Green Paper on Technological Innovation in Key Areas of Made in China 2025

Technology Roadmap for Key Areas of Made in China 2025

National Advisory Committee on the Strategy of Building a Strong Manufacturing Country

October 2015

Preface Introduction

The manufacturing industry is the mainstay of the real economy, the backbone of the national economy, the material foundation for national security and people's happiness and well-being, and the main battlefield for China's economy to achieve innovation-driven, transformation and upgrading. World Bank statistics show that since 2010, China's manufacturing value added has exceeded that of the United States for five consecutive years, becoming a major manufacturing country, and some advantageous fields have reached or approached the world's advanced level. However, compared with developed countries, there is still an obvious gap between the innovation capacity, overall quality and competitiveness of China's manufacturing industry, which is large but not strong. Therefore, to realize the transformation from a big manufacturing country to a strong manufacturing country is a major strategic goal that China's manufacturing industry should strive to achieve in the new period.

To facilitate this historic transformation, the State Council organized the preparation and implementation of the 2015

On May 8, the "Made in China 2025" was officially released, making an overall plan for the transformation and upgrading of China's manufacturing industry and leapfrog development, proposing a "three-step" strategic goal for China's manufacturing industry to become stronger, clarifying the strategic tasks and priorities for building a strong manufacturing country, and being the first ten-year action programme for the implementation of China's manufacturing power strategy.

The manufacturing industry covers a wide range of areas, and in order to ensure that in ten years' time, by 2025, it will be a manufacturing power, we must adhere to the overall promotion and key breakthroughs. The Made in China 2025 focuses on the major needs of economic and social development and national security, and selects 10 major advantages

The aim is to achieve international leadership or advanced international level by 2025. The ten key areas are: **new generation information technology industry, high-grade CNC machine tools and robots, aerospace equipment, marine engineering equipment and high-tech ships, advanced rail transportation equipment, energy-saving and new energy vehicles, electric power equipment, agricultural equipment, new materials, biomedicine and high-performance medical devices.**

In order to indicate the development trends and priorities of the ten key areas and to guide the creation of enterprises

For the new activities, the National Advisory Committee for the Construction of a Strong Manufacturing Country has organised the preparation of technology roadmaps for these areas, which are summarised in a booklet called "Technology Roadmaps for Key Areas of Made in China 2025". As the cover is green, it can also be called the "Green Book on Technological Innovation in Key Areas of Made in China 2025".

The preparation of the technology roadmap was launched in mid-April 2015, mobilizing 48 academicians, more than 400 experts and senior management of relevant enterprises to participate, and extensively collecting opinions from enterprises, universities, scientific research institutions and professional societies and associations. For example, the technical roadmap preparation group in the automotive field, organised by the Chinese Society of Automotive Engineering, involved 89 experts from the China Association of Automobile Manufacturers, key enterprises, universities and scientific research institutions in the discussion and preparation work, and fully discussed the direction and development path of energy-saving vehicles, new energy vehicles and intelligent networked vehicles, formed a basic consensus and drew up a technical roadmap. 10 key areas The technology roadmap has been widely consulted and drafted six times, and was submitted to the first meeting of the

National Advisory Committee for the Construction of a Strong Manufacturing Country for discussion and adoption on 25 August 2015. It was submitted to the first meeting of the National Advisory Committee for the Construction of a Strong Manufacturing Country on 25 August 2015.

The "Technology Roadmap for Key Areas of Made in China 2025" is the crystallization of the collective wisdom of academicians and experts who participated in its preparation, and is a scientific, forward-looking and strategic advisory report with very important reference value. Release of the "Technology Roadmap" can guide the majority of enterprises and scientific research, education and other professional institutions to determine the direction and focus of development on the basis of full market research and prudent consideration of their own conditions and characteristics; it can also guide financial investment institutions to use the financial means at their disposal to support research and development.

enterprises and projects that develop, produce and use the products and technologies listed in the Technology Roadmap.

market and social resources to effectively focus on the country's strategic priorities. "The Technology Roadmap can also provide advice and reference for government departments at all levels to support the development of key areas.

In view of the rapid pace of technological development and market changes, the Technology Roadmap will be revised on a rolling basis every two years, in the hope of providing reference and guidance to the community to keep abreast of the times.

Thank you for the efforts and contributions of all the comrades involved in the preparation work! Thank you to the governments at all levels and to our colleagues in industry and academia for their full support! We hope that the release of this Technology Roadmap will play an important role in the implementation of Made in China 2025 and the breakthrough development of the ten key areas.

National Advisory Committee on the
Strategy of Building a Strong Manufacturing
Country

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29 September 2015

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I. New Generation Information Technology Industry

1.1 Integrated Circuits and Special Purpose Equipment

An integrated circuit is a circuit with a specific function that is made by integrating a large number of electronic components through a semiconductor process. This roadmap mainly covers integrated circuit design, integrated circuit manufacturing, integrated circuit testing and packaging, key equipment and materials, etc.

1.1.1 Demand

Global IC market size of approximately $292 - 328 billion between 2011 and 2015 US$, at a CAGR of 4%; approximately 3280 – 4000 between 2016 and 2020 This represents a CAGR of 4% and approximately US$400 - 537.5 billion between 2021 and 2030, representing a CAGR of 3%.

China's IC market size is approximately $84 – 118 billion between 2011 and 2015 US$, at a CAGR of 12%; approximately 1180 - 1734 between 2016 and 2020 This represents a CAGR of 8% and approximately US$173.4 - 244.5 billion over the period 2021 to 2030, representing a CAGR of 3.5%.

China's IC market will account for 36% of the global market in 2015, rising to 43.35% in 2020 and 46% by 2030, making it the world's largest IC market. China's local IC production value is expected to reach US$48.3 billion in 2015, meeting 41% of the domestic market demand; US$85.1 billion in 2020, meeting 49% of the domestic market demand; and US$183.7 billion in 2030, meeting 75% of the domestic market demand.

From the above data, we can see that meeting the domestic market demand and enhancing the self-sufficiency rate of IC products, while meeting national security needs and capturing strategic product markets, are always the greatest needs and driving forces for the development of the IC industry.

1.1.2 Objectives

Facing the two needs of national strategy and industrial development, we will focus on developing the IC design industry, accelerating the development of the IC manufacturing industry, upgrading the development of the advanced packaging and testing industry, and breaking through key IC equipment and materials.

By 2020, the gap between the IC industry and the international advanced level will be gradually narrowed, the average annual growth rate of the industry's sales revenue will exceed 20%, and the sustainable development capability of enterprises will be significantly enhanced. By 2020, the IC design technology in key areas such as mobile smart terminals, network communications, cloud computing, Internet of Things and big data will reach the leading international level, and a preliminary industrial ecosystem will be formed. 16/14nm manufacturing process will achieve mass production, packaging and testing technology will reach the leading international level, key equipment and materials will enter the international procurement system, and a technologically advanced, safe and reliable IC industry system will be basically built.

By 2030, the main links of the IC industry chain will reach the international advanced level, and a number of enterprises will enter the international first tier and achieve leapfrog development.

1.1.3 Development focus

1. Integrated circuit design

（1） Server / Desktop CPUs

Single/Dual Core Server/Desktop CPUs, Multi-Core Server/Desktop CPUs, Multicore Server/Desktop CPUs

（2） Embedded CPUs

Low-power high-performance embedded CPUs, low-power multi-core embedded CPUs, ultra-low-power multicore embedded CPUs

（3） Memory

Random memory (DRAM) and embedded random memory (eDRAM), flash memory

(Flash) and 3D flash memory (V-NAND Flash)

(4) FPGAs and Dynamic Reconfiguration Chips

FPGAs (Field Programmable Logic Arrays), Dynamically Reconfigurable Platforms

(5) Integrated Circuit Design Methodology

SoC (System-on-Chip) design, ESL (Electronic System Level) design, 3D-IC design

2. Integrated Circuit Manufacturing

(1) New Devices

HK Metal Grids and SiGe/SiC Stress, FinFETs (Fin Field Effect Transistors), Quantum Devices

(2) Photolithography

Double exposure, multiple exposure, EUV (extreme ultraviolet lithography), electron beam exposure, 193nm photoresist, EUV photoresist

(3) Materials and complete technology

65-32nm photomask materials and complete sets of technologies, 20-14nm photomask materials and complete sets of technologies

3. Integrated Circuit Packaging

(1) Flip-chip technology

Large area flip chip ball array packages

（2） Multi-chip packages

Two-chip packages, three-dimensional system-level packages (3D SIP) multi-element integrated circuits (MCO)

1.1.4 Major equipment and key materials

1. Manufacturing equipment

90-32nm process equipment, 20-14nm process equipment, 18-inch process equipment

2. Photolithography

90nm lithography, immersion lithography, EUV lithography

3. Manufacturing materials

65-32nm process materials, 22-14nm process materials, 12/18" wafers

4. Packaging equipment and materials

High-density packaging high-end equipment and supporting materials, TSV manufacturing part of the key equipment and materials

1.1.4 Strategic support and assurance

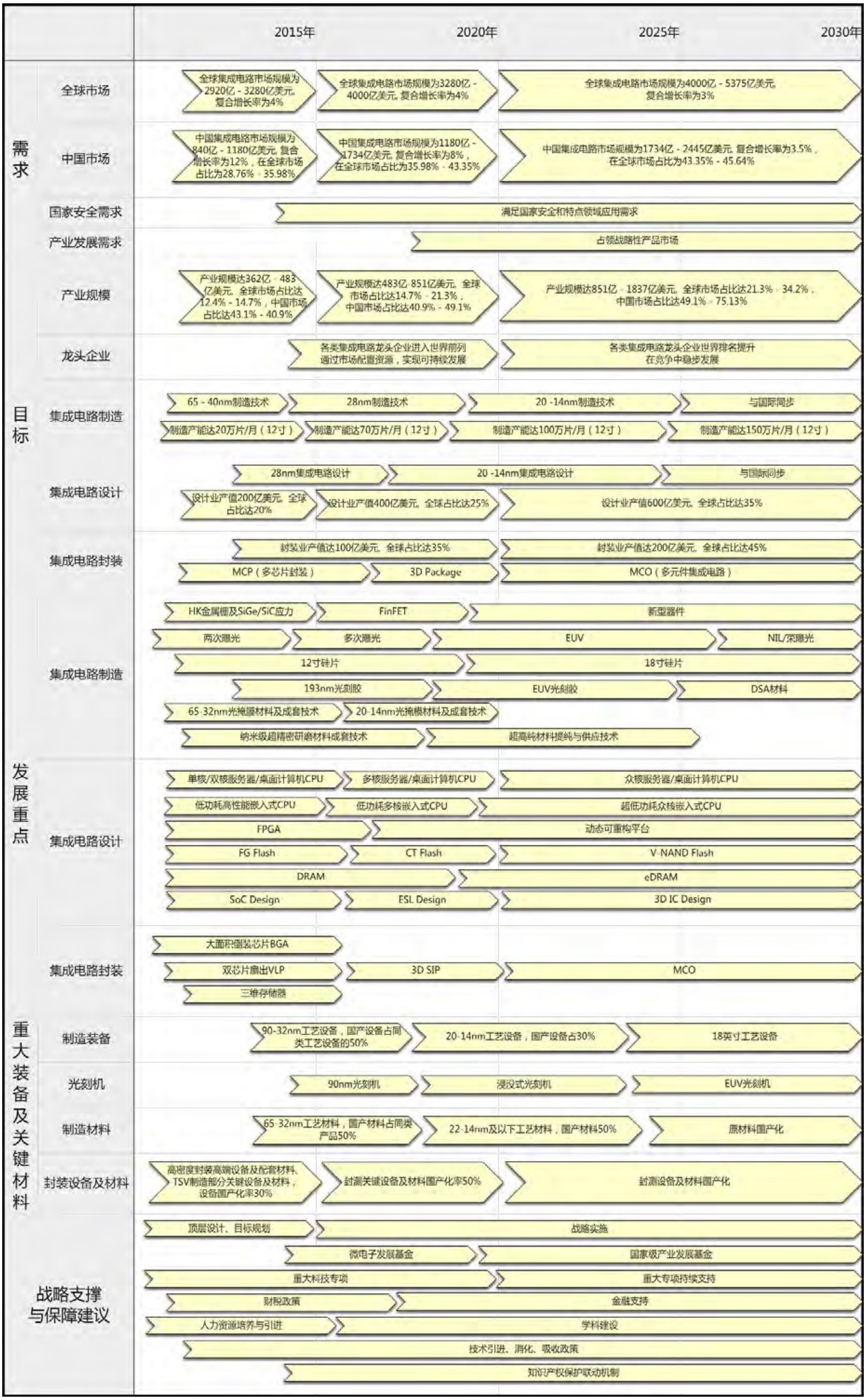
1. According to the needs of industrial development, gradually expand the scale of the National IC Industry Investment Fund or set up the second and third phase funds.

2. Strengthen the synergy of existing policies and resources, such as: IC R&D special projects, national science and technology major projects in supporting common technology research and development, and national IC industry investment funds to support industrialisation development, these resources should strengthen synergy and form a synergy.

3. Strengthen the training and introduction of human resources and enhance support for the construction of microelectronics disciplines.

4. Develop policies for the introduction, digestion and absorption of technology and provide support.

5. Establish a linkage mechanism for the protection of intellectual property rights.



2015年
2020年
2025年
2030年
需求
全球市场
全球集成电路市场规模为2920亿 - 3280亿美元，复合增长率为4%
全球集成电路市场规模为3280亿 - 4000亿美元，复合增长率为4%
全球集成电路市场规模为4000亿 - 5375亿美元，复合增长率为3%
中国市场
中国集成电路市场规模为840亿 - 1180亿美元，复合增长率为12%，在全球市场占比为28.76% - 35.98%
中国集成电路市场规模为1180亿 - 1734亿美元，复合增长率为8%，在全球市场占比为35.98% - 43.35%
中国集成电路市场规模为1734亿 - 2445亿美元，复合增长率为3.5%，在全球市场占比为43.35% - 45.64%
国家安全需求
满足国家安全和特点领域应用需求
产业发展需求
占领战略性产品市场
目标
产业规模
产业规模达362亿 - 483亿美元，全球市场占比达12.4% - 14.7%，中国市场占比达43.1% - 40.9%
产业规模达483亿 - 851亿美元，全球市场占比达14.7% - 21.3%，中国市场占比达40.9% - 49.1%
产业规模达851亿 - 1837亿美元，全球市场占比达21.3% - 34.2%，中国市场占比达49.1% - 75.13%
龙头企业
各类集成电路龙头企业进入世界前列通过市场配置资源，实现可持续发展
各类集成电路龙头企业世界排名提升在竞争中稳步发展
集成电路制造
65 - 40nm制造技术
28nm制造技术
20 -14nm制造技术
与国际同步
制造产能达20万片/月（12寸）
制造产能达70万片/月（12寸）
制造产能达100万片/月（12寸）
制造产能达150万片/月（12寸）
集成电路设计
28nm集成电路设计
20 -14nm集成电路设计
与国际同步
设计业产值200亿美元，全球占比达20%
设计业产值400亿美元，全球占比达25%
设计业产值600亿美元，全球占比达35%
集成电路封装
封装业产值达100亿美元，全球占比达35%
封装业产值达200亿美元，全球占比达45%
MCP（多芯片封装）
3D Package
MCO（多元件集成电路）
发展重点
集成电路制造
HK金属栅及SiGe/SiC应力
FinFET
新型器件
两次曝光
多次曝光
EUV
NIL/束曝光
12寸硅片
18寸硅片
193nm光刻胶
EUV光刻胶
DSA材料
65-32nm光掩膜材料及成套技术
20-14nm光掩模材料及成套技术
纳米级超精密研磨材料成套技术
超高纯材料提纯与供应技术
集成电路设计
单核/双核服务器/桌面计算机CPU
多核服务器/桌面计算机CPU
众核服务器/桌面计算机CPU
低功耗高性能嵌入式CPU
低功耗多核嵌入式CPU
超低功耗众核嵌入式CPU
FPGA
动态可重构平台
FG Flash
CT Flash
V-NAND Flash
DRAM
eDRAM
SoC Design
ESL Design
3D IC Design
集成电路封装
大面积倒装芯片BGA
双芯片扇出VLP
3D SIP
MCO
三维存储器
重大装备及关键材料
制造装备
90-32nm工艺设备，国产设备占同类工艺设备的50%
20-14nm工艺设备，国产设备占30%
18英寸工艺设备
光刻机
90nm光刻机
浸没式光刻机
EUV光刻机
制造材料
65-32nm工艺材料，国产材料占同类产品50%
22-14nm及以下工艺材料，国产材料50%
原材料国产化
封装设备及材料
高密度封装高端设备及配套材料、TSV制造部分关键设备及材料，设备国产化率30%
封测关键设备及材料国产化率50%
封测设备及材料国产化
战略支撑与保障建议
顶层设计、目标规划
战略实施
微电子发展基金
国家级产业发展基金
重大科技专项
重大专项持续支持
财税政策
金融支持
人力资源培养与引进
学科建设
技术引进、消化、吸收政策
知识产权保护联动机制

1.2 Information and communication equipment

The information and communication equipment industry refers to systems and devices that use electronic computers and modern communication technologies to acquire, transmit, store, process and apply information. This roadmap mainly includes wireless mobile communication equipment, new generation network equipment, high-performance computers and servers (including general-purpose central processing units (CPUs) storage devices), etc., and does not include other information and communication products and services.

1.2.1 Demand

With the continuous growth of mobile internet, internet+, information consumption, internet of things and other businesses, and the deepening integration of informatization and industrialization, the demand for information and communication equipment will continue to grow in the long term.

（1）Wireless mobile communications: According to the International Telecommunication Union (ITU), in 2014, the number of mobile subscribers reached 7 billion worldwide, including 2.3 billion mobile broadband subscribers and 2.3 billion mobile

Annual shipments of 2.16 billion mobile terminals and machine-to-machine (M2M) terminals

The market for mobile communication system equipment is approximately US$40 billion, with 250 million units. According to ITU, Gartner and others forecast: 72 mobile subscribers worldwide by 2020

The number of mobile broadband subscribers will reach 4 billion, the annual shipment of mobile terminals will reach 3.2 billion, the annual shipment of M2M terminals will reach 2.4 billion, and the mobile communication system equipment market will reach US$52 billion; by 2025, the number of mobile subscribers will reach 7.5 billion worldwide.

The number of mobile broadband subscribers will reach 5.5 billion, annual shipments of mobile terminals will reach 4.2 billion, annual shipments of M2M terminals will reach 6 billion and the mobile communications systems equipment market will reach US$64 billion.

（2） Next Generation Networks: The global optical communications equipment market was $14.1 billion and the router and switch market was $15.3 billion in 2014. According to Gartner

The China Academy of Information and Communication Research and others estimate that by 2020, the global optical communication equipment The market size of the market will be $18.2 billion for the backup and $23.6 billion for routers and switches

billion; by 2025, the global optical communications equipment market will reach $22.7 billion.

The market for routers and switches will reach US$33.8 billion.

（3） High Performance Computers and Servers: In 2014, the global market for high performance computers was $11 billion and the annual global server shipments reached 9.2 million units. According to IDC and other organizations forecast: by 2020, the global high-performance computer market size is $16.5 billion, the global server annual shipments will reach 12 million units; by 2025, the

Annual global server shipments will exceed 15 million units.

1.2.2 Objectives

1. 2020 Target

The technology and industrial capacity of the information and communication equipment industry entered the ranks of world powers and formed a more complete industrial system and innovation system.

（1） Wireless mobile communications: become one of the leading players in international standards, technologies and industries for the fifth generation of mobile communications (5G), maintain the first position in the international wireless mobile communications system equipment industry and enter the first position in the international mobile terminal industry. The domestic market shares of domestically produced (excluding Taiwanese enterprises, the same below) mobile communication system equipment, mobile terminals and mobile terminal chips are expected to reach 75%, 75% and 35% respectively, while the international market shares are expected to reach 35%, 25% and 15% respectively.

（2）New generation network: domestic optical communication equipment will continue to maintain the first market share in the international market, and the international market share is expected to reach 50%; the international market share of domestic routers and switches is expected to reach 20%.

（3）High Performance Computers and Servers: Domestic High Performance Computers and Servers Country

The international market share is expected to reach 30% and the domestic market share is expected to exceed 60%; the domestic high
The overall performance index of end servers is comparable to that of international advanced products and has been applied on a large scale in key areas such as finance, telecommunications and smart cities in China; domestic high-performance computers continue to maintain a leading position in the world; branded servers with domestic CPUs have achieved industrial application.

2. 2025 Objectives

The information and communication equipment industry system has become more complete, its innovation capability and overall strength have been greatly enhanced, and the comprehensive strength of the industry ranks among the forefront of world powers.

（1）Wireless mobile communications: China's mobile communications system equipment, mobile terminal and mobile terminal chip industries have all entered the international first camp. The domestic market shares of domestic mobile communication system equipment, mobile terminals and mobile terminal chips are expected to reach 80%, 80% and 40% respectively, while the international market shares are expected to reach 40%, 45% and 20% respectively, and mobile communication test instruments have achieved domestic leadership and breakthrough in the international market.

（2） New generation network: the international market share of domestic optical communication equipment is expected to reach 60%, and key components of optical communication equipment have achieved a breakthrough in localisation. The domestic router and switch industry entered the international first camp, and the international market share is expected to reach 25%.

（3） High-performance computers and servers: the share of domestic high-performance computers and servers in the international market is expected to reach 40% and the share of the domestic market is expected to exceed 80%, with the share of domestic high-end servers in the domestic market expected to exceed 50%; the share of domestic market for branded servers with domestic CPUs is expected to reach over 30%.

1.2.3 Development focus

1.Key products

(1) Wireless mobile communications, including: 5G key technology comprehensive verification platform, 5G mobile communications system equipment (including 5G base stations, 5G core network equipment, 5G industry-specific networks, etc.) and

5G mobile communication instrumentation (including 5G terminal synthesizer, 5G protocol conformance tester)

The company is also engaged in the development of 5G mobile terminals (including 5G consumer terminals, 5G industry terminals, M2M terminals, etc.) 5G key chips (including 5G baseband chips, 5G radio frequency (RF) chips, 5G system-on-chip (SoC) chips, etc.) and 5G key devices (such as 5G high-frequency communication devices).

(2) Next generation networks, including: High-speed, high-capacity optical transmission equipment (400G/1Tbps) high-speed optical access equipment (10G/100Gbps) optical switching equipment

（100Tbps 光电混合交换设备）、核心路由器（单接口 400G，交换容量 100T）、支持软件定义网络（SDN）的大容量交换机（1Tbps），全光交换设备、硅基光收发芯片（100G/400G/1Tbps）、模数数模转换（ADC/DAC）（64Gb/s 以上）、数字 DSP chips, optical transport network (OTN) chips (N*100G/N*400G) optical line terminal (OLT) chips (100G/400G/1T) wavelength division multiplexing – passive optical network (WDM-PON) chips, wavelength selective switches (WSS) network processors (400G/1T and above) and other key components.

(3) High-performance computers and servers, including:

general-purpose CPUs, high-end servers (10,000-core class) mass storage devices (100 billion billion bytes (10 EB) class) high-performance computers (10 billion billion times/second class) cloud data centres with converged architecture for cloud computing and big data, cross-regional/multi-dimensional/multi-type converged cloud storage devices, high-performance computers based on nationally produced CPUs and high-end servers, etc.

2. Key technologies

（1）Wireless mobile communications, including: large-scale antenna array technologies (supporting peak rates of tens of Gbps, ultra-dense networking technologies (link densities greater than 106/km2 and traffic densities greater than tens of Tbps/km2) new multi-access technologies, high-band communications

technologies (above 6GHz) inter-terminal communication technologies (including Telematics, etc.) new core
Key technologies such as network architecture technologies (supporting SDN, Network Function Virtualisation (NFV), etc.) 5G enhanced technologies (100Gbps, user-centric and highly-aware access and core networks), etc.

（2）新一代网络技术，包括：大容量光交换技术（100Tbps的光电混合交换技术）、高速路由交换技术（100Tbps 路由交换技术）、网络管控技术（含：NFV、SDN等）、网络测量感知技术，高速光传输技术（单端口400Gbps/1Tbps）、大容量的全光交换技术、 Key components of network equipment (including: optical transceiver technology, high-speed switching chip technology, NFV-enabled high-capacity packet switching chip technology, etc.) silicon photonic and optoelectronic integrated chip technology, WSS optical crossover technology, ultra-large-capacity long-distance optical communication technology and submarine communication technology, WDM-PON device technology, and other key technologies.

（3）High-performance computers and servers, including: high-performance/low-power/high-stability/high-reliability chip technology, 10,000-core processor high-speed interconnect technology, board-level optical interconnect technology, largeport processor high-speed interconnect technology, high-capacity non-volatile storage technology, reconfigurable computing technology, big data processing platform technology such as memory computing/streaming data processing, multi-dimensional/multi-type big data fusion platform technology, business-aware hardware resource dynamic adjustment technology, quantum computing technology and artificial intelligence technology, etc.

1.2.4 Application demonstration projects

1.5G Mobile Communication Technology Innovation and Application Project

In order to achieve China's global leadership in 5G wireless mobile communication technology, standards, industry, services and applications, as well as the application and convergence of 5G technology in multiple markets such as public networks, private networks and national defense, the leading units of 5G standards, 5G equipment manufacturers, telecom operators and

Joint implementation by application units and others.

Deploy 5G innovation demonstration network and launch 5G commercial services by 2020, applying China's own innovative 5G technology advantages and system capabilities, supporting 10Gbps peak rate, spectrum efficiency improvement of more than 3 times, end-to-end transmission test up to 1ms and traffic density of more than 5Tbps/km2, testing and verification of 5G RF, baseband and other core chips and terminals, test instruments, system equipment, etc. The test and verification of 5G RF, baseband and other core chips and terminals, test instruments, system equipment etc.

In 2020, we will start deploying a demonstration network for the integration of heaven, earth, sea and air, and will apply the research results of 5G and other terrestrial and satellite mobile communication technologies to achieve thousands to tens of thousands of kilometres of ultra-long-distance broadband communication, so as to provide an information foundation for the implementation of the"One Belt, One Road" strategy and the"Ocean Power" strategy. To provide the foundation of information technology for the implementation of the "One Belt, One Road" strategy and the "Ocean Power" strategy.

2. New Generation Network Innovation and Application Demonstration Project

It is recommended that a new generation optical communications demonstration network be deployed and completed by 2020. Support distance

Over 1000 km (e.g. Beijing to Wuhan) optical transport (OTN) equipment support

400G/1T/4T/10Tbps interfaces with parallel access to at least 96 wavelengths and a bidirectional communication capacity of at least 96Tbps, implemented jointly by mainstream equipment vendors and operators who are responsible for the development of core technologies, to commercially validate the new generation of network equipment and to test key hardware and software protocols.

It is proposed that the new controlled and trusted demonstration network will be completed by 2020. The size of the network is not

Less than 20 cities, with backbone switching capacity up to single

The control plane supports the networking of 500 backbone routers and 50,000 metro routers, with a delay of less than 50ms between data control planes, and the parallel operation and control of no less than 4,096 virtual networks with differentiated service quality assurance. Promote the use of related systems in telecommunications, broadcasting, electric power, finance, industry, national defence and other fields.

Pan application.

3. Safe and Trustworthy National Industry Software and Hardware Collaborative Innovation Project

It is proposed to build a test bed for next-generation high-performance computer servers, basic software and domain applications based on domestic CPUs with independent intellectual property rights, apply next-generation high-performance computers, high-end servers and storage devices and basic software (operating systems, databases, middleware, etc.) with independent intellectual property rights, and support technological innovation and application demonstrations of high-end servers and storage devices based on nationally produced processors.

It is proposed to promote domestic software and hardware solutions in at least three key application areas, such as finance, telecommunications and smart cities. By 2020, the market share of domestically produced servers in the finance and telecoms industries will reach 75% and the market share of domestically produced infrastructure software will reach 50%; by 2025, the market share of domestically produced servers in the finance and telecoms industries will reach 90% and the market share of domestically produced infrastructure software will reach 75%.

1.2.5 Strategic Support and Assurance

1. Intellectual Property Rights (IPR): Dovetailing with the national IPR strategy, it is recommended to actively publicise the achievements of IPR in China's information and communications sector, continue to optimise the commercial and legal environment for IPR, strengthen IPR protection and operation, and promote the international application of independent IPR.

