Implementation Opinions of Seven Ministries Including the Ministry of Industry and Information Technology on Promoting the Innovative Development of Future Industries

Ministry of Industry and Information Technology (2024) No. 12

To the industry and information technology, education, science and technology (S&T), transportation, culture and tourism, and state-owned assets supervision and management main oversight departments (主管部门) of all provinces, autonomous regions, province-level municipalities, cities with independent planning status under

the national economic and social development plan (计划单列市), and the Xinjiang Production and Construction Corps, to units affiliated with the Chinese Academy of Sciences (CAS), to the communications administrations of all provinces, autonomous regions, and province-level municipalities, to the relevant central enterprises, and to all relevant units:

Future industries, driven by cutting-edge technologies, are currently in the incubation stage or at the beginning of industrialization. They are forward-looking emerging industries with significant strategic, leading, disruptive, and uncertain characteristics. Vigorously developing future industries is a strategic choice to lead technological progress, drive industrial upgrading, and cultivate new productive forces (新质生产力). To implement the spirit of the 20th Party Congress and the *People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035*,[1] seize the opportunities of a new round of S&T revolution and industrial transformation, focus on the main battlefield—namely the manufacturing industry—to accelerate the development of future industries, and support the advancement of new-style industrialization (新型工业化), the following opinions are proposed.

I.   Guiding Ideology

Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, fully implement the spirit of the 20th Party Congress, completely, accurately, and comprehensively implement the new concept of development (新发展理念), accelerate the formation of the new pattern of development (新发展格局), coordinate development and security, focus on the high-end upgrading of traditional industries and the industrialization of cutting-edge technologies as the main line, be driven by innovation, take enterprises as the main body, scenarios as the pulling force, and iconic products as the focus. Follow the laws of S&T innovation and industrial development, strengthen forward-looking planning and policy guidance, actively cultivate future industries, accelerate the formation of new productive forces, and provide strong support for building China into a world power.[2]

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[1] Translator's note: CSET's English translation of China's 14th Five-Year Plan Outline is available online at: https://cset.georgetown.edu/publication/china-14th-five-year-plan/.

[2] Translator's note: This translation renders the Chinese word 强国 qiángguó—which literally means "strong nation"—in English in two different ways, depending on context. Where the translator judges that qiángguó is used in the general geopolitical sense, it is translated as "world power." Where the translator judges that the text refers to a specific flavor of qiángguó, it is translated as "powerhouse," as in the phrase "manufacturing powerhouse" (制造强国). For a more thorough discussion in English of the Chinese word qiángguó, see: https://www.newamerica.org/cybersecurity-initiative/digichina/blog/lexicon-wangluo-qiangguo/.

II.   Basic Principles

Forward-looking deployment, rung-by-rung cultivation (梯次培育). Follow the trend of a new round of S&T revolution and industrial transformation, face the national major needs and strategic areas, plan systematically, and be ahead of the curve in making arrangements. Grasp the development laws of future industries, cultivate in phases, and dynamically adjust.

Innovation-driven, application-led. Lead the development of future industries with breakthroughs in cutting-edge technologies, and strengthen original and disruptive technological innovation. Use scenarios as the pulling force, connect research and development (R&D) with application, and accelerate the process of industrialization.

Ecosystem collaboration, systematic advancement. Pool resources from government, industry, academia, research institutes, and users (政产学研用), integrate capital, talent, technology, data, and other factors of production (要素), and create an industry ecosystem deeply integrating innovation chains, production chains, capital chains, and talent chains.

Open cooperation with security and order. Actively participate in the global division of labor and in cooperation in future industries, and deeply integrate into the global innovation network. Coordinate technological innovation and ethical governance to create an inclusive, prudent, safe, and sustainable development environment.

III.   Development Goals

By 2025, we will have achieved comprehensive development in future industry technology innovation, industry cultivation, and security governance, with some areas reaching the international advanced level and the industry scale steadily increasing. Build a batch of future industry incubators and pilot areas, make breakthroughs in a hundred cutting-edge key and core technologies (关键核心技术), form a hundred iconic products, create a hundred leading enterprises, explore a hundred typical application scenarios, formulate a hundred key standards, cultivate a hundred professional service organizations, and initially form a future industry development model that suits China's reality.

