leading enterprises with strong international competitiveness, forming world-leading high-tech industries in some areas.

Box 2 Major National Science and Technology Projects

Core electronic devices, high-end general-purpose chips, and basic software products: Make breakthroughs in supercomputer central processing unit (CPU) architecture design technology, improve the functions, efficiency, and reliability of server and desktop computer CPUs, operating systems, databases, and office software, and achieve core key technologies such as high-performance, low power-consumption embedded CPU and operating systems; and carry out R&D for key basic software and hardware such as operating systems for new needs such as cloud computing and big data, basically form independent development capabilities for core electronic devices, high-end general-purpose chips, and basic software products, and reverse China's passivity concerning the controllable security and independent guarantees of basic information products.

Very-large-scale integration (VLSI) manufacturing equipment and complete processes: Achieve high-end manufacturing equipment and parts such as 14nm etching equipment, thin-film equipment, and doping equipment, make breakthroughs in 28nm immersion lithography machines and core components, develop 300mm silicon wafers and other key materials, develop complete processes for 14-nanometer logic and memory chip sets and the relevant system packaging and testing technology, carry out research on 75-nanometer key technology, form a relatively complete production chain of 28-14-nanometer equipment, materials, processes, packaging, and testing, and bring China into the ranks of the world leaders in overall innovation capabilities.

New generation broadband wireless mobile communication networks: Carrying out the development of key core technologies and international standards for fifth-generation mobile communications (5G) and key products such as 5G chips, terminals, and system equipment, focus on advancing 5G technology standards and ecosystem construction, support efforts to improve 4G enhanced technology chips, meters, and other technical weak links, form a complete broadband wireless mobile communications production chain, keep pace with the international progress, push China to become one of the leading countries in the field of broadband wireless mobile communication technology, standards, industries, services, and applications, and provide support for the commercial launch of 5G in 2020.

High-end CNC machines and basic manufacturing equipment: Focus on achievements in key general-purpose technologies such as high-end CNC systems, functional components, and tools, and key technologies such as reliability and accuracy retention of high-end CNC machines, meet the urgent need for high-precision, high-speed, high-reliability, and high-end CNC machines in the aerospace and automotive fields, enhance the independent development capability of high-end CNC machines and basic manufacturing equipment, and bring the overall technical level to the international front rank, with some products becoming international leaders.

Development of large oil and gas fields and coalbed methane: Focus on achievements in deep onshore and deep-water offshore oil and gas exploration and development technologies and equipment and their applications, achieve key technologies and core equipment for the economic and effective development of shale gas and coalbed methane as well as new technologies to improve the recovery of complex oil and gas fields, enhance the development of key technologies and manufacturing capacity for industrial equipment, and provide technical support to ensure safety in China's oil and gas industry.

Large-scale advanced pressurized water reactor and high-temperature gas-cooled reactor nuclear power plants: Make breakthroughs in CAP1400 pressurized water reactor shielded main pumps, control systems, fuel components, and other key technologies and test verifications as well as high-temperature reactor steam generators, fuel systems, nuclear-grade graphite, and other key technology equipment materials and verifications. In 2017, the 200,000-kilowatt high-temperature gas-cooled reactor nuclear power plant demonstration project will achieve grid-connected power generation. In

2020, we will strive to complete the CAP1400 demonstration project. Form an internationally advanced system of nuclear power technology R&D, testing and verification, key equipment design and manufacturing, standards, and independent intellectual property rights and build a complete and internationally competitive nuclear power design, construction, and service production chain.

Water pollution control and treatment: According to the procedures of resource control and emission reduction, reducing repair work, and comprehensive control, research and develop a number of core key technologies in water recycling system restoration, water pollution control, drinking water safeguards, ecological service function restoration, and long-term management mechanisms, integrate complete sets of technology and equipment, conduct comprehensive demonstrations in the Beijing-Tianjin-Hebei region and the Taihu Basin, form three major technical systems for water pollution control, water environment management, and drinking water safety protection in river basins, and build a water environment monitoring and surveillance big data platform.

Cultivation of new varieties of genetically modified organisms: Strengthen research on crop insect resistance, disease resistance, drought resistance, and cold resistance genetic technologies, increase research and development of genetically modified cotton, corn, and soybeans, promote the industrialization of major products such as new insect-resistant cotton, insect-resistant corn, and herbicide-resistant soybeans, strengthen research and development of new technologies in gene cloning, transgenic operations and biosafety; for rice, wheat, and other staple food crops, focus on supporting the improvement of traits based on new technologies such as non-endosperm specific expression (非胚乳特异性表达) and gene editing, raise the overall level of research on agricultural GMOs so that China leaps into the ranks of the most advanced countries, and provide crop varieties and technical reserves to ensure national food security. Establish a standardized biosafety evaluation technology system to ensure the safety of genetically modified products.

Creation of major new drugs: Focusing on 10 major types of diseases (such as malignant tumors, cardiovascular, and cerebrovascular diseases), strengthen the development of major vaccines and antibodies, focus on supporting the development of drugs that are highly innovative, demonstrate good efficacy, meet important needs, and have significant prospects for industrialization as well as building major general-purchase key technologies and basic research capabilities, strengthen the resource sharing and open services of innovation platforms, basically build an internationally advanced national drug innovation system, bring the comprehensive capabilities and overall level of new drug research and development into the ranks of world-leading countries, and accelerate China's transformation from a pharmaceutical power to a pharmaceutical superpower.

Prevention and treatment of major infectious diseases such as AIDS and viral hepatitis: Make breakthroughs in comprehensive prevention and control of acute infectious diseases and improving emergency response technology capabilities; achieve key technologies and products for the diagnosis and prevention of AIDS, hepatitis B, and tuberculosis (TB), strengthen vaccine research, develop a batch of advanced testing and diagnostic products, improve the effectiveness of clinical treatment programs for AIDS, hepatitis B, and tuberculosis, and form traditional Chinese medicine (TCM) treatment plans. Form a new comprehensive prevention and treatment model to reduce the "three diseases and two rates" (“三病两率”) [AIDS, hepatitis B, and TB; the TB infection rate and mortality rate] that suits our national conditions in order to provide support for maintaining the AIDS epidemic at a low level, changing China from a high-endemic area to a low-endemic area for hepatitis B, and reducing the rate of new TB infections and mortality to the level of a moderately developed country.

Large aircraft: Complete the first C919 flight, obtain the CAAC type certificate and achieve delivery, and carry out research on key technologies for civil airworthiness certification.

High-resolution earth observation system: Complete the construction of space-based and aerial observation systems, ground systems, and application systems and basically build land-based, atmospheric, and ocean-based observation systems and form a complete system.

Manned spaceflight and lunar exploration projects: Launch a new high-thrust launch vehicle (运载火箭) and launch the Tiangong-2 space laboratory, the space station testing core capsule, and manned and cargo spacecraft; master the technology related to cargo transportation and astronauts' long-term presence in space and lay the foundation for the comprehensive construction of China's

near-Earth manned space station. Make breakthroughs in key technologies such as moon arrival (全月球到达), high data rate communication, high-precision navigation and positioning, and the exploitation of lunar resources. Make breakthroughs in technology related to the automatic return of extraterrestrial objects, develop the technology required to launch lunar sampling and return vehicles, and achieve soft landing in specified areas and sample return.

II. Deploy and Launch New Major Science and Technology Projects

Looking toward 2030, we will select another batch of major scientific and technological projects that reflects our national strategic intentions and strive to make breakthroughs. Starting out from a consideration of longer-term strategic needs, we will persevere in doing all that should be done and strive to make new breakthroughs in aerospace engines and gas turbines, deep-sea and space stations, quantum communications and quantum computing, brain science and brain-inspired research, national cybersecurity, deep space exploration and in-orbit spacecraft service and maintenance systems, independent innovation in the seed industry (种业), the clean and efficient use of coal, smart grids, integrated space-to-ground information networks, big data, smart manufacturing and robotics, R&D and applications of key new materials, integrated governance of the Beijing-Tianjin-Hebei environment, and health protection. Following the principle of starting a new project when a previous project reaches maturity, project batches will be implemented in an orderly manner.

Box 3 Science and Technology Innovation 2030—Major Projects

Major Science and Technology Projects (重大科技项目):

1. Aerospace engines and gas turbines: Carry out general-purpose basic technology and interdisciplinary research in areas such as materials, manufacturing processes, and testing and achieve key technologies such as overall designs.
2. Deep-sea and space stations: Carry out research on the cutting-edge and general-purpose technologies for deep-sea exploration and operations and core key technologies for general and specialized, mobile and fixed deep-sea and space stations.
3. Quantum communications and quantum computing: Research and develop intra-city, inter-city, and free-space quantum communication technologies and develop a general quantum computing prototype and a practical quantum simulator.
4. Brain science and brain-inspired research: Based on the principles of brain cognition, use brain-inspired computing and brain-like machine intelligence (脑机智能) as two ways to diagnose and treat major brain diseases, build key technology platforms, and seize the commanding heights of cutting-edge research in brain science.
5. National cyberspace security: Develop a cyberspace security technology system covering both the information and network levels and improve technical capabilities such as information protection and network defense.
6. Deep space exploration and in-orbit spacecraft service and maintenance systems: Focus on breakthroughs in in-orbit service and maintenance technologies, improve the efficiency of China's space assets, and ensure the safe and reliable operation of spacecraft in orbit.

Major Engineering Projects (重大工程):

1. Independent innovation in the seed industry: Focusing on the four major seed industry fields of agricultural plants, animals, forests, and microorganisms, make key breakthroughs in modern seed industry key technologies such as the use of heterosis, breeding by molecular design (分子设计育种), and provide support for the national food security strategy.
2. Clean and efficient use of coal: Accelerate the development of core key technologies such as green coal development, high-efficiency coal power generation, clean coal conversion, coal pollution control, and carbon capture and storage, demonstrate and promote a number of advanced and

applicable technologies, achieve overall leadership in coal-fired power generation and ultra-low emission technologies, and make major breakthroughs in modern coal chemical and polygeneration technologies.

3. Smart grids: Focus on the deployment of large-scale renewable energy grid-connected control, flexible interconnection of large power grids, multi-user interactive power supply and demand, smart grid basic support technology, and other key tasks to achieve the full domestication of smart grid technology equipment and systems and increase China's global market share of electric power equipment.

4. Integrated space-to-ground information networks: Promote the comprehensive integration of space-based information networks, the Internet of the future, and mobile communication networks to form a global space-to-ground integrated information network.

5. Big data: Make breakthroughs in general-purpose key technologies related to big data, build a nationwide standard system and exchange platform for open data sharing, form a consensus application model and technical solution for typical applications, and form a big data industry cluster with global competitive advantages.

6. Smart manufacturing and robotics: With the overall goals of intelligent, efficient, collaborative, environmentally friendly, and safe development, build networked collaborative manufacturing platforms, research and develop intelligent robots, high-end complete equipment sets (高端成套装备), and three-dimensional (3D) printing equipment to consolidate the basic assurance capabilities of manufacturing (夯实制造基础保障能力).

7. R&D and applications of key new materials: Focus on the development of carbon fiber and its composite materials, high-temperature alloys, advanced semiconductor materials, new displays and relevant materials, special alloys for high-end equipment, new rare earth materials, new military materials, and other materials and make breakthroughs in core key technologies related to preparation, evaluation, and application.

8. Integrated governance of the Beijing-Tianjin-Hebei environment: Establish a core technology, industrial equipment, and standardized policy system for water-soil-air coordinated management, industrial-agricultural-urban resources coordinated cycles, and regional environment coordinated control. Construct a number of comprehensive demonstration projects to form a solution for comprehensive regional environmental management systems.

9. Health protection: Focusing on the needs of building a healthy China, strengthen the research and development of technologies such as precision medicine, deploy prevention and control of chronic non-communicable diseases and common and frequently occurring diseases, research the prevention and control of reproductive health and birth defects, accelerate the transfer and conversion of technological achievements, and promote demonstration services for the benefit of people.

Establish a dynamic adjustment mechanism for major projects, comprehensively grasp cutting-edge trends in international science and technology and the urgent needs of national economic and social development, select major tasks in deep earth exploration, artificial intelligence, and other fields, and enrich the layout of major projects in a timely manner.

The Science and Technology Innovation 2030—Major Projects and major national science and technology projects form a successively connected systematic layout that combines the near- and long terms. In the field of electronic information, form an overall layout covering the development of high-end chips and core software and hardware, cutting-edge technological breakthroughs, and the construction of information capabilities. In the field of advanced manufacturing, form an overall layout covering basic materials, key technologies, major strategic products, and equipment R&D. In the field of energy, form an overall layout covering multiple sources of energy, efficient and clean utilization, and cutting-edge technological breakthroughs. In the field of the environment, form a systematic technical solution from the transitions from

the treatment of individual pollutants to comprehensive regional treatment. In the field of agriculture, form an overall layout that takes into account cutting-edge technological breakthroughs and solves basic problems in the development of the seed industry. In the field of biology and health, form an overall layout covering major disease prevention, basic health protection services, and breakthroughs in cutting-edge medical technology. In the field of space and ocean development and utilization, form an overall layout covering space and ocean exploration and utilization technologies.

The connections between existing major national science and technology projects and newly deployed Science and Technology Innovation 2030—Major Projects and other scientific and technological plans and tasks need to be further strengthened to improve and innovate project implementation modes, improve project management systems, clarify management responsibilities, optimize management processes, and improve management efficiency. Improve the supervision and evaluation system and conduct regular evaluations. Strengthen dynamic adjustments and strengthen reserve demonstration of candidate major scientific and technological projects such as deep earth exploration.

Chapter 5: Constructing Modern Industrial Technology Systems with International Competitiveness

Grasp the new trends in the global scientific and technological revolution and industrial transformation, focus on the urgent need to increase the international competitiveness of our industries, strengthen major technology development in key segments of key areas, break through technological bottlenecks hindering industrial transformation and upgrades and the cultivation of emerging industries, construct technical systems with reasonable structures, advanced functions, open compatibility, and self-controllability, and provide strong support so that China's industry can move toward the mid-to-high end of the global value chain.

I. Develop Modern Agricultural Technology that is Highly Efficient and Ecologically Safe

With the goals of accelerating agricultural modernization, ensuring national food security, and increasing farmers' income, fully implement the strategy of preserving farmland and improving agricultural technology (藏粮与地、藏粮与技战略) and advance the deployment of cutting-edge and general-purpose key agricultural technology research. Focusing on making the national seed industry bigger and stronger, develop key technologies for design and breeding based on the study of species of flora and fauna, cultivate excellent varieties with independent intellectual property rights, develop technologies for improving the quality of cultivated land and comprehensive land improvement, and ensure national food security at the source; with the goal of developing a high-tech agricultural industry and supporting agricultural transformation and upgrades, focus on developing key technologies and products such as agricultural biological manufacturing, intelligent agricultural production, intelligent agricultural machinery and equipment, and facilities for agriculture; focusing on improving resource utilization, land output, and labor productivity, accelerate the transformation of agricultural development methods, achieve breakthroughs in a number of key technologies such as water-conserving agriculture, circular agriculture (循环农业), agricultural pollution control and repair, saline-alkaline land transformation, and agricultural and forestry disaster prevention and mitigation to achieve green

agricultural development. By 2020, strive to establish a modern agricultural technology system led by information technology, guided by biotechnology, and featuring intelligent production and sustainable development and support the efforts of agriculture to take a modern path of efficient output, product safety, resource conservation, and environmental friendliness.

Box 4 Modern Agricultural Technology

1. Biological breeding R&D: Focusing on crops, livestock, and poultry products and forest fruits and flowers, make breakthroughs in core key technologies such as germplasm resource mining, engineered breeding, new variety creation, large-scale testing, elite breeding, and seed processing and cultivate a number of breakthroughs in new animal and plant varieties that effectively combine high productivity, high efficiency, high quality, high resistance, and wide adaptability; and cultivate modern seed industry enterprises with strong core competitiveness and significantly improve the independent innovation capability of the seed industry.

2. Increased grain production efficiency: Focusing on food security and agricultural restructuring and the scientific and technological needs for high-yield and efficient coordination of crops and production ecosystem coordination, in the three major plains regions (the northeast, the Yellow-Huai-Hai River basin, and the middle and lower reaches of the Yangtze River), carry out research on new theories, new technologies, and integrated demonstration studies on the high yield and efficiency of the three major crops of rice, wheat, and corn. Increase output by 5%, reduce losses by more than 5%, increase fertilizer and water efficiency by more than 10%, increase light and temperature resource efficiency by 15%, and increase production efficiency by 20%.

3. High quality and high yield of major cash crops and industrial quality and efficiency improvement: With the object of the large-scale plantation of fruit trees, flowers, tea, woody (herb) oilseeds, tropical cash crops, special economic plants, miscellaneous grains, and other products, focus on breakthroughs in theories and methods for increasing production, quality, and efficiency, create excellent new germplasm, research and develop new products, form efficient lightweight technology, ensure the diversity of China's agricultural products and national agricultural security, and promote the quality and efficiency of major cash crop industries.

4. Scientific and technological innovation in marine agriculture (blue granary) and freshwater fisheries: Research new principles, new equipment, new methods, and new technologies related to germplasm resource development, the breeding of new varieties, healthy freshwater and seawater breeding, fishing and new resource development, intensive processing, and fishery environmental protection, establish a regional blue granary with ecological priority, land and sea integration, and three-industry coordination, promote the comprehensive utilization of marine agricultural resources, improve the ecological environment of fisheries, strengthen the supply of high-quality protein, and lead the healthy development of marine agriculture and freshwater fisheries.

5. Safe and efficient breeding of livestock and poultry and healthy development of grass husbandry: With the goals of safety, environmental protection, and efficiency, focus on technology R&D for the detection and prevention of major animal epidemics, the safe and healthy breeding processes and environment control of major livestock and poultry, livestock and poultry breeding facilities and equipment, the non-harmful treatment and resource utilization of breeding waste, the feed industry, herbivorous animal husbandry, grassland ecological protection, and the improvement of quality and efficiency throughout the entire animal husbandry production chain and provide theoretical and technical support for the transformation and upgrading of China's aquaculture industry.

6. Cultivation and efficient use of forestry resources: Strengthen research on key technologies such as efficient cultivation and green value-added processing of fast-growing timber forests, precious timber forests, economic forests, and flowers, carry out integration and demonstration of value-added and efficiency-enhancing technologies throughout the entire forestry production chain, form a new model of industrial cluster development, increase unit accumulation by 15%, increase resource utilization efficiency by 20%, and significantly improve the international competitiveness of major forest products.

7. Comprehensive prevention and rehabilitation of farmland polluted by agricultural non-point source and heavy metal pollution: Make breakthroughs in the basic theory of pollution mechanisms in agricultural and forest ecosystems such as nitrogen and phosphorus, toxic and harmful chemicals and organisms, heavy metals, and agricultural and forestry organic waste and major key technical bottlenecks in prevention and repair. Enhance the standardization and industrialization of technology, products, and equipment. Formulate technical plans for the comprehensive prevention and control of pollution in key areas to effectively curb agricultural non-point source and heavy metal pollution problems.

8. Sustainable use of agricultural and forestry resources and environments: Make breakthroughs in key technologies related to fertilizer reduction, efficient use of water and land resources, ecological restoration, and agricultural and forestry disaster prevention and mitigation, strengthen research on key technologies for crop disease and pest control, improve comprehensive crop disease and insect pest management capabilities, and promote the formation of an agricultural development pattern featuring efficient use of resources, stable ecosystems, good production environments, and high product quality and safety.

9. Improving grain and efficiency in low-yield fields such as saline-alkaline land: Strengthen research on basic theories and key technical improvements related to saline-alkaline soil water and salt transport mechanisms and regulation, soil washing and salt removal, brackish water utilization, selection and breeding of new varieties of salt-tolerant crops and alternative cultivation, and water regulation. Develop new high-efficiency saline-alkaline land improvers, bio-organic fertilizers, and other new products and materials. Develop new equipment for the treatment of saline-alkaline land, select typical saline-alkaline land and low-yield fields to establish demonstration bases, and promote the demonstrative application of research and development results.

10. Agricultural biological manufacturing: Focusing on biological pesticides, biological fertilizers, and biological feeds, carry out research on mechanisms of action, target design, synthetic biology, pathogenic mechanisms, and nutrient controlled release mechanisms and create new types of genetically engineered vaccines and molecular diagnostic technologies, biological pesticides, biological feeds, biological fertilizers, plant growth regulators, bioenergy sources, bio-based materials, and other agricultural biological products and industrialize them.

11. Agricultural machinery equipment and facilities: Make breakthroughs in key core technologies such as decision monitoring, advanced operating devices, and their manufacture, develop technologies and equipment for efficient and environmentally-friendly agricultural and forestry power, multi-functional and varied position operations, facility planting and healthy farming & refined production, agricultural product origin treatment and drying, forest cultivation, harvest processing, and forest disaster prevention and control, form an intelligent agricultural and forestry equipment technology system, and support comprehensive mechanized development throughout the process.

12. Efficient use of agricultural and forestry biomass: Research new theories, new technologies, and new formats related to the clean collection and storage, high-efficiency conversion, product quality improvement, and industrial efficiency of agricultural and forestry waste (crop straw, livestock and poultry manure, forestry residues, etc.) and new biomass resources (plant-based energy sources, microalgae, etc.), raise agricultural and forestry biomass efficient use technology to a world-leading level, and increase the utilization rate to over 80%.

13. Smart agriculture: Develop key technologies and products for acquiring and analyzing biological information of agricultural and forestry animals and plants, identifying and visualizing phenotypic features, and accurately implementing major operations, establish modern production technology systems such as precision production in fields and orchards, intelligent production in agricultural facilities, and large-scale livestock and poultry aquaculture information operations, and establish an information service system for agricultural production, peasant life, rural management, and the development of new rural industries.

14. Intelligent and efficient facility agriculture: Make breakthroughs in basic theories, such as facility photothermal dynamics mechanisms and environmental and biological interaction response mechanisms, and in key technical bottlenecks such as lightweight facility assembly, full-process mechanization, intelligent environmental controls, and the integration of water and fertilizer

management, develop advanced technology and equipment such as energy-saving storage in greenhouses, photovoltaic utilization, and smart aerial farms, and achieve leapfrog development in facility agricultural science & technology and industrialization.

II. Develop New Generation Information Technology

Vigorously develop a new generation of ubiquitous convergence, green broadband, and secure and intelligent information technology, research and develop new generation Internet technologies, ensure the security of cyberspace, and promote the wide penetration and deep integration of information technology into various industries. Develop advanced computing technology, focus on strengthening the R&D and application of exascale (quintillion computations per second) computing, cloud computing, quantum computing, human-based computation (人本计算), heterogeneous computing, intelligent computing, and machine learning; develop network and communication technology and focus on strengthening the R&D and application of integrated converged networks (一体化融合网络), software-defined networking/network function virtualization, ultra-high-speed/ultra-large capacity/ultra-long-distance optical communications, wireless mobile communications, terahertz communications, and visible light communications; and develop natural human-computer interaction technology focusing on the development and application of technologies such as intelligent perception and cognition, real and virtual fusion and natural interaction, semantic understanding and intelligent decision-making, cloud-based fusion and interaction, and wearable technology. Develop microelectronic and optoelectronic technologies and focus on strengthening the research and development of technologies and devices such as ultra-low-power chips, new sensors, third-generation semiconductor chips and silicon-based optoelectronics, hybrid optoelectronics, and microwave optoelectronics.

Box 5 New Generation Information Technology

1. Micro- and nanoelectronics and system integration technology: Carry out cutting-edge research and related theoretical research on new semiconductor materials, new devices, new processes, and new circuits that approach the physical limits of devices and are oriented to different system applications, make breakthroughs in key technologies such as extremely low power devices and circuits, new devices below 7 nanometers and system integration processes, new generation non-volatile memory, new generation radio frequency chips, silicon-based terahertz technology, and computing chips based on new principles, accelerate the production R&D of 10nm and below device technology, and significantly increase the market share of smart terminal and IoT system chip products.

2. Optoelectronic devices and integration: Aiming at the core technical bottlenecks that hinder the improvement of information technology in terms of speed, energy consumption, and intelligence, develop optoelectronic integrated devices required for high-speed optical communication equipment; and make breakthroughs in the standardization difficulties and technical bottlenecks of optoelectronic device manufacturing, establish and develop optoelectronic device application demonstration platforms and supporting technology systems, gradually form a systematic research and development platform covering analysis models, optimization design, chip preparation, test packaging, and reliability research, and raise China's information optoelectronic device technology and integrated circuit design to an internationally advanced level.

3. High-performance computing: Make breakthroughs in exascale computing core technology, rely on independently controllable (自主可控) technology, develop an exascale high-performance computer system to meet application needs, and raise the performance of China's high-performance computers to a world-leading level during the 13th Five-Year Plan period. Research and develop a batch of high-performance computing application software products in key areas/industries, establish a

number of high-performance computing application software centers, and build a high-performance computing application ecosystem. Establish a national high-performance computing environment with world-class resource capabilities and service levels and promote the development of China's computing service industry.

4. Cloud computing: Carry out the development of cloud computing core basic software, software-defined cloud system management platforms, new generation virtualization, and other core cloud computing technologies and equipment and the construction of cloud open source communities, build a complete cloud computing ecosystem and technology system, support cloud computing as the infrastructure of new generation ICT (information and communication technology), and promote the deep coupling and interactive development of cloud computing, big data, and mobile Internet.