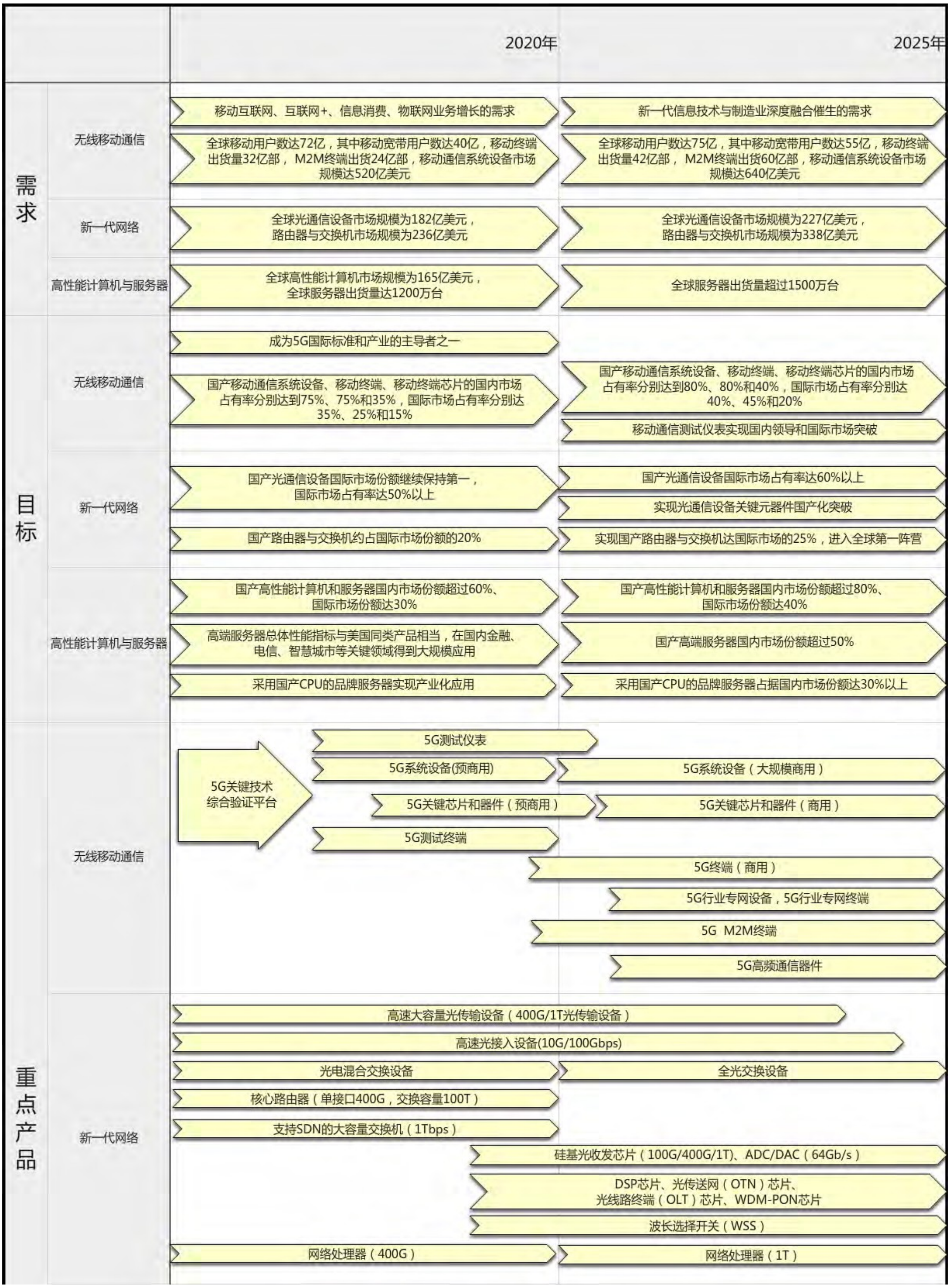
2. Government and industry market resources: continue to cultivate and optimize China's information and communications equipment Industry market space, there are already major special projects to continue to support, it is recommended to encourage the strengthening of synergistic cooperation between enterprises upstream and downstream of the industry chain, between enterprises and the government and between industry markets.

3. Spectrum planning and allocation: It is proposed that the 5G spectrum planning will include mobile, broadcasting, and The spectrum needs of satellites, civil-military integration, etc. are considered in a unified manner to maximise the value of spectrum utilisation and the integrated development of related industries.

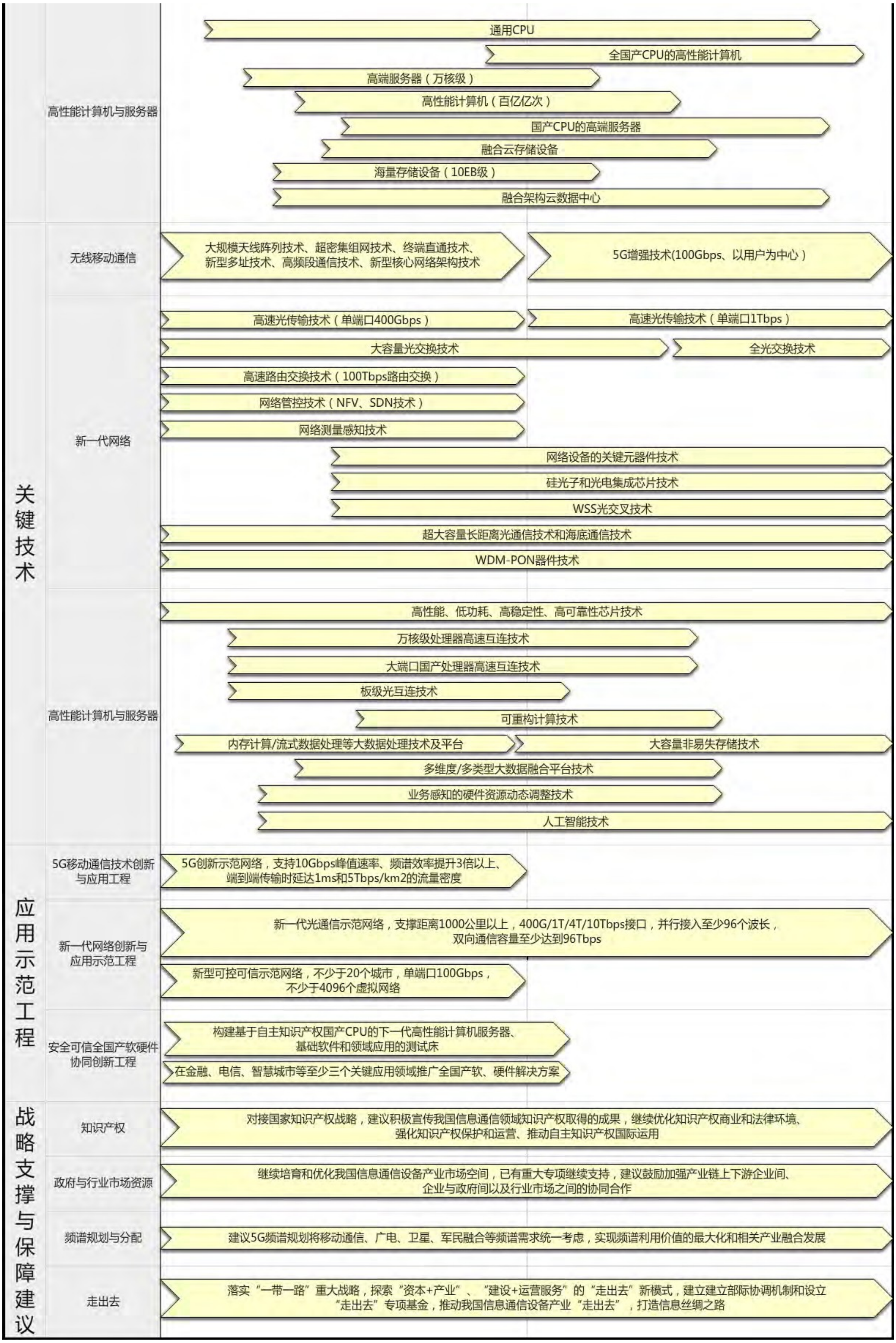
4. Going global: Implementing the "One Belt, One Road" strategy, exploring "capital + industry" and "capital + industry",

New mode of "going out" of "construction + operation services", suggesting the establishment of an inter-ministerial coordination mechanism

To establish a special fund for "going out" to promote China's information and communication equipment industry to "go out" and create an information silk road.



2020年
2025年
需求
无线移动通信
移动互联网、互联网+、信息消费、物联网业务增长的需求
新一代信息技术与制造业深度融合催生的需求
全球移动用户数达72亿，其中移动宽带用户数达40亿，移动终端出货量32亿部， M2M终端出货24亿部，移动通信系统设备市场规模达520亿美元
全球移动用户数达75亿，其中移动宽带用户数达55亿，移动终端出货量42亿部， M2M终端出货60亿部，移动通信系统设备市场规模达640亿美元
新一代网络
全球光通信设备市场规模为182亿美元，路由器与交换机市场规模为236亿美元
全球光通信设备市场规模为227亿美元，路由器与交换机市场规模为338亿美元
高性能计算机与服务器
全球高性能计算机市场规模为165亿美元，全球服务器出货量达1200万台
全球服务器出货量超过1500万台
目标
无线移动通信
成为5G国际标准和产业的主导者之一
国产移动通信系统设备、移动终端、移动终端芯片的国内市场占有率分别达到75%、75%和35%，国际市场占有率分别达35%、25%和15%
国产移动通信系统设备、移动终端、移动终端芯片的国内市场占有率分别达到80%、80%和40%，国际市场占有率分别达40%、45%和20%
移动通信测试仪表实现国内领导和国际市场突破
新一代网络
国产光通信设备国际市场份额继续保持第一，国际市场占有率达50%以上
国产光通信设备国际市场占有率达60%以上
实现光通信设备关键元器件国产化突破
国产路由器与交换机约占国际市场份额的20%
实现国产路由器与交换机达国际市场的25%，进入全球第一阵营
高性能计算机与服务器
国产高性能计算机和服务器国内市场份额超过60%、国际市场份额达30%
国产高性能计算机和服务器国内市场份额超过80%、国际市场份额达40%
高端服务器总体性能指标与美国同类产品相当，在国内金融、电信、智慧城市等关键领域得到大规模应用
国产高端服务器国内市场份额超过50%
采用国产CPU的品牌服务器实现产业化应用
采用国产CPU的品牌服务器占据国内市场份额达30%以上
重点产品
无线移动通信
5G关键技术综合验证平台
5G测试仪表
5G系统设备(预商用)
5G系统设备（大规模商用）
5G关键芯片和器件（预商用）
5G关键芯片和器件（商用）
5G测试终端
5G终端（商用）
5G行业专网设备，5G行业专网终端
5G M2M终端
5G高频通信器件
新一代网络
高速大容量光传输设备（400G/1T光传输设备）
高速光接入设备(10G/100Gbps)
光电混合交换设备
全光交换设备
核心路由器（单接口400G，交换容量100T）
支持SDN的大容量交换机（1Tbps）
硅基光收发芯片（100G/400G/1T)、ADC/DAC（64Gb/s）
DSP芯片、光传送网（OTN）芯片、光线路终端（OLT）芯片、WDM-PON芯片
波长选择开关（WSS）
网络处理器（400G）
网络处理器（1T）


关键技术
高性能计算机与服务器
通用CPU
全国产CPU的高性能计算机
高端服务器（万核级）
高性能计算机（百亿亿次）
国产CPU的高端服务器
融合云存储设备
海量存储设备（10EB级）
融合架构云数据中心
无线移动通信
大规模天线阵列技术、超密集组网技术、终端直通技术、新型多址技术、高频段通信技术、新型核心网络架构技术
5G增强技术(100Gbps、以用户为中心）
新一代网络
高速光传输技术（单端口400Gbps）
高速光传输技术（单端口1Tbps）
大容量光交换技术
全光交换技术
高速路由交换技术（100Tbps路由交换）
网络管控技术（NFV、SDN技术）
网络测量感知技术
网络设备的关键元器件技术
硅光子和光电集成芯片技术
WSS光交叉技术
超大容量长距离光通信技术和海底通信技术
WDM-PON器件技术
高性能计算机与服务器
高性能、低功耗、高稳定性、高可靠性芯片技术
万核级处理器高速互连技术
大端口国产处理器高速互连技术
板级光互连技术
可重构计算技术
内存计算/流式数据处理等大数据处理技术及平台
大容量非易失存储技术
多维度/多类型大数据融合平台技术
业务感知的硬件资源动态调整技术
人工智能技术
应用示范工程
5G移动通信技术创新与应用工程
5G创新示范网络，支持10Gbps峰值速率、频谱效率提升3倍以上、端到端传输时延达1ms和5Tbps/km2的流量密度
新一代网络创新与应用示范工程
新一代光通信示范网络，支撑距离1000公里以上，400G/1T/4T/10Tbps接口，并行接入至少96个波长，双向通信容量至少达到96Tbps
新型可控可信示范网络，不少于20个城市，单端口100Gbps，不少于4096个虚拟网络
安全可信全国产软硬件协同创新工程
构建基于自主知识产权国产CPU的下一代高性能计算机服务器、基础软件和领域应用的测试床
在金融、电信、智慧城市等至少三个关键应用领域推广全国产软、硬件解决方案
战略支撑与保障建议
知识产权
对接国家知识产权战略，建议积极宣传我国信息通信领域知识产权取得的成果，继续优化知识产权商业和法律环境、强化知识产权保护和运营、推动自主知识产权国际运用
政府与行业市场资源
继续培育和优化我国信息通信设备产业市场空间，已有重大专项继续支持，建议鼓励加强产业链上下游企业间、企业与政府间以及行业市场之间的协同合作
频谱规划与分配
建议5G频谱规划将移动通信、广电、卫星、军民融合等频谱需求统一考虑，实现频谱利用价值的最大化和相关产业融合发展
走出去
落实“一带一路”重大战略，探索“资本+产业”、“建设+运营服务”的“走出去”新模式，建立建立部际协调机制和设立“走出去”专项基金，推动我国信息通信设备产业“走出去”，打造信息丝绸之路

1.3 Operating systems and industrial software

Operating systems and industrial software are the cornerstone of the digitalization and networking of the manufacturing industry, and are the core elements of the new round of industrial revolution. The development of real-time industrial operating systems and high-end manufacturing embedded systems, industrial data platforms and manufacturing core software as the representative of the basic industrial software, for advanced rail transportation equipment, electric power equipment, agricultural equipment, high-grade CNC machine tools and robots, aerospace equipment, marine engineering equipment and high-tech ships and other key areas of industrial application software, independent and controllable for China's industrial sector, has an important significance.

1.3.1 Demand

The new generation of scientific and technological revolution and industrial change is characterized by digitalization, networking and intelligence, the core of which is the deep integration of the new generation of information technology represented by cloud computing, the Internet of Things and big data with modern manufacturing industries, in order to promote industrial transformation and upgrading. In response to the current situation that developed countries control the core technology of traditional operating systems and industrial software and dominate the international industrial competition discourse, relying on China's strategic imperative as a "manufacturing power" and advantageous industries, and taking advantage of China's position as a global leader in Internet ecology and applications, we will seize the historical opportunity provided by the new technological revolution and industrial change. To achieve independent and controllable operating systems, combined with a new generation of information technology to promote the reconstruction and leapfrog development of industrial software.

1.3.2 Objectives

By 2020, we will break through some key core technologies, basically form China's industrial software technology standards and ecological system, and have a market share of more than 30% in the middle and low-end markets. Focusing on production efficiency and service-oriented manufacturing, the application penetration rate of independent "cloud" + "terminal" industrial big data platforms in key industries will exceed 40%.

By 2025, most of the core technologies will have made a breakthrough and an independent and controllable

Operating systems and industrial software and their standard systems, with the market share of independent industrial software exceeding 50%. The application penetration rate of "Internet+" intelligent industrial cloud in key industries exceeds 60%. Formation of an industrial Internet based on intelligent and connected products and independent industrial software.

1.3.3 Development focus

1. Key products

(1) Industrial operating systems and their applications

Connecting with the achievements of "Nuclear High Foundation" and other major special projects, we will build a tailorable industrial basic software platform. Aiming at the needs of digital products and intelligent complete sets of equipment, we will focus on developing highly secure and reliable real-time industrial operating systems, realizing the adaptation to mainstream control devices, CPUs and bus protocols, and on this basis, we will develop a set of embedded software interfaces, configuration languages and integrated development environments, and form standards and specifications for measuring the security, trustworthiness and performance of embedded operating systems.

Research and develop embedded systems for high-end manufacturing industries and promote their application in important key areas such as advanced rail transportation equipment, electric power equipment and agricultural equipment.

(2) "Cloud" + "Terminal" industrial data platform

Facing the integration of data exchange and intelligent collaboration between terminals and the cloud, we develop an embedded data management platform and real-time data intelligent processing system at the device end, and develop an industrial data processing software stack with massive processing capacity for industrial data collection, storage, query, analysis, mining and application in the cloud. Build an industrial data platform covering the whole life cycle of products and the whole business activities of manufacturing, supporting the integration of internal and external, structured and unstructured, synchronous and asynchronous, dynamic and static, equipment and business, real-time and historical data of enterprises

Integration and unified access for a "data-driven" approach.

(3) Smart Industrial Cloud and Core Software for Manufacturing

Research and development of "Internet+" intelligent industrial cloud system architecture and standard system, and construction of industrial resource base (including knowledge base, model base, parts base, process base and standard base, etc.) Reconstructing product lifecycle management for the "Internet+" manufacturing ecosystem (CAD/CAE/CAPP/CAM/PLM), Enterprise Resource Planning (ERP), Supply Chain Management

(The company will develop core software for manufacturing industries such as SCM and CRM, and form a new industrial cloud component library. Develop data-driven component combination engines, intelligent software and collaborative control platforms for industrial energy management, intelligent software and collaborative control platforms for industrial energy management, build "Internet+" intelligent industrial cloud platforms, promote the internetisation of industrial enterprises, and form industry-wide and cross-industry industrial application ecosystems.

(4) Industrial applications for key areas

For advanced rail transportation equipment, electric power equipment, agricultural equipment, high-grade CNC machine tools and robots, aerospace equipment, offshore equipment and high-tech ships and other key industrial fields, the development of industry application software covering the entire life cycle from design and development, manufacturing to product services, focusing on breakthroughs in product innovation and development, intelligent control and analysis and optimization, equipment intelligent services and other key technologies, the development of independent industrial The development of independent industrial application software systems.

2. Key technologies

1("End-to-end" industrial software security technology. Research on the security of control systems, hardware security, network communication security, system security, data security, information and system security from the device end to the cloud end. Research and development of security standards, verification technologies and certification systems for secure and highly trusted industrial software systems.

(2) **Industrial base resource base and standardisation technology.** Focusing on building and autonomous industrial

A standardized system of industrial basic repository interface that is compatible with software. Research on the classification standard of industrial basic repositories, and layout of industrial basic repository architecture and ecological system adapted to the characteristics of China's manufacturing environment. Research on the standardised evaluation and certification system of industrial basic repositories.

(3) **Embedded operating system technology.** To develop real-time scheduling algorithms that meet the needs of highly secure and trustworthy embedded operating systems by focusing on the security mechanisms and trustworthy mechanisms of real-time embedded operating systems. Research on the adaptation technology of the operating system to the underlying heterogeneous and complex equipment and its fieldbus protocols. Research on model-driven control program unified design, development, testing and release technology.

(4) **Intelligent technology on the device side.** Research small-capacity embedded database systems, as well as data caching and data synchronisation and exchange technologies. Accelerate the research of terminal's environmental

semantic modelling technology, as well as new terminal intelligence technologies such as real-time data dynamic acquisition, frequency conversion transmission, visual understanding, stand-alone intelligent analysis and control, and regional collaboration.

(5) **Industrial big data management and analysis technologies. Research** and development of key technologies for real-time industrial data collection, high-throughput storage, data compression, data indexing, query optimisation, data caching and other key technologies. Research on key technologies for data quality inspection and repair under spatio-temporal correlation and mechanism models. Research on the integration technology of real-time data of front-end equipment and relational data of back-end information system. Breakthrough in industrial big data parallel analysis and processing technology, mechanism model modelling technology, knowledge reasoning technology and simulation model.

(6) **Data-driven component combination technology. Research into** key technologies for the development of component sets and component information integration platforms for industry vertical application software. Research on data integration through manufacturing resources

The analysis of information elements such as data, enterprise data, industry data and internet data drives the industry

Rapid response within the industry and between companies to dynamically integrate and optimise the efficiency of resource utilisation.

1.3.4 Application demonstration projects

1. Demonstration of the application of "industrial operating systems and their application software". **Application** of embedded operating systems and application software in safety-critical fields such as aerospace, military, shipping, energy and chemical industry.

2. Demonstration of the application of "industrial big data platform". Select leading process and discrete manufacturing enterprises and industrial chains to carry out "industrial big data platform" application demonstrations.

3. Application demonstrations in key areas of "intelligent industrial cloud and core software for manufacturing". It will develop industry application software and carry out multi-level industry-wide and cross-industry application demonstrations, taking into account group enterprises and small and medium-sized enterprise groups, in line with the strategic and advantageous industries deployed in "Made in China 2025".

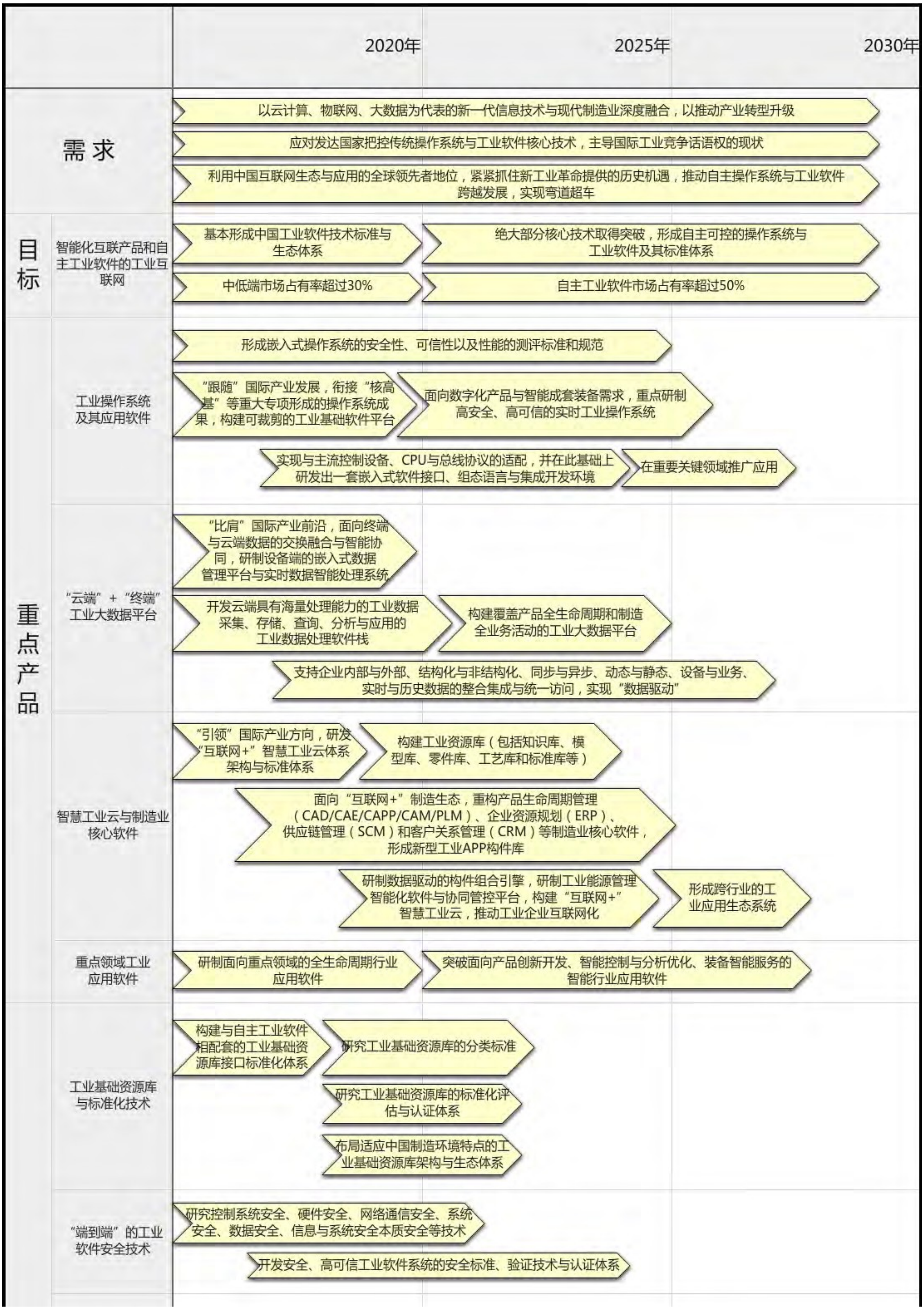
1.3.5 Strategic Support and Assurance

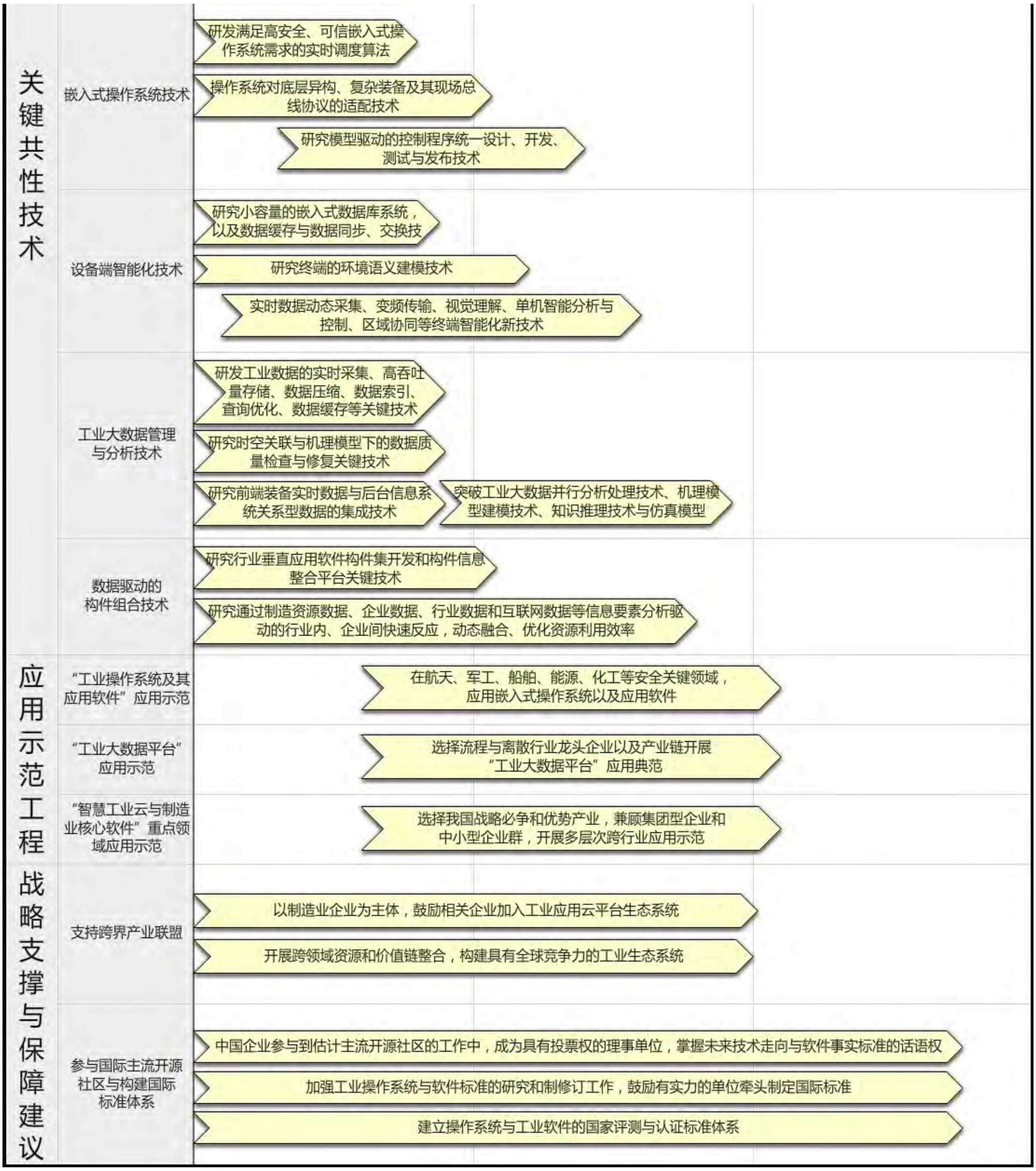
1. Supporting cross-border industry alliances

Taking manufacturing enterprises as the mainstay, we encourage related enterprises and others to join the industrial application cloud platform ecosystem, carry out cross-discipline resource and value chain integration, and build an industrial ecosystem with global competitiveness.

2. Building a system of standards

Encourage Chinese enterprises to participate in the mainstream international open source community and become a voting member of the board. Strengthen the development and revision of industrial operating system and software standards, and encourage competent units to take the lead in developing international standards. Establish a national evaluation and certification standard system for operating systems and industrial software.