By 2027, the comprehensive strength of future industries will be significantly enhanced, with some areas achieving global leadership. We will achieve major breakthroughs in key and core technologies, a batch of new technologies, products, business formats (新业态), and models will be widely applied, and key industries will achieve development at scale. We will cultivate a batch of ecosystem-leading enterprises, construct a development pattern where future industries and

well-positioned (优势), emerging, and traditional industries synergize and interact, forming a sustainable long-term mechanism, becoming an important source of innovation for the world's future industries.

IV.   Key Tasks

(i)   Comprehensive Layout of Future Industries

1. Strengthen forward-looking planning and deployment. Grasp the global trends of technological innovation and industrial development, focusing on advancing the development of industries in six major directions: future manufacturing, future information, future materials, future energy, future space, and future health. Establish observation stations (瞭望站) for future industries, utilizing artificial intelligence (AI), advanced computing, and other technologies to precisely identify and cultivate high-potential future industries. Leverage the advantages of the new structure for leveraging national capabilities (新型举国体制) to guide localities to combine their industrial bases and resource endowments, to plan, cultivate, and develop future industries accurately and distinctively. Give play to the role of cutting-edge technology as an incrementer (增量器), aiming for high-end, intelligent, and green directions, accelerate the transformation and upgrading of traditional industries, and provide new momentum for building a modern industrial system.

Column 1: Foreseeing and Deploying New Tracks (赛道)

Future Manufacturing: Develop smart manufacturing, biomanufacturing, nanofabrication, laser manufacturing, and circular manufacturing, make breakthroughs in key and core technologies such as intelligent control, intelligent sensing, and simulation and emulation, promote flexible manufacturing and shared manufacturing models, and drive the development of the industrial internet and industrial metaverse.

Future Information: Promote the industrial application of technologies such as next-generation mobile communications, satellite internet, and quantum information, accelerate innovation breakthroughs in quantum and photonic computing technologies, accelerate deep empowerment (赋能) with brain-inspired intelligence, swarm intelligence, and large models, and foster intelligent industries.

Future Materials: Promote the upgrading of advanced basic materials such as non-ferrous metals, chemicals, and inorganic non-metals, develop key

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strategic materials such as high-performance carbon fiber and advanced semiconductors, and accelerate innovation and application of cutting-edge new materials such as superconducting materials.

Future Energy: Focus on key areas such as nuclear energy, nuclear fusion, hydrogen energy, and biomass energy, and build a "collection-storage-transportation-application" complete chain of future energy equipment systems. Develop new types of crystalline silicon photovoltaic cells, thin-film solar cells, and related electronics equipment, accelerate the development of new types of energy storage, and promote the integration and upgrading of the energy electronics (能源电子) industry.

Future Space: Focus on the aerospace, deep-sea, and deep-earth fields, develop manned spaceflight, lunar and Martian exploration, satellite navigation, near-space unmanned systems, advanced and efficient aircraft, and other high-end equipment. Accelerate the development and innovative application of deep-sea submersibles, deep-sea operations equipment, deep-sea search and rescue and detection equipment, and deep-sea intelligent unmanned platforms, and promote equipment development in deep-earth resource exploration, urban underground space development and utilization, and polar exploration and operations.

Future Health: Accelerate the industrialization of cutting-edge technologies such as cell and gene technology, synthetic biology, and bioengineered breeding, promote new medical services empowered by technologies such as 5G/6G, the metaverse, and AI, and develop high-end medical equipment and health products integrating digital twins, brain-computer interaction, and other advanced technologies.

(ii)   Accelerating Technological Innovation and Industrialization

2. Enhance innovation capabilities. Implement national S&T major projects and major S&T projects focusing on the key directions of future industries, and accelerate breakthroughs in key and core technologies. Leverage the role of national laboratories, state key laboratories, and other innovation vehicles, and strengthen the supply of basic general purpose technologies. Encourage leading enterprises to head innovation consortia, gather industry-academia-research institute-user (产学研用) resources, and systematically advance technological breakthroughs in key fields. Promote cross-field technology integration and innovation, accelerate disruptive technological breakthroughs, and make China into a wellspring of original

technologies. Hold future industry innovation and entrepreneurship competitions to stimulate innovation across all sectors.