5. Artificial intelligence: Focus on the development of big data-driven humanlike machine intelligence technology methods; make breakthroughs in the theory, methods, and key technology of human-centered human-cyber-physical fusion (人机物融合) and develop related equipment, tools, and platforms; and make important breakthroughs in the direction of humanlike machine intelligence based on big data analysis, achieve human-like vision, human-like hearing, human-like language, and human-like thinking, and support the development of intelligent industries.

6. Broadband communications and new networks: Focusing on the development of network integration as the main approach, make breakthroughs in core key technologies such as integrated converged networking (一体化融合网络组网), ultra-high-speed and ultra-broadband communications, and network support, make a number of breakthrough achievements in chips, complete network equipment (成套网络设备), network architecture, and other areas, advance the deployment of new generation network technology, and significantly enhance the international competitiveness of the network industry.

7. Internet of Things: Carry out basic theoretical research on IoT system architecture, sensing and control of information and physical systems, and other areas, make achievements in key technologies such as intelligent hardware (hardware-embedded intelligence) and low-power trusted ubiquitous access to Internet of Things, build a basic support platform for general-purpose technical innovation related to the Internet of Things, and convert intelligent sensing chips, software, and terminal technology into products.

8. Intelligent interaction (智能交互): Explore the realization of cognitive processing mechanisms and mental movement models in machines, build a theoretical system for intelligent interaction, make breakthroughs in core key technologies such as natural interaction, physiological computing (生理计算), and emotional expression, form a common basic software and hardware platform for intelligent interaction, improve original innovation capabilities for intelligent interaction equipment and systems, form demonstration applications in key industries such as education, office work, and medical care, and raise research and applications in the field of human-computer interaction to an internationally advanced level.

9. Virtual reality and augmented reality: Make breakthroughs in a number of key technologies, such as virtual-real fusion rendering, true three-dimensional rendering, real-time location registration, and human-friendly virtual reality technology, form core devices with independent intellectual property rights such as high-performance true three-dimensional displays, smart glasses, motion capture and analysis systems, and personalized virtual reality packages. Basically form the normative standards of virtual reality and augmented reality technologies in terms of display, interaction, content, and interfaces. Realize professional and popular demonstration applications in fields such as industry, medical care, culture, and entertainment and cultivate virtual reality and augmented reality industries.

10. Smart cities: Carry out basic theoretical research on urban computing intelligence, urban system models, and group collaborative services, make breakthroughs in general-purpose key technologies such as urban multi-scale stereo perception (城市多尺度立体感知), cross-domain data aggregation and management, intelligent decision-making for spatio-temporal data fusion, urban data activation services, and urban system security assurance, research and develop smart city public service integrated operation platforms, and carry out innovative demonstrations of the centralized application of new smart city clusters.

III. Develop Smart Green Service Manufacturing Technology

Focusing on building a manufacturing superpower (制造强国), vigorously promote the development of the manufacturing industry in an intelligent, environmentally friendly, and service-oriented direction. Develop network collaborative manufacturing technology, focus on researching key technologies such as innovative design based on "Internet+," IoT-based smart factories, manufacturing resource integration and control, and full life-cycle manufacturing services; develop green manufacturing technologies and products, focus on key technologies such as redesign, remanufacturing, and resource recovery, and promote innovation in manufacturing production models and industrial formats. Develop key technologies such as robots, intelligent sensing, intelligent control, micro/nanomanufacturing, and complex manufacturing systems, develop key intelligent equipment sets, photoelectronic manufacturing equipment, intelligent robots, additive manufacturing, laser manufacturing, and other key equipment and processes, and promote the intelligent development of manufacturing. Carry out research and development of basic general-purpose manufacturing technologies such as design technology, reliability technology, manufacturing processes, key basic parts, industrial sensors, intelligent instruments, basic databases, and industrial test platforms to improve basic manufacturing capabilities. Promote the improved efficiency of manufacturing information services, strengthen the innovative application demonstration of the "numerical control generation" (“数控一代”) of manufacturing equipment and products, improve the level of manufacturing informatization and automation, and support the transformation and upgrading of traditional manufacturing.

Box 6 Advanced Manufacturing Technology

1. Network collaborative manufacturing: Carry out research on cutting-edge technologies such as industrial information and physical fusion theory and systems and industrial big data, make breakthroughs in key technologies such as smart data spaces and smart factory heterogeneous integration, development of new models of "Internet+" manufacturing, such as new R&D design, intelligent engineering, cloud services, and personalized customization, cultivate a group of smart enterprises, and conduct typical demonstration applications.

2. Green manufacturing: Develop green design technology, basic processing technology, electromechanical product development technology, and remanufacturing and resource recovery technology, build a green manufacturing technology system based on the entire product lifecycle, and promote the application and industrial demonstration of green manufacturing technologies and equipment.

3. Intelligent equipment and advanced technology: Carry out research on key technologies such as non-traditional manufacturing processing and processes and the reliability and intelligence of major equipment, develop a group of representative intelligent processing equipment, advanced process equipment, and complete sets of major intelligent equipment, and lead the intelligent upgrade of equipment.

4. Key equipment for optoelectronic manufacturing: Carry out research and development of key manufacturing equipment for emerging industries such as new optical communication devices, semiconductor lighting, high-efficiency solar cells, MEMS (microelectromechanical systems) sensors, flexible displays, new power devices, and new generation semiconductor material preparation, and enhance independent R&D capabilities for core equipment in emerging fields.

5. Intelligent robots: Carry out research on cutting-edge technologies such as new generation robotics, intelligent robot learning and cognition, and natural human-machine interaction and collaboration, make achievements in key technologies of core components, achieve the

industrialization of industrial robots, achieve the commercialization of service robots, and achieve the batch application of special robots.

6. Additive manufacturing: Carry out basic theoretical research on shape control (空形控性) of laser additive manufacturing for high-performance metal structural parts, make achievements in core components such as cladding nozzles for efficient and high-precision laser additive manufacturing, research and develop typical processing equipment for metal, non-metal, and bioprinting, and construct a relatively complete additive manufacturing technology innovation and R&D system.

7. Laser manufacturing: Carry out theoretical research on ultra-fast-pulse and ultra-high-power laser manufacturing, make breakthroughs in key laser manufacturing technologies, develop core functional components for high-reliability long-life lasers and processing equipment for the manufacture of advanced Chinese-made lasers and high-end lasers, and develop advanced laser manufacturing application technologies and equipment.

8. Basic technology and key components for manufacturing: Research basic cutting-edge technologies such as key basic parts and basic processes, establish and improve basic databases, improve the technical standard system and industrial test verification platform, develop a number of high-end products, improve support capabilities for key areas and major complete equipment sets.

9. Industrial sensors: Carry out technical research on industrial sensor core devices, intelligent instruments and meters, and sensor integration applications, strengthen the application of industrial sensor technology in the construction of smart manufacturing systems, and improve the technological innovation capability of the industrial sensor industry.

IV. Develop New Materials Technologies

Focusing on the major needs for new materials in key basic industries, strategic emerging industries, and national defense construction, accelerate technological breakthroughs and applications of new materials. Develop advanced structural material technologies, with a focus on technologies and applications such as high-temperature alloys, high-quality special steels, advanced light alloys, special engineering plastics, high-performance fibers and composite materials, special glass, and ceramics. Develop advanced functional material technologies, with a focus on the technologies and applications of third-generation semiconductor materials, nanomaterials, new energy materials, printed display and laser display materials, smart/bionic/supermaterials, high-temperature superconductor materials, new rare earth materials, membrane separation materials, new biomedical materials, and ecological materials. Develop transformative materials R&D and new green manufacturing technologies, with a focus on key technologies and supporting platforms for genetically engineered materials and green manufacturing technologies and engineering applications of materials features short processes, near-end shape (近终形), high energy efficiency, and low emissions.

Box 7 New Materials Technology

1. Key basic materials: Focus on solving major common problems such as the homogeneity, low value, high environmental impact, low energy efficiency, and resource bottleneck constraints of basic material products, make breakthroughs in key technologies related to the design and development of basic materials, manufacturing processes, process optimization, and intelligent green transformations and Chinese-made equipment, and carry out advanced production demonstrations.

2. Advanced electronic materials: With third-generation semiconductor materials, semiconductor lighting, and new displays in the central position and focusing on high-power laser materials and devices and high-end optoelectronics and microelectronic materials, promote cross-border technology integration and seize a commanding position in the field of advanced electronic materials technology.

3. Genetically engineered materials: Build high-throughput calculation, high-throughput experiment, and dedicated database platforms, research and develop the four key technologies of

multi-level and cross-scale design, high-throughput preparation, high-throughput characterization and service evaluation, and material big data, achieve the transition of new materials R&D from the traditional "experience-guided experiment" model to the "theoretical prediction, experimental verification" model, make breakthroughs in the application demonstration of five types of typical new materials, and achieve the goal of shortening the R&D cycle of new materials by half and reducing the cost of R&D by half.

4. Nanomaterials and devices: Research and develop new nano functional materials, nano optical devices and integrated systems, nano biomedical materials, nano-medicines, nano energy materials and devices, nano environmental materials, and nano security and detection technologies, make breakthroughs in the key technologies and standards of nanomaterial macro preparation and device processing, and strengthen demonstration applications.

5. Advanced structural materials: With high-performance fibers and composite materials and high-temperature alloys at the central position and focusing on lightweight and high-strength materials, metal-based and ceramic-based composite materials, material surface engineering, and 3D printing materials, solve major scientific issues in material design and structural regulation, make breakthroughs in key general-purpose technologies in the preparation and application of structures and composite materials, and improve the support capability and international competitiveness of advanced structural materials.

6. Advanced functional materials: Focus on strategic new materials such as rare earth functional materials, advanced energy materials, high-performance membrane materials, functional ceramics, and special glass, and vigorously improve the support capability of functional materials in major projects; use advanced carbon materials such as graphene and high-end carbon fiber, superconducting materials, smart/bionic/supermaterials, and extreme environment materials as breakout points to seize a commanding position in the field of cutting-edge materials.

V. Develop Clean and Efficient Energy Technologies

Vigorously develop clean, low-carbon, safe, and efficient modern energy technologies, support the optimization and adjustment of energy structures and reduce greenhouse gas emissions, ensure energy security, and promote the energy revolution. Develop the clean and efficient use of coal and new energy-saving technologies, focusing on strengthening R&D and application of technologies such as high-efficiency coal power generation, clean coal conversion, coal-fired carbon dioxide capture and storage, deep recovery of waste heat and pressure, shallow low-temperature ground energy development and utilization, new energy-saving motors, integration of urban energy conservation systems, industrial process energy conservation, energy cascade utilization, "Internet+" energy conservation, and large data center energy conservation. Develop large-scale renewable energy development and utilization technologies focusing on strengthening the R&D and application of technologies such as high-efficiency and low-cost solar cells, CSP, solar heating and cooling, large advanced wind turbines, offshore wind power construction and O&M, biomass power generation and heating, and liquid fuels. Develop smart grid technology focusing on strengthening the R&D and application of technologies such as UHV transmission, flexible transmission, large-scale renewable energy grid connection and consumption, grid interaction with users, distributed energy, energy Internet, and large-capacity energy storage and energy microgrids. Steadily develop nuclear energy and nuclear safety technologies and their applications focusing on the R&D and application of technologies such as safe nuclear power plant operation, large advanced pressurized water reactors, ultra-high temperature gas-cooled reactors, advanced fast reactors, small nuclear reactors, and reprocessing. Implement the "Science and Technology Winter Olympics" action plan to provide

zero-carbon/low-carbon and economically intelligent energy solutions for the Olympic area and surrounding areas.

Box 8 Clean and Efficient Energy Technology

1. Safe, clean, and efficient coal development and utilization and new types of energy conservation: Make breakthroughs in coal-fired power generation technology, achieve an average coal consumption of 305 grams of standard coal per kilowatt-hour in thermal power plants, raise the domestic production of key technologies and equipment for coal-based clean gas to over 90%. Make breakthroughs in coal pollution control technologies and reduce emissions of conventional pollutants to 50% of their current levels. Carry out large-scale demonstrations of post-combustion carbon dioxide capture to achieve one million tons/year.

2. Renewable energy and hydrogen technology: Carry out research on systems, components, equipment, materials, and platforms in the fields of solar photovoltaic and solar thermal utilization, wind energy, biomass energy, geothermal energy, marine energy, hydrogen energy, and the comprehensive utilization of renewable energy.

3. Nuclear safety and advanced nuclear energy: Carry out research on advanced nuclear fuel, spent fuel reprocessing, radioactive waste treatment, severe accidents, risk management, reactor simulations (数值反应堆), aging and life extension of power plants, ultra-high temperature gas-cooled reactors, advanced fast reactors, supercritical water-cooled reactors, new modular small reactors, and other areas.

4. Smart grids: Develop a set of ± 1100 kV DC and flexible DC power transmission equipment and construct a ± 1100 kV UHV DC transmission demonstration project. Achieve grid-connected consumption of 250 million kilowatts of wind power and 150 million kilowatts of photovoltaic power and build an interactive power supply system with millions of users.

5. Energy-efficient buildings: Make breakthroughs in technical standards for ultra-low-energy building and building energy evaluation systems, research basic technologies such as energy-saving integration technology and high-efficiency cooling technology, develop key technologies for the coordinated and efficient utilization of active/passive multi-energy systems, new types of daylighting, and efficient lighting, and reduce energy consumption.

VI. Develop Modern Transportation Technology and Equipment

Facing the major needs of building “safe transportation, efficient transportation, green transportation, and harmonious transportation,” vigorously develop new-energy, efficient, and safe system technologies and equipment, improve the core technology systems of modern transportation in China, and cultivate emerging industries such as new energy vehicles, high-end rail transportation, and civil aviation. Focus on the development of intelligent, connected, lightweight, and autonomous driving technologies for electric vehicles, develop internationally competitive high-speed trains, high- and medium-speed maglevs, and fast freight transportation technology and equipment, develop safe, intelligent, and green technologies for rail transportation, research and develop cutting-edge transportation management technology, and enhance the sustainable development capacity of the transportation industry and its capability to support the "Go Global" (“走出去”) strategy.

Box 9 Modern Transportation Technology and Equipment

1. New energy vehicles: Implement the "pure electric drive" technology transformation strategy, following the "three vertical and three horizontal" R&D system, make breakthroughs in basic cutting-edge and core key technologies for batteries and battery management, motor drive and power electronics, intelligent technology for electric vehicles, fuel cell power systems, plug-in/extended range hybrid power systems, and pure electric power systems, improve the system of energy consumption

and safety standards for new energy vehicles, form a complete electric vehicle power system technology system and production chain, and achieve the industrialization of various electric vehicles.

2. Rail transportation: In the directions of rail transportation system security, comprehensive efficiency improvement, sustainability, and interoperability, form core technologies, key equipment, integrated applications, and standards that are characterized by new architectures, new materials, new energy, and cross-border interconnection. Strengthen the research and development of key technologies and equipment for high-speed trains, high-speed maglevs, medium-speed maglevs, combined transportation, express freight, and high-speed freight, meet the requirements for inter-European railway interconnection, and reach internationally advanced levels in operating costs, operational safety, and energy consumption per unit turnover for rail transportation systems.

3. Marine transportation: Make breakthroughs in the core technology for green and intelligent ships, form an intelligent technology system for ship operation and maintenance, develop a batch of high-tech, high-performance ships and high-efficiency general supporting products, provide support for improving the overall level of China's shipbuilding and shipping, and nurture industries such as green ships and intelligent ships.

4. Air transportation technology and equipment: Carry out demonstrations and research for future civil aircraft product concept plans (new configurations, new energy, supersonic speed), make breakthroughs in aeroacoustics and low-noise design, advanced avionics, flight control technology, advanced multi-power system aircraft, and integrated aircraft/engine designs, and provide support for improving the competitiveness of civilian aircraft products. Aiming at the technical foundation required for the opening of low-altitude airspace to air transport services, the development of general aviation, and the establishment of an aviation emergency rescue system and focusing on the two main lines of safe, efficient, and green aircraft and air transport systems, master cutting-edge core technologies in key areas such as navigable aircraft, coordinated air traffic control, and airport traffic control technology.

5. Comprehensive transportation and intelligent transportation: With the goal of providing efficient, convenient, and sustainable transportation, make breakthroughs in common key technologies such as accurate perception and reliable interaction of traffic information, collaborative interoperability of transportation systems, and ubiquitous intelligent transportation services. Focus on solving problems related to the functional improvement and design of comprehensive transportation information services, transportation system control optimization, and urban traffic control and promote the integrated development of the transportation industry and related industries.

VII. Develop Advanced and Efficient Biotechnology

Aiming at the forefront of world technology, seize the strategic opportunities for the integrated development of biotechnology and various other fields, adhere to the principles of advanced deployment and leadership in innovation, promote innovation and development of healthy living, bio-manufacturing, and bio-energy through biotechnology innovation, and accelerate the transformation of China from a biotech power (生物技术大国) to a biotech superpower (生物技术强国). Focus on the deployment of cutting-edge general-purpose biotechnology, new biomedicine, green biomanufacturing technology, advanced biomedical materials, biological resource utilization, biosafety assurance, and the R&D of life science instruments, accelerate innovative breakthroughs and application development for leading technologies such as synthetic biotechnology, biological big data, regenerative medicine, and 3D bioprinting, improve the national level of biotechnology originality, strive for integrated breakthroughs in several areas, promote the conversion of technologies into applications to serve national economic and social development, and significantly improve the international competitiveness of China's bioeconomy.

Box 10 Advanced Efficient Biotechnology

1. Cutting-edge general-purpose biotechnology: Accelerate breakthroughs in cutting-edge key technology in life sciences such as new genomics technologies, synthetic biotechnology, biological big data, 3D bioprinting technology, brain science and artificial intelligence, gene editing technology, and structural biology, strengthen the R&D of key equipment for the development of biological industry and life science research, improve the originality of cutting-edge biotechnology in China, and seize a commanding position in international biotechnology competition.

2. New biomedical technologies: Carry out research on key technologies such as major vaccines, antibody development, immunotherapy, gene therapy, cell therapy, stem cell and regenerative medicine, and human microbiome analysis and regulation, research and develop a number of innovative pharmaceutical biological products, and construct an internationally competitive pharmaceutical biotechnology industry system.

3. Biomedical materials: Following the directions of tissue replacement, functional repair, and intelligent regulation, accelerate key technological breakthroughs in areas such as 3D bioprinting, biological functionalization and modification of material surfaces, and new generation biomaterial inspection and evaluation methods, focus on a layout that organizes major strategic products such as bio-inductive medical materials, tissue engineering products, new generation implanted medical devices, and artificial organs, raise the standards of medical-grade basic raw materials, build a product innovation chain for new generation biomedical materials, and enhance the competitiveness of the Chinese biomedical materials industry.

4. Green biomanufacturing technology: Carry out research on the manufacturing of major chemical products, the development of new bioenergy, the biotransformation of organic waste and gaseous carbon oxide resources (气态碳氧化物), and the replacement of biological processes in heavily polluting industries, make breakthroughs in key technical bottlenecks such as raw material conversion and utilization, bioprocess efficiency, and biomanufacturing costs, expand new sources of industrial raw materials and develop new green manufacturing processes, and form a new route for the economical and green development of industry and energy led by biotechnology.

5. Biological resource utilization technology: Focus on the integration, mining, and utilization of strategic biological resources, promote the systematic integration and deep utilization of human genetic resources, build a national strategic biological resource bank and information service platform, expand resource reserves, strengthen development sharing, take the initiative in utilization and development, and provide resources for the sustainable development of the biological industry.

6. Biosafety technology: Carry out research on biosafety technologies such as biological threat risk assessment, monitoring and early warning, detection and traceability, prevention and control, and emergency treatment, establish a biosafety information and physical resource library, and construct a highly integrated national biosafety defense system.

VIII. Develop Modern Food Manufacturing Technology

Following the high-tech, intelligent, multi-gradient, full utilization, low energy consumption, highly beneficial, and sustainable international development trends in modern food manufacturing, and focusing on major industrial needs such as standardized processing, intelligent control, and healthy consumption, use modern processing and manufacturing as the main approach to accelerate the development and application of engineering technologies such as efficient separation, texture reorganization, physical property modification, biological manufacturing, energy-saving drying, and new sterilization; make achievements in the manufacturing technology of continuous, automated, digital, and programmatic complete equipment sets and break through the equipment constraints hindering the development of the food industry; attach importance to food quality and safety, focus on prominent issues such as the increasing pollution of food sources, weak process safety control capabilities, and insufficient

support of regulatory technology, and focus on research on key technologies for food safety protection such as monitoring and detection, risk assessment, traceability-based early warning, process control, and regulatory emergency response; focus on the development of freshness-preserving logistics, carry out R&D on technologies urgently needed by industry such as intelligent cold chain logistics, green preservation, new packaging control, modern grain storage, and grain loss reduction; and targeting nutrition and health, make breakthroughs in advanced technologies such as steady-state maintenance and targeted delivery of nutritional functional components, targeted nutrition design and precision manufacturing of healthy foods, and the modernization of staple foods. Strive to achieve major breakthroughs in the fields of nutrition optimization, physical property modification, intelligent processing, low-carbon manufacturing, cold-chain logistics, and full-process control and form a relatively complete modern food manufacturing technology system to support the transformation, upgrading, and sustainable development of China's modern food manufacturing industry by 2020.

Box 11 Modern Food Manufacturing Technology

1. Processing and manufacturing: Carry out research on new energy-saving drying, ultra-fine crushing, freezing and refrigeration, sterilization packaging, and other general-purpose technologies, make breakthroughs in key technologies such as physical property reconstruction, flavor modification, texture reorganization, low-temperature processing, and biological manufacturing, make achievements in core technologies such as green processing, low-carbon manufacturing, and quality control, and effectively support the technological upgrading of the food processing industry.

2. Mechanical equipment: Carry out research on new methods and principles for the mechanical physical properties, digital design, information perception, and simulation optimization of food equipment, research and develop general-purpose equipment for non-thermal processing, new sterilization, efficient separation, and automatic packaging, key equipment for energy-saving extrusion, efficient drying, continuous baking, and 3D printing, as well as continuous, automated, intelligent, and programmatic complete sets of processing equipment, and provide support for the upgrade of food equipment.

3. Quality and safety: Carry out common technical research on food quality evaluation and system identification, targeted screening and precise verification of hazard factors, multi-risk analysis and exposure assessment, online monitoring and rapid detection, safety control principles and processes, and supervision and emergency response, focus on breakthroughs in core technologies such as non-targeted screening of food risk factors, efficient screening of core reagents for rapid detection, in vitro alternative toxicity testing, full gene traceability of pathogenic organisms, traceability and control throughout the entire production chain, and authenticity identification, strengthen research on key technologies for food safety protection, strengthen research on basic food safety standards, strengthening research on regulatory technologies based on emerging Internet formats, and build a quality and safety technology system for the entire production chain.

4. Freshness-preserving logistics: Carry out general-purpose technology research on food quality maintenance, loss control, and shelf life extension in the logistics process, make breakthroughs in key technologies such as the precise control of environmental factors, intelligent detection and control of quality deterioration, and new green packaging, strengthen the research and development of key technologies and equipment for modern grain reserves, carry out R&D and demonstration of key technologies for grain distribution and food loss reduction, master the core technologies of intelligent cold chain logistics, and green preservation, establish a new cold chain logistics model for food in China, and promote the leapfrog development of the food preservation logistics industry.

5. Nutrition and health: Carry out research on the regulation of food nutrition quality, nutritional genomics, and anti-chronic disease mechanisms, make breakthroughs in key technologies such as nutritional functional component screening, homeostasis maintenance, and efficacy evaluation, master core technologies such as efficient delivery and targeted delivery of nutritional functional components

and big data mining of nutritional metabolomics as well as nutrition-targeted design based on improved intestinal microecology and new precision manufacturing technology for health foods, strengthen the R&D of key food nutrition and health mechanisms and modern key technologies, develop diverse and personalized nutritional health foods, and strongly support the improvement of national nutrition and health.

IX. Develop Modern Service Technology to Support Business Model Innovation

Looking at the development needs of the platform economy, crowdsourcing economy, maker economy, cross-border economy, and sharing economy in the "Internet+" era, and supported by new generation information and network technologies, strengthen the technical infrastructure construction of the modern service industry, strengthen technology integration and business model innovation, and improve the level of innovation and development of the modern service industry. With respect to the common needs of productive services, focus on promoting the development of e-commerce, modern logistics, and system outsourcing, enhance service capabilities, improve service efficiency, and increase the added value of services. Strengthen the R&D and integrated application of service technologies under the conditions of networking, personalization, and virtualization, and strengthen the R&D of key technologies for the cultural industry. Vigorously carry out service model innovation and focus on the development of emerging services such as digital culture, digital healthcare and health, digital lifestyle, and education and training. Focusing on the technological innovation needs of enterprises, accelerate the integrated development of industrial design, cultural creativity, and related industries and enhance China's innovative design capabilities in key industries.