2020年
2025年
2030年
需求
以云计算、物联网、大数据为代表的新一代信息技术与现代制造业深度融合，以推动产业转型升级
应对发达国家把控传统操作系统与工业软件核心技术，主导国际工业竞争话语权的现状
利用中国互联网生态与应用的全球领先者地位，紧紧抓住新工业革命提供的历史机遇，推动自主操作系统与工业软件跨越发展，实现弯道超车
目标
智能化互联产品和自主工业软件的工业互联网
基本形成中国工业软件技术标准与生态体系
绝大部分核心技术取得突破，形成自主可控的操作系统与工业软件及其标准体系
中低端市场占有率超过30%
自主工业软件市场占有率超过50%
重点产品
工业操作系统及其应用软件
形成嵌入式操作系统的安全性、可信性以及性能的测评标准和规范
“跟随”国际产业发展，衔接“核高基”等重大专项形成的操作系统成果，构建可裁剪的工业基础软件平台
面向数字化产品与智能成套装备需求，重点研制高安全、高可信的实时工业操作系统
实现与主流控制设备、CPU与总线协议的适配，并在此基础上研发出一套嵌入式软件接口、组态语言与集成开发环境
在重要关键领域推广应用
“云端”+“终端”工业大数据平台
“比肩”国际产业前沿，面向终端与云端数据的交换融合与智能协同，研制设备端的嵌入式数据管理平台与实时数据智能处理系统
开发云端具有海量处理能力的工业数据采集、存储、查询、分析与应用的工业数据处理软件栈
构建覆盖产品全生命周期和制造全业务活动的工业大数据平台
支持企业内部与外部、结构化与非结构化、同步与异步、动态与静态、设备与业务、实时与历史数据的整合集成与统一访问，实现“数据驱动”
智慧工业云与制造业核心软件
“引领”国际产业方向，研发“互联网+”智慧工业云体系架构与标准体系
构建工业资源库（包括知识库、模型库、零件库、工艺库和标准库等）
面向“互联网+”制造生态，重构产品生命周期管理（CAD/CAE/CAPP/CAM/PLM）、企业资源规划（ERP）、供应链管理（SCM）和客户关系管理（CRM）等制造业核心软件，形成新型工业APP构件库
研制数据驱动的构件组合引擎，研制工业能源管理智能化软件与协同管控平台，构建“互联网+”智慧工业云，推动工业企业互联网化
形成跨行业的工业应用生态系统
重点领域工业应用软件
研制面向重点领域的全生命周期行业应用软件
突破面向产品创新开发、智能控制与分析优化、装备智能服务的智能行业应用软件
工业基础资源库与标准化技术
构建与自主工业软件相配套的工业基础资源库接口标准化体系
研究工业基础资源库的分类标准
研究工业基础资源库的标准化评估与认证体系
布局适应中国制造环境特点的工业基础资源库架构与生态体系
“端到端”的工业软件安全技术
研究控制系统安全、硬件安全、网络通信安全、系统安全、数据安全、信息与系统安全本质安全等技术
开发安全、高可信工业软件系统的安全标准、验证技术与认证体系


关键共性技术
嵌入式操作系统技术
研发满足高安全、可信嵌入式操作系统需求的实时调度算法
操作系统对底层异构、复杂装备及其现场总线协议的适配技术
研究模型驱动的控制程序统一设计、开发、测试与发布技术
设备端智能化技术
研究小容量的嵌入式数据库系统，以及数据缓存与数据同步、交换技
研究终端的环境语义建模技术
实时数据动态采集、变频传输、视觉理解、单机智能分析与控制、区域协同等终端智能化新技术
工业大数据管理与分析技术
研发工业数据的实时采集、高吞吐量存储、数据压缩、数据索引、查询优化、数据缓存等关键技术
研究时空关联与机理模型下的数据质量检查与修复关键技术
研究前端装备实时数据与后台信息系统关系型数据的集成技术
突破工业大数据并行分析处理技术、机理模型建模技术、知识推理技术与仿真模型
数据驱动的构件组合技术
研究行业垂直应用软件构件集开发和构件信息整合平台关键技术
研究通过制造资源数据、企业数据、行业数据和互联网数据等信息要素分析驱动的行业内、企业间快速反应，动态融合、优化资源利用效率
应用示范工程
“工业操作系统及其应用软件”应用示范
在航天、军工、船舶、能源、化工等安全关键领域，应用嵌入式操作系统以及应用软件
“工业大数据平台”应用示范
选择流程与离散行业龙头企业以及产业链开展“工业大数据平台”应用典范
“智慧工业云与制造业核心软件”重点领域应用示范
选择我国战略必争和优势产业，兼顾集团型企业和中小型企业群，开展多层次跨行业应用示范
战略支撑与保障建议
支持跨界产业联盟
以制造业企业为主体，鼓励相关企业加入工业应用云平台生态系统
开展跨领域资源和价值链整合，构建具有全球竞争力的工业生态系统
参与国际主流开源社区与构建国际标准体系
中国企业参与到估计主流开源社区的工作中，成为具有投票权的理事单位，掌握未来技术走向与软件事实标准的话语权
加强工业操作系统与软件标准的研究和制修订工作，鼓励有实力的单位牵头制定国际标准
建立操作系统与工业软件的国家评测与认证标准体系

1.4 Intelligent manufacturing core information equipment

Intelligent manufacturing core information equipment is the key infrastructure equipment for information acquisition, real-time communication and dynamic interaction and decision analysis and control in all aspects of the manufacturing process.

Intelligent manufacturing core information equipment mainly includes intelligent manufacturing basic communication equipment, intelligent manufacturing control system, new industrial sensors, manufacturing IOT equipment, instruments and testing equipment, manufacturing information security protection products.

1.4.1 Demand

The world is setting off a new round of industrial revolution with intelligent manufacturing at its core, and China's manufacturing industry is also accelerating its transformation to intelligent manufacturing.

In the next five years, China's intelligent production facilities, digital workshop/factory upgrade and transformation will be further accelerated, and the demand for intelligent manufacturing core information equipment in the manufacturing industry will also grow significantlyIt is expected that the market size of China's intelligent manufacturing core information equipment will continue to grow at a growth rate of about 30%.

1.4.2 Objectives

By 2020, the standard system of core information equipment for intelligent manufacturing will be basically completed, a number of core key technologies in the field of core information equipment for intelligent industry will be broken through, so that China's basic communication equipment for intelligent manufacturing, industrial control equipment, industrial sensors, intelligent instruments and testing equipment, manufacturing IOT equipment and industrial information security products will be applied on a large scale in China, and the share of the domestic market will reach 40%. To cultivate more than 5 related enterprises with annual revenue of more than RMB 10 billion.

By 2025, an independently controllable, safe, reliable and advanced intelligent manufacturing core information equipment industrial ecosystem and technological innovation system will be established, domestic intelligent manufacturing core information equipment will occupy a dominant position in the domestic market, and the share of the domestic market will reach

60%, the overall technical level reached the international advanced level.

1.4.3 Development focus

1. Key products

(1) Intelligent manufacturing infrastructure communication equipment

Develop industrial communication network infrastructure equipment such as high-speed IPv6-enabled industrial switches, high-speed industrial wireless routers/repeaters, industrial low-power tele/near-field communication equipment, fast self-organising industrial wireless communication equipment, industrial protocol converters/gateways, industrial communication consistency testing equipment, etc., which are highly reliable, high-capacity, high speed and high quality, to build a smart manufacturing-oriented The company will build a high-speed, safe and reliable industrial communication network for intelligent manufacturing and lay the foundation for the interconnection of manufacturing information.

(2) Intelligent manufacturing control systems

Develop distributed control systems (DCS), programmable control systems (PLC), industrial control systems (PAC), embedded control systems and data acquisition and monitoring control systems (SCADA) that support fieldbus communication to improve the capability and level of independent and safe control of intelligent manufacturing.

（3） New industrial sensors

Development of intelligent photoelectric sensors, intelligent proximity sensors, high resolution vision sensors, high accuracy flow sensors, inertial navigation sensors for vehicles with low power consumption, high accuracy and high reliability with data storage and processing, automatic compensation and communication functions

（The new industrial sensors, such as the DOMAIN domain controller for vehicles and high-precision detectors for analytical instruments, meet the needs of typical industries and fields for ubiquitous information acquisition.

（4） Manufacture of IOT equipment

Vigorously develop RFID chips and read/write devices, industrial portable/handheld intelligent terminals,

Industrial IoT gateway, industrial wearable devices to achieve interconnection and integrated management between people, equipment, environment and materials.

（5） Instrumentation and testing equipment

Develop online composition analysers, online non-destructive testing devices, online high-precision three-dimensional digital ultrasonic flaw detectors and online high-precision non-contact geometric accuracy testing equipment to achieve quality information collection and quality traceability in the intelligent manufacturing process.

（6） Manufacturing information security assurance products

Invest in the development of industrial control system firewalls/net gates, disaster recovery and backup systems, active defence systems, vulnerability scanning tools, wireless security detection tools and intrusion detection equipment to improve the information security protection capability of intelligent manufacturing.

2. Key technologies

（1） Manufacturing information interconnection standards and interface technologies

Develop technical standards for manufacturing information interoperability, focusing on the development of technical standards and specifications for intelligent equipment and digital workshops/factories. Research the interface technology for manufacturing information interoperability, provide an overall framework for protocol interoperability between devices and equipment and between devices and systems, and protocol interoperability service interface definitions to support the interoperability and collaborative work of devices with heterogeneous protocols.

（2） Industrial sensor core technology

Research into sensor wireless communication technology, sensor signal processing technology, sensor reliability design and testing technology, and sensor precision manufacturing and inspection technology.

（3） Artificial Intelligence Technology

Research into knowledge engineering, situational awareness, pattern recognition, self-determination, self-execution, and

Visualisation and other key technologies to improve the intelligence of core information equipment for intelligent manufacturing.

（4） Augmented Reality

Research on 3D spatial RFID registration and positioning technology, 3D spatial modelling, search, display and interaction technology for industrial IoT information.

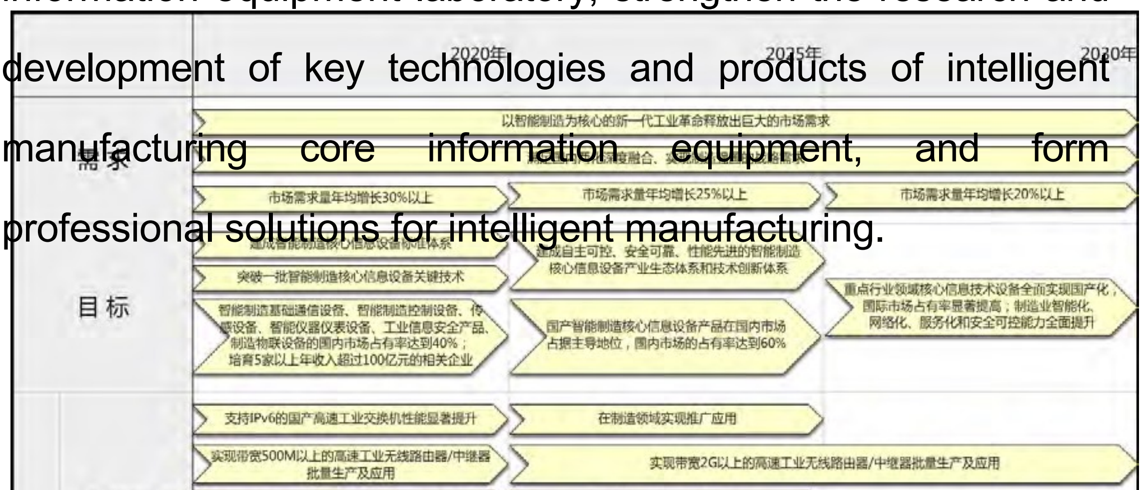
1.4.4 Strategic Support and Assurance

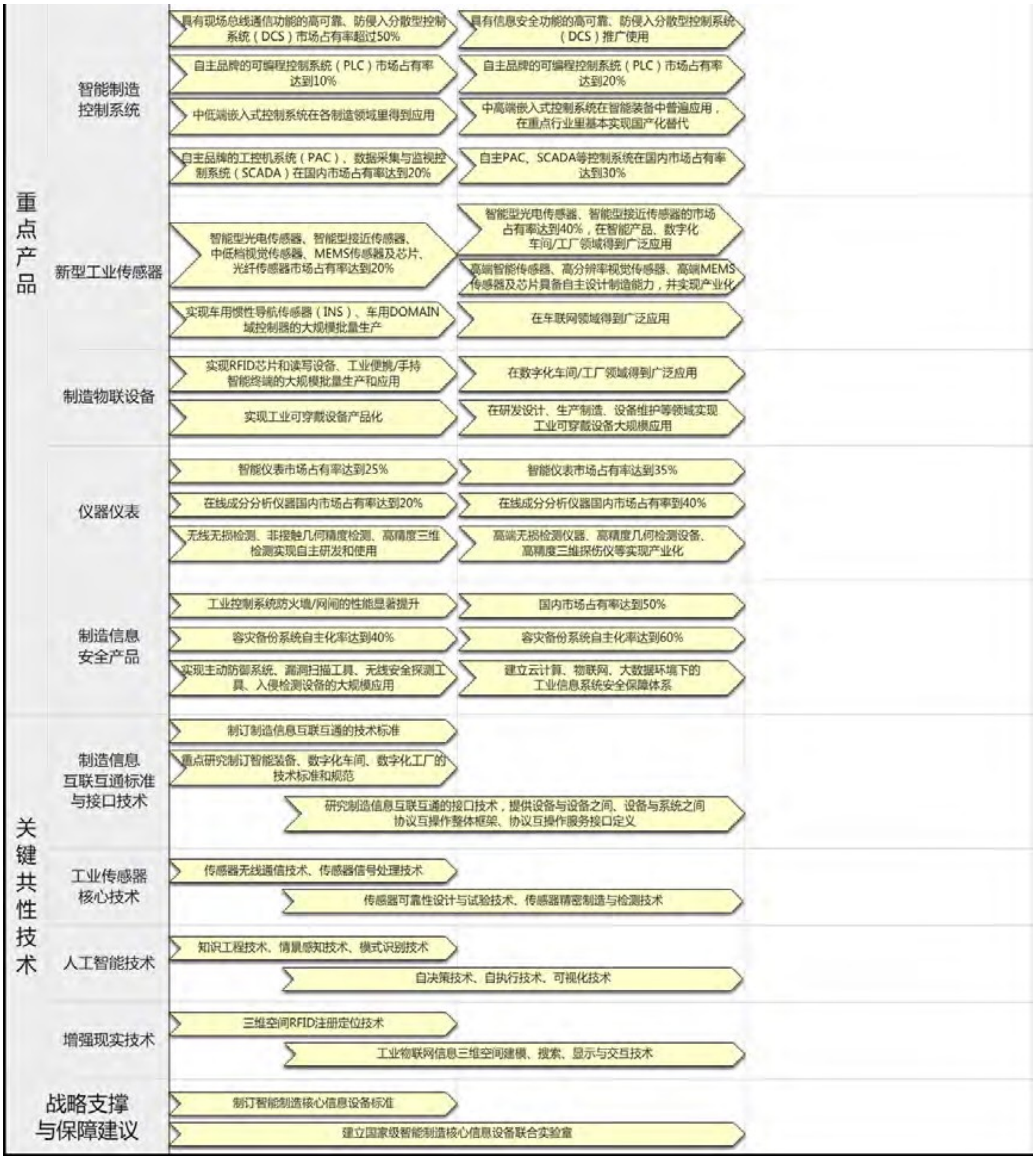
1. Development of core information equipment standards for smart manufacturing

Accelerate the development of a standardisation system for smart manufacturing, and research and develop standards for manufacturing information interoperability and cyber security. Focus on supporting the development of technical standards and specifications in areas such as smart equipment and digital workshops/factories.

2. Establishment of a national joint laboratory for core information equipment for intelligent manufacturing

Support relevant units to jointly prepare for the establishment of a national intelligent manufacturing core information equipment laboratory, strengthen the research and development of key technologies and products of intelligent manufacturing core information equipment, and form professional solutions for intelligent manufacturing.





重点产品
智能制造控制系统
具有现场总线通信功能的高可靠、防侵入分散型控制系统（DCS）市场占有率超过50%
具有信息安全功能的高可靠、防侵入分散型控制系统（DCS）推广使用
自主品牌的可编程控制系统（PLC）市场占有率达到10%
自主品牌的可编程控制系统（PLC）市场占有率达到20%
中低端嵌入式控制系统在各制造领域里得到应用
中高端嵌入式控制系统在智能装备中普遍应用，在重点行业里基本实现国产化替代
自主品牌的工控机系统（PAC）、数据采集与监视控制系统（SCADA）在国内市场占有率达到20%
自主PAC、SCADA等控制系统在国内市场占有率达到30%
新型工业传感器
智能型光电传感器、智能型接近传感器、中低档视觉传感器、MEMS传感器及芯片、光纤传感器市场占有率达到20%
智能型光电传感器、智能型接近传感器的市场占有率达到40%，在智能产品、数字化车间/工厂领域得到广泛应用
高端智能传感器、高分辨率视觉传感器、高端MEMS传感器及芯片具备自主设计制造能力，并实现产业化
实现车用惯性导航传感器（INS）、车用DOMAIN域控制器的大规模批量生产
在车联网领域得到广泛应用
制造物联设备
实现RFID芯片和读写设备、工业便携/手持智能终端的大规模批量生产和应用
在数字化车间/工厂领域得到广泛应用
实现工业可穿戴设备产品化
在研发设计、生产制造、设备维护等领域实现工业可穿戴设备大规模应用
仪器仪表
智能仪表市场占有率达到25%
智能仪表市场占有率达到35%
在线成分分析仪器国内市场占有率达到20%
在线成分分析仪器国内市场占有率到40%
无线无损检测、非接触几何精度检测、高精度三维检测实现自主研发和使用
高端无损检测仪器、高精度几何检测设备、高精度三维探伤仪等实现产业化
制造信息安全产品
工业控制系统防火墙/网闸的性能显著提升
国内市场占有率达到50%
容灾备份系统自主化率达到40%
容灾备份系统自主化率达到60%
实现主动防御系统、漏洞扫描工具、无线安全探测工具、入侵检测设备的大规模应用
建立云计算、物联网、大数据环境下的工业信息系统安全保障体系
关键共性技术
制造信息互联互通标准与接口技术
制订制造信息互联互通的技术标准
重点研究制订智能装备、数字化车间、数字化工厂的技术标准和规范
研究制造信息互联互通的接口技术，提供设备与设备之间、设备与系统之间协议互操作整体框架、协议互操作服务接口定义
工业传感器核心技术
传感器无线通信技术、传感器信号处理技术
传感器可靠性设计与试验技术、传感器精密制造与检测技术
人工智能技术
知识工程技术、情景感知技术、模式识别技术
自决策技术、自执行技术、可视化技术
增强现实技术
三维空间RFID注册定位技术
工业物联网信息三维空间建模、搜索、显示与交互技术
战略支撑与保障建议
制订智能制造核心信息设备标准
建立国家级智能制造核心信息设备联合实验室

Second, high-grade CNC machine tools and robots

2.1 High-grade CNC machine tools and basic manufacturing equipment

High-grade CNC machine tools are high-speed, precision, intelligent, composite, multi-axis linkage, network communication and other functions of CNC machine tools, basic manufacturing equipment is the manufacture of a variety of machines and equipment of the general name of the equipment. High-grade CNC machine tools and basic manufacturing equipment, including metal cutting machine tools, special processing machine tools, casting, forging, welding, heat treatment and other thermal processing equipment, additive manufacturing equipment, etc., with basic, universal, and strategic features.

2.1.1 Demand

China has become the world's largest producer, consumer and importer of machine tools and equipment for many years. In the next decade, electronics and communications equipment, aerospace equipment, rail transportation equipment, power equipment, automotive, shipping, construction machinery and agricultural machinery and other key industries such as the rapid development of new materials, new technologies and continuous progress in CNC machine tools and basic equipment will put forward new strategic needs and transformation challenges. The demand for CNC machine tools and basic manufacturing equipment will change from low-grade to high-grade, from a single machine to include robot loading and unloading and online inspection functions of manufacturing units and complete systems, from digital to intelligent change, from general machine tools to tailor-made personalized machine tools, electronics and communications equipment manufacturing equipment will be the new demand for hot spots.

2.1.2 Objectives

By 2020, the domestic market share of high-grade CNC machine tools and basic manufacturing equipment exceeds 70%, the domestic market share of standard and intelligent CNC systems reaches 60% and 10% respectively, and the domestic market share of high-grade functional components such as spindles, screws and guideways reaches
50%;

By 2025, the domestic market share of high-grade CNC machine tools and basic manufacturing equipment will exceed

More than 80% of the machine tools used in the automotive industry have an average failure-free time of 2000

Hours, precision maintenance to 5 years; CNC system standard, intelligent domestic market share of 80%, 30%; spindle, screw, guide and other high-grade functional components of the domestic market share of 80%; high-grade CNC machine tools and basic manufacturing equipment overall into the ranks of the world's power.

2.1.3 Development focus

1. Key products

Focus on aerospace equipment, automotive, electronic information equipment and other key industrial development needs, the development of high-grade CNC machine tools, advanced forming equipment and group process production lines.

(1) Electronic information equipment processing equipment

The focus is on the development of 20,000-60,000 r/min high-speed drilling and tapping centres, five-axis linked high-speed machining centres, PSA dressing machines and robotised intelligent inspection and assembly lines.

(2) Manufacturing and assembly equipment for large structural parts of aerospace equipment

Focus on the development of aluminum/magnesium/titanium/high-temperature alloy and other difficult-to-machine materials with multi-axis gantry CNC milling machine, five-coordinate skin mirror processing machine tools, robot cluster automatic drilling and riveting, composite materials automatic laying wire/banding, multi-dimensional friction welding, super-plastic/diffusion forming, precision control of heat treatment, structural fatigue and load-bearing test equipment, digital assembly of large aircraft and large rockets, etc.

(3) Key equipment for aero-engine manufacturing

Focus on the development of finishing horizontal machining centres, turning and milling centres, boring machines, internal and external circular grinding machines for the machining of key components such as blades, impellers, turbine disks, cassettes and spindles, as well as heavy-duty inertia friction welding, lapping and forming, single crystal casting, high-temperature vacuum heat treatment and

Surface strengthening, laser micro-hole forming equipment, etc.

(4) Key manufacturing equipment for ships and marine engineering equipment

Focus on the development of ship and offshore high-strength steel single-sided welding double-sided forming (FCB), curved segmentation flexible support, high-powered laser composite welding, multi-point pressure forming and other flat, curved segmentation line key equipment; large diesel engine block, crankshaft, gears, blades, offshore rack and other advanced processing and forming technology and equipment; water depth of more than 1,000 meters full diving welding equipment.

(5) Complete sets of processing equipment for key components of rail transportation equipment

Focus on the development of aluminum-magnesium alloy / stainless steel body of the new high-efficiency laser / stir friction welding equipment, 30-ton axle weight heavy-duty electric locomotive core manufacturing equipment, 120Km / h mobile high-speed rail welding equipment, 350Km / h speed above the train with gears, bearings, wheelsets, bogies, braking systems and other lightweight processing into a set of equipment.

(6) Complete sets of equipment and production lines for processing key automotive parts

Focus on the development of high-efficiency processing/near-net forming equipment and assembly process production lines for automotive engines/transmissions, etc.; development of diesel high-pressure common rail, automotive safety, low-cost ultra-high strength steel /Aluminium alloy/carbon fibre auto parts, new energy vehicle electromechanical coupling system and other industrialisation of the urgent need for efficient processing and forming, online inspection and assembly of complete sets of equipment.

(7) Four major process assembly lines for automobiles

Aiming at medium and high-end models, the company will focus on the application of ultra-high-strength steel/aluminium alloy/carbon fibre lightweight and high-strength materials, and develop production lines such as lightweight mixed bodywork of dissimilar materials, servo stamping/moulding based on domestic robots, high-efficiency connections (laser welding, riveting and gluing) environmentally friendly and energy-saving painting, and digital robotic assembly.

(8) Large capacity power equipment manufacturing equipment

Focus on the development of high-quality casting of megawatt-class nuclear power main pumps and the manufacture of welded rotors for gas turbines

Complete sets of equipment, million-kilowatt turbine runners and other robot welding equipment, ultra-high voltage transmission and transformation equipment precision manufacturing equipment, digital assembly sets of equipment, etc.

(9) Construction and agricultural machinery lines

The focus of research and development is on precision machining and forming equipment and complete production lines for engines, transmissions and high-pressure, high-flow hydraulic systems for construction and agricultural machinery, and the development of robot-based production lines for welding, painting and assembly.

2. Additive manufacturing equipment

Focus on breakthroughs with a series of original technology of titanium alloys, high-strength alloy steel, high-strength aluminum alloys, high-temperature alloys, non-metallic engineering materials and composite materials and other high-performance large key components of efficient additive manufacturing processes, complete sets of equipment, special materials and engineering key technologies, the development of laser, electron beam, ion beam and other energy-driven mainstream process equipment; to overcome the bottleneck of material preparation, print head, intelligent software, etc. Create an industrial chain.

3. High-grade CNCs

Focus on the development of multi-axis, multi-channel, high-precision interpolation, dynamic compensation and intelligent programming, with self-monitoring, maintenance, optimization, restructuring and other functions of intelligent CNC system; provide a standardized base platform, allowing developers, different hardware and software modules to intervene, with standard interfaces, modularity, portability, scalability and interchangeability and other functions of open CNC system.

4. High performance functional components

Focus on the development of 20,000 ~ 40,000r/min high-speed electric spindle, multi-axis linkage spindle head, precision grating, tell high-precision spindle bearings, 1-2 level ball screw guide, positioning accuracy of less than 6" rotary table, etc., research and development of high-performance functional components precision machining, forming, Testing and assembly of complete sets of equipment.

5. Key common technologies

(1) Digital Collaborative Design and 3D/4D Full Manufacturing Process Simulation

Carry out open network-based, crowd-sourced collaborative innovation design and digital whole-process modelling and simulation technologies for the whole life cycle of equipment products.

(2) Reliability and accuracy maintenance technology for precision and ultra-precision machine tools

Research on key technologies and advancement paths for reliability and accuracy stability of high precision machine tools, and establish a big data platform for reliability and accuracy retention.

(3) Efficient machining and forming technology for complex surfaces and difficult to machine materials

Research into high-speed, high-efficiency machining and advanced forming technologies for difficult to machine and complex profile materials for aerospace equipment.

(4) 100% in-line inspection technology

Research into 100% in-line inspection technology based on advanced technologies such as machine vision, non-contact measurement and dexterous robotics.

2.1.4 Application demonstration projects

1. National Science and Technology Major Project "High-grade CNC Machine Tools and Basic Manufacturing Equipment" Intelligent Upgrade Project
2. Aerospace high-end manufacturing equipment application demonstration project
3. Demonstration of the application of new process equipment for key components and assemblies of lightweight materials for automobiles

Program

4. Demonstration project for the application of intelligent flat/surface machining line for ships

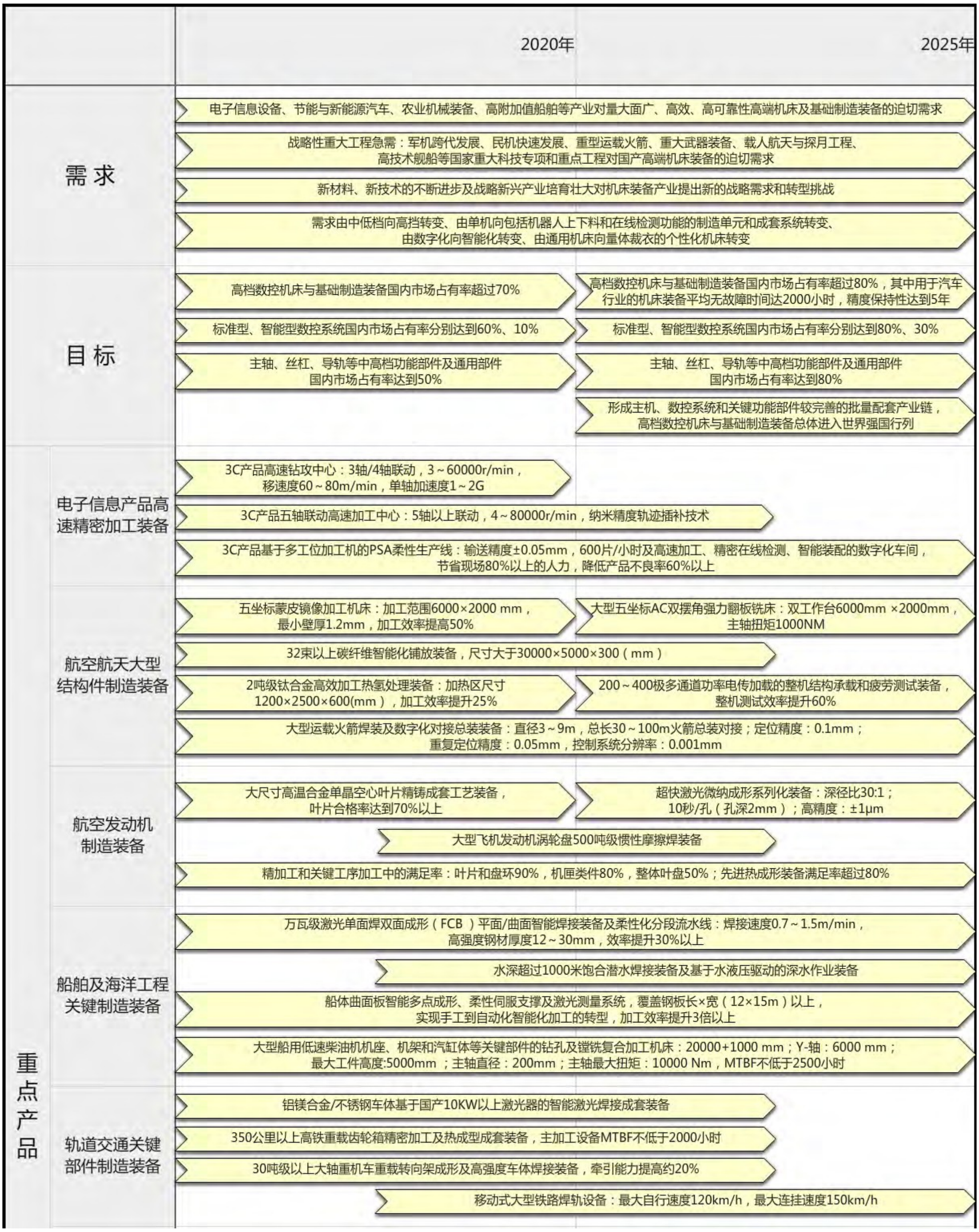
2.1.5 Strategic Support and Assurance

1. It is recommended that a national collaborative innovation centre for common technologies of CNC machine tools be formed to focus on

Digital design technology, static and dynamic thermal testing technology as well as reliability and accuracy retention

The key technologies that are constraining, such as

2. It is proposed to set up a national innovation centre for advanced forming processes and to promote the close



汽车关键零部件加工成套生产线	年产50万台以上轿车用缸内直喷汽油发动机缸体、缸盖柔性生产线：缸体设备主轴转速≥10000rpm，缸盖主轴转速≥15000rpm；定位精度≤0.005mm，重复定位精度≤0.002mm
	年产100万套ABS/ESP精密加工及100%在线检测、智能装配柔性化生产线
	年产100万台，180MPa以上压力的柴油高压共轨系统精密加工及100%在线检测智能化装配生产线
	汽车关键零部件加工成形装备及成套生产线国产化率达到80%，核心设备的MTBF不低于2000小时
汽车四大工艺总成生产线	40000KN以上，15-20次/分钟大型伺服智能覆盖件冲压生产线
	20000KN以上，20-35次/分钟，工位数≥5的大型多工位结构件冲压生产线
	适应5种车型以上、国产机器人50台以上，万瓦级激光器示范应用的柔性化车身智能焊接生产线
	Cpk值≥1.67的汽车低成本碳纤维零部件快速树脂传递模压(RTM)成形、连接、涂装成套装备，其中模压工件节拍＜6分钟
大容量电力产品制造装备	百万千瓦级核电主泵优质铸造成套装备，产品合格率达到80%以上
	百万千瓦级水轮机转轮等大型件机器人焊接成套装备，智能化焊接率达到70%，降低人工60%以上
工程及农业机械制造装备	工程机械和农业装备发动机（国5排放标准以上）、200-400马力变速箱关键零部件高效低成本加工及自动化装配检测成套装备
	35-50MPa高压泵/阀、马达及高频响电液伺服阀和比例阀，及其精密加工与智能化检测装配生产线，国产化配套率达到80%以上
	工程机械高强钢伸臂大跨度龙门式10KW级激光—电弧复合焊接机器人工作站产业化应用，提高效率100%，节省人工60%
增材制造高端装备	铸造砂型增材制造装备:加工尺寸：2m*2m*1m，精度±0.1%，效率提升3倍以上
	飞机发动机整体叶盘、涡轮盘的产品开发和小批量制造增材制造装备：最大直径 1.5m以上；制造效率：2Kg/h；制造精度：0.5mm；连续工作300小时无故障；变形控制：1mm/300mm
	航空航天大型结构件3维融覆增材成形装备：梁珩类长度大于3m，框架类投影面积大于4，制造效率5Kg/h以上；制造精度0.5mm以上, 适应高温合金、钛合金等3种难加工材料,成形件强度达到锻件标准，实现航空航天等结构件工程化应用
	航天精密复杂件高精度四光束激光选区熔化增材制造装备:成形材料为钛合金或铝合金，成形精度钛合金优于30μm，铝合金优于40μm；成形件的表面粗糙度可达Ra6-15μm，成形件的相对致密度达到100%，通过装弹验证
	高温合金超细粉末等离子旋转雾化制粉设备：粒度5-50μm；效率提升60%
	钛合金增材制造材料：D50<30μm，粉末流动性<50s/50g;，含氧量<1500ppm
数控系统	开放型数控系统：提供标准化基础平台，允许开发商、不同软硬件模块介入，具有标准接口、模块化、可移植性、可扩展性及可互换性等功能，支持温度、振动、RFID等传感器接入；具有网络化接口，支持无线与移动互联设备接入；支持DNC管理功能
	智能型数控系统：实现多轴、多通道，纳米插补、超前预读、小线段高速精密插补数控加工技术；具备双轴同步控制、低转矩波动和高过载能力的伺服电机优化、转矩波动抑制、电机损耗和温升抑制、刀具空间长度补偿（RTCP）等功能；具有自适应加工、刀具寿命管理、工件在位测量，虚拟现实加工仿真以及自监控、维护、优化、重组等功能
关键功能部件	系列化铣头、动力头等用高速电主轴：2～40000r/min，功率5～100KW
	滚珠丝杠：运动速度120m/min；DN值>150000；精度P1级，精度寿命20000h
	高端摆角铣头和回转工作台：摆角定位精度小于8″，转台定位精度小于6″
	攻克主轴、导轨、转台、卡盘、刀库、刀架等精密加工成形成套装备，加工、装配和检测效率提高30%以上
关键共性技术	数字化协同设计及3D/4D全制造流程仿真技术
	精密及超精密机床的可靠性及精度保持技术
	复杂型面和难加工材料的高效精密加工成形技术
	100%在线精密检测技术
应用示范工程	国家科技重大专项"高档数控机床与基础制造装备"智能化升级工程
	航空航天高端制造装备应用示范工程
	汽车轻量化多材质关键部件及总成新工艺装备应用示范工程
	舰船FCB平/曲面智能化流水线应用示范工程
战略支撑与保障建议	建议组建国家数控机床共性技术创新中心，集中解决数字化设计技术、试验技术以及可靠性、精度保持性等制约性关键技术
	建议组建国家先进成形工艺创新中心，加速新型工艺技术和智能制造技术的融合创新，推进基于成组工艺的智能化生产线、数字化工厂集成创新

2.2 Robots

A robot is a semi-autonomous or fully autonomous machine that combines modern manufacturing technology, new materials technology and information control technology, and is a representative product of intelligent manufacturing. Robots include industrial robots for use in manufacturing environments and service robots for use in non-manufacturing environments. Depending on the application environment, service robots are divided into personal/household service robots for use in the home or for direct service to people, and professional service robots for use in special environments.