3. Promote the conversion of S&T achievements into practical applications (成果转化). Release a catalog of cutting-edge technology applications for promotion, establish an "online announcement hall" for future industry achievements, create product trading platforms, hold achievement matchmaking exhibitions, and promote precise supply-demand linking. Construct new models of S&T services and technology markets, select professional organizations for S&T achievement evaluation and for transfer and conversion, and explore application scenarios and business models. Implement incentive policies for the first set of major technical equipment and first batch of materials [related to a new technology], and accelerate the application and promotion of new technologies and products.

(iii) Creating Iconic Products

4. Achieve breakthroughs in next-generation smart terminals. Develop industrial terminal products adaptable to the trend toward general intelligence (通用智能), supporting industrial production quality and efficiency improvement, empowering new-style industrialization. Develop consumer-grade terminals that are widespread, intelligent, and convenient, with immersive experiences to meet new demands in digital life, digital culture, public services, etc. Create smart medical and health terminals suitable for the elderly to improve the quality of public health and life. Achieve breakthroughs in high-level intelligent connected vehicles, metaverse portals, and other super-terminals (超级终端) with explosive potential to build new competitive advantages in the industry.

5. Optimize information service products. Develop next-generation operating systems to construct a secure and reliable digital foundation. Promote open-source technology, build open-source communities, and establish an open-source ecosystem. Explore innovative applications and digital ecosystems for next-generation Internet that use blockchain as their core technology and data as their key factor of production. Accelerate software product development towards the new generation of mobile information networks, brain-inspired intelligence, etc., encourage demonstration applications of new products, and unleash the potential of information services.

6. Strengthen future high-end equipment. Aimed at the country's major strategic needs and the people's aspirations for the good life (美好生活),

accelerate the implementation of major technical equipment projects, achieving breakthroughs in humanoid robots, quantum computers, ultra-high-speed trains, next-generation large aircraft, green intelligent ships, unmanned boats, and other high-end equipment products. Drive the industrialization of new technologies through complete machines (整机), and create a globally leading high-end equipment system. Implement the industrial foundation reengineering project (产业基础再造工程), addressing gaps in basic components, parts, materials, processes, and software to solidify the foundation for future industry development.

Column 2: Creating Iconic Products

Humanoid Robots: Achieve breakthroughs in core technologies such as high torque density servo motors, highly dynamic motion planning and control, bionic perception and cognition, intelligent dexterous hands, electronic skin, etc., focusing on developing and applying products in areas such as smart manufacturing, home services, and special environment operations.

Quantum Computers: Strengthen the development of fault-tolerant universal quantum computing (通用量子计算) technology, enhance physical hardware indicators and algorithm error correction performance, promote the collaborative deployment of quantum software and quantum cloud platforms, leverage the superiority of quantum computing, and explore penetration into vertical industry applications.

New Displays: Accelerate research on quantum dot displays and holographic displays, and make breakthroughs in Micro-LED, laser, printing, and other display technologies for applications at scale, achieving barrier-free, fully flexible, 3D stereoscopic display effects, and accelerate adoption in smart terminals, intelligent connected vehicles, remote connectivity, cultural content presentation, and other scenarios.

Brain-Computer Interface: Achieve breakthroughs in key technologies and core devices such as brain-computer fusion (脑机融合), brain-inspired chips, and brain computing (大脑计算) neural models, develop a batch of user-friendly and safe brain-computer interface products, and encourage exploration in medical rehabilitation, self-driving, virtual reality, and other typical fields.

6G Network Equipment: Conduct research on advanced wireless communication, new network architecture, cross-domain fusion,

space-air-ground integration, and network and data security technologies, develop conceptual prototypes of wireless key technologies, and form characteristic applications represented by holographic communications (全息通信), digital twins, etc.

Ultra-large-scale New Intelligent Computing Centers: Accelerate breakthroughs in graphics processing unit (GPU) chips, cluster low-latency interconnect networks (集群低时互联网络), and heterogeneous resource management technologies. Build ultra-large-scale intelligent computing centers to meet the needs of large model iterative training and application inference.