X. Develop Disruptive Technology to Lead Industrial Transformations

Strengthen early warning systems for industrial changes and major technologies, strengthening the predictions of inflection points marking the replacement of traditional industries by disruptive technologies, and promptly plan cutting-edge technology R&D in emerging industries; accelerate the deployment of a number of disruptive technology research projects with significant impact that can change or partially change the technological, economic, social, and ecological landscape in fields such as information, manufacturing, biology, new materials, and energy, and especially those featuring cross-integration; and gain a competitive advantage in the new round of industrial transformation. Focus on the development of mobile Internet, quantum information, artificial intelligence, and other technologies, promote the development of technologies such as additive manufacturing, intelligent robots, and driverless cars, emphasize the profound impact of technologies such as gene editing, stem cells, synthetic biology, and regenerative medicine on the fields of life sciences, biological breeding, and industrial biology, develop new generation energy technologies such as hydrogen and fuel cells, and allow nanotechnology, smart technology, and graphene to play a leading role in the development of the new materials industry.

Chapter 6: Reinforcing the Technological Systems Supporting the Improvement of People's Lives and Sustainable Development

Focusing on the urgent need to improve people's lives and promote sustainable development, strengthen the research on and practical application of key technologies in the

fields of resources and the environment, population health, new urbanization, and public safety, form a green development approach and lifestyle, and provide the technological support to comprehensively improve the quality of people's lives.

I. Develop Environmental Protection Technology

With the goals of providing systematic technical solutions to major environmental problems and developing eco-friendly high-tech industrial systems, form a complete set of technologies for source control, clean production, end-of-line management, and ecological restoration. Strengthen research on the formation mechanisms of atmospheric pollution and key technologies for the tracking and analysis of pollution sources and improve air quality forecasting and pollution warning technology; strengthen the construction of water quality monitoring, forecasting, and early warning technology systems for important bodies of water, water sources, source areas, and water conservation areas; make breakthroughs in key technologies such as drinking water quality and health risk control, groundwater pollution prevention and control, sewage and wastewater resource reclamation, energy utilization, and safe use, waste treatment and clean incineration power generation, and radioactive waste treatment and disposal; conduct basic research on soil pollution mechanisms and risk assessment and improve key technologies for soil environment monitoring and pollution early warning; strengthen environmental benchmarking research; and carry out research on new technologies and methods of environmental monitoring and improve the environmental monitoring technology system. Improve the comprehensiveness, automation, and intelligence environmental monitoring and promote the construction of an environmental monitoring network that integrates land and sea, sky and earth and is characterized by full coordination and information sharing.

Make breakthroughs in ecological evaluation and ecological product designs and realize key technologies for environmental safety process control and environmentally friendly replacement. Develop environmental health risk assessment and management technologies and environmentally friendly alternative technologies for high-risk chemicals and carry out research on ecological evaluation and ecological reconstruction for major projects. Conduct pilot demonstrations of environmental pollution prevention technology applications in key areas such as the Beijing-Tianjin-Hebei region and the Yangtze River Economic Belt, promote green technology transfers and conversion into practical applications, strengthen the construction of eco-friendly high-tech industrial parks, and promote the formation of collaborative and innovative communities for regional environmental governance. Develop environmental big data application technology and establish a smart environmental protection management and technical support system. Strive to achieve leapfrog development in environmental protection technology and provide scientific and technological support for China's environmental pollution control, quality improvement, and environmental protection industry competitiveness.

Box 12 Environmental Protection Technology
1. Prevention and control of air pollution: Strengthen research on the formation mechanisms, source analysis, laws of movement, and monitoring and early warning of haze and ozone, provide scientific support for pollution control, strengthen research on the relationship between air pollution and human health, strengthen the R&D of technologies such as desulfurization, denitration, efficient dust removal, volatile organic compound control, diesel engine (vehicle) emission purification, and environmental monitoring, construct air pollution emission control and air quality technical systems,

conduct demonstrations of joint atmospheric protection and control technology, support the improvement of air quality in key areas, and ensure the environmental quality of major national activities.

2. Prevention and control of soil pollution: For the governance of farmland soil pollution, industrial land pollution, and mining area soil pollution, carry out research on soil environmental standards, soil environmental capacity and carrying capacity, laws of pollutant migration and transformation, ecological effects of pollution, screening of low-heavy metal accumulation crops and remediation plants, and the relationship between soil pollution and agricultural product quality and human health. Promote the R&D of general-purpose key technologies related to soil pollution diagnosis, risk management and control, and treatment and restoration.

3. Water environment protection: Accelerate the R&D of advanced wastewater treatment, low-cost and high-standard treatment for domestic sewage, seawater desalination and industrial high-salt wastewater desalination, treatment of trace toxic pollutants in drinking water, groundwater pollution repair, hazardous chemical accidents response, and emergency treatment of oil spills and carry out research on water environment benchmarks such as organics and heavy metals, the impact of water pollution on human health, risk assessment of new pollutants, water environmental damage assessment, and the use of high-quality recycled water to supplement drinking water sources.

4. Clean production: For industrial and agricultural pollution emissions and urban pollution, conduct research on ecological design, clean production, pollution reduction, and other technologies for the steel and chemical industries and research technology policies and standard systems for environmentally friendly products and clean production and a circular economy.

5. Ecological protection and restoration: Focusing on the construction of the national "two screens and three belts" [the Qinghai-Tibet Plateau ecological screen, the Loess Plateau-Sichuan-Yunnan ecological screen, the Northeastern forest belt, the Northern sand-blocking belt, and the Southern hill and mountain belt] ecological security barrier and looking at forests, grasslands, wetlands, deserts, and other ecosystems, study the evolution of major ecological problems in key areas, the mechanisms of ecological degradation, and the maintenance of ecological stability and conduct research on ecological protection and restoration, monitoring, and early warning technologies; develop governance technologies for typical ecologically fragile areas such as karst areas, the Qinghai-Tibet Plateau, the upper and middle reaches of the Yangtze River and the Yellow River, the Loess Plateau, important wetlands, deserts and desertification areas, deltas and coastal zones, red soil hilly areas in the south, salinized land in the Tarim Basin, farming-pastoral border zones, and mineral extraction zones, research and develop technologies to deal with ecological fragmentation and species habitat degradation caused by urban development and construction areas, develop appropriate ecological industry technologies, support the sustainable development of ecologically degraded areas, and enhance terrestrial ecosystem service capabilities.

6. Environmental risk prevention and control for chemical products: Integrating the structural characteristics of China's chemical industry and the needs of chemical safety, strengthen technical research on chemical hazard identification, risk assessment and management, and early warning and emergency control of chemical fires and explosions and pollution accidents, develop key technologies such as environmentally friendly alternatives to high-risk chemicals, deep geological disposal of highly radioactive waste, and safety guarantees for typical chemical production processes, establish a technical framework for chemical integration testing strategies in line with China's national conditions, and comprehensively improve China's chemical environmental and health risk assessment, prevention, and control technology level.

7. Eco-Friendly Industry Technology: Promote the R&D, demonstration, and promotion of environmental protection technology, develop new formats, new models, and new mechanisms for the environmental protection industry, build a green technology standard system, promote "urban mining," "environmental hospitals," the "Kubuqi Desert Sand Control Industry," and other such models, and accelerate the industrialization of advanced environmental protection technologies.

8. Monitoring, early warning, and risk control of major natural disasters: In response to major environmental natural disasters caused by earthquakes, geology, meteorology, water use, and marine events, accelerate the systematic research of medium- and long-term refined numerical forecasting,

global numerical marine forecasting, numerical haze forecasting, geological hazard monitoring and early warning, flood and drought monitoring and early warning, earthquake monitoring and early warning, forest fire monitoring, early warning, and prevention, and sand and dust storm monitoring and early warning, and improve monitoring, early warning, and risk assessment capabilities for major natural disasters.

9. Response to global environmental change: Break through technical bottlenecks hindering greenhouse gas emission control, biodiversity protection, biosafety management, chemical risk management, ozone layer protection, desertification control, and wetland protection, solve scientific problems related to the cross-border transportation mechanism of pollutants and international compliance negotiations, and enhance China's ability to implement international environmental conventions.

II. Develop Resource-Efficient Recycling Technology

With the goal of ensuring the safe supply of resources and promoting the green transformation of resource-based industries, vigorously develop technologies for the efficient development and economical use of water resources and mineral resources. In terms of the comprehensive utilization of water and land resources, optimized development of land and space, green development of coal resources, natural gas hydrate exploration and development, oil and gas and unconventional oil and gas resources development, clean development of metal resources, comprehensive utilization of salt lakes and non-metal resources, and recycling of waste, concentrate efforts on breakthroughs in a number of basic theories and core key technologies, focus on the R&D of certain key equipment, build a theory and technical system for resource exploration, development, and comprehensive utilization, and solve the outstanding problems concerning sustainable resource development safeguards and industrial transformation and upgrading in China; establish a number of internationally advanced basic theoretical research and technology R&D platforms, engineering transformation and technology transfer platforms, and engineering demonstration and industrialization bases, gradually form a technical system for efficient resource use that is compatible with China's level of economic and social development, and provide strong scientific and technological support for the establishment of a resource-conserving and environmentally friendly society.

Box 13 Resource-Efficient Recycling Technology

1. Efficient development and utilization of water resources: Focusing on improving the support capabilities of national science and technology for water resources security, develop technologies and equipment for industrial water conservation, comprehensive water conservation, and unconventional water resources development and utilization, study comprehensive water resources allocation strategies, water project construction and operation, safety and emergency management technologies, develop joint water and sediment regulation, estuary management, and river and lake ecological security protection technologies, carry out research on intelligent dispatch and refined management of water resources systems, build a theoretical and technical system for the comprehensive utilization of water resources and a demonstration and extension platform, and raise China to a leading position in international water resources research.

2. Green development of coal resources: Focusing on the goals of safe, green, and smart coal, carry out theoretical and technological research on eco-friendly coal resource exploration, the rapid construction of large mines, safe and eco-friendly mining, intelligent coal mining equipment, quality enhancement for low-quality coal, the collaborative development of resources associated with coal, and all-material cycle planning and carbon emission control in mining areas, promote the construction of major scientific and technological demonstration projects for ecological mines, smart mines, and the

clean processing and comprehensive utilization of coal, promote the intensive development of coal, and provide strong scientific and technological support to allow the coal industry to change its development mode and improve quality and efficiency.

3. Development of oil and gas and unconventional oil and gas resources: Focusing on national energy security needs and looking at the four major fields of complex environments, low grade oil, old oilfield tapping, and deep oil and gas resources, use key technologies and equipment such as drilling, oil production, storage, and transportation to develop major high-end equipment, tools, software, materials, and complete technology sets with independent intellectual property rights and provide technical support for the efficient exploration, development, and clean utilization of oil and gas resources.

4. Clean development and utilization of metal and non-metal resources: Study technologies for the efficient development of metal mineral resources such as the cleaning and dressing of complex ores and comprehensive utilization of "three industrial waste products" [liquid, gas, and solid waste], study technology related to the protective development of mineral resources composed of rare metals, rare earth elements, and dispersed elements (稀散元素), study important strategic resource protection and development technologies such as efficient extraction of radioactive resources, comprehensive utilization of saltwater lake resources, and high-value application of non-metal resources, and solve the problems of serious environmental pollution, high material consumption, and low comprehensive resource utilization in the metallic ore resource dressing (金属矿产资源选冶) process.

5. Waste recycling: Study the basic theories and models of resource cycles, research and develop complete sets of technical equipment for waste sorting, disposal, and recycling, focus on promoting the development of key technologies and equipment for bulk solid waste source reduction and recycling, efficient use of biomass waste, and refined high-value utilization of minerals in emerging cities, and strengthen research on technologies related to solid waste recycling management and decision-making. Strengthen the integration and demonstration of cyclic development in typical regions and implement the "Ten Cities and One Hundred Buildings" waste disposal technology demonstration project.

III. Develop Population Health Technology

Focusing on the needs of a healthy China, highlight the solution of major issues affecting the national economy and people's lives such as the prevention and control of major chronic diseases and coping with an aging population. With the goal of improving the health of the entire population, systematically strengthen the integration of biological data, clinical information, and sample resources, coordinate and promote the construction of the National Clinical Medical Research Center and the collaborative disease research network, promote the joint efforts of medical and research enterprises in innovative and integrated research, and accelerate the development of medical technology. Focus on tasks such as disease prevention and control, precision medicine, reproductive health, rehabilitation and care for the elderly, drug quality and safety, innovative drug development, the domestic production of medical devices, and the modernization of traditional Chinese medicine, accelerate key technological breakthroughs in areas such as chronic disease screening, smart medical treatment, and active health, assist the popularization of disease prevention and control technology and the conversion of new clinical technologies and products into practical applications, and establish and improve the systems of clinical medical technology standards. By 2020, strive to form an integrated and continuous health protection system and provide solid technological support for improving the quality of medical services, accelerating the development of the health industry, promoting medical reforms, and building a healthy China.

Box 14 Population Health Technology

1. Prevention and control of major diseases: Focus on major chronic diseases such as cardiovascular and cerebrovascular diseases, malignant tumors, metabolic diseases, respiratory diseases, and mental and nervous system diseases; common diseases of the digestive tract, oral cavity, eyes, ears, nose, and throat; parasitic diseases such as human echinococcosis, malaria, and schistosomiasis; and injury prevention and treatment technologies, strengthen the integration of basic research, clinical conversion, evidence-based evaluation, and demonstration applications, make breakthroughs in a number of key prevention and control technologies, develop a batch of new diagnosis and treatment programs, promote a number of suitable technologies, and effectively solve practical clinical problems and improve basic service levels.

2. Key technologies of precision medicine: Seize the opportunity for the integrated development of biotechnology and information technology, establish a prospective cohort of millions of healthy people and patients with key diseases, establish a multi-level precision medical knowledge base system and a national biomedical big data sharing platform, focus on achievements in core key technologies of precision medicine such as new generation gene sequencing technology, omics research, and big data fusion analysis technology, develop a batch of precise application solutions and decision support systems for the early screening of major diseases, molecular typing, personalized treatment, efficacy prediction, and monitoring, and promote reforms in medical diagnosis and treatment models.

3. Reproductive health and the prevention and control of birth defects: Solve outstanding problems in the prevention and control of birth defects, infertility, and contraception in China, establish cohorts of reproductive age and birth populations across the country, establish a national bioinformatics and sample resource database, research and develop a number of suitable basic technologies and innovative products, comprehensively improve the level of birth defect prevention and control technology, safeguard the reproductive health of the reproductive age population, and improve the quality of the birth population.

4. Digital diagnosis and treatment equipment: Following the path of early, accurate, and minimally invasive diagnosis and treatment, focus on promoting the R&D of multi-modal molecular imaging, new magnetic resonance imaging systems, new X-ray computed tomography, new generation ultrasound imaging, low-dose X-ray imaging, composite speculum imaging, new micro-imaging, large-scale radiotherapy equipment, surgical robots, and active implantable medical devices and accelerate the domestic production of higher-end products and the branding of digital diagnosis and treatment equipment.

5. In vitro diagnostic products: Make breakthroughs in key technologies such as microfluidic chips, single molecule detection, and automated nucleic acid detection, develop major products such as fully automatic nucleic acid detection systems, high-throughput liquid suspension chips, medical bio-mass spectrometers, and rapid pathological diagnostic systems, develop a batch of diagnostic reagents for the early diagnosis and precise treatment of major diseases and high-precision diagnostic products suitable for primary medical institutions, and improve the competitiveness of China's IVD industry.

6. Key technologies for health promotion: In the directions of quantitative monitoring and precise intervention and focusing on health status identification, health risk early warning, and autonomous health intervention, focusing on key technologies and products such as non-invasive detection, wearable monitoring, biosensors, the Internet of Health (健康物联网), and interventions for health risk factors, strengthen the construction of a national fitness monitoring network, build a healthy big data cloud platform, develop health management solutions such as digital and personalized behavior/psychological intervention, energy/nutrition balance, and functional compensation/promotion, and accelerate breakthroughs in key technologies for active health and research on closed-loop health management services.

7. Health service technology: Promote the integration and innovation of information technology and medical and health services, make breakthroughs in key technologies such as network collaboration and distributed support systems, develop and improve privacy protection and information security standards and technical specifications, establish an integrated, continuous disease diagnosis, treatment, and health management service model based on information sharing, knowledge

integration, and multidisciplinary collaboration, promote "Internet+" health and medical technology demonstration activities, and achieve the goals of optimizing resource allocation, improving medical treatment models, and strengthening health promotion.

8. Drug quality and safety: Targeting clinical medication needs, improve the technical evaluation system for chemical generics consistency, carry out research on quality and efficacy evaluations for high-risk varieties, children's medicines, and auxiliary medicines as well as adverse drug reaction monitoring and evaluation and drug quality control, improve the level of drug protection for Chinese residents, and improve the ability to prevent and control drug safety risks.

9. Technology for the elderly and disabled: In the directions of intelligent services, functional rehabilitation, and personalized adaptation, make breakthroughs in key technologies such as human-computer interaction, neural-machine interfaces, multiple information fusion, and intelligent control, develop rehabilitation aid products such as functional compensation, life assistance, and rehabilitation training, establish and improve comprehensive evaluation and monitoring index systems and early warning methods for human psychological and physiological functions, establish and improve intervention points and appropriate technical measures to promote the health of the elderly, and establish and improve the technical standard system and solutions for elder care services.

10. Modernization of traditional Chinese medicine: Strengthen original theoretical innovation in traditional Chinese medicine (TCM) and study the modern forms of TCM, accelerating key technological breakthroughs such as the objectification of the four diagnostic methods of TCM, non-disease treatments of TCM, the ecological planting of plants used in TCM, and the precise use of TCM, formulate a number of clinical programs for the prevention and treatment of major diseases and difficult diseases with TCM, develop a number of TCM health products, enhance the level of international scientific and technological cooperation in TCM, and accelerate the modernization of TCM services and the development of large health industries.

IV. Develop New Urbanization Technologies

Focusing on the bottlenecks hindering development in the new urbanization field, aiming at the construction of green, smart, innovative, cultured (人文), and compact cities, and starting from a system engineering approach, respect the laws of urban development, innovate and improve planning methods, incorporate the ideas of ecological environment carrying capacity, historical context and heritage, and eco-friendly and low-carbon into the entire planning and design process, guide urban planning, construction, and management through technological innovation, and develop systematic technical solutions. Strengthen R&D for key technologies related to the dynamic monitoring of urban area development, optimization of urban layouts and morphological functions, improvement of urban infrastructure functions, intensive urban land use and redevelopment of inefficiently used land, comprehensive underground urban corridors, rational layout and economical use of underground space, urban informatization, and smart cities, strengthen the R&D of green ecological infrastructure and sponge city construction technology, and focus on restoring natural urban ecosystems; strengthen the research on planning and design, construction, and O&M integration technology and standard systems for building energy conservation, the improvement of indoor and outdoor environmental quality, green buildings and prefabricated buildings, develop a technology system for near-zero energy consumption and existing building renovation, and promote and upgrade the application and promotion of land-conservation, energy-conservation, water-conservation, material-conservation, and environmental protection technologies in urban construction; and strengthen research on the key technologies of cultural heritage protection and inheritance as well as public services such as public culture and physical fitness, cultivate new forms of innovation and development in cities such as education, culture, sports, and tourism, and promote the continuation of historical

traditions and the construction of cultured cities. By 2020, strive to form a relatively complete new theoretical system for urbanization construction and development, common key technologies, and a standardization system, promote the construction of sustainable human settlements and the improvement of public service functions in cities and towns, and provide effective assurance for new urbanization with Chinese characteristics.

Box 15 New Urbanization Technology
<p>1. Urban function improvement and coordinated development: Carry out R&D and demonstration of key technologies such as urban spatial planning, infrastructure construction and function enhancement, urban land conservation and intensive use, and the redevelopment of inefficiently used land, form technical systems and equipment for urban planning and construction management and the upgrading of infrastructure functions, make breakthroughs in key technologies and equipment for the construction of comprehensive underground urban pipeline corridors, geological survey technology to support the construction of urban underground infrastructure pipeline networks, urban ecological restoration and organic renewal technologies, municipal pipeline construction-detection-maintenance-repair and operation technologies, and urban electricity-gas-thermal energy system structure layout and pipe network optimization technology, promote the construction and refined urban management of sponge cities, green cities, and smart cities, optimize the layout and form of urbanization, build a comprehensive city management database and intelligent infrastructure management and control system, promote the construction of smart residential neighborhoods, communities, and parks, comprehensively promote the optimization and improvement of regional human living environments and the inheritance of urban traditions, and provide scientific and technological support for the construction of green, intelligent, innovative, cultured, and compact cities.</p> <p>2. Research on green buildings and prefabricated buildings: Strengthen research on green building planning and design methods and models, near-zero-energy buildings, and new high-efficiency heating solutions for buildings, establish a basic data system for green buildings, and develop indoor environmental protection and high-performance reconstruction technology for existing buildings. Strengthen the R&D and application of building information models and big data technology in the entire process of building design, construction, and O&M management. Strengthen research on the design theory, technical systems, and construction methods of prefabricated buildings. Study technical systems, key technologies, and generalized and standardized modular parts for prefabricated concrete structures, steel structures, wooden structures, and hybrid structures. Conduct research on prefabricated decoration integration technology. Establish technology and standard systems for prefabricated building design, engineering, construction, inspection, and evaluation, develop lightweight high-strength green building materials with good durability and intrinsic safety, and promote the large-scale, high-efficiency, and sustainable development of green buildings and prefabricated buildings.</p> <p>3. Cultural heritage protection and public cultural services: Strengthen the R&D and demonstration of cultural heritage cognition, protection, monitoring, utilization, and transmission, support the utilization of the value of cultural heritage, support the protection of cultural relics, important heritage sites, tombs, murals, and other cultural objects, support the implementation of the Wisdom Museum, the "Peaceful Palace Museum" project, and the "Chinese Ancient Books Protection Plan," and promote the management, protection, and utilization of world heritage sites and scenic spots. Strengthen the research, development, and application of cultural facility spaces and services and promote the open sharing of public cultural resources. Carry out R&D and demonstration of key technologies in competitive sports and sports equipment and promote the improvement of national health and the development of the sports industry.</p>

V. Develop Reliable and Efficient Public Safety and Social Governance (社会治理) Technologies

Focusing on building a safe China, guided by the establishment of a sound public safety system, and with the goal of improving social governance capabilities, concentrate on key technical research and application demonstrations for public safety assurance such as general-purpose basic scientific issues of public safety, comprehensive protection of national public safety, early warning and control in social safety monitoring, prevention and control of severe and major production safety accidents and production safety assurance, major national infrastructure safety assurance, urban public safety risk prevention and control, and technical equipment for comprehensive emergency response, and form a public safety technology system featuring proactive protection. Concentrate on the basic theoretical issues related to major natural disasters such as earthquakes, geological disasters, meteorological disasters, floods and droughts, and marine disasters, focus on technical areas of disasters and frequent disasters and high-risk areas, and carry out basic research, technology R&D, and integrated application demonstrations of major natural disaster monitoring and early warning, risk prevention and control, and comprehensive responses to key scientific and technological issues. Use modern technology to improve social governance methods and techniques, carry out research on multi-system and multi-platform information integration and sharing and policy simulation modeling and analysis technology for social governance public service platforms, and carry out research on key technologies and comprehensive application technologies for the sharing and exchange of data such as social basic information (社会基础信息) and credit information. By 2020, strive to form a relatively complete, reliable, and efficient public safety and social governance technology system and provide scientific and technological guarantees for sustainable, stable, and safe economic and social development.

Box 16 Public Safety and Social Governance Technology
<p>1. Technologies and equipment for public safety risk prevention and control and emergency response: Carry out R&D and application demonstrations of key technologies related to public safety risk prevention preparation, monitoring and early warning, situation investigation and judgement, rescue and handling, and comprehensive security, strengthen the R&D of national public safety comprehensive security platforms, public safety video monitoring and intelligent application technology, safe mining technology for ultra-deep wells and ultra-large mines, and port emergency response technology, promote the use of a number of independently developed major emergency response technologies and equipment, and provide scientific and technological support for the reduction of the death rate per unit of GDP in production safety accidents by 30% and the comprehensively improvement of public safety assurance capabilities.</p> <p>2. Monitoring and prevention of major disaster risks: Deepen the scientific understanding of the multi-scale coupling impacts of major natural disasters on the dynamic evolution of the earth and the sea, land, and air, develop key technologies for integrated space-ground-air observation, and improve the refinement and accuracy of risk analysis, risk assessment, and predictive disaster scenario analysis. Strengthen R&D of efficient numerical simulation and other technologies and improve the timeliness and accuracy of early warning and disaster assessment. Strengthen the development of related equipment and business platform construction, strengthen the decision-making support capabilities of governments at all levels in disaster prevention, response, and relief, improve community risk prevention capabilities, and effectively reduce the human and property losses from major natural disasters.</p> <p>3. R&D and application demonstration of key technologies in social governance and social safety: Strengthen technology R&D and application demonstrations in areas such as social basic information sharing and utilization, integrated urban and rural community service management platforms, social organizations, mobile population, monitoring of underprivileged and special populations, employment</p>

and entrepreneurship, and the integration of mobile talent management services, strengthen technology R&D and application demonstrations of the comprehensive application of basic social safety information, the sharing and exchange of information and data for the comprehensive management of social safety, three-dimensional social security prevention and control, and new-type crime investigation, and construct a three-dimensional social safety risk prevention and control technology system.

Chapter 7: Developing Technology Systems to Protect National Security and Strategic Interests

Focusing on national and global long-term development needs, make key technological breakthroughs to strengthen the development of maritime, air, deep earth, polar region, and space capabilities, enhance the capabilities of strategic space exploration, development, and exploitation, and provide technical support for promoting the effective use of humanity's common resources and ensuring national security.