2.2.1 Demand

In recent years, China's robotics market has grown rapidly, with sales of 56,000 industrial robots in 2014, making it the world's largest industrial robot market. A variety of service robots for the elderly and disabled, disaster relief and rescue, and public safety have begun to enter demonstration applications, and home service robots such as cleaning robots, two-wheeled self-balancing vehicles and model drones have entered the consumer market. Sales of industrial robots are expected to reach

The number of industrial robots sold will reach 150,000 by 2025 and 800,000 by 2025.

The number of units reached 260,000, with a holding of 1.8 million units.

2.2.2 Objectives

By 2020, a market-oriented, enterprise-oriented and closely integrated industry-academia-research-application robotics industry system will be basically completed. The domestic market share of domestic brand industrial robots will reach 50%, the domestic market share of domestic key components will reach 50%, and the MTBF of products will reach 80,000 hours; service robots will be produced in small quantities and applied in the fields of elderly care, rehabilitation, social services, disaster relief and rescue; breakthroughs will be made in the core technology of new generation robots; 2-3 robots with an annual output of more than 10,000 units will be cultivated, output value

The company will be a leading enterprise with more than 10 billion yuan and international competitiveness, and will create 5-8 robots

Supporting industry clusters.

By 2025, a comprehensive robotics industry system will be formed, and the robotics R&D, manufacturing and system integration capabilities will strive to reach the world's advanced level. The domestic market share of domestic brand industrial robots will reach more than 70%, the domestic market share of key domestic components will reach 70%, the main technical indicators of the products will reach the similar level of foreign countries, and the average trouble-free time will reach the international advanced level; service robots will be produced on a large scale and begin to be popularly used in people's life, social services and national defense construction, and some products will be exported; a new generation of robots will be successfully developed and the prototypes will be applied on a certain scale; 1-2 enterprises will enter the top five in the world. The new generation of robots will be successfully developed and applied on a certain scale; 1-2 enterprises will be among the top five in the world.

2.2.3 Development focus

1.Key products

（1） Industrial robots

Realize the development and mass production of multi-joint industrial robots, parallel robots and mobile robots, so that domestic industrial robots in welding, handling, painting, processing, assembly, testing, cleaning production and other aspects of the realization of large-scale integrated applications.

（2） Service robots

Focus on the development of robots for the elderly and disabled, domestic services, social and public services, education and entertainment and other consumer services; focus on the development of medical rehabilitation robots, space robots, rescue robots, energy security robots, drones and other special robots.

（3） New generation robots

Active research and development can meet the needs of intelligent manufacturing, especially with small batch customization, personalized manufacturing, flexible manufacturing to adapt, can complete dynamic, complex operational mission, can work with human collaborative new generation of robots.

2. Key components

（1） Cycloid reducers for robots

Drive accuracy and return less than 1 arc minute, drive efficiency more than 80%, noise less than 75 dB, temperature rise less than 45℃, life more than 6000 hours, rated output torque 100-6000Nm, acceleration torque 200-12000Nm, instantaneous acceleration torque 500-30,000Nm.

（2） Harmonic Reducers

Transmission accuracy and backlash less than 1 arc minute, transmission efficiency greater than 80%, maximum permissible input speed 6000 rpm, life time greater than 10000 hours, rated output torque 4-500Nm, acceleration torque 8-1100Nm, instantaneous acceleration torque 16-2200Nm.

（3） High-speed, high-performance robot controllers

Communication: High-speed bus interface, 8 axes of control, interpolation cycle less than 1 ms.

（4） Servo Drives

Supply voltage 220V-380V, continuous output current 1-50A, overload capacity: 2x overload for 1 second, 3x overload for 0.5 seconds, 5x overload for 0.3 seconds, no-load speed loop bandwidth: 600Hz or more, communication mode CAN,EtherCAT, PowerLink bus interface.

（5） Servo motors for high precision robots

Supply voltage 220V-380V, power 0.1-15KW, overload capacity: 2 times overload for 1.5 seconds, 3 times overload for 0.8 seconds, 5 times overload for 0.5 seconds, speed 1500-6000rpm, rated output torque 0.32-32Nm, peak torque 1.6-160Nm.

（6） Sensors

Focusing on the development of joint position, torque, vision, tactile, optical, high-frequency measurement, the

Laser displacement and other sensors to meet the application needs of the domestic robotics industry.

3. Key common technologies

（1） Complete machine technology

With the objectives of serial design and batch manufacturing of robots, improving the control performance, human-robot interaction performance and reliability performance of robot products, improving the load/self-weight ratio of robots and the safety of human-robot collaboration, key common technology research will be carried out in phases.

（2） Component Technology

To break through the key components of robots, meet the application of the domestic market, meet the demand for key components of robots that collaborate with people, and meet the demand for key components of new robots as the goal, and carry out key common technology research and development in phases.

（3） Integrated application technology

The aim is to improve the robot's ability to reconfigure tasks and adjust deviations adaptively, to improve the robot's ability to complete complex tasks in a human-robot coexistence environment, and to promote the integration of robots into human life, and to carry out key common technology research and development in phases.

2.2.4 Application demonstration projects

1. Robot key components development and application demonstration project

Support the development and industrialisation of key components such as reducers, controllers, servo motors and drives, sensors and other applications.

2. Industrial robot core technology research and application demonstration project

Support research on core industrial robot technologies, multi-industrial robot collaboration technologies and intelligent industrial robot technologies, and promote demonstration applications according to industry segments.

3. Service Robot Technology Research and Application Demonstration Project

Focus on supporting social and public services such as medical care, rehabilitation, elderly care, disability assistance and rescue The development of the robot, the creation of a favourable social and policy environment, and the promotion of the demonstration application of domestically produced products.

4. Robotics Talent Training Demonstration Project

Strengthen the construction of professional disciplines related to robotics, enhance cross-integration of multiple disciplines, strengthen international exchange and learning, accelerate the introduction of overseas high-end talents, set up robotics teaching demonstration sites and cultivate basic talents.

2.2.5 Strategic support and assurance

1. Compile special planning for robotics, support and promote the construction of independent innovation capacity and independent brand building for robotics, reward enterprises or projects with driving or outstanding contributions to industrial development, and implement the Three-Year Action Plan for Enhancing Core Competitiveness in Manufacturing (2015-2017)" support for industrial robotics key technology industrialisation projects.

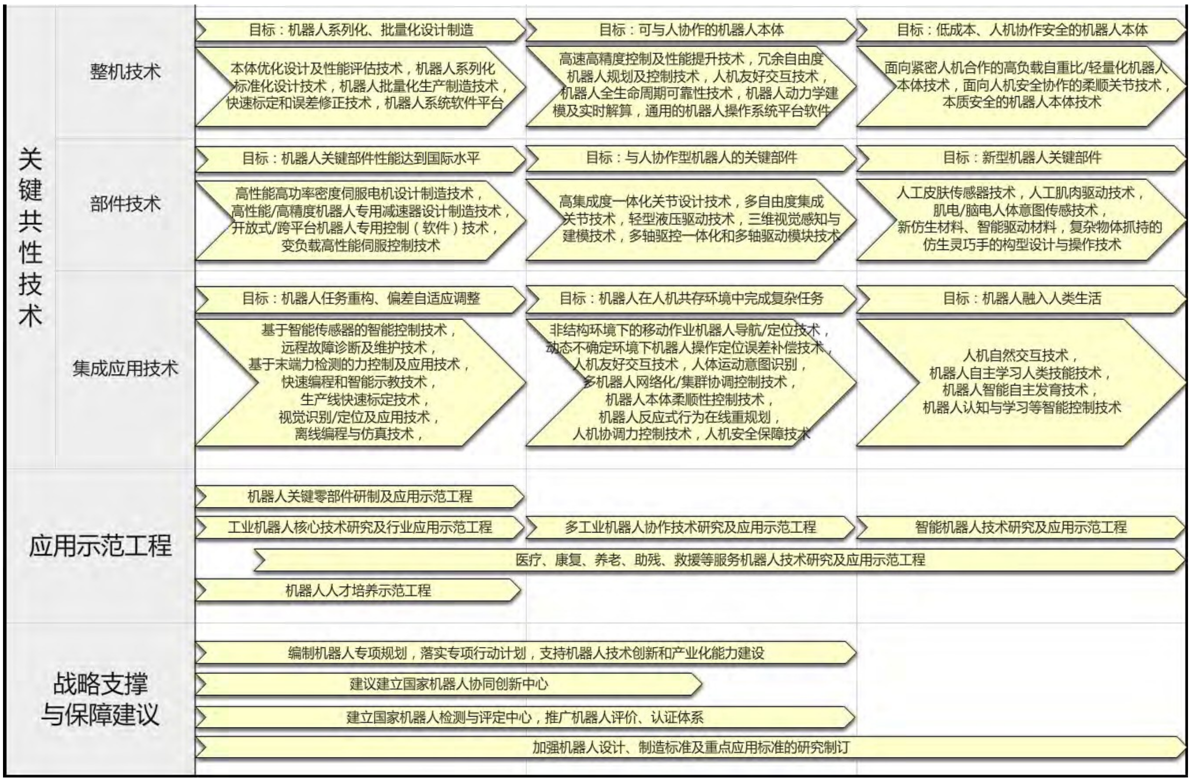
2. It is proposed to establish a National Collaborative Innovation Centre for Robotics to carry out research on common and key robotics technologies.

3. Establish a national robot testing and evaluation centre to achieve performance testing capabilities for robots and their key components, as well as reliability and safety performance evaluation capabilities, and promote robot evaluation and certification systems.

4. Strengthening basic common standards, key technical standards and key application standards for robots

The company is actively involved in the development of research and international standardisation.

		2020年	2025年	2030年
需 求		预计2020年工业机器人销量达到15万台，保有量达到80万台	预计2025年工业机器人销量达到26万台，保有量达到180万台	预计2030年工业机器人销量达到40万台，保有量达到350万台
		各领域对生产设备数字化、标准化、模块化、网络化的需求	各领域对高决策力、高智能化成套生产设备和高柔性制造系统的需求	
		随着技术进步、消费水平提升，用于公共安全、救灾救援、教育娱乐的服务机器人需求增速逐渐加快		
			社会进入加速老龄化阶段，全社会对家政服务、养老助残、康复护理机器人的需求增长迅速	
目 标		自主品牌工业机器人国内市场占有率达到50%	自主品牌工业机器人国内市场占有率达到70%以上	
		关键零部件的国产化率达到50%以上	关键零部件的国产化率达到80%以上	
		产品平均无故障时间（MTBF）达到8万小时	产品平均无故障时间达到国际先进水平	
		自主品牌服务机器人实现实现小批量生产及应用	自主品牌服务机器人实现产业化及普及应用	自主品牌服务机器人达到国际先进水平
		培育出2-3家年产万台以上、产值规模超过百亿元、具有国际竞争力的龙头企业	有1-2家企业进入世界前五名行列	
		速度、载荷、精度、自重比等主要技术指标达到国外同类水平		主要技术指标达到国际一流水平
		新一代机器人的核心技术取得突破	新一代机器人样机研制成功，进入示范应用	新一代机器人实现小批量生产及应用
重点产品	工业机器人	国产焊接机器人在汽车、工程机械、船舶、石化、农机等行业大批量应用		国产智能焊接机器人实现产业化并批量应用
		国产搬运机器人在汽车、家电、食品、医药、物流等行业大批量应用	国产搬运机器人实现柔性控制与碰撞检测及人机协同作业；整体小型化、灵活化	
		国产喷涂机器人在汽车、家俱、船舶、航空航天等行业实现大批量应用	国产喷涂机器人具备实时检测、自主规划喷涂路径的能力；能够实现工件的无人化、绿色化涂装生产	
		国产加工机器人在航空、汽车、木制品、塑料制品、食品等领域实现批量应用	国产智能加工机器人在制造业实现打磨、抛光、钻削、铣削等工序的广泛应用	
		国产装配机器人在汽车、电气、电子等行业市场占有率达到30%	智能装配、协作装配技术取得突破；国产装配机器人在航空航天、仪器制造等行业市场占有率达到60%	
		国产检测机器人在食品、汽车、航空航天等领域大批量应用		国产检测机器人应用领域进一步拓展
		国产洁净机器人在IC装备、平板显示领域国内市场占有率达到70%	国产洁净机械手及成套洁净传输生产线占国内市场的一半以上	
	服务机器人	家庭服务机器人具备家居环境自主认知、自主移动、与互联网及“智能家电”相结合、指令语言理解等功能，可代替人从事简单家务劳动	家庭服务机器人具备移动与多功能手臂结合、灵活安全作业、自主学习、初步自然语言理解等功能，可代替人从事比较复杂的家务劳动	家庭服务机器人具备类人操作、与人共用工具、与人自然交互（语言）等功能
		智能轮椅、护理床等养老助残机器人化逐步产品化，并实现示范应用	多功能手臂与智能轮椅、护理床等结合，可实现生理信号监测、初步自然语言理解，逐步实现规模化应用，可穿戴智能假肢开始实用化	实现完全可穿戴行为辅助、人意图理解、与人自然交互等功能，养老助残机器人逐步产业化
		通用机械臂与多自由度灵巧手术工具结合，仿人结构的上肢、下肢、手指康复机器人等医疗康复机器人逐步产品化	体内手术工具向软体、多手指方向发展，体内靶向移动、操作机器人开始临床应用，生机电融合的康复机器人开始临床应用	软体、多手指、体内移动操作机器人开始产业化，医疗机器人与医学影像系统相融合，医疗康复机器人向个性化自主操作发展
		无人机实现预编程控制、动平台起降、静态环境适应能力，以及小型化、大载荷能力	无人机自主能力进一步提高，动态环境适应能力增强，仿生飞行器取得明显进展	无人机环境适应能力进一步增强，可实现多机合作，仿生飞行器开始产业化、规模化应用
关键零部件	减速器	机器人用摆线针轮减速器		
		精密谐波减速器		
			新型传动（驱动）机构和新型驱动材料	
	控制器	基于总线的高性能机器人控制器		
		网络化、智能型机器人控制器		
	伺服系统	高精度伺服电机		
		高功率密度伺服电机		
		高性能机器人专用伺服驱动器		
		直驱电机		
	传感器	关节位置、力矩传感器		
		视觉传感器、触觉传感器、六维力/力矩传感器、光敏传感器		
		高频测量传感器、激光位移传感器		


关键共性技术
整机技术
目标：机器人系列化、批量化设计制造
本体优化设计及性能评估技术，机器人系列化标准化设计技术，机器人批量化生产制造技术，快速标定和误差修正技术，机器人系统软件平台
目标：可与人协作的机器人本体
高速高精度控制及性能提升技术，冗余自由度机器人规划及控制技术，人机友好交互技术，机器人全生命周期可靠性技术，机器人动力学建模及实时解算，通用的机器人操作系统平台软件
目标：低成本、人机协作安全的机器人本体
面向紧密人机合作的高负载自重比/轻量化机器人本体技术，面向人机安全协作的柔顺关节技术，本质安全的机器人本体技术
部件技术
目标：机器人关键部件性能达到国际水平
高性能高功率密度伺服电机设计制造技术，高性能/高精度机器人专用减速器设计制造技术，开放式/跨平台机器人专用控制（软件）技术，变负载高性能伺服控制技术
目标：与人协作型机器人的关键部件
高集成度一体化关节设计技术，多自由度集成关节技术，轻型液压驱动技术，三维视觉感知与建模技术，多轴驱控一体化和多轴驱动模块技术
目标：新型机器人关键部件
人工皮肤传感器技术，人工肌肉驱动技术，肌电/脑电人体意图传感技术，新仿生材料、智能驱动材料，复杂物体抓持的仿生灵巧手的构型设计与操作技术
集成应用技术
目标：机器人任务重构、偏差自适应调整
基于智能传感器的智能控制技术，远程故障诊断及维护技术，基于末端力检测的力控制及应用技术，快速编程和智能示教技术，生产线快速标定技术，视觉识别/定位及应用技术，离线编程与仿真技术，
目标：机器人在人机共存环境中完成复杂任务
非结构环境下的移动作业机器人导航/定位技术，动态不确定环境下机器人操作定位误差补偿技术，人机友好交互技术，人体运动意图识别，多机器人网络化/集群协调控制技术，机器人本体柔顺性控制技术，机器人反应式行为在线重规划，人机协调力控制技术，人机安全保障技术
目标：机器人融入人类生活
人机自然交互技术，机器人自主学习人类技能技术，机器人智能自主发育技术，机器人认知与学习等智能控制技术
应用示范工程
机器人关键零部件研制及应用示范工程
工业机器人核心技术研究及行业应用示范工程
多工业机器人协作技术研究及应用示范工程
智能机器人技术研究及应用示范工程
医疗、康复、养老、助残、救援等服务机器人技术研究及应用示范工程
机器人人才培养示范工程
战略支撑与保障建议
编制机器人专项规划，落实专项行动计划，支持机器人技术创新和产业化能力建设
建议建立国家机器人协同创新中心
建立国家机器人检测与评定中心，推广机器人评价、认证体系
加强机器人设计、制造标准及重点应用标准的研究制订

III. Aerospace equipment

3.1 Aircraft

Aircraft are aerial means of transport serving the national economy, social development and people's transportation. They mainly include mainline aircraft, regional aircraft, general aviation aircraft, helicopters and drones.

3.1.1 Demand

The growing demand for air transport and general aviation services has created a vast market for the development of aircraft manufacturing. It is expected that in the next decade, the world will need a total of 1.5 million mainline aircraft.

12,000 aircraft, 0.27 million regional aircraft, 18,300 general aviation aircraft, helicopters

At the same time, with the reform of China's airspace management and the opening up of low-altitude airspace, the domestic market for general aviation, helicopters and drones is huge.

3.1.2 Objectives

By 2020, the annual revenue of the civil aircraft industry will exceed 100 billion yuan; the development, production and delivery of 150-seat single-aisle mainline aircraft will be completed; the delivery of mainline aircraft will account for more than 5% of the domestic market share, the delivery of turboprop regional aircraft will account for 5-10% of the global market share, and the delivery of general aviation aircraft and helicopters will account for 20% and 20% of the global market share, respectively.

10%.

By 2025, the annual revenue of the civil aircraft industry will exceed RMB 200 billion; the development, production and delivery of 280-seat class twin-aisle mainline aircraft will be completed; the delivery of mainline aircraft will account for more than 10% of the domestic market share, and the delivery of turboprop regional aircraft will account for 10% to 10% of the global market share.

20% of the global market share for utility aircraft and helicopter deliveries reached 40% and
15%.

3.1.3 Development focus

1. Key products

(1) Mainline aircraft

--Single-aisle mainline aircraft

130-200 seat class, single-aisle, high subsonic, short to medium range transport aircraft.

--Twin-aisle mainline aircraft

250-350 seat class, twin-aisle, high subsonic, medium to long range transport aircraft.

(2) Regional aircraft

--Advanced turbofan regional aircraft

70-120 seat class short and medium range turbofan transport aircraft.

--Turboprop regional aircraft

50-60 seat class short-haul turboprop transport aircraft.

--Advanced 70-seat turboprop regional aircraft

70-seat class short-haul turboprop transport aircraft.

(3) General Purpose Aircraft

--Business Aircraft

Large, medium and small turbofan business jets, medium and light (turboprop.

--Multipurpose aircraft

With a maximum take-off weight of around 1 tonne, it is used for training, recreational and aerial mapping operations.

--Special Aircraft

The maximum take-off weight is around 50 tonnes and is used for rescue/fire-fighting, forest protection, water transport and other operations.

--Enhancement of existing products

The existing products, including the Transport-12F, have undergone improvements such as cockpit pressurisation, aerodynamic optimisation, engine replacement, increase in maximum cruise speed and lift, and comfort enhancement.

(4) Helicopters

--Heavy Helicopter

With a maximum take-off weight of 30-40 tonnes, it is mainly used for fire-fighting, lifting and installation of equipment and materials, emergency rescue and land/sea law enforcement.

--Advanced Medium Utility Helicopter

Maximum take-off weight 7 tons, 16 passengers.

--Advanced light twin-engine helicopter

Maximum take-off weight 3-4 tonnes, 8 passengers.

--Enhancement of existing products

Comprehensive improvements to existing products such as 1-ton light piston single-engine helicopters, 2-ton light civil helicopters, 4-ton twin-engine multi-purpose helicopters and 13-ton large civil transport helicopters were implemented to improve service life, reliability and product quality.

(5) Drones

Develop different levels of fixed-wing and rotary-wing UAVs, break through key technologies such as miniature mission loads, autonomous navigation, adaptive control, sensing and avoidance, highly reliable communication, airworthiness and airspace management, and gradually improve the reliability and safety level of UAVs to meet the needs of various applications such as border patrol, security and anti-terrorism, agriculture and forestry operations, mapping, pipeline monitoring and maintenance, emergency rescue, photography and entertainment.

2. Key common technologies

(1) Integrated Design and Verification Technology for Green Vehicles

The use of multidisciplinary optimisation and new concept layouts for efficient and environmentally friendly aircraft design and verification, to achieve future low fuel consumption, low emissions and low noise green flight.

(2) Research on the design, manufacture and verification technology of typical main structures of composite materials for aircraft and breakthroughs in the application of thermoset resin matrix composites to main structures such as wings and fuselages

Design analysis, manufacturing processes, test verification and other key technologies required for the structure.

（3） Large-scale lightweight monolithic and high-strength metal structure manufacturing technology

With the fuselage wall panels, wing wall panels and landing gear, frame beam ribs and other components as the main targets, the focus is on research into the manufacturing process of titanium alloys, aluminium alloys, aluminium-lithium alloys, high-strength steels and other metal structures.

（4） Highly comfortable helicopter dynamics design and verification techniques

Through comprehensive analysis and design of dynamic loads, drive paths and airframe response, the vibration levels of the helicopter are reduced and the reliability and comfort of the helicopter is improved.

（5） Integrated integration of health monitoring, intelligent maintenance systems and customer product support

With technology

A comprehensive health management system integrating flight status data, component failure data, life expectancy, fleet management and ground operations for individual aircraft and fleets.

3.1.4 Application demonstration projects

1. Web-based design/manufacturing/service integration demonstration project

On the basis of improving the existing off-site collaborative design and manufacturing platform, different levels of design optimisation and whole-life product health management centres with big data analysis/cloud computing processing capabilities will be established to realise the management of the whole manufacturing process and whole life of use.

2. Aircraft Intelligent Manufacturing Demonstration Project

Carry out demonstration of integrated application of intelligent manufacturing technology for aircraft and helicopters, enhance intelligence, and build a demonstration line for intelligent processing and assembly of typical large components by 2020; build a number of demonstration workshops for intelligent production of large components by 2025.

3. Demonstration project for efficient and low-cost manufacturing of large composite parts

Carry out the development, application and test integration demonstration of efficient and low-cost manufacturing processes and equipment for large composite fuselages and wings to form advanced development and production capabilities.

4. Civil Aircraft Technology Integration Flight Verification Application Demonstration Project

To build an integrated flight verification platform for civil aircraft technology, master the integrated assessment and flight verification methods for civil aircraft technology, accelerate the maturity of civil aircraft technology and develop China's civil aircraft integrated verification capability.

5. Civil Aircraft Demonstration Operation Project

To "make airlines want to use them, flight crews want to fly them and passengers want to sit on them"

The principle is to carry out demonstration operations of mainline aircraft, regional aircraft and general aviation aircraft respectively and Design optimisation to continually improve product performance, daily utilisation and sign-on rates to improve route adaptability and competitiveness.

3.1.5 Strategic Support and Assurance

1. Strengthening civil aircraft standards and regulations and airworthiness capacity building

Establish a market-oriented and enterprise-oriented open civil aircraft standard specification system, vigorously promote innovation in civil aviation standardization, and focus on solving the core technical standards and basic standards for civil aircraft development; improve airworthiness validation and verification capabilities, increase the number of validation agencies and personnel, improve validation and verification technologies, expand international bilateral airworthiness, and meet the development needs of the civil aircraft industry.

2. Formulation of a general aviation development platform and establishment of a joint industry association

Formulate an outline of China's general aviation aircraft development and supporting policies, and step up efforts to promote the development of the domestic general aviation aircraft industry; at the same time, establish a general aviation manufacturing association to guide the rapid and healthy development of the general aviation industry.

3. Support the construction of a marketing and service guarantee system for domestic civil aircraft

Build a complete marketing and service guarantee system for civil aircraft, enhance the international competitiveness of China's civil aircraft industry and expand foreign exports.

4. Encourage the development of home-made special key process equipment to improve the guarantee capability

Formulate development plans for aviation-specific process equipment, focusing on special, critical and unavailable process equipment; implement special policy support for the development of domestic aviation-specific process equipment.