Web 3.0: Promote the application pilot of Web 3.0 in data exchanges, explore the use of blockchain technology to connect platforms and data for key industries and fields, research the digital identity authentication system for Web 3.0, establish data governance and trading mechanisms, and form replicable and promotable exemplars.

High-End Cultural and Tourism Equipment: Develop specialized and complementary software for cultural and entertainment creation, promote the development of advanced performance and amusement equipment, high-end equipment for air, land, and sea tourism, immersive experience facilities, smart tourism systems, and detection and monitoring platforms. Develop intelligentized (智能化), high-end, and complete sets of cultural and tourism equipment.

Advanced and Efficient Aviation Equipment: Focus on the development of next-generation large aircraft. Make breakthroughs in core technologies such as new layouts, intelligent piloting, interconnected avionics, more electric aircraft (MEA) systems, and open rotor hybrid engines. Promote research on advanced concepts such as supersonic, ultra-efficient subsonic, and new energy passenger aircraft. Accelerate the development and application of electric vertical takeoff and landing (eVTOL) aircraft, intelligent and efficient aviation logistics equipment, etc., focusing on the needs of future smart air traffic.

Deep Resource Exploration and Development Equipment. Focus on deep operation needs, with ultra-deep intelligent drilling rig engineering prototypes, deep-sea oil and gas underwater production systems, deep-sea polymetallic nodule mining vehicles, etc., as the impetus, and promote a series of breakthroughs in key technologies.

(iv)   Strengthen Industry Entities

7. Cultivate high-level enterprise echelons. Guide leading enterprises to plan new tracks in advance, cultivate new future industry entities through internal entrepreneurship (内部创业), investment incubation, etc. Implement the Action Plan for Central Enterprises Launching Future Industries (中央企业未来产业启航行动计划), and accelerate the cultivation of new future industry enterprises. Build incubation bases for innovative small- and medium-sized enterprises in future industries, nurturing professional, meticulous, specialized, and innovative (专精特新) new small- and medium-sized enterprises, high-tech enterprises, and "little giant" enterprises. Support the rapid development of new R&D institutions, cultivating diverse forces to advance future industries.

8. Create production chain for characteristic industries (特色产业链). Rely on leading enterprises to cultivate future industry production chains and construct advanced technology systems. Encourage regions with [the right] conditions to pilot first. Combine national independent innovation demonstration zones, national high-tech industrial development zones, national new-style industrialization industry demonstration bases (国家新型工业化产业示范基地), etc., to create future industry pilot areas, promoting the development of clusters of characteristic industries. Create new management mechanisms, build digital supply and production chains, promote the convergence of innovation resources, and accelerate the efficient circulation of factors of production such as data and knowledge.

9. Build an industrial ecosystem. Strengthen industry-academia-research institute-user collaboration, create future industry innovation consortia, and build an ecosystem for the integrated development of large, medium, and small enterprises and the collaborative innovation of the upstream and downstream of the production chain. Strengthen the mutual recognition of standards and the interconnectivity of factors of production under the nationwide unified market (全国统一大市场), enhance the resilience of the production and supply chains, and construct an industrial ecosystem featuring complementary products and software-hardware coordination (软硬协同).

(v)   Enrich Application Scenarios

10. Develop new industrialization scenarios. Focused on key areas such as equipment, raw materials, and consumer goods, and targeting the design, production, testing, and operations and maintenance (O&M) stages, create

application test fields to promote the technological maturation of future industries through iterative application of products at scale. Deepen the integration of new generation information technology (IT) with the manufacturing industry, accelerate the restructuring of production chain structures, processes, and models, and open up new applications in future manufacturing. Leverage the diverse scenario advantages of central enterprises to accelerate the construction of diversified future manufacturing scenarios. Speed up the promotion of emerging scenarios such as the industrial metaverse and biomanufacturing, driving the transformation and upgrading of the manufacturing industry through scenario innovation.