I. Develop Efficient Marine Resource Development, Use, and Protection Technologies

In accordance with the overall deployment and requirements for building a maritime power and the "21st Century Maritime Silk Road," adhere to the principles of near-shore strengthening, offshore expansion, deep-sea exploration, and leading development and focus on the development of major key technologies to safeguard marine sovereignty and rights, develop marine resources, ensure maritime safety, and protect the marine environment. Carry out basic scientific research in fields such as global ocean change and deep ocean science, make breakthroughs in key core technologies such as deep-sea supply operations, marine environmental monitoring, marine oil and gas resource development, marine biological resource development, seawater desalination and comprehensive utilization, marine energy development and utilization, and offshore nuclear power platforms, strengthen the development of marine standards, and integrate the development of application systems for marine ecological protection, disaster prevention and mitigation, and shipping protection. Through innovation chain design and integrated organization and implementation, provide powerful scientific and technological support for the deep understanding of the ocean, rational development of the ocean, and scientific management of the ocean. Strengthen the construction of marine technology innovation platforms, cultivate a group of independent marine instrument equipment enterprises and well-known brands, and significantly enhance the sustainable development of the marine industry and coastal economy.

Box 17 Marine Resource Development and Use Technology

1. Deep-sea exploration: Focusing on the scientific and technological needs of implementing a deep-sea security strategy, make breakthroughs in the development of submersibles that can operate at all depths (maximum depth of 11,000 meters), and form operation and application capabilities for submersibles that operate at 1000-7000 meters. Develop deep-sea oil and gas exploration and development equipment, expedite the exploration and trial mining of oceanic seabed mineral resources, take the first steps to form a "transparent ocean" technology system, and provide scientific and technological support for the development and utilization of China's deep-sea resources.

2. Marine environment safety assurance: Develop offshore environmental quality monitoring sensors and instrument systems as well as key instruments and equipment for the long-term

continuous observation of the deep-sea marine power environment, develop numerical prediction models for the marine environment, improve the level of forecasting and early warning for marine environmental disasters and emergencies and emergency response capabilities, solve the key technical problems related to the construction of a national marine environment safety platform, build a standard measurement system for marine environment and resource development, and improve China's marine environment safety capabilities.

3. Sustainable development and utilization of marine biological resources: Focusing on marine biological science research and the development needs of the blue economy, targeting specific marine group resources, genetic resources, and product resources, and in terms of the recognition of scientific issues, breakthroughs in key technologies, and industrial demonstration applications, form an integrated layout of the key tasks of the marine biological resource development and utilization and an innovation chain, cultivate and strengthen China's marine biological industry, and comprehensively enhance the sustainable development and innovation capacity of marine biological resources.

4. Desalination and comprehensive utilization of seawater: Make breakthroughs in core technologies for the design optimization, complete set setup, and construction of low-cost, high-efficiency desalination systems; research and develop high-value deep processing technology and equipment sets for extracting potassium from seawater, extracting bromine from seawater, and bromine and magnesium products, and build a dedicated production base for separation materials and equipment; and make breakthroughs in the core general-purpose technology related to the eco-friendly and large-scale use of seawater to supply daily water needs and actively promote the construction of a large-scale seawater utilization demonstration park.

5. Large-scale offshore engineering equipment: Make breakthroughs in ultra-deep-water semi-submersible drilling platforms and production platforms, floating liquefied natural gas production, storage, offloading, and regasification devices, deep-water drilling vessels, deep-water survey vessels, polar region scientific icebreakers, and other marine engineering equipment and related equipment design and manufacturing technologies, form independent R&D and design and manufacturing capabilities, and establish a sound R&D, design, manufacturing, and standards system.

II. Develop Aerospace Exploration, Development, and Exploitation Technology

Develop new generation aerospace system technology and near-space technology, improve satellite platform and payload capabilities and the ability to support persistent information in near space, and strengthen the comprehensive service and support role played by aerospace technology in national security, economic and social development, and global strategic force deployment. Enhance the application level and technical support capabilities of comprehensive aerospace information and expand China's global information production chain. Strengthen research on new technologies and new theories in space science and conduct space exploration activities. Carry out research and application demonstrations for core key technologies such as new mechanisms and systems, remote sensing loads, and platforms, space radiation reference and transmission calibration, ultra-agile satellite and space-air-land intelligent networking, accurate acquisition and quantitative application of global spatial information, high-precision all-physical positioning and intelligent navigation, ubiquitous precision navigation and location services, quantum navigation, multi-source and multi-scale spatiotemporal big data analysis and earth system simulation, online visualization services for geographic information systems, and space-based nuclear power. Comprehensively improve the technical capabilities of space transportation systems and carry out technical research on transportation systems based on new concepts.

Box 18 Aerospace Exploration, Development and Exploitation Technologies

1. Scientific satellites: Carry out cutting-edge research in basic science relying on scientific satellites. Focusing on missions such as the launch of the Dark Matter Particle Explorer (DAMPE) satellite, make major scientific discoveries and breakthroughs in areas such as dark matter, quantum mechanical completeness, space physics, black holes, microgravity science, and space life science. Develop the Solar Wind Magnetosphere Ionosphere Link Explorer (SMILE) satellite, the Einstein Probe satellite, the Water Cycle Observation Mission (WCOM) satellite, and the Advanced Space-Based Solar Observatory (ASO-S) satellite and strive to launch them around 2020. Lay the foundation for original results in areas such as geospatial coupling laws, the detection of gravitational wave electromagnetic counterparts, global change and the water cycle, and the relationship between the solar magnetosphere and explosive activities, and lead the development of cutting-edge aerospace technology.

2. Deep-space exploration: Focusing on major scientific issues such as the origin and evolution of the solar system and the earth-moon system, the impact of asteroids and solar activity on the earth, and the search for extraterrestrial life, and with the goal of improving China's deep space exploration and scientific research capabilities, strive to achieve a number of original scientific results. Launch Chang'e-4 in 2018 to carry out the world's first ground-based exploration of the dark side of the moon. In 2020, complete in-depth demonstrations of the plans for deep space exploration projects such as missions to asteroids, Jupiter, and follow-up missions to the moons and complete research on key technologies.

3. First Mars exploration: Focusing on scientific issues such as the Mars environment, geological research, and the search for signs of life and in accordance with the development route of "first complete a round trip and then take samples and bring them back," launch the first Mars rover by 2020, make breakthroughs in core key technologies related to Mars orbit, entry, landing, and ground-based inspection, achieve Mars orbit, landing, and ground-based exploration with one launch, carry out global and comprehensive scientific explorations of Mars, complete the first Mars exploration mission from a high starting point, and make breakthroughs in deep-space exploration capabilities beyond the Moon.

4. Earth observation and navigation: Make breakthroughs in key technologies such as accurate information acquisition and quantitative remote sensing applications and general-purpose technologies for complex system integration, carry out technical research on prospective technologies and theories of earth observation and navigation, key general-purpose technologies, and application demonstrations, and lay the foundation for building a comprehensive, accurate, autonomous, and controllable earth observation and navigation information application technology system.

5. New spacecraft: Make breakthroughs in key technologies such as distributed reconfigurable elastic space systems and technology systems, coordinated measurement and control of distributed reconfigurable spacecraft, and energy transmission; strengthen the R&D of super-performance spacecraft platforms, repairable and reusable satellites, and space robots; and, looking forward to the construction of next-generation new space systems, develop new intelligent and high-quality satellite platforms. Promote the strategic transformation of China's space systems, new space exploration mechanisms, cutting-edge theories of space technology, and the development of independent core technologies.

6. Heavy lift launch vehicles: Focusing on the needs of large-scale space activities such as deep space exploration and manned moon landings, develop a 100-ton heavy-lift launch vehicle with a low-Earth orbit carrying capacity. By 2020, make breakthroughs in core key technologies such as dual large-thrust rocket engines with 10-meter large-diameter arrow body structures, 500 tons of liquid oxygen/kerosene and 220 tons of liquid hydrogen/liquid oxygen, and formulate a reasonable and feasible overall plan. Comprehensively carry out engineering organization and implementation and drive a series of high-tech cluster breakthroughs.

III. Develop of Key Core Technologies for Deep Earth and Polar Regions

Focusing on the technical requirements of deep earth and polar exploration, focus on the research of theories and technical equipment related to deep earth resource exploration and carry out polar environment observation and resource development and utilization. Carry out production chain-wide research in areas such as of tectonic background, deep processes, metallogeny (成矿规律), exploration technology, and metallogenic information extraction, improve comprehensive understanding of the metallogenic process, improve deep resource detection capabilities, and establish a sustainable resource development model that guarantees the supply of deep resources. Study the mechanisms of sea ice-ocean-atmosphere condensation change and the global impact of changes in polar regions and focus on the impact mechanisms on climate and severe weather in China; explore and understand the oil and gas, minerals, fisheries, and waterway resources of the polar region and assess their resource potential and commercial value; develop instruments and equipment resistant to low temperatures, develop networking technology for automated polar observation networks, and develop continuous observation capabilities for polar regions; and through international cooperation in polar observation networks, subsea resource development, and deep ice core drilling, explore the creation of large-scale international collaborative research programs and improve China's polar scientific research level and technical support conditions.

Box 19 Deep Earth and Polar Regions Technology

1. Deep earth resource exploration: Reveal the three-dimensional structure and spatial-temporal distribution regularities of metallogenic systems, build a deep mineral prediction and evaluation system, expand the theories and technologies of deep-earth mineral extraction, develop key technologies and equipment for mineral resource exploration, achieve exploration capabilities for oil and gas resources at depths of 8,000-10,000 meters and mineral resources at depths of 1,000-3000 meters, and establish a 3000 meter-deep exploration platform for mineral resources and a deep exploration platform for oil, gas, and uranium resources.
2. Polar region environmental observation: Carry out research on polar ice and snow observation, ice cap movement and material balance, polar environmental process observation and biogeochemical cycles, life characteristics, ecosystems, and succession of polar organisms, the structure of marine sediments in the polar region, and paleoclimate and paleoenvironment changes. Establish an observation system for the interaction and integration of sea ice-ocean-atmosphere at the two poles, develop a platform for environmental information services for the polar region, and form a multidisciplinary data source in China for understanding the polar region.
3. The impact of polar changes on the global and Chinese climate: Study polar circulation and sea ice-ocean-atmosphere condensation changes and their climatic effects and study the Antarctic deep ice core records, the evolution of the Arctic cryosphere, and the interaction of atmospheric weather in polar regions and its effects on global climate change and China's climate and severe weather processes.
4. Detection and utilization of polar resources: Carry out polar geological structure and potential mineral resource exploration, explore oil and gas and natural gas hydrate resources in polar regions, and strengthen investigation into the feasibility of Arctic waterways and relevant safety measures.
5. China-led large-scale international cooperation plans for polar regions: Implement the Long-Term Arctic Observation Program, the Long-Term Southern Ocean Observation Program, and the Antarctic Deep Ice Exploration Joint Research Program and enhance China's influence and voice in polar geopolitics.

IV. Develop Key Technologies to Maintain National Security and Support Counter-terrorism Activities

Strengthen scientific and technological support for national responses to urgent needs in traditional and non-traditional security and support the R&D of key core technologies in information security, network security, biosecurity, counter-terrorism, and confidentiality.

Part 3: Enhancing Original Innovation Capabilities

Focusing on increasing the sources of innovation, continue to strengthen basic research, lay out and construct major scientific and technological innovation bases, strengthen the team of innovative scientific and technological talent, strive to guide the development direction of cutting-edge international scientific research in more fields, and make greater contributions to the progress of human science and technology.

Chapter 8: Continuously Strengthening Basic Research

Persist in facing the major national needs and the frontiers of international science, persist in encouraging the combination of free exploration and goal orientation, strengthen research on major scientific issues, improve basic research institutions and mechanisms, address shortfalls in basic research, strengthen the supply of sources and drivers of innovation, and significantly enhance China's scientific status and international influence.

I. Strengthen Free Exploration and Discipline System Construction

Oriented toward the frontiers of basic research and following the laws of science, further increase support for curiosity-driven basic research, guide scientists to combine academic interests with national goals and encourage scientists to orient themselves toward major scientific research directions, courageously overcome cutting-edge scientific problems, propose more original theories, and make more original discoveries. Effectively increase support for non-consensus (非共识) and transformative innovation research, encouraging questioning traditions and challenging authority, and focus on research that may reshape important scientific or engineering concepts and spawn new paradigms or new fields and new disciplines.

Strengthen the construction of the academic discipline system. Focus on basic subjects such as mathematics, physics, chemistry, astronomy, geosciences, and life sciences and promote the continuous development of disciplines; strengthen the construction of emerging disciplines such as information, biology, and nanotechnology, encourage cross-disciplinary research, and promote interdisciplinary work and integration; and focus on core scientific issues that need to be solved for industrial upgrades and restructuring and promote the development of applied sciences such as environmental science, marine science, materials science, engineering science, and clinical medicine. Further increase the total number of papers and citations in various disciplines and raise the academic influence of some disciplines to world-leading status.

II. Strengthen Goal-oriented Basic Research and Cutting-Edge Technology Research

Facing the key scientific issues related to China's economic and social development, the frontiers of international scientific R&D, and the scientific basis for transformative technologies in the future, coordinate advantageous scientific research teams, national scientific base platforms and major scientific and technological infrastructure, and push forward investment and

strengthen the deployment of goal-oriented basic research and cutting-edge technology research.

Focus on basic research for the deployment of major national strategic tasks. Facing major national needs and the main areas of competition of the national economy and aiming at major strategic tasks related to the national economy, people's lives, and the core competitiveness of Chinese industry, concentrate on key scientific issues in the fields of modern agriculture, population health, resource environments and ecological protection, industrial transformation and upgrading, energy conservation, environmental protection, new energy, and new urbanization, promote the close integration of basic research with the needs of economic and social development, provide sources for innovation-driven development.

Box 20 Basic Research for the Deployment of Major National Strategic Tasks
<ol style="list-style-type: none">1. Agricultural biological (genetic) improvement and sustainable development2. Physical and chemical bases for the efficient and clean utilization and conversion of energy3. Information science for future human-cyber-physical fusion4. Earth system processes and resources and environmental and disaster effects5. New principles and new methods for the design and preparation of new materials6. Manufacturing under extreme environmental conditions7. Disaster formation and prediction in major projects and complex systems8. Major mechanical problems in the aerospace field9. Issues in medicine and immunology

Oriented toward the frontiers of international science and future technology development trends, select major strategic and forward-looking scientific issues that provide a strong driving force and have a good research base and talent reserve for the improvement of sustained innovation capabilities, strengthen the large scientific research organization model featuring original innovation and a systemic layout, deploy key special topics for basic research, and achieve major scientific breakthroughs and seize a commanding position in international scientific development.

Box 21 Major Strategic and Forward-Looking Scientific Issues
<ol style="list-style-type: none">1. Nanotechnology2. Quantum regulation and quantum information3. Protein machinery and regulation of life processes4. Stem cells and transformation5. Cutting-edge research relying on large scientific installations6. Global change and responses7. Developmental genetics and environmental regulation8. Synthetic biology9. Gene editing10. Scientific research on deep sea, deep ground, deep space, and deep blue11. Research on the deep structure of matter and large-scale physics of the universe12. Core mathematics and applied mathematics13. Development of magnetically constrained nuclear fusion energy

With the goal of achieving strategic leadership in key scientific and technological fields, and looking to achieve leapfrog development at the cutting edge of fields with the potential to lead future human life and industrial production, establish cultivation mechanisms for the basics of transformative technology and science, strengthen the deployment of basic research and advanced exploration in gene editing, materialization (材料素化), neural chips, metamaterials, accurate mesoscopic measurement, and other fields, drive the emergence and development of transformative technologies through scientific research innovations and breakthroughs, and provide scientific reserves for China's industrial transformation and sustainable economic and social development in the future.

III. Organize the Implementation of Major International Science Programs and Scientific Projects

Oriented toward basic research and major global issues and with respect to the needs of China's development strategy and the nation's actual fundamental capabilities and advantages, actively participate in major international science programs and scientific projects. Strengthen top-level design, make long-term plans, and select advantageous layouts, focus on areas where China has comparative advantage, such as mathematical astronomy, life sciences, earth and environmental sciences, energy, and cross-disciplinary fields, and study and propose international science programs and scientific projects that may be organized and initiated by China in the next 5 to 10 years. Mobilize international resources and forces and, based on sufficient preliminary research, strive to launch and organize a number of new major international science programs and scientific projects and contribute to the scientific development of the world.

Box 22 Major International Science Programs and Scientific Projects

1. International Thermonuclear Experimental Reactor (ITER) Program: Fully participate in the management of the international organization of the ITER program and enhance China's nuclear fusion energy R&D capabilities; use participation in the ITER program as an opportunity to encourage more domestic institutions to participate in international R&D, improve China's ability to participate in the management of major scientific engineering projects, and establish a model of Chinese participation in the management of major international scientific engineering projects.
2. Square Kilometer Array (SKA) Program: Actively participate in formal intergovernmental negotiations for the SKA Program, continually deepen participation in the R&D of SKA international work packages and ensure the advantageous position of China's industry in the construction of SKA-1, and deploy exploratory scientific research in China and promote the establishment of the SKA-1 project.
3. Group on Earth Observations (GEO): Build a system of global cooperation in the field of integrated earth observation, lead the construction of the Global Earth Observation System of Systems (GEOSS) in the Asia-Pacific region, operate China's global integrated earth observation data sharing service platform, and publish thematic reports to a worldwide audience. Select the "Belt and Road" region for remote sensing product production and demonstration applications.
4. International Ocean Discovery Program (IODP): Aim at international cutting-edge scientific issues, verify the major theoretical hypotheses of continental breakup and ocean formation, and solve key issues in oil and gas exploration and development in the northern South China Sea. Adopt innovative participation modes and improve China's leading role.
5. Initiate and implement major international science programs and scientific projects: In the fields of mathematical astronomy, life sciences, earth and environmental sciences, energy, and comprehensive interdisciplinary work, select major scientific issues of common concern to the world,

initiate and implement several major international science programs and major scientific projects, and play an important role in them.

IV. Strengthen the Construction of Major National Science and Technology Facilities

Focusing on areas such as energy, life sciences, particle physics and nuclear physics, space and astronomy, oceans, earth systems, and the environment, and with the goal of improving original innovation capabilities and supporting major technological breakthroughs, build a number of major scientific and technological infrastructure facilities relying on the layout of universities and research institutes and support research on cutting-edge scientific issues relying on major scientific and technological infrastructure. Strengthen operation management, promote the close integration of major scientific and technological infrastructure such as large scientific installations and national laboratories, strengthen the performance evaluation of major national science and technology infrastructure such as large scientific installations, and promote open sharing. Focusing on national needs such as ecological security, modern agriculture, climate change, and disaster prevention, construct and deploy a number of scientific observation and research field stations, improve the national field observation system, promote the multi-functional, standardized, and networked construction and operation of scientific observation and research field stations, and promote networked observation and collaborative innovation.

V. Carry Out Major Scientific Studies and Investigations

Oriented toward important scientific issues, sustainable agricultural development, ecological restoration and reconstruction, natural disaster prevention and mitigation, the protection of national rights and interests, and major strategic needs, organize major scientific studies and investigations across disciplines, fields, and regions and acquire a number of basic, public service-oriented, systematic, and authoritative scientific and technological resources. In China's important geographical areas, typical ecological environment areas, international economic cooperation corridors, and polar, oceanic, and other key, special, and uninhabited areas, carry out scientific studies and investigations, observe natural backgrounds and dynamic changes, and provide support for original innovation, major project construction, and national decision-making.

Box 23 Scientific Studies and Investigation

1. Major comprehensive scientific investigations: In China's key, special, and uninhabited areas such as important geographical areas and typical ecological environment areas, carry out scientific studies and investigations in geography, geology, ecology, environment, biology, agriculture, forestry, oceanography, health, and other fields, collect and bring together basic science and technology resources, and observe the natural background and dynamic changes.

2. Polar scientific investigations: Focusing on the rapid changes in polar regions and their important impact on regional and global climate, the environment, ecology, and human activities and relying on polar scientific research stations, scientific research vessels, and integrated stereo observation systems, carry out scientific studies and investigations on polar snow and ice, resources and environment, marine sediments, aurora and ionosphere characteristics, and geological structures, gain a new scientific understanding of polar systems, and improve China's capabilities and level of polar scientific research.

3. Survey and collection of germplasm resources: Carry out nationwide germplasm resource surveys and collections, carry out surveys of germplasm resources in typical regions, rescue and collect ancient local varieties of various cultivated crops, wild relatives of important crops, and other rare and

endangered wild plant germplasm resources, and enrich the quantity and diversity of germplasm resources.

4. Scientific investigation: Carry out scientific investigations on rocks, strata, paleontology, structures, minerals, hydrology, the environment, geomorphology, geochemistry, and key diseases and obtain the basic data and information required for research on related subjects.

VI. Strengthen the Coordination of Basic Research

Improve basic research investment mechanisms, increase the share of basic research in the nation's R&D investment, give full play to the primary role of the state in basic research investment, increase the central government's support for basic research, increase stable support for basic disciplines, basic research bases, and major basic science facilities. Strengthen the system designs of the policy environment, institutional mechanisms, scientific research layout, and evaluation orientation and take various measures to support basic research. Actively guide and encourage local governments, enterprises, and social forces to increase investment in basic research and join forces to have the whole society focus on and support basic research.

Strengthen the top-level design and overall layout, improve the communication and coordination mechanisms between national basic research management departments, and systematically deploy and support basic research in accordance with the new national science and technology planning system. Allow the National Natural Science Foundation of China to play its important role in the support of innovation sources, show ample respect for the academic sensitivity of scientists, tolerate and support non-consensus research, and construct a relaxed and inclusive academic environment. Use National Key R&D plans and special base and talent projects to strengthen support for the development of goal-oriented basic research and collaborative innovation, and establish an effective mechanism for concentrating basic research tasks in accordance with national goals and provide long-term stable support.

Promote the integration of science and education, integrate the construction of international world-class (国际一流) scientific research institutions, world-class (世界一流) universities, and first-class (一流) academic disciplines, support independent research on the basic layout of universities and research institutions, expanding the academic autonomy of universities and research institutions and the rights of individuals to select research topics, support a number of high-level universities and research institutes in their formation of interdisciplinary and comprehensive scientific research teams, promote the full participation of universities and research institutes in basic research, and promote the comprehensive, coordinated, and sustainable development of basic research.

Improve the academic environment and establish an evaluation mechanism that complies with the characteristics and laws of basic research. Have free-exploration-type basic research adopt long-term evaluation mechanisms, implement international peer assessment, and primarily evaluate the originality and academic contributions of research; have goal-oriented basic research emphasize the degree of goal achievement and primarily evaluate its effectiveness in solving major scientific problems; and establish a system of evaluation guidance built around innovation quality and academic contributions.

Chapter 9: Constructing High-Level Scientific and Technological Innovation Bases

Focusing closely on national strategic needs, vigorously promote the construction of science and technology innovation bases led by national laboratories, strengthen the optimization and integration of bases, create innovative operating mechanisms, promote the open sharing of scientific and technological resources, and consolidate the material and technological foundation of independent innovation.

I. Optimize the National Scientific Research Base and Platform Layout

With the goal of improving scientific and technological innovation capabilities and looking at the long-term and overall situation, coordinate the construction of scientific research bases, scientific and technological resource sharing service platforms, and scientific research conditions to ensure capabilities, adhere to the principles of optimized layout, key construction, hierarchical management, and standardized operation, reasonably merge existing national scientific research base platforms based on national strategy and the needs of the innovation chain layout, optimize the integration of strategic integration, technology innovation, scientific research, and basic support, and further clarify functional positioning and goal-based tasks. The entities involved in strategic integration are mainly national laboratories. The entities involved in technology innovation include the National Technology Innovation Center, the National Clinical Medical Research Center, and the scientific research bases formed after the optimization and integration of the existing National Engineering Technology Research Center, National Engineering Research Center, National Engineering Laboratory, and the State Key Laboratories of Enterprises (企业国家重点实验室). The entities involved in scientific research are mainly national key laboratories. The entities involved in basic support include basic and public welfare bases and platforms such as the national field scientific observation and research stations and science and technology resource service platforms.

With national laboratories taking the lead in the overall layout of the construction of national scientific research bases, promote local and departmental arrangements in accordance with the overall layout of national scientific research bases, build scientific and technological innovation based suitable for regional development and industry characteristics, and form a rational framework at the national, departmental, and local levels. Further improve management and operation mechanisms, strengthen evaluation and assessment, and strengthen stable support.

II. Lay Out the Construction of National Laboratories in Major Innovation Areas

Focusing on national goals and strategic needs, prioritize major areas with clear national goals and urgent strategic needs, occupy strategic positions that should allow China to lead future development, pursue future-oriented and coordinated deployment, lay out the construction of a group of breakthrough-type, leading-type, and platform-type national laboratories. Focusing on major scientific and technological tasks and national large-scale scientific and technological infrastructure and relying on the most advantageous innovation units, integrate national innovation resources, bring together first-class talent from China and abroad, explore the establishment of scientific research organization formats and academic and personnel management systems that conform to the scientific research regularities of the era of big science, establish new operating mechanisms for goal orientation, performance management, collaborative research, and open sharing, and form a new pattern of coordinated innovation with

complementary functions and positive interactions with other types of research institutions, universities, and enterprise R&D institutions. Increase the strength of continuous and stable support, carry out cross-disciplinary and synergistic innovation research that plays a significant leading role, create a key strategic scientific and technological force that reflects the will of the country, has a world-class level, and leads development.