2020年
2025年
2030年
需求
全球将需要干线飞机1.2万架、支线飞机0.27万架、通用飞机1.83万架、直升机1.2万架，总价值约2万亿美元
随着空域开放的不断推进，国内通用飞机、直升机和无人机市场巨大
目标
民用飞机产业年营业收入超过1000亿元
民用飞机产业年营业收入超过2000亿元
150座级单通道干线飞机完成研制和交付
280座级双通道干线飞机完成研制和交付
国产干线飞机交付量占国内市场份额5%以上
国产干线飞机交付量占国内市场份额10%以上
涡桨支线飞机交付量占全球市场份额5～10%
涡桨支线飞机交付量占全球市场份额10～20%
通用飞机交付量占全球市场份额接近20%
通用飞机交付量占全球市场份额接近40%
直升机交付量占全球市场份额接近10%
直升机交付量占全球市场份额接近15%
重点产品
干线飞机
150座级单通道飞机基本型完成研制交付
150座级单通道飞机实现批量交付和系列化发展
根据市场需求改型升级或开展新一代研制
280座级双通道飞机基本型完成研制交付
280座级双通道飞机实现批量交付和系列化发展
支线飞机
先进涡扇支线飞机实现批量交付和系列化发展
先进涡扇支线飞机精品型完成研制
视情开展新一代涡扇支线飞机研制
涡桨支线飞机实现批量交付
涡桨支线飞机市场适应性改型和系列化发展
先进70座级涡桨支线飞机完成研制交付
先进70座级涡桨支线飞机实现批量交付
先进70座级涡桨支线飞机改型和系列化发展
通用飞机
大型涡扇商务机完成研制交付
大型涡扇商务机改进改型
轻型涡桨商务机交付并批产
细分市场再定位，启动适应性改型和系列化发展
先进初级教练机完成研制交付
产业化发展，拓展私人客户
大型水陆两栖飞机交付
大型水陆两栖飞机系列化发展
研制具有3米抗浪能力的两栖飞机
运12F涡桨增压飞机研制交付
8吨级涡桨增压飞机改进改型
直升机
重型直升机完成研制交付
重型直升机改进改型和系列化发展
先进轻型双发直升机完成研制交付
先进轻型双发直升机实现批量交付
先进轻型双发直升机改进改型
先进中型多用途直升机完成研制交付
先进中型多用途直升机实现批量交付
先进中型多用途直升机改进改型
1吨级、2吨级、4吨级、13吨级现有产品综合改进改型
无人机
无人机在边境巡逻、治安反恐、农林作业、地图测绘、管线监测与维修、应急救援、摄影娱乐等领域大量应用
关键共性技术
大型飞机机翼综合效率达到波音787水平
民用飞机二氧化碳、氮氧化物排放、噪声等指标满足当时适航标准
完成典型复合材料结构全尺寸试验件的设计、制造和验证
实现大型民机复合材料用量超过50%
建成大型金属结构数字化制造生产线
融合智能化制造理念，进一步提升大型金属结构加工的质量和效率
直升机振动水平在0.1g以下，内部噪声水平在85～90分贝
直升机振动水平在0.05g以下，内部噪声水平在70～80分贝
突破飞行器健康管理瓶颈技术，实现在新研装备上初步应用
提高健康管理的智能化、综合化水平，建立以网络为中心的智能化服务保障体系
应用示范工程
完善异地协同设计/制造平台
建立产品全寿命健康管理中心，实现制造全过程和使用全寿命的管理
建设典型大部件智能加工与装配示范线
建设若干大部件智能生产示范车间
开展复合材料大部件高效低成本制造工艺和装备的开发、应用与试验一体化示范
民用飞机技术集成飞行验证应用示范工程
支线飞机和通用飞机示范运营
干线飞机示范运营
战略支撑与保障建议
建立以市场为导向、以企业为主体的开放式民用飞机标准规范体系，提高适航审定和验证能力，
增加审定机构和人员，拓展国际双边适航
制订通用飞机发展纲要，成立通用飞机制造商协会
建成相对完善的国产民机市场营销和服务保障体系
制订航空专用工艺装备发展规划，对国产航空专用工艺装备研制实行特殊的政策扶持

3.2 Aero engines

The aero-engine industry refers to the integrated industrial cluster of turbofan/turbojet engines, turboshaft/turboprop engines and transmission systems as well as aero-piston engines that integrate research and development, production, maintenance and guarantee services. The aero-engine industry chain is long, covering a wide area, and has a huge driving effect on the national economy and science and technology development.

3.2.1 Demand

Total cumulative global demand for turbofan/turbojet engines to exceed 73,600,000 over the next decade

The total cumulative demand for turboshaft engines exceeds 34,000 units, with a total value of over US$416 billion.

The total cumulative demand for turboprop engines exceeded 16,000 units, with a total value of over US$19 billion.

The total value exceeds US$15 billion; the total cumulative demand for piston engines exceeds 33,000 units, accounting for

More than 60% of the market for through-flight power, with a total value of approximately US$3 billion. Meanwhile, the domestic mainline passenger

The total cumulative market demand for large turbofan engines exceeds 6,000 units, with a total value of over

The opening up of low-altitude airspace will also further stimulate demand for turboshaft, piston and other engines for general aviation aircraft.

3.2.2 Objectives

By 2020, the CJ-1000A will have completed model development; tre 1000kgf class turbofan and 1000kW class turboshaft will have completed demonstration and model development; the aero-piston engine will have achieved industrialisation; some products will have begun to capture the domestic aircraft market and develop the after-sales service market, further expanding China's aero-engine industry.

2025, CJ-1000A in commercial service; 1000kgf class turbofan, 1000kW class

The key products, such as the turboshaft, completed their airworthiness certification; the 5000kW-class turboprop completed its type development. Achieved the first independently developed advanced large civil turbofan engine in domestic commercial service, enabling China's aero engine industry to enter the world's first echelon.

3.2.3 Development focus

1. Key products

（1） Large turbofan engines with large culvert ratios

CJ-1000A turbofan engine for the C919, a domestic mainline passenger aircraft.

Wide-body passenger jet turbofan engine for a joint Russian-Chinese wide-body passenger jet.

（2） Medium / small turbofan / turbojet engines

7000-11000kgf class geared turbofan engines for jet regional aircraft.

5000kgf class turbofan engines for jet regional or business jets.

1000kgf class small turbofan engine for 7-8 seat light business jets.

（3） Medium / high power turboshaft engines

1000kW class turboshaft engine for the new 5 tonne helicopter.

8000kW class high-powered turboshaft engine for future heavy helicopter requirements.

（4） High-powered turboprop engines

5000kW class turboprop engine for future turboprop regional airliners and small to medium sized transport aircraft.

（5） Aero piston engines

200kW aviation piston engine, safe low carbon fuel such as heavy oil and aviation biofuel, power to weight ratio greater than 3, fuel consumption rate not greater than 235g/kWh, direct output piston engine for light utility aircraft and UAVs.

2. Key components

（1） Advanced large culvert ratio fan system

Titanium/resin based composite fan and composite fan magazine in a wide chord swept design with a culvert ratio of >8 and a stage pressure ratio of 1.6.

（2） Advanced Advanced Pressure Ratio High Pressure Compressor

Multi-stage axial high-pressure presses with 9-11 stages and pressure ratios >20.

（3） Advanced low-pollution combustion chamber

Outlet temperature >1700K, meeting ICAO CAEP/8 requirements for COx, UHC, NOx and smoke emissions.

（4） Single crystal/ceramic matrix composite high pressure turbine blades

Single crystal/ceramic matrix composite, temperature resistance >1700K, efficiency >0.91, total expansion ratio >4.8 for class 2.

（5） Advanced Health Management System

Contains condition monitoring, fault diagnosis and handling, fault prediction and life-cycle management to significantly improve mission safety and reliability and reduce life-cycle costs.

（6） Advanced high performance long life transmission system

Contains long life heavy duty bearings, high power reducer and high speed drive system, speed > 20,000 rpm, bearing TBO > 5,000 hours, maximum power transfer > 3,000 kW, maximum power of reducer > 15,000 kW.

（7） Advanced full authority digital electronic control system

Integrated flight/propulsion active control, temperature resistance >220°C, 50%-60% reduction in system cost.

3. Key common technologies

（1）Advanced overall design and verification techniques

Contains advanced aerodynamic overall design and integrated verification technology, integrated flight and development design and verification technology, etc.

（2）Highly efficient high stability margin compression system technology

Contains low noise large size fan/boost stage technology, axial/centrifugal/combined pressuriser technology, high speed propeller/propeller fan system technology, etc.

（3）High performance, low emission combustion chamber technology

Contains high heat capacity annular/reflux combustion chamber technology, ceramic based composite combustion chamber technology, low emission tissue combustion technology, long life flame tube technology, etc.

（4）High load, high efficiency, long life turbine technology

Contains single crystal/ceramic matrix composite turbine blade technology, no guide vane counter-rotating turbine technology, variable speed power/low pressure turbine technology, etc.

（5）Advanced Aero Engine Design/Test/Integrated Maintenance Assurance Technology

Contains advanced information technology, and integrated design/test/manufacturing/maintenance and security platform technology, etc.

（6） Aero-engine key component remanufacturing technology

Contains remanufacturing of key parts such as turbine blades and turbine discs, non-destructive testing, coating recovery technology, remanufacturing/design and manufacturing sharing technology, etc.

3.2.4 Application demonstration projects

1. Aero-engine integrated verification technology application demonstration project

Formation of an aero-engine complete test system, construction of a complete ground test stand, high-altitude test stand, flight test stand and other common platforms to be applied to aero-engine integration verification

Demonstration.

2. Aero-engine Advanced Materials and Manufacturing Application Demonstration Project

Formation of an advanced materials and manufacturing R&D system, construction of R&D and verification systems for green manufacturing, precision manufacturing and intelligent manufacturing of titanium alloys, high-temperature alloys and advanced composite materials, and promotion of their application in the aero-engine industry to meet development cycle and economic affordability needs.

3. Commercial Aero Engine Operation Demonstration Project

Carry out airworthiness certification and operational demonstration of commercial aero engines, continuously improve product performance and safety, and enhance the competitiveness of the aero engine market to meet the needs of airlines and passengers.

4. Aero-engine intelligent production line demonstration project

Using digitalisation, information technology and intelligent technology to upgrade the engine production line, realise digital interaction and collaboration in design and manufacturing, build an intelligent production line for typical aero-engine products, with agile manufacturing and flexible manufacturing capabilities to meet the needs of rapid R&D and intelligent production of aero-engines.

5. Aero-engine key parts remanufacturing demonstration project

The use of advanced surface engineering and other remanufacturing technologies, the implementation of aero-engine turbine blades, turbine discs and other key parts of remanufacturing, the establishment of aero-engine remanufacturing and design and manufacturing of the feedback interaction mechanism, research and development of key special equipment for engine remanufacturing.

3.2.5 Strategic Support and Assurance

1. Strengthen top-level planning for aero-engine development, implement major special projects for aero-engines as soon as possible, and lay the foundation for strategic upgrading of the aero-engine industry.

2. Increase national strategic emerging industries to nurture the aero-engine market, through appropriate

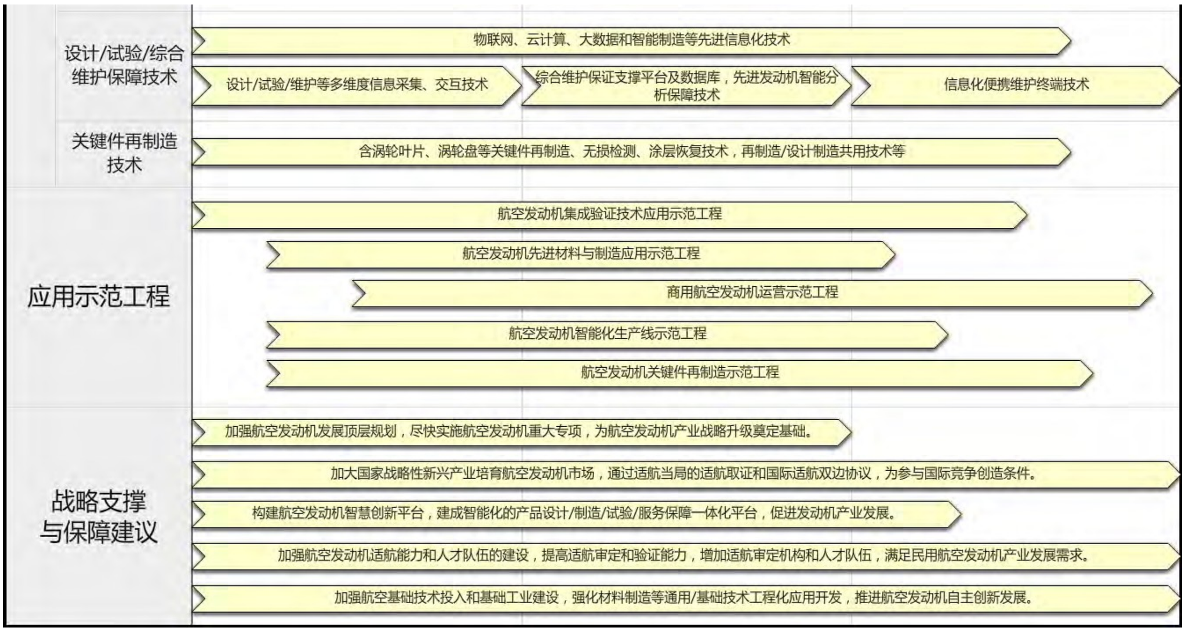
Aviation authorities' airworthiness certification and international airworthiness bilateral agreements create conditions for domestic aero engines to participate in international competition.

3. Build an intelligent innovation platform for aero-engines and an intelligent product design/manufacturing/testing/service guarantee integration platform to promote the development of the engine industry.

4. Strengthen the construction of aero-engine airworthiness capabilities and talent teams, improve airworthiness certification and verification capabilities, and increase the number of airworthiness certification bodies and talent teams to meet the development needs of the civil aero-engine industry.

5. Strengthen the investment in basic aviation technology and basic industrial construction, strengthen the development of general/basic technology engineering applications such as material manufacturing, and promote the development of independent innovation in aviation engines.

		2020年	2025年	2030年
需求		涡扇/涡喷累计需求总量超3.34万台，总值超2000亿美元	涡扇/涡喷累计需求总量超4.02万台，总值超2160亿美元	
		涡轴累计需求总量超1.7万台，总值超94亿美元	涡轴累计需求总量超1.7万台，总值超96亿美元	
		涡桨累计需求总量超8000台，总值超70亿美元	涡桨累计需求总量超8000台，总值超80亿美元	
		航空活塞累计需求总量超1.6万台，总值约15亿美元	航空活塞累计需求总量超1.7万台，占60%通飞动力市场，总值超15亿美元	
		国内干线客机对涡扇发动机累计需求总量超2500台，总值超200亿美元	国内干线客机对涡扇发动机累计需求总量超3500台，总值超300亿美元，低空开放刺激涡轴、活塞需求	
目标		CJ-1000A完成型号研制	CJ-1000A商业服役	
		1000kgf级涡扇、1000kW级涡轴等适航取证	1000kgf级涡扇、1000kW级涡轴等投入市场	
		航空活塞产业化发展	5000kW级涡桨型号研制	
		部分产品抢占国内市场，开拓售后服务市场	首型自主研制大型民用涡扇国内服役	
		进一步扩大中国航空发动机产业	中国航空发动机产业进入世界第一梯队	
重点产品	大涵道比大型涡扇发动机	CJ-1000A型号研制	CJ-1000A商业运营	CJ-1000A改型发展
		CJ-2000关键技术研究	CJ-2000验证机研制	CJ-2000型号研制
	中小型涡扇/涡喷发动机	7000~11000kgf级GTF验证机研制	7000~11000kgf级GTF型号研制	
		5000kgf级涡扇验证机研制	5000kgf级涡扇型号研制	5000kgf级涡扇投入市场并改型发展
		1000kgf级涡扇适航取证	1000kgf级涡扇投入市场并改进发展	
	中/大功率涡轴发动机	1000kW级涡轴适航取证	1000kW级涡轴投入市场并改进发展	
		8000kW涡轴验证机研制	8000kW涡轴验证机研制	
	大功率涡桨发动机	5000kW级涡桨验证机研制	5000kW级涡桨适航取证	投入市场并改型发展
	航空活塞发动机	200kW活塞适航取证	200kW活塞系列发展，形成产业规模	
关键零部件		钛合金风扇叶片部件和整机验证	树脂基复合材料风扇叶片部件和整机验证	树脂基复合材料风扇系统验证
		10级压比超过20高压压气机整机验证	11级压比超过25高压压气机部件验证	
		先进低污染燃烧室部件和整机验证	陶瓷基复合材料燃烧室部件验证	陶瓷基复合材料燃烧室部件服役
		镍基单晶合金高压涡轮叶片整机验证	陶瓷基复合材料高压涡轮叶片部件验证	陶瓷基复合材料高压涡轮叶片整机验证
		先进健康管理系统整机验证	主动综合控制的健康管理系统系统和整机验证	
		15000kW减速器和1200小时TBO传动部件验证	15000kW减速器和1200小时TBO传动系统整机验证	20000kW减速器和5000小时TBO传动系统整机验证
		第三代FADEC整机验证	突破分布式控制系统关键技术	分布式控制系统完成系统验证
关键共性技术	先进总体设计及验证技术	先进燃气涡轮发动机总体设计与集成验证	GTF等新型发动机总体设计与集成验证	新概念动力总体设计与集成验证
		先进涡扇/涡轴/涡桨飞/发一体化设计与验证	下一代航空发动机飞/发一体化设计与验证	
	高效高稳定裕度压缩系统技术	涵道比8一级低噪声大尺寸风扇/增压级技术	涵道比10一级低噪声大尺寸风扇/增压级技术	
		轴流(10级)/离心(2级)压气机技术	轴流(10级)/组合压气机技术	10级以上轴流压气机技术
		活塞发动机高速螺旋桨技术	涡桨发动机高速螺旋桨技术	先进桨扇系统技术
	高性能、低排放燃烧室技术	高温升环形/回流燃烧室技术	低排放组织燃烧技术	长寿命火焰筒技术
	高负荷、高效率、长寿命涡轮技术	大功率气冷单晶涡轮叶片技术	复合冷却单晶涡轮叶片技术	陶瓷基复合材料涡轮叶片技术
		含导叶涡轮技术	无导叶对转涡轮技术	
		定转速动力/低压涡轮技术	变转速动力/低压涡轮技术	


设计/试验/综合维护保障技术
物联网、云计算、大数据和智能制造等先进信息化技术
设计/试验/维护等多维度信息采集、交互技术
综合维护保证支撑平台及数据库，先进发动机智能分析保障技术
信息化便携维护终端技术
关键件再制造技术
含涡轮叶片、涡轮盘等关键件再制造、无损检测、涂层恢复技术，再制造/设计制造共用技术等
应用示范工程
航空发动机集成验证技术应用示范工程
航空发动机先进材料与制造应用示范工程
商用航空发动机运营示范工程
航空发动机智能化生产线示范工程
航空发动机关键件再制造示范工程
战略支撑与保障建议
加强航空发动机发展顶层规划，尽快实施航空发动机重大专项，为航空发动机产业战略升级奠定基础。
加大国家战略性新兴产业培育航空发动机市场，通过适航当局的适航取证和国际适航双边协议，为参与国际竞争创造条件。
构建航空发动机智慧创新平台，建成智能化的产品设计/制造/试验/服务保障一体化平台，促进发动机产业发展。
加强航空发动机适航能力和人才队伍的建设，提高适航审定和验证能力，增加适航审定机构和人才队伍，满足民用航空发动机产业发展需求。
加强航空基础技术投入和基础工业建设，强化材料制造等通用/基础技术工程化应用开发，推进航空发动机自主创新发展。

3.3 Airborne Equipment and Systems

Aviation airborne equipment and systems and supporting facilities include avionics, flight control and aviomechanical systems, as well as aviation materials and components and other supporting industries. Aviation airborne equipment and systems and supporting facilities are an important guarantee for improving the performance of domestic aircraft, achieving independent innovation in the aviation industry and forming the competitiveness of the aviation industry.

3.3.1 Demand

There is a strong demand for airborne equipment and systems and support for various types of aircraft and helicopters in research, production and service at home and abroad. In the next ten years, the output value of airborne equipment and systems for dry and regional passenger aircraft will reach RMB 800 billion.

3.3.2 Objectives

By 2020, we will have established a three-tier system of aerospace equipment and systems, including systems, equipment and components, and a long-term, stable, high-quality and reliable system of aerospace materials and components and a complete industrial chain.

By 2025, we will achieve a 30% market share of domestic dry and regional aircraft airborne products; a 50% market share of general aviation airborne products; cultivate a number of system-level suppliers in key aviation airborne equipment and systems; and achieve independent assurance of aviation materials and components.

3.3.3 Development focus

1. Key products

(1) Avionics

-Integrated processing and networking systems

It is equipped with comprehensive processing and reconfiguration functions for on-board systems with more than 150 application partitions; it has a variety of information intelligent collection and output functions, and the remote interface unit can be dynamically configured; it has high-speed security network functions and realizes open network architecture.

-Integrated Navigation System

Includes inertial reference unit for atmospheric data with satellite navigation and radio navigation functions.

--Cockpit Display and Control System

It is equipped with flight, navigation, engine parameters and aircraft status information display and human-machine interaction, and provides crew alert functions.

--Airborne maintenance systems

Condition monitoring, fault detection and isolation and trend analysis are available, and the health assessment model has a prediction fidelity of no less than 80%.

--Communication systems

Features VHF communication, HF communication, selective calling, satellite communication, data link communication, audio synthesis, radio tuning, emergency locator transmission and cockpit door monitoring.

(2) Flight control systems

--Main flight control system

Active control function and mastery of active side stick technology; electric actuators on some of the manoeuvring surfaces; ability to achieve integrated main flight control, automatic flight and high lift integration systems.

--High lift system

Realisation of advanced high-lift systems equipped with domestic dry and regional passenger aircraft; development of high-lift systems with new technologies such as distributed drive and adaptive.

(3) Electromechanical systems

--Hydraulic systems

Realisation of a 35MPa based high pressure system design for the application of distributed hydraulic systems for domestic civil aircraft.

--Electricity systems

Realisation of a wide frequency AC power supply system with distributed automatic power distribution and single channel power levels greater than 250kVA.

--Circuit control systems

Realisation of three-wheeled boosted high-pressure dewatering refrigeration system equipped with domestic transporters, mastering the technology of four-wheeled boosted loop control system and developing an electric loop control system.

--Auxiliary power systems

Integrated starting/generation function for multi-electric combined power unit installation applications.

--Cabin equipment

Knowledge of water/wastewater system pressure supply and vacuum flushing technology for water/wastewater systems

The system is installed on civilian aircraft.

--Freight systems

Realisation of an integrated system for cargo-type aircraft and a sliding carpet system for the cargo hold of passenger-type aircraft.

2. Aerospace key components

（1） Display components

Development of highly reliable, high-capacity displays and organic light-emitting diode displays suitable for airborne conditions; development and application of new airborne display components such as digital image sources.

（2） Inertial Devices

Developed high-precision resonant photonic crystal fibre-optic gyro; carried out research on cold atomic gyro technology.

（3） High Power Power Devices

Engineering of 20kW high power brushless motors and 20kW switched reluctance motors; mastery of packaging, testing and screening techniques for silicon carbide diodes and JFET/MOSFET chips.

（4） Aerospace-specific sensors

Improve the monitoring accuracy and reliability of aviation sensors for oil, gas, temperature and pressure; develop sensors based on new sensitive materials, new encapsulation materials, new conductive materials and other new materials.

（5） Intelligent skinned microelectromechanical systems

Relevant MEMS technologies for the need of flexible wings and smart skins

Research and

integration

verification. 3.

Key common

technologies

（1） General design technology for avionics systems

Includes requirements analysis and definition of avionics systems for civil aircraft, avionics concept solutions for future large passenger aircraft, and a model-driven avionics automation design platform.

（2） Integrated Modular Avionics (IMA) technology

This includes the architecture design of integrated modular avionics systems, the evaluation and simulation of modular avionics systems, the principle prototype of integrated modular avionics systems, and the demonstration and validation techniques for IMA-oriented integrated airborne processing and networking systems.

（3） Integrated Flight Control System Technology

This includes main flight control, automatic flight control, high lift integrated design and verification techniques, flight control computer partitioning and isolation techniques, and advanced control law design techniques.

（4） Electromechanical systems technology in multi-electric systems

This includes power supply systems and specifications adapted to multi-electric aircraft, highly reliable and fault-tolerant power distribution technologies, auxiliary power system technologies under multi-electric systems, green electric taxiing technologies, and low energy fault-tolerant electromechanical actuation technologies.

（5） Non-propulsion energy system technology for civil aircraft

This includes full aircraft energy distribution and optimisation techniques, non-propulsion energy system architecture solutions, and civil aircraft non-propulsion energy system modelling and simulation techniques.

3.3.4 Application demonstration projects

1. Demonstration Project of Intelligent Manufacturing of Airborne Equipment and Systems

By 2018, we will build an integrated intelligent manufacturing system with multiple types of production units demonstrated by the backbone units of avionics and electromechanical systems; by 2025, we will extend the system to 40~50 enterprises and institutions, so as to achieve a manufacturing capability comparable to that of mainstream international aviation system suppliers.

2. Demonstration Project for the Application of Integrated Verification Technology for Airborne Systems

Build an aviation airborne system integration verification platform, break through the aviation airborne system architecture organization consistency and conformity assessment technology, master the aviation airborne system comprehensive assessment and verification method, realize the aviation airborne system and various technologies collaborative verification, and form China's aircraft aviation airborne system integration capability.

3. Demonstration Project of Green Manufacturing Technology Application for Aviation Airborne Equipment and Systems

In response to national environmental protection requirements, we will carry out analysis and application research on green manufacturing technologies to replace traditional manufacturing technologies that are toxic, harmful, highly polluting and energy-intensive, in order to guarantee the construction of a "resource-saving and environment-friendly" enterprise.

3.3.5 Strategic Support and Assurance

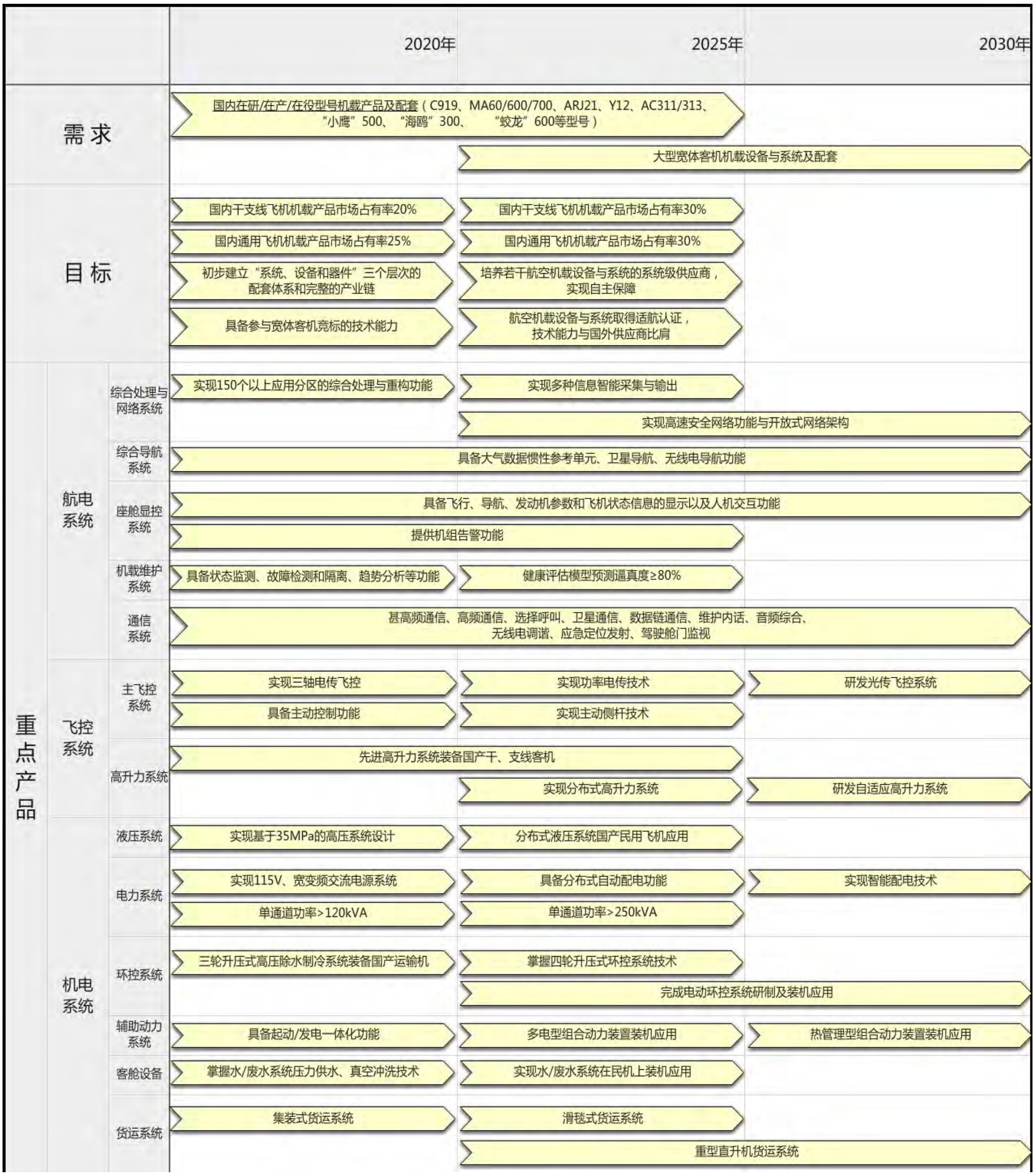
1. Proposal to establish a national key laboratory for airborne equipment and systems

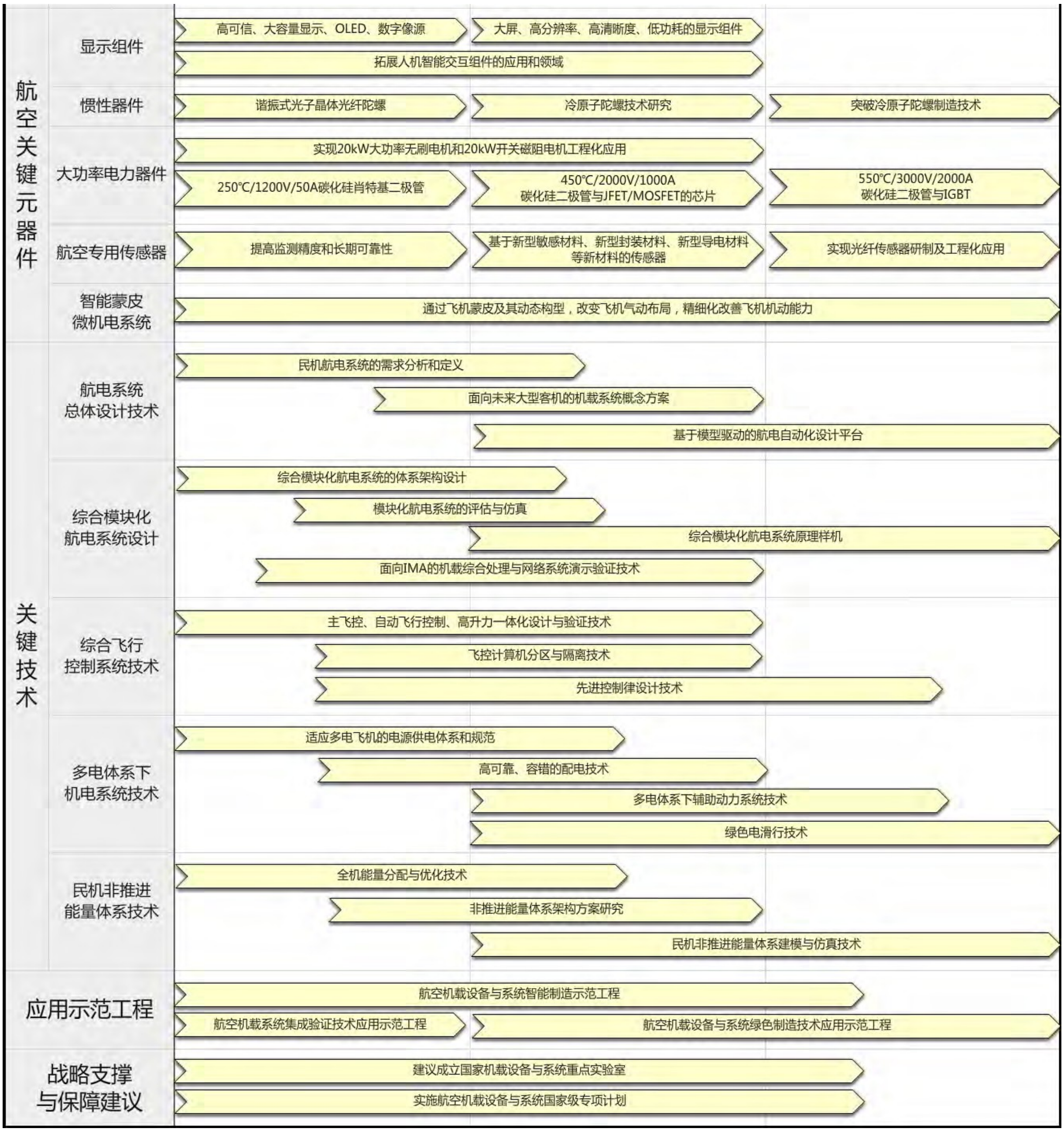
Through the Key Laboratory of Airborne Equipment and Systems, we will increase investment, strengthen basic research and advance research on key technologies, achieve technological leapfrogging and comprehensively enhance the technological capability of China's aviation airborne equipment and systems.