11. Create cross-industry integration scenarios. Leverage major campaigns (重大活动) to implement cross-field, comprehensive pilot applications of cutting-edge technologies and products, creating demonstration benchmarks. Relying on major projects and project scenarios such as manned spaceflight, deep-sea exploration, and deep-earth exploration, accelerate the exploration of innovative applications in the direction of future space to serve national strategic needs. Relying on the construction of urban agglomerations and metropolitan areas, create green and intensive industry-city integration (产城融合) scenarios. Create new future information services scenarios, accelerating the formation of a new paradigm of inclusive, egalitarian, convenient, and intelligent information services.

12. Construct iconic scenarios. Regularly select and publish lists of typical application scenarios and recommendation catalogs, and establish a database of excellent cases and solutions. Guide localities to develop characteristic benchmark demonstration scenarios, organize high-level supply and demand linking activities based on scenarios, and accelerate the promotion of new technologies and products. Encourage enterprises to innovate and develop based on application scenarios, and support universities and research institutes in constructing early experimental scenarios for original and disruptive technologies, leading iterative breakthroughs in future technologies.

(vi) Optimize the Industrial Support System

13. Strengthen standards leadership and patent safeguarding (专利护航). In line with the development needs of future industries, coordinate the layout of future industry standardization development routes, and accelerate the

development of key standards. Timely carry out promotion and training for key standards, guide enterprises to meet standards, and accelerate the application and promotion of future industry standards. Promote the coordinated development of standards, patents, and technology, guiding enterprises to integrate independent (自主) intellectual property rights with technical standards. Perfect the construction and reserve mechanism for independent intellectual property rights in key areas, deepen collaboration with international and domestic intellectual property organizations, and construct a high-quality patent selection, evaluation, and promotion system for future industries.

Column 3: Strengthening Standards Leadership
Forward-looking standard research: Focusing on key areas such as the metaverse, brain-computer interface, and quantum information, develop standardization roadmaps, develop standards for basic and general purpose technologies, key technologies, testing methods, key products, typical applications, and safety and ethics, and promote the establishment of relevant standards in a timely manner.
Promote standard application pilots: Organize relevant industry associations, standardization professional institutions, and technical organizations to carry out promotion and training in the field of future industry standards based on enterprise development needs, introducing advanced technology, concepts, and methods into enterprise R&D, production, and management in standard form.
Deepen international cooperation on standards: Support the in-depth participation of domestic enterprises and public institutions[3] in the international standardization activities of the International Telecommunication Union (ITU), International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), etc., organize upstream and downstream enterprises in the production chain to

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[3] Translator's note: "Public institutions" (事业单位) are organizations created and led by Chinese government departments that provide social services. Unlike state-owned enterprises (SOEs), public institutions do not create material products and do not generate income. Public institutions are not considered government agencies, and their employees are not civil servants. Most public institutions are fully or partially government-funded, but some fully privately funded (but still government-led) public institutions exist. Public institutions typically provide services in areas such as education, science and technology, culture, health, and sanitation.

jointly promote the development of international standards, and explore the establishment of international standardization alliance organizations.

Construct an intellectual property system: Build a future industry intellectual property operational service platform, and carry out intellectual property risk monitoring and assessment. Establish an intellectual property alliance, construct an industrial patent pool, carry out key production chain patent analysis, and construct a high-quality patent selection, evaluation, and promotion system.

14. Synchronously build pilot capabilities. According to industrial needs, construct a batch of pilot and application verification platforms, enhance the supply capacity of precision measurement instruments, high-end testing equipment, design simulation software, etc., provide trial environments for key technology verification, and accelerate the conversion of new technologies into productive forces (生产力). Construct a batch of public service institutions for pilot testing, and improve the level of pilot services such as engineering development, technology maturation, sample trial production, and testing verification.

15. Build a professional talent cadre. Vigorously cultivate leading entrepreneurs and scientists in future industries, and optimize an innovative and entrepreneurial environment that encourages originality and tolerates failure. Inspire the innovative vitality of scientific researchers, construct a batch of schools of future technology [at universities], and explore the training model of hybrid innovative talents (复合型创新人才). Strengthen school-enterprise joint training, expand overseas talent recruitment channels, and increase the recruitment of scarce high-level talents in cutting-edge fields.