III. Promote the Construction of National Scientific Research and Technological Innovation Bases

Aiming at the frontiers of science and the development directions of key industry fields, strengthen the construction of scientific research bases using national key laboratories as important vehicles, play an important role in fostering original innovation, promote the development of disciplines and R&D on cutting-edge technologies, keep pace or take the lead in several subject areas, and produce world-class results. Based on the overall requirements of the management reform of the national science and technology plan and in accordance with the top-level design of national scientific research bases, optimize the layout of existing national key laboratories, focus on the construction of a number of national key laboratories in cutting-edge cross-disciplinary and advantageous areas, promote province-ministry co-construction, military-civilian co-construction, and the construction and development of Hong Kong and Macau partner laboratories. Improve operation management systems and mechanisms, strengthen regular assessments and adjustments, and form important scientific research bases with continuous innovation vitality and the ability to enter and exit.

Focus on the national strategic industry technology field and construct a comprehensive and integrated national technological innovation center that faces global competition and features open cooperation. Facing the needs of industry and industrial development, integrate the National Engineering Technology Research Center and the National Engineering Research Center, perfect the layout, and implement dynamic adjustment and orderly exit mechanisms. Build high-level technological innovation and achievement conversion bases in important fields such as advanced manufacturing, modern agriculture, the environment, and social livelihood. Establish several national clinical research centers and a nationwide networked, clustered, and collaborative research networks and promote the transformation and application of scientific and technological achievements in the medical field.

IV. Strengthen the Construction of Scientific and Technological Resource Open Sharing and Service Platforms

Strengthen the platform construction system layout, form a scientific and technological resource sharing service platform system covering scientific research instruments, scientific research facilities, scientific data, scientific literature, and experimental materials, strengthen support for cutting-edge scientific research, corporate technological innovation, and mass innovation and entrepreneurship, strive to solve the problems of the lack of an overall layout of scientific and technological resources, repeated construction, and idle and wasted resources. Integrate and improve technology resource sharing and service platforms and better meet the needs of technological innovation. Establish and improve the performance evaluation, post-subsidy, and management supervision mechanisms of shared service platforms. Conduct in-depth investigations of key scientific and technological resources, improve the construction of

national science and technology resource databases, and strengthen the mining, processing, evaluation, and appraisal of scientific and technological resources. Provide high-level special services for major national needs. Establishing a scientific and technological resource information disclosure system, improve scientific data transfer and sharing mechanisms, and strengthen the exchange of data on scientific and technological plans and projects.

Box 24 Scientific and Technological Sharing and Services

1. Scientific research instrument sharing and service platforms: Improve the construction of a national network management platform for scientific instruments, conduct intensive management of various scientific research equipment purchased through state financing, actively promote open sharing by scientific research institutes, enterprises, and society as a whole, and provide support and guarantees for scientific research and innovation and entrepreneurship.

2. Scientific research facility sharing and service platforms: Give full play to the advantages of important public scientific and technological resources such as major national scientific research infrastructure, large-scale scientific installations and research facilities, and scientific observation and research field stations, promote open sharing by the technology community, and provide support and guarantees for the development of related disciplines.

3. Scientific data sharing and service platforms: Strengthen the integration and quality control of various scientific data, improve scientific data transfer mechanisms, promote the convergence and updating of scientific data, form thematic data products through processing, and provide scientific data support for major national strategic needs.

4. Scientific literature sharing and service platforms: Expand the collection scope of scientific and technological literature and information resources, establish a long-term archival system, build a semantic knowledge organization system oriented to major scientific and technological development directions, improve the support capabilities of technological data big data semantic disclosure, open association, and knowledge discovery, and comprehensively build a national science and technology literature and information guarantee and service system that meets the needs of the big data environment and knowledge services.

5. Biological (germplasm) resource and experimental material sharing and service platforms: Focus on strengthening the collection, organization, and preservation of laboratory animals, reference materials, scientific research reagents, special human genetic resources, genes, cells, microbial strains, plant germplasm, animal germplasm, rock fossil specimens, biological specimens, and other resources improve the quality of resources, and enhance resource security capabilities and services.

V. Improve The Ability to Ensure Scientific Research Conditions

With the goal of improving original innovation capabilities and supporting major technological breakthroughs, strengthen the construction of scientific research conditions to ensure the research and development of large-scale scientific instruments and equipment, experimental animals, scientific research reagents, and innovative methods, consolidate the material and conditional foundation for technological innovation, and improve the ability to ensure scientific research conditions. Strengthen the research and development of major scientific research equipment, core technology, and key components and promote the engineering and industrialization of scientific instruments and equipment; strengthen basic research on national quality technology, support the R&D of measurement, standards, inspection and testing, and certification and recognition methods, and strengthen research on technological trade measures; strengthen the breeding of experimental animal species, the creation of models, and the development of related equipment and comprehensively promote the construction of laboratory animal standardization and quality control systems; strengthen the R&D, application,

and demonstration of domestic research reagents, develop a number of original scientific research reagents that fill international gaps and for which China holds independent intellectual property rights, and continuously meet the needs of China's scientific and technological research and high-end testing fields; and research and develop key general-purpose technologies for the digital preservation of scientific and technological literature and information, information mining, semantic disclosure, and knowledge computing.

Box 25 Scientific Research Condition Assurance

1. Scientific instruments and equipment: Using independent R&D of key core technologies and components as a breakout point, focus on the R&D, engineering, and industrialization of high-end major general-purpose and specialized scientific instruments and equipment, develop a number of core key components, significantly reduce the external dependence for core key components, significantly improve the product quality and reliability of high-end general-purpose scientific instruments, and significantly enhance the core competitiveness of China's scientific instrument industry.

2. National quality technology foundation: Conduct R&D on international-level measurement, standards, inspection, testing, and certification technologies, enhance China's international mutual recognition measurement capabilities, participate in and lead the development of international standards, make breakthroughs in a number of new technologies for inspection, testing, and quarantine certification, and achieve an overall level in national quality and technology foundations comparable with developed countries, taking the lead in some individual areas.

3. Experimental animals: Cultivate new experimental animal resources and new breeds, accelerate the creation and application of humanized (人源化) and complex disease animal models, add a batch of new varieties and strains, and bring total national resources to a level close to that of developed countries; carry out the development of new technologies and equipment for animal experiments, strengthen the construction of a laboratory animal standardization system, and provide effective technical safeguards for human health and public safety.

4. Scientific research reagents: Focusing on the needs of population health, resources and the environment, and public safety, strengthen the research and development of high-end detection reagents, high-purity reagents, and high-value-added proprietary reagents and develop a batch of original reagents with independent intellectual property rights; carry out research on general-purpose reagent testing technology for scientific research, strengthen technical standards, improve the quality system, and improve the ability to ensure the reagents used in scientific research.

Chapter 10: Accelerate the Cultivation and Formation of a Team of Innovative Talent

Talent is the first resource for economic and social development and the foundation of innovation. In essence, innovation-driven means talent-driven. Comprehensively implementing a talent-first development strategy, persist in putting human resources development at the top of the scientific and technological innovation agenda, optimize the talent structure, establish a scientific, standardized, open, inclusive, and efficient operation talent development management system, form the advantages of an innovative scientific and technological talent system with international competitiveness, strive to cultivate a large-scale, reasonably structured, and high-quality team of innovative scientific and technological personnel, and make important contributions to building a talent superpower (人才强国).

I. Promote the Strategic Adjustment of Innovative Scientific and Technological Talent Structures

Promote the coordinated development of scientific research, engineering technology, scientific and technological management, scientific and technological entrepreneurial personnel, and skilled personnel and form an orderly, hierarchical, and rational distribution of various innovative scientific and technological talent. Comprehensively implement major national talent projects and build a national high-level team of innovative scientific and technological talent. Highlight the orientation toward shortages in sophisticated and high-level talent and strengthen the selection and training of strategic scientists and scientific and technological leaders. Strengthen innovation team building and form a rational team of scientific research talent and scientific research assistant talent. Increase the discovery, training, and funding of outstanding young scientific and technological talent, establish an employment system suitable for the growth of young scientific and technological talent, and strengthen the reserve of scientific and technological innovation talent. Vigorously promote the spirit of craftsmanship in the new era and increase the training of practical engineering talent, outstanding engineers, and skilled professionals for frontline production. Cultivate a large number of entrepreneurial talent with global strategic vision, innovative capabilities, and a sense of social responsibility. Increase the cultivation and use of ethnic minorities with innovative scientific and technological talent and attach importance to and increase the proportion of women in science and technology. Strengthen the creation of a team of intellectual property and technology transfer talent and improve the professionalism and specialization of science and technology management personnel. Increase support for emerging industries, key areas, and enterprises in urgent need of talent. Study and formulate talent support measures for major national strategies, major national science and technology projects, and major projects. Establish and improve the mechanisms for talent exchange and cooperation with underprivileged areas and promote the coordinated development of regional talent.

II. Vigorously Train and Introduce Innovative Science and Technology Talent

Give play to the role of government input and guidance, encourage enterprises, higher education institutions, research institutes, social organizations, and individuals to participate in the development of talent resources and talent introduction in an orderly manner, gather talent from all over the world and make use of it. Promote the scientific classification and management of innovative scientific and technological talent and explore individualized training paths. Promote the integration of science and education, build an innovative scientific and technological talent training model, strengthening interest and creative thinking in basic education, and exploring new models of postgraduate training for academic degrees combining science and education. Deepen the reform of innovation and entrepreneurship education in higher education institutions, promote the organic integration of professional education and innovation and entrepreneurship education, support higher vocational colleges in strengthening the construction of manufacturing and other professional talent and the training of skilled personnel, and improve the collaborative education model combining production, education, and research. Encourage scientific research institutes and universities to jointly train talent.

Increase support for national high-level talent. Speed up the construction of scientist studios, encourage exploratory and original research, and cultivate a group of forward-looking strategic scientists with international vision; form a team of outstanding scientists with original innovation capabilities; build a number of high-level innovation teams with strong foundations, high

potential, and clear research directions in several key areas and enhance scientific and technological innovation capabilities in key areas; aiming at the world's technological frontiers and strategic emerging industries, support and train young and middle-aged leaders in science and technology innovation with development potential; reform the postdoctoral system, encourage the main role that universities, research institutes, and enterprises play in recruiting and training postdoctoral researchers, and provide good conditions for postdoctoral technology innovation; and follow the laws of entrepreneurial talent growth, broaden training channels, and support the development of leading talent through the transformation of scientific and technological achievements into commercial products (科技成果转化). Cultivate a group of young and middle-aged scientific research and management talent with an international perspective and an understanding of international scientific frontiers and international rules.

Increase the introduction of high-level talent from abroad. Focusing on major national needs, introduce high-level innovative talent such as chief scientists from abroad. For special talent urgently needed by the country, open up special channels and implement special policies to achieve precise introduction. Improve and perfect the work and living environments and related services enjoyed by foreign experts in China. Support the introduction of talent to participate in national projects and carry out scientific and technological research and establish a mechanism to allow foreign scientists to lead national science and technology projects. Carry out pilot projects for the global recruitment for positions in universities and research institutes that do not deal with confidential information. Improve the talent training and promotion mechanisms of international organizations.

Optimize the layout of various innovative scientific and technological talent plans and strengthen convergence and coordination. Make overall funding arrangements for talent development and training, adjust and standardize financial expenditures for talent engineering projects, improve the efficiency of capital use, and bring into play the guidance and leveraging action of government investment, including special funds for talent development. Promote the connection of talent engineering projects with various scientific research and base plans.

III. Improve the Classification, Evaluation, and Incentive Mechanism for Scientific and Technological Talent

Improve talent evaluation and assessment methods, emphasize character, ability, and performance evaluations, and implement the classified evaluation of scientific and technological personnel. Exploring peer review systems for the representative work of basic research scientists, enhance the role of international peer review, and appropriately extend the evaluation and assessment cycles for basic research talent. Focus on market inspection and user evaluation for scientific research personnel engaged in applied research and technology development. Provide guidance to scientific research assistants and experimental technical personnel to improve their service levels and technical support capabilities. Improve the evaluation system of scientific and technological personnel titles, highlight the leading role of the employment subject in title reviews, reasonably define and delegate the authority to review titles, promote the independent review of universities, research institutes, and state-owned enterprises, explore direct employment methods for high-level talent and urgently needed talent, simplify the channels by which non-public economic and social organizations can apply for and participate in the appraisal

of job titles. Do a good job in organically connecting talent evaluation with project evaluation and institutional evaluation.

Reform pay and personnel systems and create rule-based and fair development opportunities for all types of talent. Improve the income distribution systems of scientific research institutions, promote the implementation of performance-based pay, ensure a reasonable level of pay for scientific researchers, improve the distribution of incentive mechanisms that are closely linked to job responsibilities, work performance, and actual contributions and encourage innovation and creation, and emphasize personnel in key positions and who provide important support for businesses and make outstanding contributions. According to relevant laws, empower leaders in innovation with greater control over human resources, property, and technology and implement an incentive mechanism oriented to increasing the value of knowledge. Actively promote social and market-oriented selection and employment. Establish innovative institutional mechanisms for the selection and hiring of high-end talent by scientific research institutions and explore a variety of distribution methods, such as an annual salary system for heads of institutions of higher learning and scientific research institutes and agreement-based and project-based pay for urgently needed talent and other special talent. Deepen the reform of the national science and technology award system, optimize the structure, reduce the quantity, improve the quality, and raise the status and motivating force of rewards, gradually improve recommendation and nomination systems, and guide and regulate social forces to establish awards. Improve the system of academicians (院士) and improve the mechanisms for the selection, management, and resignation of academicians.

IV. Improve Talent Mobility and Service Assurance Mechanisms

Optimize human capital allocation and let talent flow freely in accordance with market rules so individuals and the nation can make the best use of talent. Improve the salary and post management systems for scientific researchers, remove barriers to talent mobility, study and formulate policies and measures for scientific research personnel who resign from institutions of higher learning, scientific research institutes, and other institutions, allow universities and research institutes to set up a certain proportion of mobile posts, attract part-time entrepreneurs and technology specialists with innovative practical experience, and promote the rational flow of scientific research personnel between institutions and enterprises. Improve the policy system so it is conducive to the flow of talent to grassroots organizations and central and western regions. Accelerate the reform of the social security system, improve the policies governing the transfer and continuation of social security relations when scientific researchers move between enterprises and institutions, facilitate the flow of talent across regions, industries, and systems, and promote the two-way flow of talent.

Formulate corresponding management policies and service assurance measures for different levels and different types of talent. Implement a more open and innovative science and technology talent policy, explore the mechanisms of flexible intelligence introduction, and promote and guarantee the international flow of innovative scientific and technological talent. Implement a permanent residence management policy for foreigners and explore the establishment of a skill-based migration system. Carry out innovative activities such as the establishment of technology-based enterprises by high-level foreign talent holding permanent residence permits for foreigners, giving them the same treatment as Chinese citizens, relaxing

position (岗位) restrictions for foreign personnel in scientific research institutions, and relax the conditions high-level foreign scientific and technological talent must meet to obtain a permanent residence permit for foreigners. Promote the two-way flow of innovative technological talent between mainland China and Hong Kong, Macau, and Taiwan. Strengthen the support and protection of overseas talent and avoid intellectual property disputes. Improve the assistance mechanism for the protection of innovative talent and establish an intellectual property identification mechanism for the introduction and use of innovative technological talent. Improve the support mechanisms for international student training, raise government scholarship funding standards, expand the scale of study abroad programs in China, and optimize the structure of international students. Encourage and support the participation of foreign students and overseas students in innovative entrepreneurship activities in various forms. Further improve the classification and management policies governing the temporary foreign travel of teaching and scientific personnel due to business reasons.

Expanding new models of talent services. Actively cultivate professional talent service agencies, develop integrated internal and external professional and industrial talent markets, and improve the supervision and management of public services for talent. Build a platform for the development of innovative scientific and technological talent to serve regions and industries and explore long-term service mechanisms for talent and intelligence mobility.

Part 4: Open Up Spaces for Innovative Development

Coordinate the overall Chinese and international situations and promote the gathering and efficient flow of innovative resources. Focusing on the creation of regional innovation hubs to promote the overall level of regional innovation and development, deeply integrate and deploy global innovation networks and comprehensively improve the internationalization of technological innovation.

Chapter 11: Creating Regional Innovation Hubs (区域创新高地)

Focusing on promoting the local implementation of innovation-driven development strategies and implementation of overall national and regional development strategies, give full play to the main role of localities in regional innovation, optimize development layouts, establish innovative institutional mechanisms, integrate superior innovation resources, strive to build regional innovation hubs, and lead the increase in the overall level of regional innovation.

I. Support the Construction of Science and Technology Innovation Centers with Global Influence in Beijing and Shanghai

Support Beijing so it can leverage its advantages in high-level universities and research institutions, high-end scientific research achievements, and high-level talent, and build a national science and technology innovation center with a strong leading role. Encourage the development of major basic and cutting-edge scientific research, bring together world-class research institutions and innovation teams, and create sources of original innovation strategies. Strengthening central-local co-construction and sharing, establish a cross-regional science and technology resource service platform, comprehensively improve the technological innovation capabilities of key industries, actively cultivate emerging business formats, and form a national

"high-grade, precision, and advanced" (“高精尖”) industrial agglomeration area. Build a national science and technology financial innovation center, promote open services related to scientific and technological personnel, scientific research conditions, financial capital, and scientific and technological achievements, play a core support and first-mover leadership role in the innovation-driven development of Beijing-Tianjin-Hebei and the nation as a whole. Build a global open innovation hub, a global leader in technological innovation, and a key hub of innovation networks.

Support Shanghai so it can leverage its resources such as science and technology, capital, markets, and its high degree of internationalization and openness and build a science and technology innovation center with global influence. Aiming at international cutting-edge technology and first-class capabilities, lay out the construction of major world-class scientific and technological infrastructure groups. Support the construction of several technological innovation platforms for advantageous industries such as biomedicine and integrated circuits, and form a high-tech industrial cluster with international competitiveness. Encourage the pilot implementation to test policies, promote the conversion and implementation of major national scientific and technological achievements, attracting the world's top scientific research institutions, leading talent, and first-class innovation teams, guide the rapid development of new R&D institutions, and cultivate a culture of innovation and entrepreneurship. Promote the linkage between the Shanghai Zhangjiang National Independent Innovation Demonstration Zone, the China (Shanghai) Pilot Free Trade Zone, and the Comprehensive Innovation Reform Pilot Zone and comprehensively improve the level of international cooperation in science and technology. Taking advantage of Shanghai's high-end leadership and influential role in the Yangtze River Economic Belt and even across the country, build an important hub for global technology innovation networks and a vibrant world innovation city.

II. Promote the Innovation and Development of National Independent Innovation Demonstration Zones and High-Tech Zones

Closely integrated with major national strategies, optimize the layout in accordance with the principle of "east to west" and construct a number of national independent innovation demonstration zones relying on national high-tech zones. Vigorously enhance the innovation capacity of national independent innovation demonstration zones, give full play to their advantages in the collection of science and education resources, unleash the innovative effectiveness of universities and research institutes, integrate domestic and foreign innovation resources, deepen industry-university-research cooperation led by enterprises, focus on improving the competitiveness of strategic emerging industries, and give play to leading demonstrations and influential driving forces in innovative development. Support national pilot projects for independent innovation, comprehensively deepen the reform of scientific and technological systems and policy innovation, and build innovative special zones incorporating the needs of function enhancement and reform demonstration. Strengthen the policy summary and evaluation and accelerate the extension of mature pilot policies to the whole country.

National high-tech zones shall focus on doing a good job on both "advanced" and "innovative" articles, intensify the reform of institutional mechanisms and policies, promote the optimal allocation and configuration of science and technology resources, talent and policies, and improve innovative services and industry cultivation system to move from technology R&D,

technology transfer, and business incubation to industrial agglomeration. Steadily promote the upgrading of provincial high-tech zones and, in accordance with the principles of merit-based selection, promoting the construction of high-tech zones through the upgrade of provincial to national high-tech zones, step-by-step advancement, and distinctive characteristics, promote the layout of national high-tech zones in most prefecture-level cities across the country, and accelerate the upgrading of high-tech zones in the central and western regions. Building innovative industrial clusters, give play to the role of cluster backbone enterprises in innovation demonstrations, promote the division of labor and cooperation among large and small enterprises, and guide the coordinated development of cross-region and cross-sector clusters.

Strengthen the construction of national agricultural science and technology parks and national modern agricultural science and technology demonstration zones, lay out a number of agricultural high-tech industry demonstration zones and scientific and technological innovation centers for modern agricultural industries, cultivate and expand agricultural high-tech enterprises, and promote the development of high-tech agricultural industries.

III. Construct Provincial, Municipal, and Regional Innovation Centers to Drive Innovation

According to the overall deployment for the construction of an innovation-oriented country, give play to the role of local entities, strengthen cooperation and co-construction between central and local governments, effectively gather scientific and technological resources and innovation forces from all parties, accelerate the construction of innovative provinces and cities, and promote innovation-driven development with provinces and cities that are at the forefront being among the first to enter the ranks of innovative provinces and cities. Relying on areas with large scientific installations, such as Beijing, Shanghai, and Anhui, build national comprehensive science centers, form a group of important cradles of science and technology and cradles of emerging industries with national and even global influence, and build up global competitiveness in advantageous industries and areas. According to the basic conditions such as resource endowments, industrial characteristics, regional advantages, and development levels, highlight advantages, explore unique innovation-driven development models, and build a number of regional innovation centers with strong driving forces, whose influence will drive innovation and development in surrounding areas.

IV. Systematically Advance Comprehensive Innovation and Reform Experiments

Focusing on the leading role of scientific and technological innovation in comprehensive innovation, carry out systematic, integrated, and coordinated comprehensive innovation and reform experiments in Beijing, Tianjin, Hebei, Shanghai, Anhui, Guangdong, and Sichuan, and in Shenyang, Wuhan, and Xi'an, promote the formation of a number of regional reform and innovation platforms to serve as demonstrations, and form an institutional framework for promoting innovation. Support the coordination of production chains, innovation chains, capital chains, and policy chains in the experimental reform area, make a number of major reforms and breakthroughs in fair market competition, intellectual property rights, the conversion of scientific and technological achievements into commercial products, financial innovation, personnel training and incentives, open innovation, and scientific and technological management systems, and take substantive steps to take the lead in achieving innovation-driven development. Based

on the summary evaluation of the eight regional reform experiments, form major reforms that can be replicated in other regions and promote the demonstrations across the whole country.

Chapter 12: Enhancing the Level of Coordinated Development in Regional Innovation

Improve the cross-regional collaborative innovation mechanisms, guide the collection and flow of innovation elements, build cross-regional innovation networks, concentrate efforts to increase science and technology-driven poverty alleviation and development, and fully stimulate grassroots innovation.

I. Promote Cross-Regional Collaborative Innovation

Focusing on the need for coordinated development of Beijing, Tianjin, and Hebei, build a community for collaborative innovation. Focusing on solving major scientific and technological issues related to industrial transformation and upgrading and environmental protection, accelerate the interconnection and open sharing of scientific and technological resources, establish an integrated technology trading market, promote the construction of a demonstration zone for the transfer and conversion of S&T achievements into commercial products (科技成果转移转化) in Hebei and the area south of Beijing (京南), promote the orderly interlinkage of industries, and encourage the Beijing-Tianjin-Hebei region to take the lead in achieving innovation-driven development. Focusing on major strategic deployment around the Yangtze River Economic Belt, strive to resolve major scientific and technological issues related to environmental protection and restoration of the river basin and industrial transformation and upgrading, promote technology transfers, R&D cooperation, and resource sharing in various regions of the Yangtze River Economic Belt, promote the deep integration of technology, industry, education, finance, and other fields, and improve the overall level of innovation and development. Accelerate the integration of technological innovation in the Yangtze River Delta and the Pearl River Delta and build a new hub of open innovation and industry transformation and upgrade.

Break down barriers of regional institutions and mechanisms, promote the flow of innovative resources, and achieve coordinated development of the eastern, central, and western regions. Encourage the eastern regions to take the lead in achieving innovation-driven development and make better use of the role of positive influence. Focusing on the revival of old industrial bases in the Northeast and the rise of central China, increase support for innovation in key industries, increase the marketization of innovative resource configurations, and enhance the force and vitality of innovation. Accelerate the optimization of the layout of innovation bases in the central and western regions and develop characteristic and advantageous academic disciplines and industries. Strengthen differentiated support for western regions and less developed regions, closely interlink the scientific and technological needs of the old revolutionary base areas, ethnic minority areas, border areas, and underprivileged areas, increase science and technology assistance to Xinjiang, Tibet, youth, and in efforts where stronger parties help weaker ones, and provide strong support for leapfrog development and long-term stability. Support the efforts of the central and western regions to explore unique innovation-driven development models based on their development needs, support and promote the construction of the Lanbai Scientific and Technological Innovation and Reform Pilot Zone, the Guizhou Big Data Industry

Technological Innovation Pilot Zone, Sichuan Chengdu Sino-Korean Innovation and Entrepreneurship Park, Yunnan Airport International Science and Technology Innovation Park, and the Pilot Zone for Scientific and Technological Innovation Reform along the Yellow River Economic Belt in Ningxia, optimize the environment for innovation and entrepreneurship, gather innovation resources, and use demonstrations to lead regional transformation and development. Deepen provincial consultation mechanisms and increase the integration and coordination of central and local scientific and technological resources.