2. Implementation of a national special programme for aviation airborne equipment and systems

Strengthen aviation airborne equipment through the implementation of a national special program for airborne equipment and systems

It will also develop airborne systems that meet domestic and international airworthiness regulations, and nurture system-level suppliers to provide system-level shelf products for international and domestic civil aircraft.





航空关键元器件
显示组件
高可信、大容量显示、OLED、数字像源
大屏、高分辨率、高清晰度、低功耗的显示组件
拓展人机智能交互组件的应用和领域
惯性器件
谐振式光子晶体光纤陀螺
冷原子陀螺技术研究
突破冷原子陀螺制造技术
大功率电力器件
实现20kW大功率无刷电机和20kW开关磁阻电机工程化应用
250℃/1200V/50A碳化硅肖特基二极管
450℃/2000V/1000A
碳化硅二极管与JFET/MOSFET的芯片
550℃/3000V/2000A
碳化硅二极管与IGBT
航空专用传感器
提高监测精度和长期可靠性
基于新型敏感材料、新型封装材料、新型导电材料
等新材料的传感器
实现光纤传感器研制及工程化应用
智能蒙皮
微机电系统
通过飞机蒙皮及其动态构型，改变飞机气动布局，精细化改善飞机机动能力
关键技术
航电系统
总体设计技术
民机航电系统的需求分析和定义
面向未来大型客机的机载系统概念方案
基于模型驱动的航电自动化设计平台
综合模块化
航电系统设计
综合模块化航电系统的体系架构设计
模块化航电系统的评估与仿真
综合模块化航电系统原理样机
面向IMA的机载综合处理与网络系统演示验证技术
综合飞行
控制系统技术
主飞控、自动飞行控制、高升力一体化设计与验证技术
飞控计算机分区与隔离技术
先进控制律设计技术
多电体系下
机电系统技术
适应多电飞机的电源供电体系和规范
高可靠、容错的配电技术
多电体系下辅助动力系统技术
绿色电滑行技术
民机非推进
能量体系技术
全机能量分配与优化技术
非推进能量体系架构方案研究
民机非推进能量体系建模与仿真技术
应用示范工程
航空机载设备与系统智能制造示范工程
航空机载系统集成验证技术应用示范工程
航空机载设备与系统绿色制造技术应用示范工程
战略支撑
与保障建议
建议成立国家机载设备与系统重点实验室
实施航空机载设备与系统国家级专项计划

3.4 Aerospace equipment

Space equipment mainly refers to launch vehicles, satellites, spacecraft, deep space probes and other space vehicles, as well as related ground equipment. The level of space equipment is the core symbol of a country's space capability, and is also one of the important symbols to measure the country's comprehensive national power.

3.4.1 Demand

The development of space is a matter of national strategic interests and security, satellite applications have become an indispensable means of national innovation management, protection of resources and environment, provision of universal information services and cultivation of new industries, the output value of satellite applications in China exceeded 100 billion yuan in 2013, and is expected to reach 500 billion yuan in 2020 and nearly 1 trillion yuan in 2025. Building a moderately prosperous society and an innovative country has put forward a higher and broader demand for the development of advanced space equipment to guarantee access to space and the ability to explore and use space resources.

3.4.2 Objectives

By 2020, a new generation of launch vehicles will be formed, a national civil space infrastructure with complete main functions will be basically built to meet the main business needs of China in various fields, the three-step task of manned spaceflight and lunar exploration projects will be completed, the rate of independent guarantee of space information applications will reach over 60%, and a more complete satellite and application industry chain will be formed.

By 2025, an efficient, safe and adaptable space transportation system will be built, a national civil space infrastructure with a reasonable layout, global coverage and efficient operation will be established, a long-term stable and efficient space application service system will be formed, interplanetary exploration capabilities will be available, the autonomous guarantee rate of space information applications will reach 80%, and the industrial development will reach an international advanced level.

3.4.3 Development focus

1. Key products and major space projects

（1）Launch vehicles

The development of a new generation of non-toxic and non-polluting Long March series of launch vehicles will be completed, the first flight of the Long March 5 launch vehicle will be realized in 2016, the development of a new generation of medium-sized launch vehicles will be completed around 2020, a breakthrough in key technologies of heavy launch vehicles will be made, and the ground test verification of heavy launch vehicles will be completed in 2025 to enhance China's ability to enter space independently.

（2）National civil space infrastructure

To build a national civil space infrastructure consisting of satellite remote sensing systems, satellite communication and broadcasting systems, satellite navigation and positioning systems and other integrated systems in heaven and earth, which are independent and open, safe and reliable, and operate continuously and stably for a long period of time.

The satellite remote sensing system focuses on the development of three satellite series: land observation, ocean observation and atmospheric observation, gradually forming a comprehensive and efficient global observation capability with a reasonable configuration of high, medium and low spatial resolutions and an optimal combination of multiple observation means.

The satellite communication broadcasting system develops three satellite series: fixed communication broadcasting, mobile communication broadcasting and data relay, gradually covering major regions of the world and integrating with terrestrial communication networks.

On the basis of the Beidou regional navigation system, the satellite navigation and positioning system will continue to launch and build the Beidou global satellite navigation system to form a global service capability.

（3） Space Broadband Internet

Build a space-based backbone transmission network, a space-based mobile broadband access network and a terrestrial node network, and develop application terminals to form a network interconnection, global coverage, broadband services and mobile

Guaranteed satellite communication systems, with terrestrial broadband networks, fifth generation mobile communication systems, etc. Interconnection and integration, the formation of China's independent integrated information network of air, sky and earth.

（4） In-orbit maintenance and service systems

Construction of an in-orbit service and maintenance system, forming the capacity for orbital rescue, fault repair, in-orbit assembly and processing.

（5） Manned Spaceflight and Lunar Exploration Project

Promote manned spaceflight and lunar exploration projects. According to the "three-step" strategy for manned spaceflight, the construction of a space station will be initially completed around 2020; according to the three-phase project plan for the lunar exploration project, the lunar sampling return vehicle will be developed and the lunar sampling return will be realized around 2020.

Carry out subsequent programme demonstration and engineering implementation of manned spaceflight and lunar exploration projects. Complete the construction of space stations and fully master the construction and operation, maintenance and expansion technologies of large space facilities. Develop a new generation of partially reusable, low-cost manned transportation systems to and from heaven and earth, enhance core capabilities such as manned access to space and space services, and promote the commercialisation of the exploitation of space resources.

（6） Deep Space Exploration

It will develop deep space probes, establish a deep space exploration engineering system, focus on Mars exploration, and gradually implement exploration missions for asteroids and the Jupiter system, and achieve Mars landing and survey exploration in 2021.

2. Key technologies

（1） High Thrust Rocket Engines and Heavy Lift Vehicle Technology

Breakthroughs in large thrust rocket engines, overall design of heavy launch vehicles, large diameter arrows

A series of major key technologies such as body structure development and large launch vehicle test verification.

（2） Integrated Sky-Terrestrial Systems and Networking Technology

Develop key technologies such as integrated system design and integration between heaven and earth, constellation networking, satellite formation flight, satellite payload integration, seamless connection between satellite networks and ground networks, and high-capacity space links.

（3） Long life, high reliability and high positioning accuracy advanced satellite platform technology

Breakthroughs in high stability, high positioning accuracy, large carrying capacity and strong agile remote sensing satellite platform technology, high power, large capacity and long life advanced communication and broadcasting satellite platform technology, development of advanced agile platform, super quiet platform, next generation large geosynchronous orbit public platform, high reliable all-electric propulsion platform, etc.

（4） High performance, new payload technology

The development of high-resolution, high-precision, highly reliable optical, microwave, laser and integrated detection and other remote sensing payload technologies, high-power, large antenna and multi-beam advanced satellite communication payload technologies, high-precision new navigation satellite payloads and autonomous orbiting technologies, as well as other new payload technologies such as advanced payloads for deep space exploration.

（5） Key technologies for human spaceflight and in-orbit maintenance and services

Breakthroughs in key technologies such as long-term healthy survival and efficient work of astronauts in orbit, construction of near-Earth space station assemblies, 3D printing of spacecraft components in orbit, intelligent robots in space, human-machine collaboration in space facility construction and in-orbit maintenance services.

（6） Key technologies for deep space exploration

Develop key technologies for deep space exploration such as interplanetary orbit design, deep space measurement and control communications, high-precision autonomous navigation and control, high-speed re-entry mini-returner, high-efficiency energy and propulsion technologies, and special space environment adaptation and testing technologies for planetary exploration.

3. Application demonstration projects

To carry out multi-level demonstrations of comprehensive applications of satellite remote sensing, communication and navigation in industry, region, industrialisation, internationalisation and scientific and technological development, to strengthen the sharing of spatial information resources and the integration of applications with new-generation information technology, and to actively promote the comprehensive application of spatial information.

1. Demonstration project of comprehensive satellite applications in the field of resource environment and ecological protection. To provide timely and accurate space information services for dynamic monitoring and early warning of resources and environment, assessment and governance as well as major national surveys.

2. Demonstration project on comprehensive application of disaster prevention, mitigation and emergency response satellites. Focusing on the major tasks of monitoring and early warning, emergency response, comprehensive assessment and post-disaster reconstruction of major natural disasters, the project will carry out comprehensive application demonstrations in typical disaster areas.

3. Demonstration projects on urbanization, regional and cross-

regional satellite applications. Demonstration of comprehensive satellite applications for new urbanisation, regional and main functional area construction, "smart city" and "smart transportation".

4. Demonstration projects for industries and the general public. Combining the needs of key industries for satellite applications as well as the needs of the general public for satellite application demonstration and promotion.

5. Demonstration project of comprehensive application of satellites for the benefit of the people in remote areas. Aiming at the sustainable development of remote areas and the demand for universal services, the demonstration of comprehensive satellite applications for communications, culture and education, medical care and location services is carried out.

3.4.4 Strategic support and assurance

1. Promote the formulation of space law, improve national space policy, data policy and pricing mechanism for space products, and encourage social capital to enter satellite communication and broadcasting and commercial satellite remote sensing, etc.

areas and support the development of terminal products and applications based on autonomous satellites.

2. Promote aerospace digitalisation, networking and intelligence, and establish a digital, networked and intelligent manufacturing integration system that adapts to the characteristics of aerospace products with multiple varieties and small batches and collaborative design and manufacturing.

3. Implement aerospace independent and controllable projects, break through the bottleneck constraints of aerospace SoC/SiP, KW/MW-level high-power microwave components and new high-power terahertz devices, high-end MEMS devices and other aerospace-grade high-reliability components, high-performance carbon fiber materials, (super) large-size aluminum alloy materials, high-performance polymer fibers, deformed high-temperature alloys and other key raw materials, and enhance the independent guarantee capability of aerospace products.

4. Establish a "prime contractor-subcontractor-supplier" division of labour and supply chain collaboration system, and build an open and collaborative aerospace supply chain and industrial chain.

		2020年	2025年
需求		2020年卫星应用产业产值预计达5000亿元	2025年卫星应用产业产值预计超过1万亿元
		完善运载火箭型谱，满足无污染、低成本、短周期、高密度发射及高运载能力需求	
		宽带、多媒体固定与移动卫星通信需求	天地一体化宽带互联安全通信网络需求
		卫星导航亚米级高精度定位需求	卫星导航厘米、毫米级精确定位需求
		多尺度、多种观测手段、高定位精度、高时间分辨率卫星遥感需求	
		高清晰、快速反应、低成本、多样化和个性化空间信息服务需求	
		地球系统科学、空间科学及基础研究发展需求	
目标		形成新一代运载火箭型谱	建成高效、灵活、安全的航天运输体系
		基本建成主体功能完备的国家民用空间基础设施，满足我国及周边地区主要服务需求	建成布局合理、全球覆盖、高效运行的空间基础设施，形成长期稳定高效的空间应用服务体系
		完成载人航天与探月工程三步走任务	初步具备行星际探测能力
		空间信息应用自给率达到60%以上 建立较为完善的卫星应用产业链	空间信息应用自给率达到80%以上 卫星及应用产业达到国际先进水平
	运载火箭	完成新一代大中型运载火箭研制进入实用	完善新一代运载火箭型谱，提升研制生产能力
		开展重型运载火箭方案论证与关键技术攻关	完成大推力火箭发动机研制、 完成重型运载火箭初样研制与地面试验验证

重点产品及航天工程	国家民用空间基础设施	发展大容量宽带通信卫星系统	发展新一代广播电视传输卫星和超大容量宽带通信卫星系统
		发展区域卫星移动通信系统	发展新一代卫星移动通信系统、卫星移动多媒体通信系统
		建成北斗全球导航定位系统及重大导航地面基础设施	提升北斗全球系统卫星及服务能力
		发展涵盖全色、多光谱、高光谱、微波等数据源的卫星遥感基础设施	发展更高分辨率、新型光学和雷达观测手段提升卫星遥感基础设系统能力
		重点完成一站多星、海量数据处理及集成融合等技术及地面设备升级改造等任务	建设形成天地一体化协同、全球数据及时获取、接收和处理能力
	空间宽带互联网	建设天基骨干传输网、天基移动宽带接入网，连接地面宽带网络、第五代移动通信网络	
		初步建成具备全球通信能力的天基通信系统，发展商业终端，实现对全球重点区域的通信互联服务	逐步建成具备全球常态化通信能力的天基通信系统，形成与新一代移动通信网和互联网相互融合的空天地一体化信息网络
	在轨维护与服务	在轨维护与服务系统关键技术攻关与试验验证	研制建设在轨维护与服务系统基本型，初步形成轨道救援、故障恢复、在轨装配与加工能力
	载人航天与深空探测	完成载人航天工程第三步任务，初步建成长期有人照料的空间站	完成空间站建设；发展新一代可重复使用、低成本载人天地往返运输系统；推进载人航天与月球探测后续工程
		研制月球采样返回器，实现探月工程第三步月球采样返回任务	
		载人航天与探月后续工程方案论证与预先研究	
		研制深空探测器，建立深空探测技术体系，开展行星际探测,实现火星着陆巡视探测	推进行星巡视探测
关键共性技术		大推力火箭发动机及重型运载火箭技术	
		卫星长寿命高可靠技术	
		天地一体化系统、星载一体化、卫星组网技术	
		微皮纳卫星平台技术	全电推平台技术
		敏捷平台技术	下一代大型地球同步轨道公用平台
		超静平台技术	
		大功率合成、高功率多波束形成技术	大型多口径多波束天线、宽带转发器功率动态调配技术
		星载数字化信号处理技术	大型可展开网状天线、大动态范围星间链路技术
		卫星导航多系统兼容互操作可交换技术，卫星网络与地面网络无缝连接、大容量空间链路技术	高精度导航载荷和自主定轨技术
		高分辨率敏捷成像技术	
		多波速激光测量技术	一体化大功率激光探测技术
			可见红外高光谱一体化成像技术、高轨中分辨率多波段成像技术
		高轨SAR成像、L波段差分干涉测量技术	深空多谱段多模式成像等探测技术
		航天员长期在轨技术	长周期可循环生命保障技术
		近地空间站组合体建造技术	航天器部件在轨3D打印、空间智能机器人技术
		行星际轨道设计、深空测控通信、自主导航与控制、高速再入小型返回器、高效能源与推进等关键技术	
应用示范工程		资源、环境和生态保护领域的典型卫星综合应用示范	
		防灾减灾与应急反应卫星综合应用示范	
		城镇化、区域、跨区域综合应用示范	
		行业及大众卫星应用示范	
		边远地区信息惠民卫星综合应用示范	
战略支撑与保障建议		边远地区信息惠民卫星综合应用示范	
		完善航天政策，制定国家数据政策，落实航天产业化、商业化发展政策；推进重点行业和区域卫星应用示范	建立和完善标准规范体系；建立区域化、商业化的空间信息服务体系，大力开展综合性卫星应用示范,积极促进大众应用，拓展全球服务
			强化导航定位授时与遥感、移动通信、互联网等的深度融合，形成长期持续稳定的空间信息服务能力，广泛开展全球服务
		发展满足航天需求的智能装备和智能技术，推进数字化、网络化、智能化制造技术在航天装备制造领域的创新应用	
		变革研制生产模式，推进资源优化重组	建立形成数字化、网络化、智能化制造集成体系
		实施航天自主可控工程，突破宇航级高可靠元器件、关键原材料等瓶颈制约	
		建立“主承包商-子承包商-供应商”分工与供应链协作体系，建立开放协同的航天供应链与产业链	

IV. Marine engineering equipment and high technology ships

4.1 Marine engineering equipment and high technology vessels

Marine engineering equipment and high-tech ships are the main carriers and means for human development, utilization and protection of marine mineral resources, marine renewable energy, marine chemical resources, marine biological resources and marine space resources and other marine resources as well as maritime transportation activities. Marine engineering equipment and high-tech ship manufacturing is an important part of China's strategic emerging industries and a pioneering industry for the development of marine economy.

4.1.1 Demand

Since the new century, China's marine engineering equipment and ship manufacturing industry has made significant development: since 2010, China's shipbuilding three major indicators for five consecutive years to maintain the world's first; 2014, China's marine oil and gas engineering equipment, the number of new orders and the total amount of orders ranked first in the world; marine renewable resources development equipment, as well as seawater desalination and comprehensive utilization, marine observation, marine biological development and other aspects of the equipment are The development of marine renewable resources development equipment, as well as seawater desalination and comprehensive utilization, marine observation, marine biological development and other equipment have been achieved. In the future, with the opening of the polar shipping lanes, polar, deep sea and other resource development needs continue to strengthen, marine food, marine new energy, marine mining and other emerging industries continue to become new areas of the economy, maritime safety and environmental protection requirements are increasingly stringent, marine rights and interests to maintain the situation is increasingly urgent, marine engineering equipment and high technology ship demand will be further expanded. It is expected that by 2020, the world market demand for marine engineering equipment and high-tech ships will be about US$170 billion.

The market demand is expected to increase to $260 billion by 2025.

4.1.2 Objectives

In 2020, we will enter the ranks of the world's leading shipbuilding countries: we will build a more complete industry of design, assembly and construction, equipment supply and technical services for marine engineering equipment and high-tech ships.

system and standard specification system; major equipment design and manufacturing capabilities among the world's leading, backbone 企业国际知名度不断提升；海洋工程装备与高技术船舶自主设计建造装备国际市场份额分别达到 35%和 40%；部分前沿技术和重大装备的概念/基础设计达到世界先进/领先水平；海洋工程装备与高技术船舶关键系统和设备自主配套率分别达到 40%和 60%；形成国内海洋石油勘探装备 The research and development bases of domestic marine oil exploration technology, marine oil exploration equipment manufacturing and application bases; basically realize the core equipment on the surface of marine engineering equipment, 500m-level underwater production system and special system production and testing capability; carry out research and development of marine mineral resources, natural gas hydrate mining equipment, wave energy/tidal energy and other marine renewable resources development equipment, seawater desalination and other new marine resources development equipment. Research and development of key technologies and breakthroughs in some key core technologies.

By 2025, it will become a powerful country in the manufacturing of marine engineering equipment and high-technology ships with certain influence: forming a complete industrial system and standard specification system for the design, assembly and construction, equipment supply and technical service of marine engineering equipment and high-technology ships; having more than five internationally renowned manufacturing enterprises and leading international design and manufacturing technologies in some fields; reaching 40% and 50% of the international market share of major marine engineering equipment and high-technology ships independently developed, designed and built; reaching 50% and 80% of the independent matching rate of key systems and equipment respectively; fully realizing the capability of independent matching of marine equipment with core equipment on the surface, 1500-meter-class underwater production systems and special systems, The international market share of the main marine engineering equipment and high-tech ships independently developed, designed and built reaches 40% and 50% respectively, the independent matching rate of key systems and equipment reaches 50% and 80% respectively; the independent matching of marine equipment with core equipment on the surface, 1500m-level underwater production systems and special systems is fully realized, and the key technologies of design, manufacturing, testing and installation of underwater production systems at a depth of 3000m are broken through; the key technologies of marine mineral resources, natural gas hydrate mining equipment, natural gas hydrate mining equipment, natural gas hydrate mining systems, natural gas hydrate mining systems, natural gas hydrate mining systems, natural gas hydrate mining systems and natural gas hydrate mining systems are fully realized, The company has the ability to develop new marine resources development equipment such as marine mineral resources, natural gas hydrate mining equipment, wave energy/tidal energy and other marine renewable resources development equipment, seawater desalination and other new marine resources development equipment, and carry out pilot applications of some devices; comprehensively build a digital, networked, intelligent, green design

Manufacturing system.

4.1.3 Development focus

1. Key products

（1）Integrated Marine Spatial Stereoscopic Observation System

Focus on the development and development of key equipment and systems such as marine detection sensors, shipboard marine observation instruments, marine buoys, marine submersible beacons, underwater communication equipment, marine environmental databases, maritime target radar echo databases，etc. to achieve engineering applications.

（2）Marine oil and gas resources development equipment

The focus is on the development and integrated innovation of marine conventional and polar oil and gas resources exploration/exploitation and production equipment, surface support equipment, engineering vessels and equipment such as deepwater and ultra-deepwater drillships, pipelay cranes and offshore support vessels; the development and industrialisation of oil and gas production equipment such as deepwater and ultra-deepwater semi-submersible production platforms, large and medium-sized liquefied natural gas floating production, storage and offloading units (LNG-FPSO/FSRU),floating drilling production, storage and offloading units (FDPSO), tension leg platforms (TLP), deepwater column platforms (Spar) and production support equipment such as underwater production systems, deepwater physical exploration vessels of 12 cables or more, and industrialisation of production support equipment. FDPSO, TLP, Spar, and other oil and gas production equipment, as well as the development and industrialisation of production auxiliary equipment such as subsea production systems and deepwater exploration vessels with more than 12 cables.

（3） Marine mineral resources development equipment

Focus on the development and application of polymetallic nodules, cobalt-rich crusts and other seabed resources exploration, combustible ice development equipment, drilling and related vessels and equipment.

（4） Marine Renewable Energy Development Equipment

Focus on the development and industrialisation of marine renewable energy development and utilisation equipment such as offshore solar energy, offshore wind energy, tidal energy, wave energy and temperature difference energy.

（5） Equipment for offshore island use and safety and security

Focus on maritime law enforcement command and dispatch system, large/ultra-large floating security base

The following are some of the most important floating airports in the world: the Earth, very large offshore floating airports, offshore satellite launch platforms, medium-sized floating islands and reefs.

The development and application of equipment such as platforms, construction devices for the development and construction of distant sea islands and reefs, and support platforms for distant sea communication network systems.

（6） Deep-sea exploration and expedition equipment

Focus on the development and application demonstration of 300-tonne class underwater large manned transport equipment, and 3000 tons of small nuclear-powered underwater large manned transport equipment system assembly integration; deep-sea geological and environmental exploration, hydrological monitoring, environmental investigation, offshore oil spill monitoring and treatment and other key equipment and systems development and application; scientific research vessels, unmanned and manned submersibles and other deep-sea exploration equipment development and application.

（7） Deep-sea fish farming/Marine food and marine medicine equipment

Using the vast expanse of China's seas, combined with traditional/emerging fisheries production, develop high value-added fish farming equipment suitable for the deep sea. Develop marine food and marine medicine equipment to suit demand.

（8） Super eco-friendly ships

Focus on the development of super eco-friendly oil tankers, bulk carriers, container ships and other international routes, feeder vessels, as well as dual-fuel vessels with direct river and sea access. To reduce greenhouse gas (CO_2) emissions by more than 50%, using technological developments during the period when the MARPOL Convention was in force as a baseline.

（9） Polar transport vessels

Focus on the development of polar oil tankers, container ships and other ships applicable to the requirements of different ice classes, with emphasis on the research of PC3 and PC4 ice class ships to achieve safety, economic and environmental characteristics at the international advanced level.

（10） Offshore fishing vessels

Focusing on ocean-going tuna fishing vessels, deep-cooled transport vessels, Antarctic krill fishing plus

Integrated research for industrial vessels and equipment for fishing exploration, fishing, processing, deep-freezing storage and transport The system.

（11） High Performance Law Enforcement Operating Vessels

The focus is on the development of new high-speed, multi-functional maritime official law enforcement vessels, deep-sea rescue vessels and sewage salvage vessels.

（12） Large Luxury Cruise

Focus on the research of the overall design, general arrangement, design, interior, structure, special structure and hydrodynamic performance optimisation design technology of medium (100,000 gross tonnage)and large (200,000 gross tonnage) luxury cruise ships to realise the development of medium and large luxury cruise ships.

（13） Large LNG fuel powered vessels

We have achieved the conversion of ships from traditional diesel fuel to liquefied natural gas (LNG), and achieved independent intellectual property rights in the design and construction technology of our main ship types, with a localisation rate of over 70%.

（14） Large low speed engines for marine applications

The development of a full range of independent intellectual property rights for large low-speed engines (diesel, gas and dual-fuel engines) for ocean-going vessels has been achieved, with the basic realization of self-support for heavy parts and other components.

2. Key components

（1） Underwater production control systems

Through breakthroughs in underwater control equipment modularity and integration technology, underwater control system communication technology, underwater control system electro-hydraulic transmission calculation and analysis technology, underwater control system fast link technology, underwater control system installation and testing technology, etc., to master the core technology of underwater control, to achieve the development and industrial application of all-electric control system.

（2） Core technologies and equipment for subsea oil and gas production systems

The focus is on engineering technologies and key equipment for subsea oil and gas production systems in shallow waters and engineering applications for subsea oil recovery trees at 500-1500m water depth.

（3） Underwater specialised equipment and equipment

Development of mainstream subsea pipelines, reel-to-reel subsea pipeline laying sets, deepwater manned underwater vehicles（HOVs）and deepwater subsea pipeline working tools.

（4） Deep sea mooring and power positioning control systems

Focus on breaking through the key core technology of deep-sea mooring or power positioning system for large offshore operation equipment, and carry out industrial application of deep-sea mooring and power positioning system.

（5） Key components for high efficiency, low emission, high power, low speed engines

Focus on marine high power engine casting and welding technology of steel cylinder block, high efficiency turbocharger technology, fuel injection system, in-cylinder process, intelligent speed control system design and experimentation technology, intelligent core control components and system key mechanical parts design technology, long-term very low load operating conditions of marine low speed engine key parts technology, modular design and integration technology research, to achieve high power Low-speed engines are produced independently.

（6） Intelligent monitoring systems for ships

The focus is on the integration of technologies such as integrated ship-shore data exchange technology, multi-source sensor data fusion technology, integrated ship intelligent navigation application technology, multi-dimensional data model transformation and reality.

（7） Key components for marine LNG and other gas fuel supply systems

Focus on the development of equipment components required for the filling system, gas storage system and gas supply system of LNG gas-fuelled power vessels (including refuelling vessels), and the realization of the vaporizer, the

Independent production of key equipment and components such as deep submersible pumps and line valve parts.

（8） Hull friction resistance reduction coatings

Focus on breakthroughs in new high-performance resistance-reducing coating technology, air lubrication resistance-reducing technology for ship bottom, etc.

（9） Cryogenic materials and cold-proofing equipment

Focus on research and development of low-temperature materials, pumps, valve components and other core hydraulic components suitable for polar navigation vessels for low-temperature start-up and sealing technology.

3. Key common technologies

（1） New materials and design technologies for lightweight hull structures

Focus on the research of corrosion control technology for large ships and offshore platform equipment based on new high-performance steel materials, and the development of new high-performance steel materials and composite materials that combine excellent properties such as ultra-high strength, toughness and long life.