16. Strengthen new infrastructure. Deeply promote the construction of 5G, computing power infrastructure, the industrial Internet, the Internet of Things (IoT), Internet of Vehicles (IoV), gigabit fiber-optic networks, etc. Lay out 6G, satellite Internet, and direct satellite-to-handset (手机直联卫星) technology research in a forward-looking manner, construct a new type of digital infrastructure that is high-speed and ubiquitous, integrated and interconnected, intelligent and green, and secure and efficient. Guide major S&T infrastructure to serve future industries, deepen the sharing of facilities, equipment, and data, and accelerate the conversion and application of cutting-edge technologies. Promote the integration and empowerment of new generation IT with traditional infrastructure such as transportation,

energy, and water conservancy, develop the digital economy of highways (公路数字经济), and accelerate the digital transformation of basic infrastructure.

V.   Assurance Measures

(i)   Strengthen overall coordination. Under the leadership of the Central Science and Technology Commission (中央科技委) and in accordance with the requirements of the State Leading Group for Building China into a Manufacturing Powerhouse (国家制造强国建设领导小组), establish a working pattern of inter-ministerial collaboration and central-local cooperation. Use these *Implementation Opinions* as a guide, formulate special policy documents around professional fields such as brain-computer interface and quantum information, and form a complete policy system for future industries. Leverage the role of industry associations and other social organizations, promote advanced exemplars, and create a favorable atmosphere for advancing the development of future industries.

(ii)   Increase financial support. Encourage increased investments from funds such as the [National] Manufacturing Industry Transformation and Upgrading Fund (制造业转型升级基金) and the National Development Fund for Small- and Medium-Sized Enterprises (国家中小企业发展基金), implement the "S&T Industry-Finance Integration" Special Projects ("科技产业金融一体化"专项), and drive more capital to invest earlier in smaller projects and hard S&T (硬科技). Improve financial, fiscal, and tax support policies, encourage institutional banks[4] and financial institutions to increase investments, guide localities to set up special funds for future industries, explore the establishment of special funds for risk compensation, and optimize compensation measures such as contingency reserves.

(iii)   Strengthen security governance. Adhere to a governance philosophy of inclusiveness and prudence, explore a cross-ministry joint governance model, and build a governance pattern for future industries with multi-party participation and effective coordination. Strengthen research on ethical norms, scientifically define "red lines" and "bottom lines," and construct an integrated mechanism for differentiation-evaluation-defense-governance. Guide enterprises to establish self-regulatory mechanisms for data management and product development. Improve

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[4] Translator's note: The term "institutional bank" (政策性银行)—alternately, "policy bank" or "policy lender"—refers to two Chinese government-run banks: The Export-Import Bank of China (中国进出口银行) and the Agricultural Development Bank of China (ADBC; 中国农业发展银行). The former specializes in trade financing, foreign investment, and foreign aid, and the latter funds development projects in rural areas of China.

safety monitoring, early warning analysis, and emergency response measures to prevent risks associated with the application of cutting-edge technologies.

(iv)   Deepen international cooperation. Relying on mechanisms such as the Belt and Road Initiative,[5] encourage domestic enterprises and research institutions to go global (走出去) and deeply participate in the global division of labor for future industries. Encourage multinational corporations and foreign research institutions to build cutting-edge technology R&D centers in China, and promote joint technological R&D and industrial application between domestic and foreign enterprises. Host events such as the Global Future Industry Development Forum (全球未来产业发展论坛), and form an International Innovation Alliance for Future Industries (未来产业国际创新联盟). Strengthen cooperation with related international organizations, actively participate in the formulation of international governance rules and standards, and actively contribute Chinese products, Chinese solutions, and Chinese wisdom.

Ministry of Industry and Information Technology

Ministry of Education

Ministry of Science and Technology

Ministry of Transport

Ministry of Culture and Tourism

State-owned Assets Supervision and Administration Commission of the State Council

Chinese Academy of Sciences

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[5] Translator's note: The "Belt and Road Initiative" (“一带一路”), abbreviated BRI, refers to the Silk Road Economic Belt (丝绸之路经济带) and the 21st Century Maritime Silk Road (21世纪海上丝绸之路).