II. Increase the Development of Science and Technology for Poverty Alleviation

Focusing on the fight against poverty, strengthen the supporting role of scientific and technological innovation in targeted poverty alleviation, vigorously promote intelligent poverty alleviation, entrepreneurial poverty alleviation, and collaborative poverty alleviation. Encourage scientific and technological personnel to support construction in remote poverty-stricken areas, frontier ethnic minority areas, and old revolutionary base areas, convert the conversion of a large number of advanced and applicable technological achievements into practical applications and promote their use in underprivileged areas and old revolutionary base areas. Strengthening the construction of science and technology parks and innovation and incubation carriers, guide capital, technology, talent, and other innovative entrepreneurial resources to gather in underprivileged areas, and encourage and support technology-based entrepreneurship that incorporates the resources and industrial characteristics of underprivileged areas. Support regional poverty alleviation and improve inter-provincial coordination mechanisms. Taking the needs of underprivileged areas into consideration, strengthen targeted poverty alleviation, implement the "one county, one regiment" (“一县一团”) and "one county, one policy" policies, and construct innovation-driven precision poverty alleviation test fields and demonstration sites. Give play to the leading role of science and technology in industry-based poverty alleviation and focus on supporting the development and growth of characteristic and advantageous industries in underprivileged areas.

III. Improve Grassroots Scientific and Technological Innovation Service Capabilities

Further strengthen the design and guidance of basic science and technology work systems, persist in facing the grassroots and move the center of gravity downward, and coordinate central and local scientific and technological resources to support grassroots technological innovation. Carry out county-level innovation-driven development demonstrations and strengthen the monitoring and evaluation of the scientific and technological innovation capabilities of counties (cities) across the country. Strengthen the construction of grassroots science and technology management teams, develop and expand social entrepreneurship services, and encourage and cultivate a diversified and personalized service model. Comprehensively implement the science and technology special commissioner system, develop and expand the team of science and technology special commissioners, cultivate and develop new agricultural operations and service entities, improve the agricultural socialization science and technology service system, encourage the establishment of leading technology-based enterprises, professional cooperatives, and professional technology associations, and increase the promotion and application of advanced and applicable technologies.

Box 26 Demonstration of Innovation-Driven Development in Counties and Regions

1. Innovation-driven development demonstration counties: Select characteristic counties (cities) with the ability to drive demonstrations, focus on the construction of scientific and technological cooperation platforms between scientific research units and counties (cities), cultivate and expand high-tech agricultural industries, develop county (city) scientific and technological research result conversion and innovation service platform, and strengthen innovation-driven assessment.

2. Agricultural modernization scientific and technology demonstration counties: Select counties (cities) with high levels of agricultural modernization, strong scientific and technological innovation capabilities, intensive high-tech agricultural industries, and rich science and education resources, create agricultural modernization science and technology demonstration counties, and form a model for the development of agricultural modernization.

3. Demonstration counties for the integrated development of primary, secondary, and tertiary rural industries: Choose counties (cities) with rich agricultural resources, biomass resources, and agricultural leisure resources and strong industrial foundations, develop "Internet+" modern agriculture, extend the agricultural production chain, promote the integrated development of primary, secondary, and tertiary rural industries, and expand the value added by the agricultural industry.

IV. Promote Regional Sustainable Development

Optimize the layout of national sustainable development experimental areas, target the problems of the coordinated development of the economy, society, and resources and the environment in different types of regions, and carry out experiments and demonstrations of innovation-driven regional sustainable development. Improve the experimental area indicators and assessment system, increase the ability to transform scientific and technological achievements into commercial products, promote innovation and entrepreneurship in experimental areas, and actively explore new models for coordinated regional development. On the basis of national sustainable development experimental areas, focusing on the implementation of major national strategies and the United Nations 2030 Agenda for Sustainable Development, and centered on the promotion of green development, create national sustainable development innovation demonstration zones and strive to form a group of innovative models and typical examples of modern green agriculture, resource conservation and recycling, new energy development and utilization, pollution control and ecological restoration, green urbanization, population health, public safety, disaster prevention and mitigation, and social governance at the regional level.

Chapter 13: Building a “Belt and Road” Collaborative Innovation Community

Give play to the leading role of scientific and technological innovation cooperation in jointly building the "Belt and Road," focus on the needs of science and technology innovation cooperation of the countries along the route, comprehensively improve the stage and level of scientific and technological innovation cooperation, create an innovation community featuring shared development concepts, the smooth flow of resources, connectivity of science and technology facilities, integration of innovation chains, and smooth exchange of personnel.

I. Foster In-Depth Science and Technology Communication and Cultural Exchange

Strengthen cultural exchanges with countries along the "Belt and Road" and expand personnel exchanges. Work with countries along the route to jointly train science and technology

talent, expand the scale of work plans for outstanding young scientists in China, and conduct extensive training on advanced applicable technologies, science and technology management and policy, and science and technology entrepreneurship. Encourage Chinese science and technology personnel to carry out science and technology volunteer services in countries along the route to solve technical problems and meet technical needs. Cooperate in science popularization activities and promote science popularization among young people. Conduct in-depth science and technology policy exchanges and communication with the countries along the route and form a scientific and technological innovation policy collaboration network.

II. Strengthen the Construction of Joint R&D and Technology Transfer Centers

Incorporating the major scientific and technological needs of the countries along the route, encourage China's scientific research institutions, universities, and enterprises to cooperate with relevant institutions in countries along the route, focus on working together to build joint laboratories (joint research centers) in key fields, jointly advance high-level scientific research, carry out the exchange and training of scientific and technological talent, promote the transfer of applicable technologies and the conversion of results, and build long-term and stable cooperative relationships. Give full play to the roles played by China's international technology transfer centers oriented toward ASEAN, Central Asia, South Asia, and the Arab countries as well as the China-Israel Innovation Cooperation Center, build a number of advanced and applicable technology demonstration and promotion bases, and promote technology exchanges and cooperation with countries along the route. Work together to build a number of distinctive science and technology parks, explore diversified construction models, and build a platform for enterprises to "Go Global." Encourage scientific and technological enterprises to innovate and start businesses in countries along the route, promote the integration of enterprises in industries such as mobile Internet, cloud computing, big data, and the Internet of Things with traditional industries in countries along the route, and promote cooperation in new technologies, new formats, and new business models.

III. Promote the Connectivity of Science and Technology Infrastructure

Strengthen the R&D of adaptive key technologies and the linkage of technical standards, support the interconnection of transportation along railways and highways as well as the interconnection of power grids and information and communication networks, and ensure the construction of the maritime Silk Road transport corridor. Accelerate the construction of data sharing platforms and information service facilities and promote the interconnection of large-scale scientific research infrastructure, scientific research data, and scientific and technological resources. Continue to promote the international opening of large scientific research infrastructure and give priority to establishing platform service sites in countries along the "Belt and Road." Establish a service platform for earth observation and scientific data sharing and connect major Asia-Pacific earth observation data centers. Build a biotechnology information network and promote the co-construction and sharing of databases of biological resources and technological achievements of the countries along the route.

IV. Strengthen Cooperative Research with Countries Along the "Belt and Road"

Actively carry out cooperative research on major scientific issues and common challenges. Strengthen substantive cooperation in major public welfare technologies in fields such as agriculture, population health, water governance, desertification and salinity control, environmental pollution monitoring, desalination and comprehensive utilization, marine and geological disaster monitoring, ecosystem protection, biodiversity protection, and world heritage protection, and promote the joint development of biological resources and promotion of health services in areas such as traditional Chinese medicine and ethnic minority medicine. Strengthen cooperative development and industrial demonstrations in aerospace, equipment manufacturing, water-conservation agriculture, biomedicine, energy conservation and environmental protection, new energy, information, oceanography, and other fields to enhance the innovation capacity of China's key industries. Strengthen the construction of "Belt and Road" regional innovation centers, help Xinjiang build a pilot zone for innovation-driven development of the Silk Road Economic Belt, and help Fujian build the core area of the 21st Century Maritime Silk Road.

Chapter 14: Comprehensive Integration and Deployment of Global Innovation Networks

Persist in planning and promoting innovation from a global perspective, implement the internationalization strategy for scientific and technological innovation, actively integrate and proactively deploy global innovation networks, explore new models, new paths, and new systems of open science and technology cooperation, fully participate in global innovation governance, promote the two-way openness and flow of innovation resources, and comprehensively improve the internationalization of scientific and technological innovation.

I. Improve Open and Cooperative Mechanisms for Technological Innovation

Strengthen the systemic design of national science and technology diplomacy and cooperation. Deepen intergovernmental scientific and technological cooperation, classify and formulate country-specific strategies, enrich the scientific and technological content of new great power relationships, promote the establishment of innovative strategic partnerships with developed countries in science and technology, build an innovative community of mutually beneficial cooperation with neighboring countries, and extending the framework of the Science and Technology Partnership Program for Developing Countries. Establish innovative international scientific, technological, and cultural exchange mechanisms, enrich and deepen innovative dialogue mechanisms, expand the scope of the dialogs, conduct in-depth communication on R&D cooperation, innovation policies, technical standards, intellectual property rights, cross-border mergers and acquisitions, and other issues. Strengthen scientific and technological cooperation with Africa, Latin America, and other regions. Scale up scientific and technological assistance, pursue innovative assistance methods, and help developing countries strengthen scientific and technological innovation capacity building.

Increase the openness of national science and technology plans, assist overseas experts in leading or participating in national science and technology plan projects, and participate in national scientific and technological plans and special strategic research, guideline formulation, and project review. Set up innovation funds or cooperation plans with foreign countries. Implement a more active talent introduction policy, accelerate the reform of the visa system, focus on introducing global high-level scientific and technological innovation talent (such as the

chief scientists) to address the major needs of the country, and improve the policy and service systems for promoting foreign innovation cooperation.

Box 27 Open Cooperation Mechanisms for Scientific and Technological Innovation

1. Innovation dialogs: Strengthen dialogue and cooperation with major countries, important international organizations, and multilateral mechanisms with a focus on policy formulation, scientific cooperation and technology exchange platforms, and major international R&D tasks. Encourage and support the in-depth participation of industry sectors, promote exchanges on innovation policy and practice, deepen organic ties for high-level cultural exchanges, and expand new forms of bilateral diplomacy.

2. Scientific and technological partnership programs: Continue to expand the China-Africa Science and Technology Partnership Program, the China-ASEAN Science and Technology Partnership Program, the China-South Asia Science and Technology Partnership Program, the SCO Scientific and Technological Partnership Program, the China-BRICS Cooperation Framework Program for Science and Technology Innovation, and the China-Latin America Technology Partnership Program, prepare to launch the China-Arab Science and Technology Partnership Program, build new pragmatic, efficient, and dynamic new science and technology partnerships with relevant countries, and focus on strengthening scientific and technological personnel training, joint construction of joint laboratories (joint research centers), joint construction of science and technology parks, joint construction of technology demonstration and promotion bases, joint construction of technology transfer centers, promotion of science and technology resource sharing, science and technology policy planning and consultation, and other forms of cooperation.

II. Promote the Two-way Openness and Flow of Innovation Resources

Focusing on major national science and technology needs, cooperate with countries with relevant advantages in related fields to build a number of joint research centers and international technology transfer centers. Enhance the internationalization of enterprise development, encourage powerful enterprises to adopt various methods to carry out international cooperation in scientific and technological innovation, help enterprises set up R&D centers overseas and participate in the development of international standards, and help equipment, technology, standards, and services to "Go Global." Encourage foreign investment in strategic emerging industries, high-tech industries, and modern service industries and encourage foreign multinational companies, research and development institutions, and research universities to establish or cooperate in establishing high-level research and development institutions and technology transfer centers in China. Give full play to the role of international scientific and technological cooperation bases and cooperate with leading countries to build high-level joint research centers in relevant fields. Encourage Chinese scientific research institutions and enterprises to establish overseas research and development institutions in various ways, including joint establishment with internationally renowned scientific research institutions and multinational companies. Leverage regional innovation advantages and promote the local establishment of international scientific and technological innovation cooperation centers. Strengthen international cooperation in innovation and entrepreneurship, deepen international exchanges of scientific and technological personnel, attract outstanding young scientists from overseas to work in China and participate in exchanges, and carry out international youth science popularization activities.

Box 28 Two-Way Openness and Flow of Innovation Resources

1. Intergovernmental scientific and technological cooperation: Improve inter-governmental scientific and technological cooperation mechanisms and implement bilateral and multilateral scientific and technological cooperation agreements and various other agreements related to scientific and technological cooperation. Deploy scientific and technological cooperation in a category-based manner with large countries, neighboring countries, other developed and developing countries, international organizations, and multilateral mechanisms. Carry out major intergovernmental cooperation programs. Provide joint funding for joint research and development. Support exchanges of scientific and technological personnel.

2. Major international scientific and technological innovation cooperation: Focus on promoting major international cooperation in agriculture and rural areas, urbanization and urban development, clean energy and renewable energy, new generation electronic information and network technology, earth observation and navigation, new materials, advanced manufacturing, transportation, resources and the environment, biotechnology, oceans and polar regions, population and health, and public safety. Promote the introduction of technology and equipment in fields such as environmental protection, weather forecasting, and germplasm resources and solve major, core, and key technical issues.

3. National international science and technology cooperation bases: Strengthen the construction of international science and technology cooperation base alliances. Support bases for joint research. Carry out international training, personnel training, and information services. Optimize the cluster construction of cooperation platforms. Establish a dynamic adjustment and key funding mechanism for the evaluation of international scientific and technological cooperation bases based on their achievements in international scientific and technological cooperation and innovation.

III. Strengthen Cooperation in Scientific and Technological Innovation with Hong Kong, Macau, and Taiwan

Leverage the unique technological advantages of Hong Kong and Macau and the role of open platforms, use the Hong Kong and Macau Science and Technology Cooperation Committee mechanism, and promote the institutionalization and systemization of science and technology cooperation between mainland China and Hong Kong and Macau. Organize and implement high-level scientific and technological innovation cooperation projects and jointly build research and development bases. Promote the opening of scientific research facilities to Hong Kong, Macau, and Taiwan, assist young scientists from Hong Kong, Macau, and Taiwan in conducting short-term cooperative research in mainland China, and deepen scientific and technological exchanges in a mutually beneficial manner. Give full play to the pioneering role of the Western Taiwan Straits Economic Zone, the China (Fujian) Pilot Free Trade Zone, the Pingtan Comprehensive Experimental Zone, the Fuzhou-Xiamen-Quanzhou National Independent Innovation Demonstration Zone, and the Kunshan Pilot Zone for Deepening Cross-Strait Industrial Cooperation, and create a cooperation platform for scientific and technological innovation. Accelerate the establishment of comprehensive cooperation platforms for joint research and development, cultural exchanges, intellectual property rights, and technology transfer and conversion (技术转移转化) between the mainland and Taiwan and between mainland China and Hong Kong and Macau. Using high-tech zones and university science parks as vehicles, deepen and expand cooperation with universities, research institutes, and enterprises in Hong Kong, Macau, and Taiwan in science and technology research and development, innovation, and entrepreneurship.

Box 29 Priorities in Cooperation with Hong Kong, Macau, and Taiwan in Scientific and Technological Innovation

Strengthen cooperation between mainland China and Hong Kong and Macau and between mainland China and Taiwan in youth innovation and entrepreneurship and technology parks; introduce preferential policies to make it easier for young people from Hong Kong, Macau, and Taiwan to come to mainland China for innovation and entrepreneurship; encourage and organize youth from Hong Kong, Macau, and Taiwan to participate in various innovation and entrepreneurship competitions and training camp activities; promote the cooperation between mainland Chinese science and technology parks, makerspaces, and relevant institutions in Hong Kong, Macau, and Taiwan and expand the cooperation spaces in Beijing, Tianjin, Shanghai, Guangdong, and Hong Kong science and technology parks; and assist universities in mainland China, Hong Kong, and Macau universities in setting up university science and technology parks.

IV. Fully Participate in Global Innovation Governance

Actively participate in the formulation of major international scientific and technological cooperation rules, focus on major national concerns and global challenges, create public products for international scientific and technological cooperation, accelerate the sharing of large-scale scientific research infrastructure around the world, proactively set the global agenda, and promote Chinese influence in international scientific and technological innovation and the country's voice in global systems. Strengthen and optimize the global layout of foreign science and technology institutions and science and technology diplomats. Give play to the role of non-governmental organizations in promoting international cooperation in scientific and technological innovation. Pursue and attract international organizations to settle in our country, encourage the establishment of new international organizations, and support and recommend more talent (such as scientists) to participate in exchanges with and serve in international scientific and technological organizations.

Chapter 5: Promoting Mass Entrepreneurship and Innovation

Follow the new trend of mass entrepreneurship and innovation, build a service network that supports the entire chain of technological innovation and entrepreneurship, inspire the creative vitality of millions of people, and create new momentum for the development of the real economy.

Chapter 15: Comprehensive Improvement of the Development Level of the Science and Technology Service Industry

Aiming to meet the needs of technological innovation and promote innovation and entrepreneurship, establish and improve science and technology service systems and comprehensively improve the professional, networked, large-scale, and internationalized development level of the technology service industry.

I. Improve the Science and Technology Service Capabilities of the Entire Chain

Focus on perfecting the service chain supporting the innovation chain and vigorously develop professional and comprehensive scientific and technological services. Focus on the development of research and development, technology transfer, inspection and certification, entrepreneurial incubation, intellectual property rights, and scientific and technological

consulting and basically form a science and technology service system covering the entire science and technology innovation chain. Make full use of modern information and network technologies and, relying on various vehicles of scientific and technological innovation, integrate science and technology service resources, promote technological integration innovation and business model innovation, and actively cultivate a new industry format (新业态) for scientific and technological services. Optimize the regional and industrial layout of the science and technology service industry, promote the complementary advantages and information sharing of various science and technology service institutions, and improve the collaborative service capabilities of innovation subjects. Establish and improve the standard system for scientific and technological services and promote the standardized development of the science and technology service industry. Strengthen the entities in the science and technology service market, cultivate a group of science and technology service agencies and leading enterprises with well-known brands, and form a group of science and technology service industry clusters. Adopt various methods to support qualified science and technology service companies, support the development of public science and technology services through government purchase of services, post-subsidies (后补助), and other methods, and encourage places that meet certain criteria to use entrepreneurial vouchers, innovation vouchers, and other methods to encourage science and technology service agencies to provide high-quality services to innovative entrepreneurial enterprises and teams.

II. Establish a Unified and Open Technology Trading Market System

Strengthen the integration of the national technology market and explore the establishment of unified technical transaction specifications and processes. Develop a multi-level technology trading (技术交易) market system, promote the construction of national technology transfer regional centers, and accelerate the formation of a national technology trading network platform; encourage localities to improve regional technology trading service platforms, highlight the characteristics of regional and industrial development, and coordinate the resources of regional technology trading platforms. Assist technology trading institutions in exploring online technology trading modes based on the Internet, strengthen the integration of various innovation resources, and provide integrated online and offline professional services such as information publication, financing and mergers and acquisitions (M&As), public listing, tendering and auctions, and consulting. Encourage technology trading institutions to adopt innovative service models, develop value-added services for technical transaction information, and provide enterprises with cross-domain, cross-region, and full-process integration services. Vigorously cultivate technology brokers (技术经纪人) and guide technology trading institutions in developing in a professional, market-oriented, and international manner.

III. Promote the International Development of the Science and Technology Service Industry

Strengthen the ability of science and technology service institutions to link global resources, help science and technology service agencies to "Go Global," and develop international markets through overseas mergers and acquisitions, joint operations, and the establishment of branches. Push science and technology service organizations to lead the establishment of an international science and technology service alliance with technology, patents, and standards as the ties. Assist

scientific and technological service institutions in carrying out international exchanges and cooperation in technology and talent, and actively attract international science and technology service personnel to come to China for work, short-term exchanges, or training. Encourage well-known foreign science and technology service agencies to set up branches or carry out technology service cooperation in China. Assist domestic science and technology service institutions in carrying out in-depth cooperation with foreign counterparts and form an international scientific and technological service cooperation network for information sharing, resource sharing, and interconnection.

Chapter 16: Building a Business Incubation System That Serves the Real Economy

Focusing on the transformation and upgrading of the real economy, strengthen the construction of a specialized and high-level comprehensive vehicle for innovation and entrepreneurship, improve entrepreneurial service functions, and form an efficient and convenient entrepreneurial incubation system.

I. Build Distinctive Makerspaces (众创空间)

Promote the development of makerspaces in the direction of specialization and segmentation and enhance their ability to serve the real economy. Focusing on developing segmented makerspaces in key industries, promote the convergence of mature production chains with innovation and entrepreneurship and solve industrial needs and common technical problems in the industry. Assist leading and backbone enterprises to build makerspaces centered on main business directions. Form an industrial innovation ecosystem community centered on leading and backbone enterprises and with the active participation of higher education institutions and scientific research institutes to influence and drive the growth and development of small, medium, and micro enterprises. Encourage institutions of higher learning and scientific research institutes to build professional makerspaces in advantageous specialized fields centered on scientific and technological personnel and the transfer and conversion of S&T achievements into major functions (成果转化转化为主要功能). Increase source technology supply and provide professional services for scientific and technological innovation and entrepreneurship. National high-tech zones, national economic and technological development zones, and national modern agricultural demonstration zones shall give play to the advantages of innovation and entrepreneurial clusters in key areas and create a group of makerspaces with local characteristics.

II. Develop "Farm Star Worlds" (“星创天地”) for Rural Entrepreneurship

Strengthen the construction of "Farm Star Worlds." Using agricultural science and technology parks, the new rural development research institutes of higher education institutions, science and technology enterprises, science and technology commissioner entrepreneurial bases, and farmers' professional cooperatives as vehicles, leveraging market-oriented mechanisms, specialized services, and capitalized operations, and making use of offline incubation vehicles and online network platforms, create a "Farm Star Worlds" that integrate technology demonstration, technology integration, financing and incubation, innovation and entrepreneurship, and platform services for science and technology commissioners, college students, returned migrant workers, and professional farmers. Create a professional, socialized, and convenient rural technology

entrepreneurial service environment and promote the integration of primary, secondary, and tertiary industries.

III. Improve the Business Incubation Service Chain

Build an innovation and entrepreneurship incubation ecosystem, give full play to the role of university science parks and technology business incubators in the entrepreneurship of college students, and guide enterprises and social capital to participate in incubator investment and construction. Promote the close integration of angel investment and entrepreneurship incubation, promote incubation models such as “incubation + venture capital” and entrepreneurial mentors, and explore new Internet-based incubation methods. Strengthen the connection of business incubation services, support the establishment of a business startup incubation service chain with the format "business nursery + incubator + accelerator," encourage the development of various mutual assistance platforms such as open source communities and developer communities, and provide support at the source (源头支撑) for the cultivation of emerging industries. Build interregional incubation networks and promote the coordinated development of incubators across regions. Promote cooperation between Internet incubation platforms and key enterprises in the real economy and achieve the integrated development of the real economy and the virtual economy. Strengthen entrepreneurship training and improve the professional capabilities of employees involved in entrepreneurship and incubation. Increase the internationalization of entrepreneurial incubation institutions, strengthen the construction of offshore entrepreneurial bases for foreign scientific and technological talent, and attract more international innovation and entrepreneurship resources. Encourage activities such as the Innovation and Entrepreneurship Competition and the University Student Challenge and strengthen the linkage of innovation and entrepreneurship projects with investment and incubation institutions. Assist intellectual property service institutions in providing full-chain intellectual property services for entrepreneurial incubation.

Chapter 17: Improve the Financial System to Support Technological Innovation and Entrepreneurship

Give play to the important role of financial innovation in promoting innovation and entrepreneurship, develop financial products and services that meet the needs of innovation, vigorously develop venture capital and multi-level capital markets, improve the technology and finance integration mechanisms, increase the proportion of direct financing, and form a scientific and technological financial ecosystem with the coordination and integration of various financial instruments.

I. Increase the Scale of Scientific and Technological Venture Capital

Develop angel investment, venture capital, and industrial investment, increase the scale of venture capital and government venture capital guidance funds, and strengthen direct financing support for startups in the seed and start-up stages. Fully implement the National Fund for Technology Transfer and Commercialization (国家科技成果转化引导基金) and attract outstanding venture capital management teams to jointly establish a number of venture capital sub-funds. Give full play to the role of the National Venture Capital Guidance Fund for Emerging

Industries and the National Development Fund for Small- and Medium-Size Enterprises and drive social capital to support the development of high-tech industries. Study and formulate regulations for angel investment and encourage and regulate the development of angel investment. Guide insurance funds to invest in venture capital funds, increase support for foreign venture capital investment companies, and guide foreign capital in investing in innovation.