（2） High Performance Energy and Energy Storage Technologies

Focus on breakthroughs in high energy density, high reliability and long life energy and storage technologies required in harsh operating environments.

（3） Deep sea information transmission technology

Focus on breaking through the key information transmission technologies required for deep and distant sea data collection equipment, data transmission equipment, information fusion processing equipment and data application service equipment.

（4） Underwater installation technology

Focus on breakthroughs in key technologies such as underwater installation and positioning technology, mechanical analysis and numerical calculation of the installation and devolution process, and impact analysis technology of the installation process to achieve independent installation and service of underwater equipment.

（5） Safety and reliability technology

Focusing on the development of computational models for risk analysis of marine floating structures and underwater equipment through

Type studies to maximise the reliability and safety of marine floating structures and subsea systems.

（6）Numerical pool technology

Focus on tackling the overall design and development of numerical pool hydrosolver, ship rapidity, wave resistance and operability, marine environment flow field, marine platform motion and load, eddy vibration/motion and other key technologies for platform/system engineering applications, forming a numerical simulation wisdom system for marine equipment hydrodynamics (referred to as numerical pool).

（7）Marine Engineering Equipment Offshore Testing Technology

With the objective of systematically solving the fundamental problems of the independent and industrialization of key supporting equipment for China's marine engineering equipment, through the construction of marine engineering equipment sea test site, to achieve durability and reliability tests for various types of platform equipment and underwater equipment, to accelerate the process of localization of China's marine engineering equipment.

（8）Energy saving technology for ship type optimisation

The focus is on the integration of technologies such as low resistance hull main scale and line design technology, hull superstructure air resistance optimization technology, hull navigation longitudinal tilt optimization technology, low wave stall speed hull line design technology, air lubrication on the bottom of the ship to reduce resistance, and structural optimization design to reduce the weight of empty ships.

（9） Ship propulsion plant design technology

The focus is on the rational integration of high efficiency propeller optimisation design technology, POD-CRP combined propulsion device design technology, propeller/rudder integration design technology, propeller/transom optimisation matching design technology, high efficiency rim-to-transom combined propulsion technology, and stacked blade double propeller counter-rotation propulsion technology.

（10） Renewable/clean energy utilisation technologies

Focus on breakthroughs in dual-fuel engine technology, gas engine technology, wind power boosting technology, new wind turbine technology, solar cell application technology, nuclear energy propulsion technology, LNG fuel ship fuel supply system/equipment design and manufacturing technology, etc.

（11） Vibration and noise reduction and comfort technology

Focus on breakthroughs in equipment vibration isolation technology, high-performance marine acoustic materials, construction acoustic technology and outfitting management, active control technology for acoustic vibration, comfort cabin design technology, structural acoustic design technology, propeller noise control technology, etc.

（12） Intelligent design and manufacturing technology for ships

Internet/Internet of Things based on the realization of domestic and international cooperation in the relevant industries

Numerical pool technology based on information technology such as /e-technology/big data/cloud computing, ship overall multidisciplinary optimization (MDO) design technology, risk-based design assessment technology, ship energy efficiency assessment and verification technology based on IoT/big data technology, ship design and construction integrated design 3D technology, efficient propulsion and navigation safety design technology; ship intelligent welding technology, ship intelligent manufacturing integration platform technology, ship intelligent manufacturing equipment technology, etc.

4.1.4 Application demonstration projects

1.300 tonne class underwater large manned transport equipment application demonstration

2. Demonstration of a large floating base at sea (logistics, rights maintenance, fisheries deep-sea farming or tourism)

3. Super eco-friendly ship application demonstration

4. Demonstration of the application of domestic equipment in high efficiency oil/gas fields

4.1.5 Strategic Support and Assurance

1. Increase investment in scientific research programs for marine engineering equipment and high technology ships, and carry out heavy

Point equipment and key systems and equipment development, as well as digitalisation, networking and intelligent technology application research.

2. Launch a major project on deep and distant sea technology and carry out the development and application demonstration of underwater large-scale manned transport equipment.

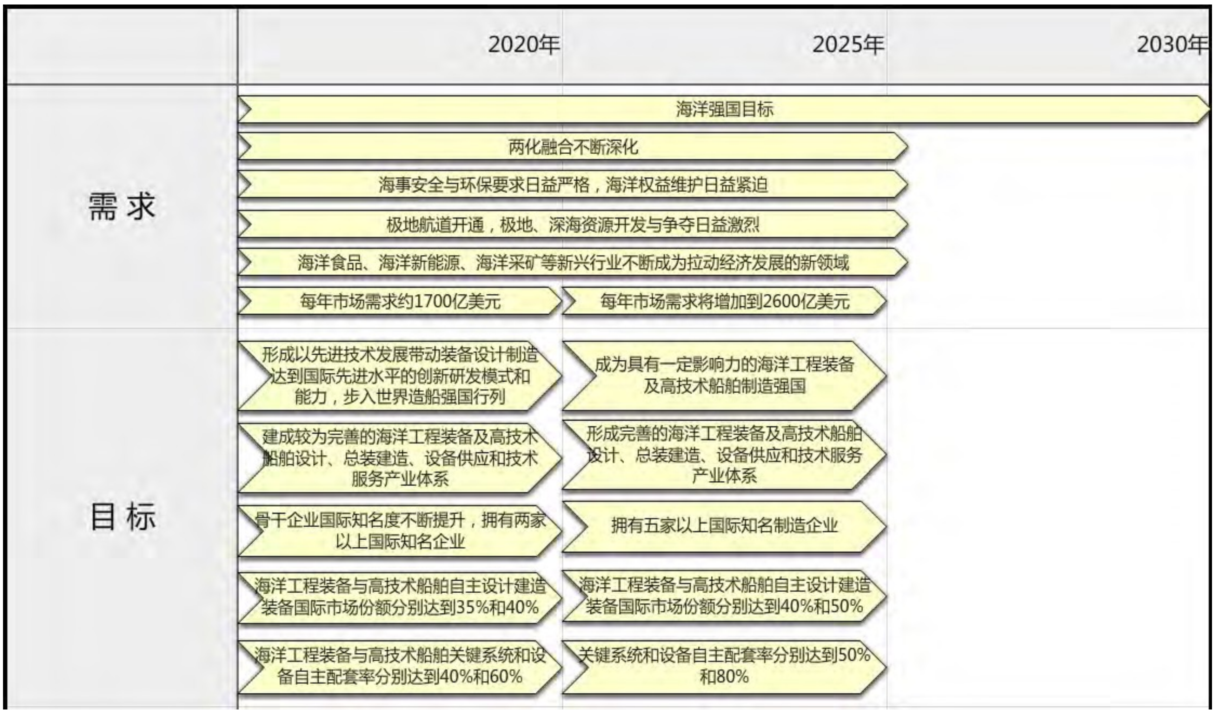
3. Develop and implement a plan to promote the independent development of the ship and marine engineering supporting industry.

4. Increase investment in basic scientific research and enhance the ability to collect and analyse basic scientific research databases; improve the level of basic analysis software and methods; and strengthen research on international standards and branding capabilities.

5. Establish a public testing/inspection platform for deep-sea engineering equipment, enhance the public testing/inspection capability of deep-sea technology and equipment, and accelerate the construction of independent innovation capability.

6. Establish a national marine engineering equipment

testing technology centre, strengthen basic scientific research and innovative technology research and development of marine engineering equipment, and achieve domestic and international peer recognition in testing technology, testing technology, forensic technology, certification technology and risk assessment technology.



重点产品	海洋空间综合立体观测系统	开展部分海区试验应用 → 实现高性能运转和应用
	海洋油气资源开发装备	开展海洋油气资源勘探/开采与生产装备、水面支持装备等工程船舶与装置的集成创新试验应用 → 实现海洋油气资源勘探/开采与生产装备、水面支持装备等工程船舶与装置的集成创新产业化应用
		深水、超深水半潜式生产平台、液化天然气浮式生产储卸装置、浮式钻井生产储卸装置、张力腿平台、深水立柱式平台的研制 → 实现产业化应用
		可燃冰开发装置研制与试验应用
		水下生产系统、12缆以上深水物探船等生产辅助装备的研制与试验应用 → 实现产业化应用
	海洋矿产资源开发装备	多金属结核、富钴结壳等海底资源勘探、钻采及相关船舶与装备的研制 → 实现试验应用
	海洋可再生能源开发装备	海上太阳能、海上风能开发利用装备的研制 → 实现产业化应用
		潮汐能、波浪能、温差能等海洋可再生能源开发利用装备的研制 → 实现产业化应用
	海上岛礁利用和安全保障装备	大型/超大型浮式保障基地的研制与应用 → 极大型海上浮式空海港、海上卫星发射平台的研制与应用
		海上执法指挥调度系统的研制与试验应用 → 海上执法指挥调度系统的高性能应用
		岛礁中型浮式平台的研制与应用 → 远海岛礁开发建设施工装置的研制与应用
	深远海探测与考察装备	300吨级水下大型载人运载装备研制和应用示范 → 3000吨级水下大型载人运载装备系统总装集成 → 3000吨级水下大型载人运载装备系统应用
		深远海地质环境勘探、水文监测、环境调查等关键装备及系统的研制与试验应用 → 实现产业化应用
		科学考察船、无人及载人潜水器等深海勘查装备的研制与试验应用 → 实现产业化应用
	超级生态环保船舶	超级生态环保油船、散货船、集装箱船等国际航线、支线船，以及江海直达双燃料船舶的研制与试验应用 → 实现产业化应用
	极地运输船舶	满足PC3、PC4冰级的船舶研制 → 实现产业化应用
	远洋渔业船舶	远洋金枪鱼捕捞船、深冷运输船、南极磷虾捕捞加工船舶以及渔探、捕捞、加工、深冷储藏、运输等设备的集成研制 → 实现产业化应用
	高性能执法作业船舶	高速化、多功能的新型海上公务执法船舶研制与试验应用 → 实现产业化应用
		高性能抢险救灾船舶以及排污打捞船舶等船型研制与试验应用 → 实现产业化应用
	大型豪华游船	开展中型（10万总吨级）豪华游船研发 → 开展中型（10万总吨级）豪华游船研制与试验应用 → 实现产业化应用
		开展大型（20万总吨级）豪华游船研发 → 开展大型（20万总吨级）豪华游船研制与试验应用
	大型LNG燃料动力船	开展大型LNG燃料动力船研制及实验应用 → 开展大型LNG燃料动力产业化应用
	船用大型低速发动机	开展船用大型低速发动机（柴油机、气体机及双燃料发动机）研发 → 开展自主品牌大型低速发动机研制与试验应用 → 实现产业化应用
	水下生产控制系统	开展模块化与集成化水下控制设备、控制系统通信技术、水下控制系统安装于测试技术的研发与试验应用 → 实现全电水下控制系统产业化应用
	水下油气生产系统核心技术与装备	开展水下油气生产系统工程技术与关键设备在浅水区工程化应用 → 实现500-1500米水深水下采油树工程化应用
	水下专用作业装备与设备	开展主流海底管道、卷管式海底管道铺设成套装置、深水水下作业载人潜器（HOV）、深水海底管道作业工具、水下声学定位系统研制与试验应用 → 实现产业化应用

关键零部件
深海锚泊及动力定位控制系统
开展大型海上作业装备深海锚泊或动力定位系统研制与试验应用
实现深海锚泊及动力定位系统产业化应用
高效、低排放大功率低速发动机关键零部件
开展高效、低排放大功率低速发动机关键零部件研制与试验应用
实现产业化应用
船舶智能监控系统
开展船舶智能监控系统研制与试验应用
实现产业化应用
LNG等气体燃料动力船供气加注系统
开展LNG气体燃料动力船（包括加注船）的加注系统、储气系统、供气系统所需要的设备零部件的研制
实现汽化器、深潜泵及线路阀件等关键设备及零部件的自主化生产和产业化应用
降低船体摩擦阻力涂料
开展降低船体摩擦阻力涂料研制与试验应用
实现产业化应用
低温材料与防寒设备
适用于极地航行船舶的低温材料、泵、阀件等核心液压元件低温启动和密封技术研发
实现产业化应用
关键共性技术
突破新材料与船体结构轻量化设计技术
突破恶劣作业环境下所需的高能量密度、高可靠性、长寿命能源与储能技术
突破深远海数据采集装备、数据传输装备、信息融合处理装备以及数据应用服务装备等所需的信息传输关键技术
突破水下安装定位技术，安装下放过程力学分析与数值计算，安装过程冲击分析技术等关键技术
开展海洋浮式结构物及水下设备风险分析计算模型研究，提高浮式结构物及水下系统的可靠性和安全性
攻克数值水池关键技术，实现数值水池应用
建设海洋工程装备海上试验场，实现对各类平台设备及水下设备的耐久性和可靠性试验
实现船型优化节能技术的集成
实现高效推进装置的技术集成
重点突破双燃料发动机技术、气体发动机技术、风能助推技术
重点突破新型风力发电机技术、太阳能电池应用技术核能推进技
重点突破设备隔振技术、高性能船用声学材料、建造声学工艺与舾装管理等
重点突破声振主动控制技术、舒适性舱室设计技术、结构声学设计技术、螺旋桨噪声控制技术等
在互联网/物联网/e-技术/大数据/云计算等信息化技术的基础上实现船舶智能设计制造技术
应用示范工程
300吨级水下大型载人运载装备应用示范
海上大型浮式基地（后勤保障、维权或旅游）示范
超级生态环保船舶应用示范
高效油/气田国产装备应用示范
深远海渔业养殖基地示范
战略支撑与保障建议
实施海洋工程装备及高技术船舶科研计划
启动深海技术重大工程
制定实施船舶配套业自主化发展推进计划
加大基础科研投入力度
建立深海工程装备公共试验/检测平台
成立国家级海洋工程装备试验技术中心

V. Advanced rail transportation equipment

5.1 Advanced Rail Transit Equipment

Rail transportation equipment is the main carrier of national public transport and bulk transport, is a high-end equipment manufacturing industry, is also an important representative of China's high-end equipment "going out". Advanced rail transportation equipment includes modern technology of mainline rail transportation, regional rail transportation and urban rail transportation, transportation equipment, commutation equipment, transportation control equipment and road network equipment. The rail transportation manufacturing industry will focus on the development of safe and reliable, advanced and mature, energy-saving and environmentally friendly green intelligent spectrum of products, the establishment of the world's leading modern rail transportation equipment industry system, to achieve global operational development.

5.1.1 Demand

China is the world's largest market for rail transportation equipment. It is expected that during the 13th Five-Year Plan period, the country will build no less than 23,000 km of new railways, with a total investment of no less than 2.8 trillion yuan.

The demand for railway equipment in China will remain high. By the end of 2014, China had 38

The construction of rail transit has been approved by the state in more than 6,680 kilometres of planned mileage in six cities, with an estimated

By 2020, more than 50 cities in China are expected to build rail transit in the next decade.

The average annual demand for urban rail vehicles will exceed 5,000 units.

According to statistics, the global rail transportation equipment market has shown a strong growth trend. From 2015 to 2020, the global demand for rail transportation vehicles will be €53-61 billion, with a compound annual growth rate of 3.30%, and from 2021 to 2025, the demand will be €63-73 billion, with a compound annual growth rate of 3.75%. Our government is strongly promoting the implementation of the "One Belt, One Road" strategy construction of interconnection projects along the "One Belt, One Road" and in the radiating regions will provide a strong impetus to the development of rail vehicles in China.

The rail transportation equipment manufacturing industry brings considerable market demand.

5.1.2 Objectives

By 2020, rail transportation equipment research and development capabilities and leading products to reach the global advanced level, the industry sales value of more than 650 billion yuan, the proportion of overseas business more than 30%, the proportion of services more than 15%, key products into the developed markets in Europe and the United States.

By 2025, China's rail transportation equipment manufacturing industry to form a sound, continuous innovation capacity of the innovation system, in the main areas of the implementation of intelligent manufacturing model, the main products to reach international leading level, overseas business accounted for 40%, service business accounted for more than 20%, leading the revision of international standards, built the world's leading modern rail transportation equipment industry system, occupy the top end of the global industry chain.

5.1.3 Development focus

1. Key products

(1) China Standard High-Speed Locomotives. In-depth research on the standardization, serialization, modularization of

the rolling stock, as well as the whole vehicle joint tuning and test verification and other related technologies, the formation of the Chinese standard high-speed rolling stock technology platform, the completion of the independent Chinese standard high-speed rolling stock product series engineering verification and application assessment. The target speed class is 350km/h; formation mode: 8 units in formation, 4 moving and 4 towing; axle weight: ≤17t of efficient and low noise new high-speed rolling stock.

(2) 30-ton axle heavy-duty electric locomotives. To build a research and development platform for 30-ton axle heavy-duty electric locomotive systems, develop key components and systems such as traction converter and control systems, braking systems, etc. for electric locomotives suitable for 30-ton axle heavy-duty requirements, and develop 30-ton axle heavy-duty freight electric locomotives with independent intellectual property rights. The target speed class is 120km/h; traction power: 9600kW; axle type 2 (B0-B0); axle weight: 30t of heavy

Carrying electric locomotives.

(3) Intercity rapid trainsets. Completion of the development, engineering verification and operational assessment of intercity rapid trainsets in two speed classes, 120-140/140-160 km/h, adapted to different natural environments and line conditions, with AC25kV and DC1500V power supply systems.

(4) 100% low-floor modern trams. Developed to suit different technical routes

(Partial gridless hybrid or power battery; full line gridless supercapacitor energy storage) 100% low-floor modern trams with independent intellectual property rights, complete the complete vehicle test verification and operational assessment, and establish technical standards and specifications.

(5) Medium- and low-speed magnetic levitation system. On the basis of the successful independent development of the demonstration trains of normal-conducting short-stator medium- and low-speed maglev, build a technical platform for the design, manufacture, testing and inspection of medium- and low-speed maglev systems, and establish technical standards and specifications.

2. Key components

（1） Power semiconductor devices. Focus on breaking through the technical bottleneck of silicon-based IGBTs, MOSFETs and other advanced power semiconductor device chips, promoting the application and industrial development of domestic silicon-based devices; promoting the research and development and industrialization of next-generation power semiconductor devices such as silicon carbide (SiC) and gallium nitride (GaN).

(2) Power supercapacitor components. Research and development of 12000F, 3.0V, 10Wh/kg, 1 million times charge and discharge single components of high power, high energy, long life, high safety, maintenance-free supercapacitors, and promote the industrialization of energy storage type electric traction technology for urban public transport.

(3) High-speed rolling stock axles/wheels. Breakthroughs in metallurgical quality control of steel for axles/wheels, material heat treatment processes, surface corrosion and wear treatment technologies for hollow axles, and the development of autonomous axle/wheel batch applications for high-speed rolling stock.

（4） Train braking system. Development of a new generation of high-power AC-driven locomotives, self

Mainstreaming high-speed rolling stock braking system, technology to reach international advanced level, to achieve import substitution.

（5） Communication signal equipment. Breakthroughs in key technologies such as on-board ATP, on-board ATO, ground RBC/ZC, ground train control centre, ground interlocking equipment and wireless communication broadband for train control systems, and the development of autonomous railway communication and signal equipment covering high, medium and low speeds.

（6） Gear transmission system. Carry out technical research on gear transmission systems for high-speed trains, intercity fast trains and modern trams, breakthroughs in gear heat treatment, light alloy case casting, online fault diagnosis and other technologies, and develop gear transmission products suitable for different platforms.

（7） Hook cushioning system. Breakthrough in integrated manufacturing process, overload protection, energy absorption and other technologies for urban rail vehicles and high-speed rolling stock hooks, and development of semi-automatic, automatic and semi-permanent hook series products.

3. Key common technologies

（1） New vehicle body technology. Application of new materials such as magnesium and aluminium alloys to develop lightweight vehicle bodies suitable for intercity rapid trains and modern trams that meet the requirements of EN12663.

（2） High performance bogie technology. Development of a range of bogies with high adhesion weight utilisation, excellent dynamics, different axle series and different model configurations.

（3） Electric drive system technology. Complete the development and application of silicon carbide power electronics devices and promote the application of energy-feeding bi-directional variable current technology; promote permanent magnet motor drive technology with gearless direct drive technology.

（4） Energy storage and energy saving technology. Accelerate the development of supercapacitors with high energy density and utilise their excellent charging and discharging performance to achieve grid-free operation and energy recyclable operation for the whole line of trams and trolleybuses.

（5） Braking system technology. Research on braking control technology for high-speed trains, fast trains and modern trams, and complete the autonomy of devices and key components.

（6）Train network control technology. Independent development of network control systems for Chinese standard high-speed trains and intercity rapid trains, as well as standardised, standardised and serialised hardware and software platforms for modern trams with Ethernet systems.

（7）Communication and Signal Technology. The research focuses on advanced rail transit safety processing platform technology, vehicle-ground information exchange and safety communication technology, safe allocation and optimisation of travel permits, automatic train operation technology（ATO）, high-speed railway train control system life-cycle maintenance guarantee technology, high-speed train wireless data transmission technology, etc.

5.1.4 Application demonstration projects

1. Demonstration of "green and intelligent engineering prototype". Integration of cutting-edge technologies for urban rail transportation such as energy storage power supply, new high-efficiency converter of silicon carbide, high-efficiency permanent magnet synchronous motor drive and automatic driving based on energy-optimal characteristics to set up a sample of green and intelligent rail transportation vehicles in China.

2. Demonstration of "Green Intelligent Rail Transit System Integration Project". On the basis of the implementation of the "green intelligent engineering prototype" project, the "green intelligent rail transportation equipment integration project" was implemented by integrating Ethernet-based gigabit bandwidth real-time control, network control and bi-directional energy feeding technologies.

3. "Demonstration of a life-cycle service system for rail transport equipment based on the Internet of Things.

Green intelligent rail transit vehicles as a "mobile terminal", integrated vehicle intelligent state monitoring, fault disaster monitoring system and other networked, intelligent technology, to explore the establishment of "Internet of Things-based rail transit equipment whole life cycle service system".

5.1.5 Strategic Support and Assurance

1. Improving innovation capacity

With enterprises as the main body, the combination of industry, academia, research and application, strengthening the basic and forward-looking research of technology, establishing and improving national R&D bases such as the National Engineering Laboratory for Electric Locomotives and Urban Rail Vehicles and the National Engineering Research Centre, and implementing the "New Generation Advanced Rail Transit Equipment" industrial innovation development project.

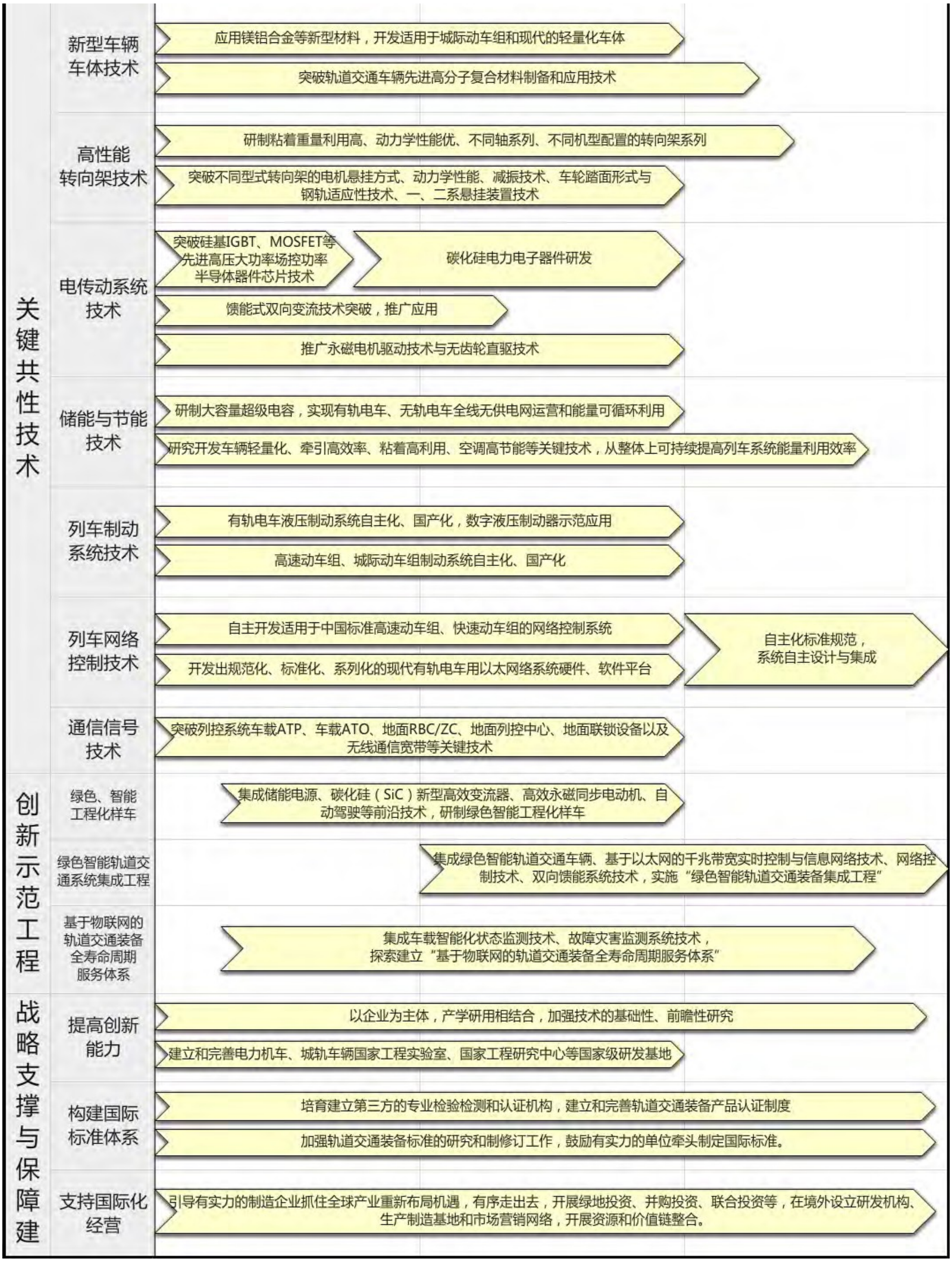
2. Building an international standard system

Strengthen product quality inspection and testing capacity building, accelerate the cultivation of the establishment of third-party professional inspection and certification bodies, the establishment and improvement of rail transportation equipment product certification system. Strengthen the research and revision of rail transportation equipment standards, and encourage competent units to take the lead in developing international standards.

3.Supporting international operations

Strengthen the macro guidance and services for enterprises to "go global", and guide competent manufacturing enterprises to seize the opportunity of global industrial redistribution, go global in an orderly manner, carry out greenfield investment, M&A investment, joint investment, etc., and set up R&D institutions, manufacturing bases and marketing networks abroad.

		2020年	2025年	2030年
需求	国内需求	我国经济发展和城镇化建设带来巨大的轨道交通建设需求，国铁、城市轨道交通建设规模长期保持高位		
	海外需求	全球轨道交通装备市场呈现出强劲的增长态势，同时，我国正强有力推动“一带一路”战略实施，带动相关企业“走出去”，将带来可观的海外市场需求		
		全球轨道交通车辆市场需求510-610亿欧元	全球轨道交通车辆市场需求630-730亿欧元	
目标	技术引领	研发能力和主导产品达到全球先进水平	形成具有持续创新能力的创新体系，在主要领域全面推行智能制造模式，主要产品达到国际领先水平，主导国际标准修订	
	市场及结构优化	行业销售产值超过6500亿元，境外业务比重超过30%，服务业比重超过15%，重点产品进入欧美市场	境外业务占比达到40%，服务业务占比超过20%。建成全球领先的现代化轨道交通装备产业体系，占据全球产业链的高端	
重点产品	中国标准高速动车组	研制中国标准高速动车组；完成可互操作的自主化高速动车组产品系列工程化验证和运用考核	形成技术标准体系	
		中国标准高速动车组“走出去”		
	30吨轴重重载电力机车	2个主型产品工程化验证和运用考核；30吨轴重电力机车技术平台建设，形成技术标准体系		
	城际快速动车组	研制时速120～140/140～160km/h两个速度级城际组，产品系列工程化验证和运用考核	形成我国城际快速动车组技术规范和标准体系	
	100%低地板现代有轨电车	研制出不同技术路线的具有自主知识产权的100%低地板现代有轨电车；建立现代有轨电车行业技术标准		
		研制自主化100%低地板现代有轨电车转向架、液压制动系统以及通信信号		
	中低速磁浮系统	运行验证；建立中低速磁浮系统技术体系和技术标准		
		中低速磁浮系统作为城市综合公共交通的必要补充推广运用		
关键零部件	功率半导体器件	研制硅基IGBT、MOSFET等先进功率半导体器件芯片，并批量应用	碳化硅电力电子器件研制及产业化	
	动力型超级电容器件	研制12000F、3.0V、10Wh/kg、100万次充放超级电容单元器件，并规模化运用	研制20Wh/kg能量密度锂离子复合超级电容，并推广应用	
	高速动车组车轴/车轮	突破车轴/车轮用钢质量控制技术、材料热处理工艺，开发高速动车组自主化车轴/车轮		
	列车制动系统	新一代自主化大功率机车制动系统研制及批量装车		
		有轨电车液压制动系统国产化		
		高速动车组、城际动车组、城轨车辆自主化制动系统自主化研发及批量应用		
	通信信号装备	研制自主化轨道交通通信信号装备；形成一整套覆盖高、中、低速轨道交通通信信号领域的技术体系		
	齿轮传动系统	研制高速动车组、城际动车组、有轨电车等不同平台齿轮传动系统		
	车钩缓冲器系统	掌握动车组、城轨车辆车钩材料、缓冲器吸能技术；国产动车组、城轨地铁车钩、缓冲器大规模应用		


关键共性技术
新型车辆车体技术
应用镁铝合金等新型材料，开发适用于城际动车组和现代的轻量化车体
突破轨道交通车辆先进高分子复合材料制备和应用技术
高性能转向架技术
研制粘着重量利用高、动力学性能优、不同轴系列、不同机型配置的转向架系列
突破不同型式转向架的电机悬挂方式、动力学性能、减振技术、车轮踏面形式与钢轨适应性技术、一、二系悬挂装置技术
电传动系统技术
突破硅基IGBT、MOSFET等先进高压大功率场控功率半导体器件芯片技术
碳化硅电力电子器件研发
馈能式双向变流技术突破，推广应用
推广永磁电机驱动技术与无齿轮直驱技术
储能与节能技术
研制大容量超级电容，实现有轨电车、无轨电车全线无供电网运营和能量可循环利用
研究开发车辆轻量化、牵引高效率、粘着高利用、空调高节能等关键技术，从整体上可持续提高列车系统能量利用效率
列车制动系统技术
有轨电车液压制动系统自主化、国产化，数字液压制动器示范应用
高速动车组、城际动车组制动系统自主化、国产化
列车网络控制技术
自主开发适用于中国标准高速动车组、快速动车组的网络控制系统
开发出规范化、标准化、系列化的现代有轨电车用以太网络系统硬件、软件平台
自主化标准规范，系统自主设计与集成
通信信号技术
突破列控系统车载ATP、车载ATO、地面RBC/ZC、地面列控中心、地面联锁设备以及无线通信宽带等关键技术
创新示范工程
绿色、智能工程化样车
集成储能电源、碳化硅（SiC）新型高效变流器、高效永磁同步电动机、自动驾驶等前沿技术，研制绿色智能工程化样车
绿色智能轨道交通系统集成工程
集成绿色智能轨道交通车辆、基于以太网的千兆带宽实时控制与信息网络技术、网络控制技术、双向馈能系统技术，实施“绿色智能轨道交通装备集成工程”
基于物联网的轨道交通装备全寿命周期服务体系
集成车载智能化状态监测技术、故障灾害监测系统技术，探索建立“基于物联网的轨道交通装备全寿命周期服务体系”
战略支撑与保障建
提高创新能力
以企业为主体，产学研用相结合，加强技术的基础性、前瞻性研究
建立和完善电力机车、城轨车辆国家工程实验室、国家工程研究中心等国家级研发基地
构建国际标准体系
培育建立第三方的专业检验检测和认证机构，建立和完善轨道交通装备产品认证制度
加强轨道交通装备标准的研究和制修订工作，鼓励有实力的单位牵头制定国际标准。
支持国际化经营
引导有实力的制造企业抓住全球产业重新布局机遇，有序走出去，开展绿地投资、并购投资、联合投资等，在境外设立研发机构、生产制造基地和市场营销网络，开展资源和价值链整合。

VI. Energy-saving and new energy vehicles

6.1 Fuel efficient cars

As conventional vehicles will continue to dominate consumption in the next 30 years, the widespread adoption of fuel-efficient vehicles will play a crucial role in easing the pressure on energy and the environment in China. The continued optimisation of conventional vehicle technology is also an important step for the Chinese automotive industry to close the gap and facilitate the development and market introduction of new energy vehicles.