II. Develop a Multi-Level Capital Market that Supports Innovation

Assist innovative and entrepreneurial enterprises to enter the capital market for financing, improve corporate merger and restructuring mechanisms, and encourage the development of various forms of merger and acquisition financing. Deepen the reform of the Growth Enterprise Market (GEM), improve institutional arrangements suitable for the development of innovative and growing enterprises, and expand the coverage of the real economy. Strengthen the financing, M&A, transaction, and other functions of the national small- and medium-size enterprise stock transfer system. Regulate the development of regional equity markets and enhance their ability to serve small and micro enterprises. Open up various capital markets and strengthen the organic connections between capital markets at different levels for the promotion of innovation and entrepreneurship financing. Develop financial services that meet the needs of innovation and promote financing using a combination of high-yield bonds and equity bonds. Give play to the role of the equity pledge financing mechanism of the Shanghai and Shenzhen Stock Exchanges and assist qualified innovation and entrepreneurial enterprises in issuing corporate credit bonds mainly through non-public means. Assist qualified enterprises in issuing project income bonds, with the funds raised used to increase investment in innovation. Accelerate the development of green finance that supports energy conservation and environmental protection.

III. Promote Innovation in Science and Technology Financial Products and Services

Deepen pilot programs to promote the integration of technology and finance, establish a full-process, diversified, and differentiated scientific and technological innovation financing model covering experimental research, pilot, and production, and encourage and guide financial institutions in participating in industry-university-research cooperative innovation. While ensuring legal compliance and controllable risks, support the development of structural and composite financial products that suit the characteristics of innovation and increase financial support for corporate innovation activities. Select qualified banking financial institutions, provide equity and debt financing for innovative startups, cooperate with venture capital institutions to achieve investment and loan linkage, and support crowdsourcing and crowdfunding by science and technology projects. Give full play to the role of policy banks and increase support for corporate innovation activities within the enterprise business scope. Guide banks and other financial institutions to create innovative credit products and financial services, increase the flexibility and convenience of credit-supported innovation, and support the financial product innovation of private banks to meet the innovation needs of small, medium, and micro enterprises. Accelerate the development of scientific and technological insurance, encourage insurance institutions to initiate or participate in the establishment of venture capital funds, and explore the support that insurance funds can provide to the development of major science and technology projects and companies. Promote intellectual property securitization and equity crowdfunding pilot programs and explore and standardize the development of Internet finance

for service innovation. Establish a market-based risk compensation mechanism for intellectual property pledge financing, simplify the intellectual property pledge financing process, and encourage regions that meet relevant criteria to establish science and technology insurance rewards mechanisms and reinsurance systems. Conduct patent insurance pilot programs and improve patent insurance service mechanisms. Promote the construction of various specialized agencies and service centers for science and technology finance, gather scientific and technological resources and financial resources, build regional science and technology financial service brands, and encourage high-tech zones and free trade pilot zones to carry out advanced scientific and technological financing pilot programs.

Part 6: Comprehensively Deepening Science and Technology Structural Reform

Focusing on promoting the in-depth integration of science and technology with economic and social development, implement the decisions and arrangements of the Party Central Committee and the State Council on deepening S&T structural reform, strengthen the implementation of key reform measures, promote the coordination of S&T structural reform and reforms in other areas, strengthen the capabilities of innovative entities, build an efficient collaborative innovation network, and maximize the massive potential of science and technology as the primary element in production capacity and the main driver of innovation.

Chapter 18: Fully Promote S&T Management Structural Reform

Focusing on the transformation of the function of the government from R&D management to innovative services, deepen S&T planning and management reform, strengthen the construction of the basic system of science and technology innovation management, and comprehensively improve the ability and level of innovation services.

I. Improve Scientific and Technological Innovation Governance Mechanisms

Follow the new trends of diversified innovation entities, diverse activities, and changing paths and promote innovation in government management, form an efficient, collaborative innovation governance structure featuring multilateral participation. Transform government functions, reasonably position government and market functions, promote decentralization, delegation, and service optimization reforms, strengthen the government functions of strategic planning, policy formulation, environmental construction, public services, supervision and evaluation, and implementation of major tasks, focus on supporting public scientific and technological activities for which the market cannot effectively allocate resources, such as basic cutting-edge research, social welfare activities, and research on major general-purpose key technologies, and actively create a market and social environment conducive to innovation and entrepreneurship. The development of competitive new technologies, new products, and new formats is left to the market and enterprises to decide. Rationally determine the functional division of labor of the central government ministries and give play to the role of industry authorities in determining innovation needs, organizing and implementing tasks, and promoting and applying results. Scientifically divide the scientific and technological authority of central and local governments. The functions of the central government focus on overall, basic, and long-

term work, while local government functions focus on promoting technology development and converting S&T achievements into applications. Accelerate the establishment of scientific and technological policy-making mechanisms for scientific and technological consulting to support administrative decision-making and promote the institutionalization of major scientific and technological decisions. Improve the national science and technology innovation policy-making consultation system, regularly report on domestic and foreign scientific and technological innovation trends to the Party Central Committee and the State Council, and provide advice on major issues related to scientific and technological innovation. Build a high-level technology innovation think tank system and give full play to the role of academics and high-level experts in universities and research institutes in strategic planning, consulting and evaluation, and macro-policy-making. Enhance the voice of entrepreneurs in national innovation policy-making systems, give play to the role of various industry associations, foundations, and scientific and technological societies in promoting technological innovation, and improve the mechanisms for public participation in decision-making.

II. Build a New Scientific and Technological Planning System

Further advance the management reforms of the central government financing plans for science and technology (special projects, funds, etc.). Restructure the national science and technology plan in accordance with the five types of science and technology plans, the National Natural Science Foundation of China, the National Science and Technology Mega-Projects, the National Key R&D Plans, the Technology Innovation Guidance Projects (Funds), and the Base and Talent Projects, and implement categorized management and categorized support. Integrate all science and technology plans (special projects, funds, etc.) into a unified national science and technology management platform, improve the operation mechanisms for inter-ministerial joint meetings on national science and technology plans (special projects, funds, etc.), strengthen the management of scientific and technological plans and the overall coordination of major events, and give full play to the role of industries, departments, and localities. The national key research and development plan focuses more on major strategic tasks. According to the major needs of national economic and social development and the priority areas of scientific and technological development, form a number of key projects with clear goals and clear boundaries, create an innovative design of the whole chain from basic frontiers and major general-purpose key technologies to application demonstrations, and practice integrated organization and implementation. Provide categorized integration of technology innovation guidance projects (fund) and guide social funds and financial capital into the field of technological innovation through market mechanisms. Accelerate the integration and distribution of bases and talent, deepen the management reform for major national science and technology projects, and strengthen results sharing and work linkage between the National Natural Science Foundation of China and other scientific and technological programs. Establish a professional institution management project mechanism, accelerate the construction and operation of professional institutions that are open and transparent, have sound and standardized systems, and have fair and just management, and improve professional management and service efficiency. Establish a unified national science and technology plan supervision and evaluation mechanism, develop monitoring and evaluation rules and standards, strengthen the implementation of scientific and

technological plans and funding supervision and inspection, and carry out third-party assessments.

III. Further Improve Scientific Research Project and Fund Management

Further improve scientific research projects and fund management, establish an efficient and standardized management system consistent with scientific research laws, solve the problems of simplistically applying administrative budget and financial management methods to manage scientific and technological resources, make funding serve people's creative activities, promote the formation of dynamic research projects and fund management mechanisms, and deepen reforms to better stimulate the enthusiasm of most scientific researchers. Formulate and revise relevant plan management methods and fund management methods, improve and standardize project management processes, and streamline and simplify procedures. Establish a financial assistant system for scientific research. Improve indirect cost management for scientific research projects, increase performance incentives, and implement the project budget adjustment right of the project undertaker. Improve the coordination mechanism between stable support (穩定支持) and competitive support (竞争性支持), increase stable support, assist research institutions in independently deploying scientific research projects, and expand the academic autonomy of universities and research institutes and the ability of individual researchers to choose research topics. Establish a system that embraces and supports non-consensus innovation projects in the field of basic research.

IV. Strengthening the Construction of the Basic System for Science and Technology Management

Establish a unified national science and technology management information system and implement full-process trace management for science and technology plans. Fully implement the national science and technology reporting system, establish a science and technology report sharing service mechanism, and use the submission and sharing of scientific and technological reports as the basis for subsequent support for the work unit responsible for the project. Improve the scientific research credit management system and establish a level-by-level assessment and accountability mechanism covering project decision-making, management, and implementation entities. Promote the establishment of a national innovation survey system and issue monitoring and evaluation reports on the innovation capabilities of countries, regions, high-tech zones, and enterprises. Establish a long-term technical forecasting mechanism and strengthen the dynamic evaluation of China's technological development level and the selection of key national technologies. Further improve the science and technology statistics system.

V. Improve Innovation-Oriented Evaluation Systems

Reform the science and technology evaluation system, establish a classification and evaluation system guided by the quality, contributions, and achievements of scientific and technological innovation, and correctly evaluate the scientific, technological, economic, social, and cultural value of scientific and technological innovation achievements. Promote the categorized evaluation of higher education institutions and research institutes, conduct performance evaluations, incorporate the impact of technology transfers and scientific research achievements on the economy and society into evaluation indicators, and use the evaluation

results as an important basis for government funding for science and technology. Implement third-party evaluations, explore the establishment of evaluation mechanisms involving the government, social organizations, and the public, and expand social, professional, and international evaluation channels. Improve the national economic accounting system, gradually explore incorporating R&D expenditures that reflect innovation activities into GDP accounting, reflect the contribution of intangible assets to the economy, and highlight the investment and effectiveness of innovation activities. Reform and improve the evaluation mechanisms for state-owned enterprises and use R&D investment and innovation performance as important assessment indicators.

VI. Strengthen Civilian Technology Support for National Defense Construction

Thoroughly implement the development strategy of military-civil fusion, promote the formation of a layout that comprehensively integrates military and civilian science and technology innovation, with full-factor coverage, multiple fields, and high efficiency. Strengthen overall coordination in the field of science and technology, implement national defense needs in national R&D task arrangements, combine the adjustment of the R&D layout with the improvement of the national defense layout, promote the overall coordination of national science and technology and national defense science and technology at the planning level, establish and improve mechanisms for joint demonstration and implementation of major military and civilian tasks, and provide more powerful technical support for national defense construction. Give full play to the advantages of higher education institutions and research institutes and actively encourage advantageous private scientific research forces to participate in major scientific and technological innovation tasks of national defense. Make breakthroughs in key links that hinder conversion, strengthen assessment guidance, provide a good policy environment for the conversion of military technology into civilian technology. Continuously promote the overall layout and open sharing of technical standards and scientific research criteria platforms, strengthen overall support for scientific and technological innovation and national defense, and vigorously raise the development level of S&T innovation military-civil fusion.

Chapter 19: Strengthening the Status and Leading Role of Enterprises as Innovation Entities

Comprehensively implement national technology innovation projects and accelerate the construction of a technological innovation system with enterprises as the main entities. Focusing on comprehensively improving corporate innovation capabilities, guide various types of innovation elements to coalesce in enterprises, continuously enhance the innovation power, innovation vitality, and innovation strength of enterprises, transform innovation into tangible industrial activities, and form a development pattern of "supporting heaven and earth" (“顶天立地”) for leading innovative enterprises and "omnipresent" (“铺天盖地”) development for small and medium-size scientific and technological enterprises.

I. Incubate Leading Innovative Enterprises

Strengthen the construction of innovative enterprises and cultivate a group of leading innovative enterprises with international influence. Encourage innovative enterprises to engage in Top 100 projects. Attract more enterprises to participate in researching and formulating

national science and technology innovation plans, programs, policies, and standards, and assist enterprises in taking the lead in joint participation with higher education institutions and research institutions to undertake national science and technology plan projects. Give full play to the motivating and guiding role of policies, carry out pilot transformations for leading enterprises, encourage enterprises to increase investment in research and development, and promote the widespread application of equipment updates and new technologies. Establish and improve the performance evaluation system for technological innovation in state-owned enterprises and implement and improve the measures for viewing the R&D investment of state-owned enterprises as profit. Encourage the establishment of high-level research institutions and construct State Key Laboratories of Enterprises within the layout of the leading and backbone enterprises. Assist qualified enterprises in carrying out basic research and cutting-edge technology research and push enterprises to climb to the high end of the production chain. Encourage the creation of makerspaces within enterprises and guide employees in technological innovation. Encourage large- and medium-size enterprises to develop new business fields and develop innovative products by investing in entrepreneurship and enhance market adaptability and innovation. Encourage the merger and restructuring of companies around the innovation chain and assist innovation-oriented enterprises in becoming bigger and stronger. Focusing on economic transformation and upgrading and the development of emerging industries, cultivate a group of top 100 innovative companies, promote the rapid growth of enterprises, and strengthen their leading role and international competitiveness.

II. Support the Healthy Development of Scientific and Technological Small, Medium, and Micro Enterprises

Bring into play the leading role of venture capital guidance funds such as the National Fund for Technology Transfer and Conversion, the National Development Fund for Small- and Medium-Size Enterprises, and the National Venture Capital Guidance Fund for Emerging Industries for the cultivation and development of the national venture capital market, and guide various types of social capital (社会资本) to provide financing support for qualified micro-, small-, and medium-size S&T enterprises. Formulate and improve standards for micro-, small-, and medium-size S&T enterprises. Implement management reforms for central financial science and technology plans (special projects, funds, etc.), strengthen enterprise technology innovation platform and environment construction, and promote the technological innovation, transformation, and upgrading of micro-, small-, and medium-size S&T enterprises. Support the development of high-growth scientific and technological micro-, small-, and medium-size enterprises, cultivate a group of "hidden champions" who have mastered the industry's "specialized, precision, and new" (“专精特新”) technology. Promote the formation of a number of technical innovation service platforms in professional fields, provide R&D design, inspection and testing, technology transfer, large-scale shared software, intellectual property rights, talent training, and other services to micro-, small-, and medium-size S&T enterprises. Explore ways to purchase services through the government, guide technical innovation service platforms to establish good mechanisms for effective operation, and provide integrated, market-oriented, professional, and networked support services for different segments and stages of innovation by micro-, small-, and medium-size S&T enterprises.

III. Deepen Mechanisms for Collaborative Innovation Among Enterprises, Universities, and Research Institutions

Adhering to a market-oriented, enterprise-oriented, and policy-oriented approach, promote the close integration of government, industry, university, research, and users in innovation. Improve the organization and management of science and technology plans, establish the functions of decisionmakers, organizers, and investors in enterprise industry-oriented science and technology plans, and bring into play the role of the National Science and Technology Plan as a means of resource allocation and mobilization to promote in-depth cooperation between enterprises, universities, and research institutes. Reform and improve the formation and operation mechanisms of strategic alliances for industrial technology innovation. In accordance with voluntary principles and market mechanisms, deepen the close cooperation among industry, universities, and research institutes, entities up and down the production chain, and large, medium, and small enterprises, and promote the deep integration of the production chain and the innovation chain. Strengthen the construction of pilot bases and general-purpose technology research and development platforms that combine industry, academia, and research. In strategic fields, explore cooperation models of enterprise-led cooperation with education institutions, diversified investment, military-civil fusion, and results sharing. Allow qualified personnel of higher education institutions and scientific research institutes to be approved by their units and bring scientific research projects and achievements to enterprises to carry out innovative work and start enterprises. Carry out pilot programs for setting up part-time mobile posts in higher education institutions and research institutes to attract talent from enterprises, allow higher education institutions and research institutes to set up a certain proportion of mobile posts, and attract part-time entrepreneurs and technologists with innovative practical experience. The pilots will use the company's employment experience as a necessary condition for recruiting engineering teachers in higher education institutions.

IV. Promote the Concentration of Innovation Resources in Enterprises

Use industrial technology innovation strategic alliances to gather industrial innovation resources, accelerate the research and development of common industrial technologies, and promote the application of major scientific and technological achievements. Assist enterprises in enhancing their innovation capabilities. Assist enterprises in introducing high-level overseas talent and strengthen the construction of teams of professional and technical personnel and highly skilled personnel. Implement innovation-driven assistance projects. Use enterprise academic expert work stations (工作站), postdoctoral work stations, and science and technology commissioners to guide scientific and technological personnel to serve enterprises. Improve the open sharing system of scientific and technological resources, strengthen the open sharing of major national science and technology infrastructure and large-scale instruments and equipment for enterprises, strengthen regional scientific research equipment collaboration, and improve the ability to support technological innovation in enterprises.

Chapter 20: Establishing Efficient R&D Organizational Systems

Deepen the reform of the scientific research organization system, comprehensively improve the innovation ability of higher education institutions, speed up the construction of distinctive

high-level scientific research institutes, foster new market-oriented R&D institutions, improve scientific research operation management mechanisms, and form an efficient R&D organization system.

I. Comprehensively Improve the Innovative Capabilities of Higher Education Institutions

Make overall plans to promote the construction of world-class universities and academic disciplines, systematically enhance collaborative innovation capabilities for talent training, discipline construction, scientific and technological R&D, and social services, enhance original innovation capabilities and the ability to serve economic and social development, and expand international influence. Strengthen the core curricula of higher education institutions with industry characteristics and strengthen distinctive school operation. Strengthen regional scientific research cooperation, academic exchanges, and open sharing of resources among higher education institutions and carry out application technology research and development in response to market needs. Accelerate the construction of a modern university system with Chinese characteristics, implement and expand the autonomy of legal persons for institutions of higher learning, coordinate the promotion of educational innovation, scientific and technological innovation, institutional innovation, open innovation, and cultural innovation, and stimulate the motivation and vitality of higher education institution operations. Deepening the reform scientific research systems and mechanisms in higher education institutions, promote the close integration of science and education, and carry out pilot reforms of scientific research organization methods in higher education institutions. Promote graduate training reform based on the principles of integration of production and education and cooperation of science and education, encourage case-based, interactive, and motivational teaching, and cultivate all kinds of innovative, applied, and hybrid talent with innovative spirit and practical capabilities. Reform and improve the organization and implementation of innovation capacity enhancement programs of higher education institutions and strengthen the construction of collaborative innovation centers.

Box 30 Higher Education Innovation Capability Enhancement Program
Targeting major national needs, strengthen the top-level design of collaborative innovation centers, promote cross-disciplinary integration, and promote collaborative innovation by higher education institutions, research institutes, and enterprises. Improve funding and policy support mechanisms, adjust the identification mechanisms, organize the performance evaluation for the “2011 Collaborative Innovation Centers,” establish incentive and exit mechanisms, and build a quality assurance system with the ability to enter and exit and to be adjusted dynamically.

II. Accelerate the Construction of Distinctive High-Level Scientific Research Institutes

Accelerate the classification reform of scientific research institutes and establish and improve the system of modern scientific research institutes. Categorize reform plans according to institution, continue to deepen the reform of public interest-type research institutes, construct and improve corporate governance structures, assist scientific research institutions in implementing charter management, improve the system of rules and regulations, gradually promote the de-administration of scientific research, and strengthen its leading role in the development of basic cutting-edge and general-purpose key technologies for industry. Establish an innovation performance evaluation system for scientific research institutions and study and

improve the performance-based appropriation mechanism for scientific research institutions. Follow the direction of the corporate transformation (企业化转制) of development-type scientific research academies and institutes (开发类科研院所). According to the different situations of undertaking general-purpose scientific research tasks for industry and production and operation activities, implement categorized reform, categorized management, and categorized assessment. Implement and expand the autonomy of scientific research institutes as legal persons. Implement the Leading Action Plan of the Chinese Academy of Sciences and, leveraging the advantages of integrating research institutes, faculties, and educational institutions, explore a system of national modern scientific research institutes with Chinese characteristics.

Box 31 Leading Action Plan of the Chinese Academy of Sciences

Accelerate the construction of a group of innovation research institutes targeting major national needs, excellence innovation centers and large scientific research centers targeting international cutting-edge science and technology, and special research institutes targeting the main strategic areas of the national economy, form a flagship team, take the lead in achieving leapfrog development in science and technology, take the lead in building a national hub for innovative talent, take the lead in building national high-level S&T think tanks, and take the lead in building world-class scientific research institutions, and transform these assets into an important strategic innovation force to seize the strategic positions in international science and technology.

III. Cultivate and Develop New R&D Institutes

Develop new market-oriented R&D institutions, focusing on major regional and industrial technology needs, and form a cross-regional, cross-industry R&D and service network. Actively promote new R&D organizational models such as crowdsourcing, design by user participation, and cloud design, encourage the specialized development of R&D enterprises, and actively cultivate new market-oriented R&D organizations, R&D intermediaries, and new forms of R&D service outsourcing. For new R&D organizations such as private research institutions, implement a non-discriminatory support policy that does not favor similar public research institutions in areas such as the undertaking of national scientific and technological tasks and talent introduction. Formulate opinions to encourage the development of new socialized (社会化) R&D institutions and explore non-profit operating models

Chapter 21: Improve Mechanisms for the Transfer and Conversion of Science and Technology Achievements into Commercial Products

Take actions to promote the transfer and conversion of S&T achievements into commercial products, further remove the institutional obstacles that restrict the transfer and conversion of S&T achievements into commercial products, improve related supporting measures, strengthen the construction of technology transfer mechanisms, strengthen the management reforms for scientific and technological achievements, and stimulate the innovation and entrepreneurship of scientific researchers.

I. Establish a Sound Technology Transfer Organization System

Promote the establishment of sound technology transfer work systems and mechanisms by higher education institutions and research institutes, strengthen the construction of specialized S&T achievement conversion teams, and optimize the process of converting S&T achievements into commercial products. Technology transfer is carried out by the institutions responsible for technology transfers or by a delegated independent S&T achievement conversion service agency. Encourage institutions of higher learning and scientific research institutes to build specialized technology transfer institutions without increasing necessary preparation work, and cultivate a group of national technology transfer institutions with flexible operating mechanisms, professional talent gathering, outstanding service capabilities, and international influence. Establish channels for the conversion of higher education institutions' and research institutes' S&T achievements into commercial products in connection with the market, and promote the effective linkage of S&T achievements with the technological innovation needs of industries and enterprises. Assist enterprises, universities, and research institutes in setting up R&D institutions or technology transfer institutions and jointly carry out R&D, the application and promotion of achievements, and standard research and formulation. Establish and improve the conversion mechanisms of national science and technology plans to create scientific and technological achievements, release and transform a batch of S&T achievement packages that conform to the directions of industrial transformation and upgrading, investment scales, and industrial driving forces, and enhance the sources of technology for industrial innovation and development. Establish a national S&T achievements information system, strengthen the exchange of information on various S&T achievements, and encourage data mining, development, and utilization of S&T achievements.

II. Deepen Rights and Interest Management Reforms for Scientific and Technological Achievements

Implement the rights of higher education institutions and research institutes to independently decide on the transfer, license, and investment of the S&T achievements they hold. Except for state secrets and information related to national security, no approval or filing is required. The valuation of the S&T achievements of institutions of higher learning and scientific research institutes is determined in accordance with the law, and shareholding confirms the equity and capital contribution ratio. In addition, the sponsor agreement, investment agreement, the company's articles of association, and other documents are used to clarify the ownership of the S&T achievements, the valuation, the number of shares converted, and the proportion of capital in order to set out clear property rights. All the income from the transformation of S&T achievements into commercial products is retained by the relevant unit. After deducting the rewards and remuneration paid to those who have made important contributions to the completion and conversion of the S&T achievements, the proceeds shall mainly be used for S&T R&D and transformation of achievements into commercial products as well as to guarantee the operation and development of technology transfer institutions. Further explore reforms on the ownership of S&T achievements. Establish and improve a management system for transferring S&T achievements overseas.

III. Improve Incentive and Evaluation Mechanisms for the Conversion of Scientific and Technological Achievements

Actively guide qualified state-owned science and technology enterprises in implementing equity and dividend incentive policies and implement relevant rewards policies for the conversion of state-owned enterprises and institutions' S&T achievements into commercial products. Improve the staff invention system, promote the revision of patent law and corporate law, and improve the S&T achievement, intellectual property ownership, and benefit sharing mechanisms. The rewards for S&T personnel in the conversion of S&T achievements into commercial products by higher education institutions and research institutes should not be less than 50% of net income, and those who have made major contributions in the R&D and conversion of S&T achievements into commercial products shall receive a share of no less than 50% of the total award. For the S&T personnel in leadership positions who earn rewards for the conversion of S&T achievements into commercial products, follow the principles of categorized management. Improve the dispute arbitration and legal relief system for staff inventions.

For the competent departments of higher education institutions, scientific research institutes, and relevant departments such as finance and science and technology, S&T achievements should be used as one of the evaluation indicators in the performance evaluations of the unit. Increase support for higher education institutions, research institutes, and personnel with outstanding performance in the conversion of S&T achievements into commercial products. Competent departments as well as other relevant departments such as finance and science and technology shall evaluate the unit's performance in the conversion of S&T achievements into commercial products according to the annual report on the conversion of S&T achievements into commercial products by the unit. The evaluation results are used as one of the bases for supporting the unit. Institutions of higher learning and research institutes shall formulate incentive systems, with rewards given to outstanding professional technology transfer institutions. Institutions of higher learning and scientific research institutes shall submit annual reports on the conversion of S&T achievements into commercial products to the competent authorities.

IV. Strengthen Market-Oriented Services for the Conversion of Scientific and Technological Achievements

Centered on "Internet+" technology transfer and conversion and guided by demand, create a national technology trading network platform combining online and offline services. Provide professional services such as information publication, financing and M&As, public listing, tendering and auctions, and consulting. Improve the layout and functions of regional technology transfer centers and international technology transfer centers, assist local and relevant institutions in establishing and improving regional and industrial technology markets, and create a technology transfer network that links domestic and foreign innovation resources such as technology, capital, and talent. Improve various platform functions such as technology property rights transactions and intellectual property rights transactions and promote the effective linkage of S&T achievements and capital. Assist qualified technology transfer institutions in cooperating with angel investors and venture capital to establish investment funds and increase the investment in S&T achievement conversion projects.

V. Vigorously Promote the Transfer and Conversion of Local Science and Technology Achievements

Improve the work network for the conversion of S&T achievements into commercial products at the provincial, city, and county levels, and strengthen S&T management departments' function of transferring and converting S&T achievements. Giving the lead to provinces, autonomous regions, and municipalities with clusters of innovative resources and good work foundations and relying on national independent innovation demonstration zones, high-tech zones, agricultural science and technology parks, innovative cities, and other facilities, build a national demonstration zone for the transfer and conversion of S&T achievements into commercial products and explore the formation of some replicable work experience and models. Support the local construction of general or industry technical innovation service platforms, build a pilot program for S&T achievements and a vehicle for industrialization, and carry out services such as R&D design, pilot program maturation, inspection and testing, intellectual property rights, and investment and financing.

Box 32 Promote the Transfer and Conversion of S&T Achievements into Commercial Products

Promote the conversion and application of a number of major S&T achievements that provide quick results and strong support for industrial upgrades, significantly improve the ability of enterprises, higher education institutions, and research institutes to transfer and convert S&T achievements, further improve the market-based technology trading service system, promote technological innovation and entrepreneurship, develop and expand the professional technology transfer and conversion talent team, establish and improve diversified investment channels for the transfer and conversion of S&T achievements into commercial products, and comprehensively establish an S&T achievement transfer and conversion system with complete functions, efficient operations, and a market orientation.

Part 7: Strengthening the Construction of a Culture of Science Popularization and Innovation

Comprehensively improve the scientific capabilities of citizens, strengthen the construction of a popular science infrastructure, accelerate the spread of the scientific spirit and innovation culture, enable the public to better understand, master, use, and participate in technological innovation, and further strengthen the population base and social foundation for innovation and development.

Chapter 22: Comprehensive Promotion of the Scientific Literacy (科学素质) of Citizens

Comprehensively implement the Outline of the Action Plan for Scientific Literacy for All (全民科学素质行动计划纲要) and focus on youth, farmers, urban workers, leading cadres, and civil servants. According to the Scientific Literacy Benchmarks for Chinese Citizens (中国公民科学素质基准), raise the proportion of Chinese citizens with scientific literacy to 10% by 2020, widely implement S&T education, communication, and popularization, and improve the overall level of scientific literacy of society as a whole.

I. Strengthen Science and Technology Education for Young People

Focusing on raising interest in science, innovative consciousness, and learning and practical capabilities, improve science education at the basic education level. Expand channels of science and technology education for young people outside school, encourage young people to participate in science and technology activities, and encourage teaching and scientific research

facilities such as higher education institutions, research institutes, and technology-based enterprises to open labs for young people. Consolidate the results of rural compulsory education, improve the quality of science and technology education in rural primary and secondary schools, and provide more opportunities for rural youth to receive science and technology education and participate in science popularization activities. Focusing on training skilled labor, strengthen science and technology education in vocational high schools (中等职业学校) and promote the inclusion of materials related to the practice of science and technology education and innovation and entrepreneurship in classroom teaching. Improve the level of science and technology education in higher education and assist college students in carrying out innovative experiments, entrepreneurship training, and entrepreneurship practice projects. Carry out a wide range of scientific and technological innovation competitions and other activities.

II. Improve the Scientific and Cultural Literacy of Workers

Vigorously carry out agricultural science and technology education and training and provide comprehensive and multi-level training for various new professional farmers and rural practical technical talent (农村实用技术人才). Widely conduct various forms of rural science popularization activities, vigorously popularize scientific and technological knowledge and concepts such as green development, safety and health, cultivated land protection, and disaster prevention and mitigation, spread scientific ideas, combat superstitious thinking, and help farmers develop scientific, healthy, and civilized production models and lifestyles. Strengthen the construction of public services for science popularization in rural areas and enhance the capacity for science popularization services in towns and villages. Improve the continuing education system for professional technical personnel and strengthen the continuing education of professional technical personnel. Establish a vocational training and technical personnel training system with enterprises as the main entities, vocational colleges as the foundation, the active participation of various training institutions, and equal participation by public and private entities. Carry out widespread training and education for migrant workers in cities and promote the widespread popularization of knowledge and concepts such as vocational skills, work safety, and information technology. Strengthen community science popularization public services and carry out widespread community science and technology education, communication, and popularization activities. Carry out scientific and technological dissemination and science popularization services for the elderly and promote healthy and scientific pensions.

III. Improve the Scientific Decisionmaking and Management of Leading Cadres

Viewing science and technology education as an important part of the training of leaders and civil servants, emphasize the study of and training in S&T knowledge and scientific methods as well as the cultivation of scientific thinking and the scientific spirit. Enrich learning channels and vehicles and guide leading cadres and civil servants to continuously improve their scientific management and scientific decision-making capabilities. Actively utilize networked, intelligent, and digital education and training methods, expand the coverage of high-quality popular science information, and meet the diverse learning needs of leading cadres and civil servants. Continuously improve the assessment and evaluation mechanisms for leading cadres, with the requirements for scientific literacy reflected in the assessment of leading cadres and the recruitment of civil servants. Formulate and continuously improve the scientific quality

monitoring and evaluation standards for leading cadres and civil servants. Improve the scientific and technological awareness, scientific decision-making ability, scientific governance, and scientific literacy of leading cadres and civil servants. Carry out widespread science popularization activities such as academic lectures by academics and experts for leading cadres and civil servants and scientific popularization reports.

Chapter 23: Strengthening National Science Popularization Capacity Building

Improve the national science popularization infrastructure system, vigorously promote the popularization of science and technology, promote the development of the science popularization industry, promote the combination of innovation and entrepreneurship with science, and improve the capabilities and level of basic science popularization services.

I. Strengthen the Construction of Science Popularization Infrastructure and Science Informatization

Strengthen the system layout of science popularization infrastructure, promote the construction of national science popularization demonstration bases and national special science popularization bases, improve science and technology infrastructure service capabilities, and achieve the balanced development of public science popularization services. Further establish and improve the modern science and technology museum system with Chinese characteristics based on physical science and technology museums, extending from popular science caravans, mobile science and technology museums, school science and technology museums, and digital science and technology museums. Strengthen the construction of science popularization facilities at the grassroots level and build a number of open, mass science popularization venues and science popularization facilities with a wide range of functions such as science and technology education, training, and demonstration. Improve the service capabilities and level of science popularization bases at all levels and improve the science and technology business levels of small and medium-sized science and technology venues. Study and formulate science and technology infrastructure standards and evaluation systems and strengthen operation and service monitoring and evaluation. Promote the construction of science popularization infrastructure in the central and western regions and in prefecture-level cities.

Vigorously promote science and technology informatization. Promote the integrated development of information technology with science and technology education and science popularization activities and promote the continuous innovation of science popularization concepts and service models such as science popularization content, communication methods, and implementation and operation mechanisms. Construct a science popularization information service system with science popularization content information, service clouds, communication networks, and applications at its core. Increase the scientific and technological communication of traditional media, take advantage of emerging media, raise the level of science popularization, develop innovative forms of popular science communication, promote the deep integration of traditional media such as newspapers and television with emerging media in popular science content, channels, platforms, operations, and management, and achieve multi-channel media-wide communication including paper publishing, network communication, and mobile terminal communication. Promote the application of popular science information, improve the quality of

scientific communication in the mass media, and meet the needs of popular science information. Adapt to the needs of modern science popularization, strengthen full- and part-time science popularization talent teams, strengthen the construction of popular science volunteer teams, and promote knowledge updates and ability training for popular science talent.

II. Raise the Level of Innovation and Industrialization Development in Science Popularization

Strengthen the creation of outstanding popular science works and promote the creation of a number of high-quality, high-impact original science popularization products. Carry out selection and promotion of excellent popular science works, micro-video selection, and other products throughout the country and strengthen commendations and rewards for outstanding popular science works. Develop innovative popular science explanation methods, improve the level of science popularization, and enhance scientific experience and results. Encourage and guide scientific research institutions, science popularization institutions, and enterprises to improve their R&D capabilities for science popularization products and promote the conversion of innovative scientific and technological achievements into science popularization products. Promote the development of popular science industries such as popular science exhibitions, popular science teaching materials, popular science books, popular science films, popular science toys, popular science tourism, popular science networks, and information by means of diversified investment and market-oriented operations. Encourage the establishment of science parks and industrial bases, cultivate a number of large and powerful science and technology design, production, exhibition, and service enterprises, and form a number of well-known science and technology brands.

III. Promote the Combination of Innovation and Entrepreneurship with Science Popularization

Promote the combination of scientific research and science popularization. In the implementation of national science and technology plans and projects, the obligations and requirements for science popularization shall be further clarified and scientific research personnel and those responsible for projects shall actively provide science popularization services to the community. Promote the opening of laboratories, showrooms, and other scientific and technological facilities by higher education institutions, scientific research institutions, and enterprises, give full play to the scientific popularization functions of high-end scientific research facilities such as observatories, field stations, key laboratories, and major science and technology infrastructure, encourage high-tech enterprises to open research and development facilities, production facilities, and exhibition halls to the public, and promote the construction of specialized science popularization locations.

Promote the combination of entrepreneurship and science popularization. Encourage and guide innovation and entrepreneurship service platforms such as makerspaces in carrying out science popularization activities for entrepreneurs and the public. Promote science popularization services for innovative entrepreneurs, such as science popularization venues and institutions. Encourage scientific researchers to actively participate in the science popularization activities of innovation and entrepreneurship service platforms and incubators and assist makers in participating in the design, development, and promotion of science popularization products.

Combined with key science popularization activities, strengthen the promotion of representative figures and milestones in innovation and entrepreneurship.

Chapter 24: Creating a Social and Cultural Atmosphere that Stimulates Innovation

Create a cultural environment that advocates innovation, accelerate the spread of the scientific spirit and values of innovation, and mobilize society as a whole to better understand and engage in technological innovation. Create an atmosphere that encourages exploration, tolerates failure, respects talent, and respects creativity, strengthens scientific research integrity, scientific research morality, scientific research ethics construction, and social supervision, and foster an innovation culture that respects knowledge, advocates creativity, and pursues excellence.

I. Vigorously Carry Forward the Scientific Spirit

Carry forward the scientific spirit as an important part of the construction of advanced socialist culture. Vigorously carry forward the scientific spirit of seeking the truth and being pragmatic, have the courage to innovate, the pursuit of excellence, unity and collaboration, and selfless dedication. Encourage academic contention, stimulate critical thinking, and promote academic freedom that is dynamic, unconstrained, and dares to invent and create. Guide the scientific and technological community and workers to strengthen social responsibility, serve the motherland, work for the benefit of the people, and take the lead in putting the socialist core values concept into practice and leading society in a good direction.

Adhere to the principles of system regulation and moral self-discipline and build a scientific research integrity system the brings together education, self-discipline, supervision, and punishment. Actively carry out scientific research integrity education and propaganda. Improve the commitment and reporting systems for scientific research integrity, clarify the subjects and procedures for the supervision and investigation of academic misconduct, and strengthen the supervision, investigation, handling, and exposure of scientific misconduct. Implement a scientific record system for serious dishonesty, and adopt restrictions on project declarations, promotion, and evaluation for the responsible entities that are included in the records of serious dishonesty. Bring into play the self-discipline function of scientific research institutions and academic groups and guide scientific and technological personnel in strengthening self-discipline and self-management. Strengthen social supervision of scientific research integrity and scientific ethics and expand the public's right to know about and monitor scientific research activities. Advocate responsible research and innovation, strengthen the construction of scientific research ethics, strengthen scientific research ethics education, increase the awareness of scientific and technological ethics among scientific and technological workers, and guide enterprises to attach importance to social responsibilities such as protecting the environment and ensuring safety in technological innovation activities.

II. Enhance Mutual Trust Between the Science and Technology Community and the Public

Strengthen communication between the scientific and technological community and the public and shape a good image of the science and technology community among the public. Expand public participation in science and technology management activities such as science and

technology planning, technology forecasting, science and technology evaluation, and task deployment for science and technology plans and expand orderly participation channels. Actively carry out dialogues between scientists and the public on important topics. Use open forums, science salons, and exhibitions to create more opportunities for the technology community to communicate with the public. Strengthen channeling of and dynamic monitoring of public opinion on S&T, establish an emergency response mechanism for major scientific and technological incidents, and resist false science and distorted, false, or shoddy scientific and technological reports.

III. Foster a Spirit of Entrepreneurship and a Culture of Innovation

Vigorously cultivate a culture of innovation with Chinese characteristics, increase innovation confidence, actively advocate for a culture of innovation that dares to take the lead and tolerates failure, form a scientific and cultural atmosphere that encourages innovation, establish a value orientation that advocates wealth creation through innovation and entrepreneurship, vigorously cultivate entrepreneurship and maker culture, form a social orientation that attracts more talent to engage in innovative activities and entrepreneurial behavior, and make planning innovation, promoting innovation, and implementing innovation into conscious actions. Guide innovation and entrepreneurship organizations in building an open, equal, cooperative, and democratic organizational culture, respect different opinions, recognize and accept differences, and promote the integration of talented people with different knowledge and cultural backgrounds. Encourage innovation and entrepreneurship organizations to establish effective incentive mechanisms to provide equal opportunities for innovative entrepreneurs of different knowledge levels and cultural backgrounds and maximize the value of innovation. Encourage the establishment of informal communication platforms such as makerspaces within organizations to provide a suitable soft environment for innovation and entrepreneurship. Strengthen the promotion of scientific and technological innovation, report on cutting-edge achievements in innovation and entrepreneurship, establish typical figures of innovation and entrepreneurship, and further form good habits of respecting labor, knowledge, talent, and creativity. Accelerate the improvement of a cultural environment that is inclusive and innovative and form a social atmosphere where everyone advocates innovation, everyone desires innovation, and everyone can innovate.

Part 8: Strengthening Plan Implementation Assurance

Strengthen the responsibilities of government departments at all levels in the implementation of the plan, fully mobilize the enthusiasm and creativity of the scientific and technological community and all sectors of society, improve the task implementation mechanism in terms of policies and regulations, resource allocation, supervision, and evaluation, and ensure that the implementation of the plan achieves obvious results.

Chapter 25: Implementing and Improving Innovation Policies and Regulations

Focusing on creating a good innovation ecology, strengthen the guarantee of the rule of law in innovation, increase the implementation of inclusive policies, strengthen the coordination and

connection of policies at all links of the innovation chain, and form a policy orientation conducive to innovation and development.

I. Strengthen the Guarantee of the Rule of Law in Innovation

Improve the legal environment for protecting innovation, speed up the legislative process for weak links and areas, revise regulatory documents that do not conform to the direction of innovation, abolish rules and regulations that restrict innovation, and build a comprehensive safeguard system to support the rule of law. Study and draft regulations regulating and managing government scientific research institutions, private science and technology non-enterprise units, and other organizations, and reasonably adjust and regulate the rights and obligations of various entities in the field of science and technology innovation. Promote legislation on the sharing of scientific and technological resources, study and draft regulations on scientific data protection and sharing, and strengthen obligations to open up and share scientific and technological resources through financial aid. Study and draft regulations and systems for regulating and managing scientific research activities and improve the norms surrounding the participation of scientific communities, enterprises, and the public in the management of scientific and technological innovation. Strengthen legislation in specific areas such as biosafety, accelerate the formulation of the *Regulations on the Management of Human Genetic Resources*, speed up the revision of the *Regulations on National Science and Technology Awards*, the *Regulations on Management of Experimental Animals*, and other regulations, study and draft related laws and regulations on angel investment management, and improve and implement relevant laws and regulations on government procurement to support the development of small- and medium-size enterprises. Further advance the implementation of the *Law of the People's Republic of China on Science and Technology Progress*, the *Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements*, and the *Law of the People's Republic of China on the Popularization of Science and Technology*, increase the level of propaganda and popularization of these, and strengthen supervision and evaluation of the implementation of laws and regulations. Encourage localities to revise and formulate relevant scientific and technological innovation regulations in accordance with actual conditions.

II. Improve Inclusive Policy Systems to Support Innovation

Bring into play the fundamental role of market competition to stimulate innovation, create a fair, open, and transparent market environment, strengthen the guidance of industry policy on innovation, promote the survival of the fittest, and strengthen the innovative power of market players. Follow the direction of structural tax reduction and gradually transform the state's investment in corporate technological innovation into inclusive fiscal and taxation policy. Increase the implementation of policies such as additional deductions for research and development expenses, tax incentives for high-tech enterprises, and accelerated depreciation of fixed assets, and promote equipment upgrades and the use of new technologies. For investment in innovative activities, including angel investment in the seed stage and the start-up stages, the relevant tax support policies shall be coordinated and studied. Study and expand preferential tax policies to promote the development of venture capital investment enterprises and appropriately relax the conditions and restrictions on venture capital investment in high-tech enterprises.

Through the implementation of tax incentives, insurance, price subsidies, and consumer subsidies, promote the market-oriented and large-scale applications of new products and technologies. Strengthen research on policies related to emerging industries and emerging formats. Strengthen policy training, improve policy implementation procedures, and effectively expand policy coverage. Implement policies to promote the digestion, absorption, and re-innovation of imported technologies. Summarize the pilot policies for regional innovation and reform in a timely manner and increase promotion efforts. Strengthen the departmental coordination mechanism for policy implementation and strengthen the monitoring and evaluation of policy implementation.

III. Comprehensively Implement an Intellectual Property Rights (IPR) Strategy

Accelerate the construction of an IPR superpower (知识产权强国) and strengthen the creation, use, management, protection, and service of IPR. Improve intellectual property laws and regulations, strengthen intellectual property protection, increase penalties for the infringement of IPR, increase compensation standards for infringement damages, and explore the implementation of a punitive compensation system to reduce the cost of rights protection. Study intellectual property protection measures for new forms of innovation such as business models. Improve the mechanisms for the investigation and prosecution of IPR infringement, strengthen the connection between administrative law enforcement and judicial protection, strengthen the comprehensive administrative law enforcement of IPR, and incorporate information on infringement into social credit records. Establish overseas IPR assistance mechanisms. Establish a green channel for patent approvals. Guide and assist market entities in creating and using IPR and use the IPR sharing mechanism as a link to promote the conversion of innovation results into intellectual property. Implement the entire process of intellectual property management of central government-funded science and technology plans (special projects, funds, etc.) and establish an intellectual property target evaluation system. Establish a diversified IPR service system for service entities and cultivate a number of IPR service brands and institutions.

IV. Continuously Push Forward a Technical Standards Strategy

Improve the technical standard system, promote coordinated innovation in science, technology, standards, and industry, and improve the mechanisms for converting scientific and technological achievements into technical standards. Strengthen the development of technical standards for basic general technologies and industrial common technologies, accelerate the development of technical standards in emerging and integrated fields, and improve the support mechanisms for technological innovation, patent protection, and standards interaction. Give play to the guiding role of standards in technological innovation, update standards in a timely manner, strengthen the formulation and implementation of mandatory standards, gradually increase the environmental protection, energy conservation, water conservation, material conservation, and safety indicators in standards for production stages and market access, and form a technical standards system to support industrial upgrade. Carry out the formulation and integration of military-civilian general standards, promote the two-way conversion of military and civil standards, and promote the compatible development of military and civil standards. Give full play to the role of industry associations, vigorously cultivate and develop group standards,

promote the standards "pace-setter" (“领跑者”) system, cultivate and develop standardized service industries, and enhance the ability of market players to develop technology standards. Promote the public availability, openness, and compatibility of the standards system and strengthen fair and strict enforcement. Assist Chinese enterprises, alliances, and social organizations in participating in or leading the development of international standards, promote the "Going Global" of Chinese standards, and enhance the international influence of Chinese standards.

V. Strengthen Policy Coordination

Establish an innovation policy coordination review mechanism, organize innovation policy cleanup, promptly abolish policy provisions that violate the laws of innovation and hinder the development of emerging industries and emerging formats, and review whether newly formulated policies restrict innovation. Strengthen the coordination of the reform of the science and technology system and the reform of the economic system, strengthen top-level design, and strengthen the coordination of science and technology policies with fiscal, taxation, finance, trade, investment, industry, education, intellectual property, social security, social governance, and other policies, form policy synergy with the same goals and coordinated departments, and improve the systemic nature and operability of policies. Strengthen central and local policy coordination to ensure that central and local policies support and cooperate with each other. Establish an innovation policy investigation and evaluation system, listen extensively to the opinions of enterprises and the public, regularly track and analyze the implementation of policies, and adjust and improve them in a timely manner.

Chapter 26: Improving Investment Mechanisms for Scientific and Technological Innovation

Give full play to the guiding and stimulating role of financial investment in science and technology and the guiding role of various types of innovations in market allocation, optimize the allocation of innovation resources, guide the investment of social resources in innovation, and form a new pattern of multilateral investment by financial funds, financial capital, and social capital.

I. Strengthen the Link Between Plan Tasks and Resource Allocation

Reform the national strategic planning and resource allocation system and mechanisms for scientific and technological innovation, deploy the innovation chain around the production chain, improve the capital chain surrounding the innovation chain, focus on national strategic goals, concentrate resources and form synergies, and make breakthroughs in major key scientific and technological issues that affect the national economy, the lives of the people, and our economic lifeline. Use planning as an important basis for the deployment of scientific and technological tasks and form a mechanism for planning and guiding resource allocation.

II. Establish Diverse Science and Technology Investment Systems

Effectively increase support for basic, strategic, and public welfare research and improve the coordination mechanism between stable support and competition-based support. Strengthen the connection between central government (财政) investment and local innovation and development needs and guide local governments in increasing investment in science and

technology. Develop innovative methods for government investment in science and technology, strengthen the coordination of government funds and financial measures, comprehensively use a variety of methods such as venture capital investment, risk compensation, and loan discounts, give full play to the leveraging action of government funds, guide financial funds and private capital into the innovation field, and improve the diversified, multi-channel, and multi-level technology investment system.

III. Improve the Efficiency of Science and Technology Investment Allocations

Strengthen the overall coordination of strategic planning for scientific and technological innovation, the layout of scientific and technological plans, priority areas for scientific and technological innovation, key tasks, major projects, and annual planning arrangements, and strengthen the comprehensive balance of scientific and technological funds. In accordance with the layout of the five new types of central government science and technology plans (specialized projects, funds, etc.), strengthen the connection of various types of scientific and technological plans and research and development stages, optimize the allocation of scientific and technological resources in various types of scientific and technological plans (specialized projects, funds, etc.), and allocate scientific and technological resources in accordance with the positioning and intent of various scientific and technological plans (special projects, funds, etc.). Strengthen the supervision and performance management of scientific research funds, establish a credit management system for scientific research funds, gradually establish a budget performance evaluation system for government scientific and technological funds, and establish and improve corresponding performance evaluation, supervision, and management mechanisms.

Chapter 27: Strengthening Plan Implementation and Management

Strengthen organizational leadership, clarify the division of responsibilities, strengthen coordination and management in the implementation of the plan, and form strong synergies and institutional safeguards for the implementation of the plan.

I. Improve the Organizational Leadership Mechanism

Under the leadership of the State S&T Structural Reform and Innovation System Construction Leading Group (国家科技体制改革和创新体系建设领导小组), establish a mechanism for the coordinated promotion of planning and implementation by various departments and localities. All departments and localities shall strengthen the deployment of science and technology innovation in their respective departments and localities in accordance with this plan, taking into account the actual situation. They shall properly link with the overall thinking and main goals of the plan and break down major tasks for implementation. Fully mobilize and stimulate the enthusiasm of all sectors of society, including science and technology, industry, and business, maximize consensus, and mobilize all parties to promote the smooth implementation of the plan.

II. Strengthen Planning and Coordination Management

Prepare a batch of special plans for science and technology innovation, refine the implementation of the main goals and key tasks set out in this plan, and form a national science

and technology innovation planning system under the guidance of the National 13th Five-Year Plan for S&T Innovation and supported by special plans. Establish a plan compliance review mechanism. The deployment and implementation of major scientific and technological tasks, major projects, and major measures must be benchmarked and reviewed with the planned tasks. Improve work consultation, communication, and coordination mechanisms between departments and central and local governments and strengthen the organic connection between different plans. Strengthen the link between annual plans and this plan and ensure that the tasks set out in the plan are implemented. Establish a rolling planning mechanism, start a new round of study and formulation of strategic planning for medium- and long-term scientific and technological innovation in a timely manner, and strengthen research on major issues associated with being a world S&T superpower.

III. Strengthen Monitoring and Evaluation of Plan Implementation

Carry out dynamic monitoring and third-party evaluation of the implementation of the plan and use the monitoring and evaluation results as an important basis for improving government science and technology innovation management. Carry out mid-term evaluation and final evaluation of the implementation of the plan and perform a comprehensive evaluation of the effects of plan implementation to provide a basis for plan adjustment and formulation of plans in the next round. On the basis of monitoring and evaluation and in accordance with the latest progress in scientific and technological innovation and new changes in economic and social needs, promptly and dynamically adjust plan indicators and task deployment. Strengthen propaganda and guidance and mobilize and enhance the initiative and enthusiasm of all sectors of society to implement the plan.