An energy-efficient vehicle is one that is mainly powered by an internal combustion engine and has a combined working fuel consumption better than the next target value.

6.1.1 Demand

At present, the consumption of automotive gas and diesel fuel accounts for about 55% of the national consumption of gas and diesel fuel, and more than 70% of the annual new oil consumption is consumed by new vehicles. Along with the increasing stringency of energy-saving and environmental protection regulations, there is a strong demand for energy-efficient vehicles at the national level, at the enterprise level and at the user level. In recent years, the average fuel consumption of vehicles has continued to fall, and the market for energy-efficient vehicles has been rapidly increasing, with annual sales of energy-efficient vehicles in China expected to reach 30% of the total automotive market demand in 2020 and over 40% in 2025.

6.1.2 Objectives

By 2020, a market-driven, enterprise-oriented and closely integrated industry-academia-research-application energy-saving vehicle industry system will be formed. The market share of autonomous products will reach 40%; the fuel consumption of new commercial vehicles will be close to the international advanced level and the market share of domestically produced key components will exceed 70%; the average fuel consumption of new passenger vehicles will be better than 5L/100km and the market share of domestically produced key components will exceed 50%; there will be star models and star vehicle enterprises and the top 10 energy-saving vehicle sales will reach 5 enterprises. The quality level of domestic products PP100 is comparable to that of joint venture brands.

By 2025, a complete energy-efficient automobile industry chain with independent control will be formed, and the market for independent products will be expanded to include the following

The average fuel consumption of new passenger cars is better than 4L/100km, and the market share of domestic key components exceeds 60%; the top five companies in sales of energy-saving vehicles reach three, the reputation of independent products exceeds that of joint venture brands, and the market share of independent key components reaches 60%, with Energy-efficient commercial vehicles of world advanced level, and the export of commercial vehicles to 20%.

6.1.3 Development focus

1. Key products

（1） Fuel-efficient internal combustion-powered passenger vehicles

Focusing on the development and mass popularisation of small-displacement energy-efficient passenger cars, we will realise the technological upgrading of petrol engines, energy loss reduction, low and medium voltage boost and energy recovery, advanced diesel engines and other technologies in the full range of passenger car products.

（2） Hybrid passenger cars

The development and popularisation of hybrid passenger cars above the A-class level will be the main focus, and the promotion and application of hybrid technology in the full range of passenger cars such as family cars and business cars will be achieved, with the energy-saving effect of comprehensive working conditions exceeding that of conventional power by 20% in the same period.

（3）Fuel efficient diesel commercial vehicles

Focus on the development of energy-efficient semi-tractor trailers and other high-volume products, and promote the application of high-efficiency powertrain, integrated electronic control and light weight technologies in the full range of commercial vehicles. Commercial vehicles in the top 20% of the market in terms of fuel consumption and market share will be the driving force for the formation of energy-saving brand products with Chinese characteristics.

（4）Hybrid commercial vehicles

The large-scale development of hybrid city bus buses is the main focus to achieve the powertrain

The application of specialised design, control strategy optimisation and other technologies to the full range of buses and logistics vehicles has resulted in a 25% reduction in fuel consumption in urban conditions compared to the same models powered by internal combustion.

（5） Alternative fuel vehicles

Achieving the mass application of low carbon fuels such as natural gas in commercial and passenger vehicles, with better whole life carbon emissions than gas and diesel fuel efficient products.

2. Key components

（1） High efficiency internal combustion engines

Passenger car gasoline engine thermal efficiency ≥ 40%, independent products equipped with a rate of 40%. Heavy commercial vehicles diesel engine thermal efficiency ≥ 52%, the independent product equipment rate of 60%.

（2） Key components for efficient internal combustion engines

Breakthroughs in variable valve, variable compression ratio, supercharging and high efficiency after-treatment technologies with a 35% market share;

Breakthrough in gasoline injection at 250 bar and diesel injection above 2000 bar, with a market share of 15%.

Breakthrough in exhaust gas energy recovery technology for industrialisation.

（3） Electronic control systems

Engine and transmission electronic control systems will reach the international advanced level, and the domestic market share of domestic core controllers will reach 20%, while the domestic market share of key sensors will reach 80%. The domestic market share of domestic hybrid power core controllers will reach 80%. The domestic market share of key controller chips will reach 30%, and the application rate of independent real-time operating system will reach 50%.

（4）Hybrid motor/battery/specialised engine

Passenger cars 20s effective specific power ≥ 4kW/kg; commercial vehicles 30s effective specific torque ≥ 19Nm/kg; battery single specific power more than 8kW/kg, and achieve batch consistency; inverter power density of not less than 20kW/L, the development of efficient and highly reliable for hybrid special engines. Product market supply capacity to meet independent demand and to achieve the supply of foreign brands.

（5）Low and medium voltage boost and energy recovery technology

30% market share of in-house products, with battery system costs reduced to $3.6

/Wh, integrated power unit achieving power density ≥ 11kW/L (including heat sink)

（6）Efficient automatic transmission

Breakthroughs in key technologies for dual clutch automatic transmissions（DCT）continuously variable transmissions (CVT) and automatic transmissions（AT）of more than 6 speeds, mechanical automatic transmissions (AMT) and other assemblies, and industrialisation, accounting for more than 40% of the independent market share.

（7）Key components for automatic transmissions

Breakthrough in clutch assembly, high-pressure silent oil pump, electro-hydraulic coupling hydraulic valve body, hydraulic torque converter technology, to achieve industrial development, key components independent market share of more than 40%.

（8）Lightweight components

Representative lightweight components such as steel/aluminium hybrids, aluminium/fibre and carbon fibre bodies account for 20% of the market. A wide range of lightweighting technologies are applied to components such as bodies, body closures, wheels, subframes, transmission housings, brakes, wire harnesses and wiring controls.

（9）Low rolling resistance tyres

Domestic energy-saving tyres continue to improve wet-slip, abrasion and noise performance, with reduced rolling resistance

The company has achieved fuel savings of more than 6% and a market share of more than 50% of its own products.

3. Key common technologies

（1）Vehicle integration technology: breakthroughs in series development, matching and control technology for energy-efficient vehicles.

（2）Power technology: breakthroughs in combustion and control technology for miniaturised supercharged direct injection petrol engines, breakthroughs in combustion and control technology for high-efficiency commercial vehicle diesel engines, and breakthroughs in advanced diesel engine technology for passenger cars.

（3）Transmission technology: breakthroughs in the development and control technology of highly efficient automatic transmissions.

（4）Lightweight technology: breakthroughs in lightweight materials, composite materials, performance analysis, forming and joining of automotive parts and other technical problems.

（5）Low resistance technology: breakthroughs in low wind resistance, low rolling resistance, low friction and other technical challenges.

6.1.4 Application demonstration projects

1. The Energy Efficient Vehicle Enterprise Leader Demonstration Project.

2. Vehicle Energy Efficiency Level Marking and Application Demonstration.

3. Energy efficient commercial vehicle fleet application demonstration.

4. Demonstration of the application of energy-efficient products for official vehicles/large event vehicles.

6.1.5 Strategic support and assurance

1. Formation of an independent innovation development plan for energy-efficient vehicles at the national level.

2. Establishment of the Institute of Common Basic Technologies for the Energy-Efficient Vehicle Industry.

3. Implementation of sustainable and viable energy efficient vehicle subsidies, tax incentives and a high taxation system for high fuel consumption vehicles by tier.

4. Increase key core technologies such as high-efficiency powertrain, low driving resistance and lightweighting

R&D support for technology, strengthening industry cooperation and developing common generic technologies.

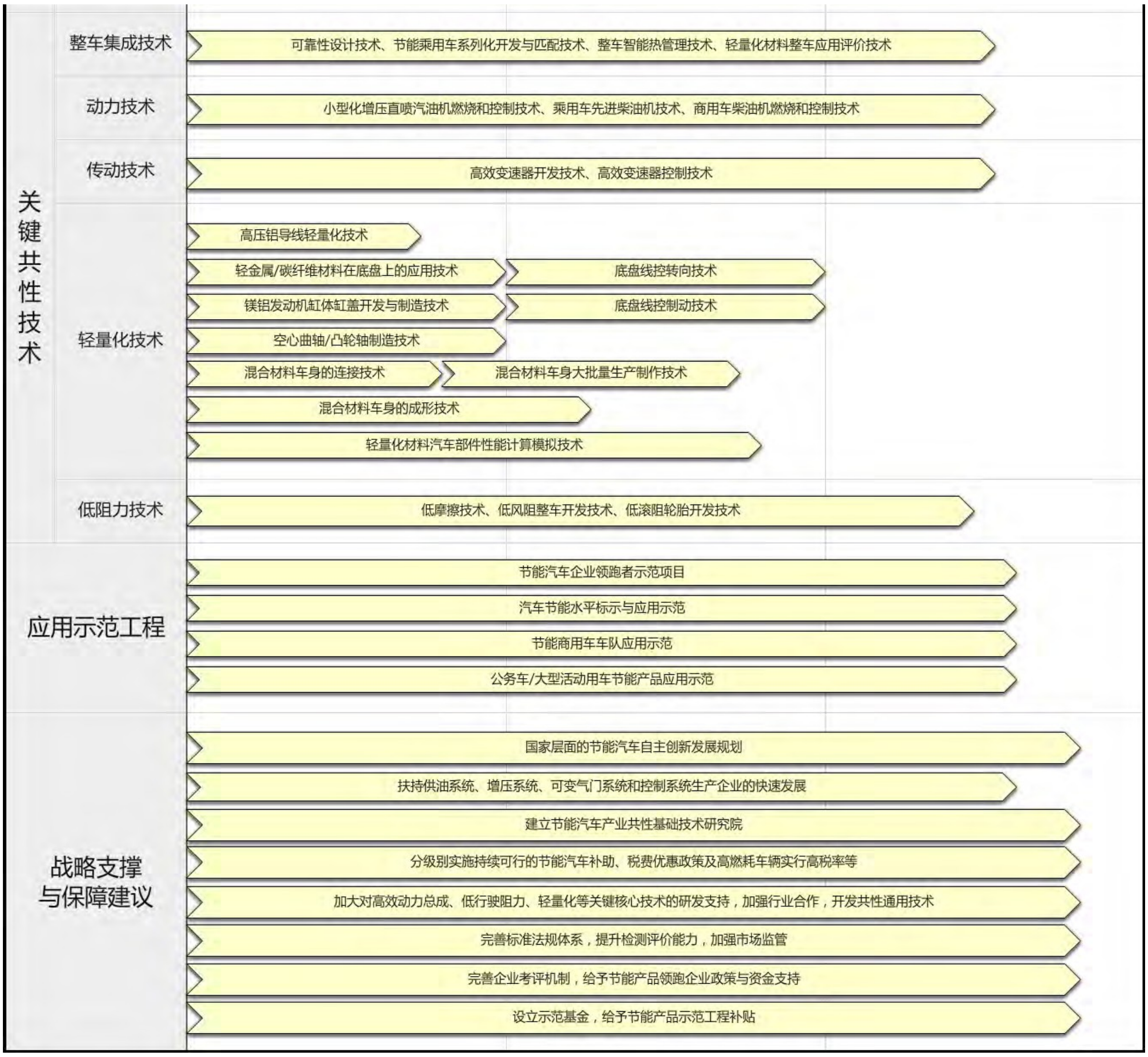
5. Improve the system of standards and regulations, enhance testing and evaluation capabilities, and strengthen market supervision.

6. Improve the assessment mechanism for enterprises and give policy and financial support to leading energy-saving product enterprises.

7. Set up a demonstration fund to grant subsidies for demonstration projects of energy-efficient products.


点
产
品
节能柴油商用车
批量生产
智能节能运输车，示范运行
实现重型车综合电子控制节能技术，
节能超过5%，实现产品化
重型车高效自动变速器批产，节能超过2%
空气动力学汽车列车量产
实现智能化编队行车，节能10%、
运输效率提升10%，道路示范运行
带编队行车功能的牵引车批产
混合动力商用车
在城市公交上实现批量应用
在城市公交、长途客车、物流车等上实现大规模应用
实现动力系统的专用化设计，
城市工况节能效果达到25%
实现控制策略和总成优化设计，
城市工况节能效果超过5%
附件电动化设计，城市工况节能效果达到5%
关键零部件国产化率超过90%
关键零部件国产化率达到100%
替代燃料汽车
实现天然气等低碳燃料在商用车和乘用车的大量应用
折算碳排放，压缩天然气商用车比
同级别节能商用车油耗降低10%
折算碳排放，压缩天然气商用车比
同级别节能商用车油耗降低10%
折算碳排放，压缩天然气商用车比
同级别节能商用车油耗降低10%
自主压缩天然气商用车市场占有率60%
自主压缩天然气商用车市场占有率70%
自主压缩天然气商用车市场占有率80%
突破天然气当量比燃烧的热负荷及爆震难题，
实现国VI排放，在主销车型上批量应用
突破天然气低温预混燃烧的燃烧控制难题，
在主销车型上批量应用

关键零部件	高效内燃机	乘用车汽油机热效率≥38%，重型商用车柴油机热效率≥50%	乘用车汽油机热效率≥40%，重型商用车柴油机热效率≥52%	乘用车汽油机热效率≥42%，重型商用车柴油机热效率≥54%
		节能汽油机自主产品装备率占20%；节能重型柴油机自主产品装备率30%	节能汽油机自主产品装备率占40%；节能重型柴油机自主产品装备率60%	节能汽油机自主产品装备率占70%；节能重型柴油机自主产品装备率70%
	高效内燃机关键部件	突破自主汽油直喷系统200bar喷油技术，自主150bar产品开发批量应用	突破自主汽油直喷系统250bar喷油技术，实现高压共轨系统产业化，形成自主共轨产品批量生产能力，自主产品市场占比达到20%	突破自主汽油直喷系统300bar及以上喷油技术，实现超高压直喷系统产业化，自主产品市场占比达到45%
		突破自主柴油共轨系统1800bar喷油技术与可变喷油规律技术，实现柴油机节油2%，自主1600bar产品开发批量应用	突破自主柴油共轨系统2000~2200bar喷油技术，实现高压共轨系统产业化，行业建立自主共轨产品批量生产能力，自主产品市场占比达到15%	突破自主柴油共轨系统2500bar及以上喷油技术，实现超高压共轨系统产业化，自主产品市场占比达到40%
		突破分段式可变气门升程技术，实现汽油机节油3%；实现产业化、形成批量生产能力，自主产品市场占比达到15%	突破电液有凸轮连续式全可变气门技术，实现汽油机节油5%;实现产业化、形成批量生产能力，自主产品市场占比达到35%	突破电控无凸轮全可变气门技术，预计实现汽油机节油8%～10%，形成产品开发和商品化能力
		汽油机突破废气旁通阀电动执行器技术、双流道技术，实现汽油机节油2%，形成批量生产能力，自主产品市场占比达到15%	汽油机突破电动增压器技术，实现汽油机节油3%，实现产业化、形成批量生产能力，自主产品市场占比达到35%	突破电辅助增压技术，实现汽油机和柴油机节油3%～5%，形成产品开发和商品化能力
		柴油机采用废气旁通阀电动执行器，实现柴油机节油1%，形成批量生产能力，自主产品市场占比达到15%	柴油机突破可变增压器技术，实现柴油机节油3%，形成批量生产能力，自主产品市场占比达到35%	
			能量管理技术达到国际先进水平，产品节油水平3%，实现产业化发展	产品节油水平8%
	电子控制系统	发动机控制系统控制器自主化率达20%，关键传感器部件国产化率达80%		
		变速器控制系统控制器自主化率达20%，关键传感器部件国产化率达80%		
		混合动力关键控制系统核心控制器自主化率达50%	混合动力关键控制系统核心控制器自主化率达80%	
		控制器自主芯片应用化率达到10%	控制器关键芯片国产化率达到30%	
		自主实时操作系统应用率达到10%	自主实时操作系统应用率达到50%	
	混合动力电机、电池、专用发动机	乘用车20s有效比功率≥3.5kW/kg；商用车30s有效比扭矩≥18N.m/kg	乘用车20s有效比功率≥4kW/kg；商用车30s有效比扭矩≥19N.m/kg	乘用车20s有效比功率≥5kW/kg；商用车30s有效比扭矩≥20N.m/kg
		电机逆变器功率密度≥15kW/L	电机逆变器国产化率占60%以上；实现功率密度≥25kW/L	电机逆变器实现功率密度≥30kW/L
		电池单体比功率达到7kW/kg	电池单体比功率超过8kW/kg，宽温度适应性，高能量密度	
		电池单体成本2.5元/Wh，系统成本3.6元/Wh	电池单体成本2.2元/Wh，系统成本3.2元/Wh	电池单体成本1.8元/Wh，系统成本2.6元/Wh
		混合动力专用发动机，高效率，高可靠		
	中低压助力与能量回收系统	48V系统实现产业化、形成批量生产能力，自主产品市场占比达到10%	48V系统自主产品市场占比达到30%	48V系统自主产品市场占比达到50%
		一体化电机总成比功率≥1.4kW/kg，比扭矩≥6.6N.m/kg	一体化电机总成比功率≥1.5kW/kg，比扭矩≥7N.m/kg，国产化率40%以上	一体化电机总成比功率≥1.7kW/kg，比扭矩≥8N.m/kg，国产化率80%以上
		集成式功率单元功率密度≥10kW/L（含散热器）	集成式功率单元实现功率密度≥11kW/L（含散热器），国产化率30%以上	集成式功率单元实现功率密度≥13kW/L（含散热器），国产化率60%以上
		电池单体比功率达到7kW/kg	电池单体比功率超过8kW/kg，宽温度适应性，高能量密度	
		电池单体成本2.5元/Wh，系统成本4.2元/Wh	电池单体成本2.2元/Wh，系统成本3.6元/Wh	电池单体成本1.8元/Wh，系统成本3元/Wh
	高效自动变速器	突破双离合器自动变速器、无级变速器和6速以上自动变速器、自动机械式自动变速器等总成关键技术，并实现产业化，占自主市场份额20%以上	突破双离合器自动变速器、无级变速器和6速以上自动变速器、自动机械式自动变速器等总成关键技术，并实现产业化，占自主市场份额40%以上	突破双离合器自动变速器、无级变速器和6速以上自动变速器、自动机械式自动变速器等总成关键技术，并实现产业化，占自主市场份额60%以上
	自动变速器关键零部件	离合器总成，打破国外垄断，自主产品市场占比达到20%	离合器总成，实现除摩擦材料外大部件部件国产化，自主产品市场占比达到40%	离合器总成，实现摩擦材料国产化，总成80%自主
		电液耦合液压阀体，打破国外垄断，自主产品市场占比达到20%	电液耦合液压阀体，开关阀国产化，总成自主产品市场占比达到40%	电液耦合液压阀体，电磁阀和传感器实现自主，自主产品市场占比达到60%
		液力变矩器，最高效率达到92%以上，自主产品市场占比达到20%	液力变矩器，最高效率达到92%以上，自主产品市场占比达到40%	液力变矩器，最高效率达到92%以上，自主产品市场占比达到60%
		高压静音油泵，打破国外垄断，自主产品市场占比达到20%	高压静音油泵，噪音下降2dB（A），自主产品市场占比达到40%	高压静音油泵，自主产品市场占比达到60%
	轻量化零部件	通过高强钢，铝镁合金等复合材料在汽车上的应用，实现平均整车降重目标5%～10%	钢/铝混合、铝/纤维、碳纤维车身等代表性的轻量化部件占市场的20%	
		车身、车身闭合件、车轮、副车架、缸体、缸盖、变速器壳体、转向节、轮毂单元、控制臂、空心曲轴、制动器、电线束、线控等零部件上的轻量化技术应用		
	轮胎	2020年国产节能轮胎滚动阻力降低20%，节油4%以上，产品市场占有率超过50%	2025年国产节能轮胎滚动阻力降低30%，节油6%以上，产品市场占有率超过50%	2030年国产节能轮胎滚动阻力降低40%，节油8%以上，产品市场占有率达100%
		湿滑、磨耗、噪声性能持续改善		



关键共性技术
整车集成技术
可靠性设计技术、节能乘用车系列化开发与匹配技术、整车智能热管理技术、轻量化材料整车应用评价技术
动力技术
小型化增压直喷汽油机燃烧和控制技术、乘用车先进柴油机技术、商用车柴油机燃烧和控制技术
传动技术
高效变速器开发技术、高效变速器控制技术
轻量化技术
高压铝导线轻量化技术
轻金属/碳纤维材料在底盘上的应用技术
底盘线控转向技术
镁铝发动机缸体缸盖开发与制造技术
底盘线控制动技术
空心曲轴/凸轮轴制造技术
混合材料车身的连接技术
混合材料车身大批量生产制作技术
混合材料车身的成形技术
轻量化材料汽车部件性能计算模拟技术
低阻力技术
低摩擦技术、低风阻整车开发技术、低滚阻轮胎开发技术
应用示范工程
节能汽车企业领跑者示范项目
汽车节能水平标示与应用示范
节能商用车车队应用示范
公务车/大型活动用车节能产品应用示范
战略支撑与保障建议
国家层面的节能汽车自主创新发展规划
扶持供油系统、增压系统、可变气门系统和控制系统生产企业的快速发展
建立节能汽车产业共性基础技术研究院
分级别实施持续可行的节能汽车补助、税费优惠政策及高燃耗车辆实行高税率等
加大对高效动力总成、低行驶阻力、轻量化等关键核心技术的研发支持，加强行业合作，开发共性通用技术
完善标准法规体系，提升检测评价能力，加强市场监管
完善企业考评机制，给予节能产品领跑企业政策与资金支持
设立示范基金，给予节能产品示范工程补贴

6.2 New Energy Vehicles

The large-scale development of new energy vehicles is an important strategic initiative to effectively alleviate the pressure on energy and the environment in China and to promote technological innovation and transformation and upgrading of the automotive industry.

New energy vehicles refer to vehicles with a new type of powertrain, driven entirely or mainly by a new type of energy source, and mainly include pure electric vehicles, plug-in hybrid vehicles and fuel cell vehicles.

6.2.1 Demand

In 2014, China sold 75,000 new energy vehicles, up 3.2 times year-on-year, making it the second largest new energy vehicle market in the world. International forecasts suggest that China will become the world's number one market for new energy vehicles by 2020. As new energy vehicles become more popular in the household, public service, bus, taxi and logistics sectors, annual sales of new energy vehicles in China will reach more than 5% of the total automotive market demand in 2020 and increase to around 20% in 2025. Under the demand of the national target of total carbon emission and primary energy substitution, the annual sales ratio of new energy vehicles will continue to increase significantly in 2030, with the scale exceeding 10 million units.

6.2.2 Objectives

By 2020, a market-oriented, enterprise-oriented and industry-academia-research-application new energy vehicle industry system will be initially established. The annual sales of autonomous new energy vehicles will exceed 1 million units, with a market share of more than 70%; star models will be built, entering the top 10 in global sales, new energy buses will be exported on a large scale, and the average mileage between failures will reach 20,000 km; key systems such as power batteries and drive motors will reach international advanced levels, with a market share of 80% in China.

By 2025, a complete industry chain with independent control will be formed, which will be comparable to the international advanced level.

Synchronised annual sales of 3 million new energy vehicles, with a market share of independent new energy vehicles

The technical level of products will be synchronized with international standards, and there will be two first-class vehicle enterprises in the top 10 in global sales, with overseas sales accounting for 10% of total sales; the supporting infrastructure for hydrogen production and hydrogen refuelling will be basically improved, and fuel cell vehicles will operate on a small scale in the region.

6.2.3 Development focus

1. Key products

（1） Plug-in hybrid vehicles

The development of plug-in hybrid passenger cars in compact models and above is the main focus, and the application of plug-in hybrid technology is being promoted in private cars, business cars and other areas where the average daily driving range is short. Fuel consumption in hybrid mode is 25% less than in conventional models (not including the extended program electric vehicles)

（2） All-electric vehicles

The main focus will be on the development of pure electric passenger cars on a medium-sized scale and below, and the promotion and application of pure electric technology in the areas of family cars, official cars, rental services and short-haul commercial vehicles. A typical small pure electric passenger car (with an overall mass of 1275kg) has an electricity consumption of less than 11.5kWh/km; a bus has an electricity consumption of less than 3.2kWh/100km/t.

（3）Fuel Cell Vehicles

Focus on the bulk application of urban private and public service vehicles to achieve the popularisation and application of fuel cell technology. Significantly reduce the cost of fuel cell systems by optimising the structural design of fuel cell systems and accelerating the industrialisation of key components.

2.Key components

Focus on promoting the autonomy of key core components such as motors, batteries, inverters, etc., full

The new energy vehicle industry has been developed to meet the needs of the industry.

（1） Drive motors

The R&D and commercialization capability of the independent motor will reach the international advanced level, and the effective specific power of the drive motor for passenger cars will not be less than 4kW/kg in 20s, and the effective specific torque for commercial vehicles will not be less than 19Nm/kg in 30s.

（2） Motor controllers

To achieve a power density of no less than 25kW/L, comprehensive performance at an international advanced level and an autonomous rate of over 60%.

（3） Power Battery Systems

The specific energy of the battery unit reaches over 400Wh/kg and the cost is reduced to RMB 0.8/Wh; the system cost is reduced to RMB 1/Wh.

（4） Fuel cell systems and power packs

Fuel cell systems with a volumetric specific power of 3kW/L, cold starting temperatures of -30°C or below, a lifetime of over 5000h and a production capacity of over 100,000 sets.

（5） Electromechanical coupling devices

The pure electric drive system achieves a maximum mechanical transmission efficiency of over 93% and the electromechanically coupled transmission is highly integrated and specialised.

（6） Booster engines

The lowest specific fuel consumption of the domestically produced add-on engine was reduced to below 225g/kWh and the domestic market share reached 80%.

（7） High pressure assembly

DC-DC converter (ＤＣ-ＤＣ）and charger systems all achieve efficiencies of 95% or more

On the high voltage relays and fuses to achieve miniaturisation and low cost; high voltage aluminium conductors to achieve
High volume applications.

（8） Complete vehicle controller

The whole vehicle controller has the intelligent driving control function combined with global positioning system, geographic information system and intelligent transportation system (GPS/GIS/ITS), the domestic market share of the domestic vehicle control system reaches 80%, the application rate of key domestic chips reaches 30%, and the application rate of independent real-time operating system reaches 50%.

（9） Lightweight body

Achieving technological breakthroughs in composite/hybrid materials, lowering costs and reaching 30% application rate in new energy vehicles and more than 50% autonomy rate.

3. Key common technologies

（1） Integrated vehicle technology: breakthroughs in the integration of multiple information, intelligent control technology for the whole vehicle with energy management as the core, highly integrated power system electrification and other technical problems, and the development of integrated application technology for solar cells for the whole vehicle.

（2） Electric drive system technology: breakthroughs in the integration of motors and transmissions, inverters, special transmissions for highly integrated electric drive systems and other technical challenges.

（3） Energy storage system technology: breakthroughs in wide temperature, long life, all-solid-state batteries, low cost, highly integrated battery management and other technical challenges.

（4） Fuel cell system technology: breakthroughs in technical problems such as highly reliable membranes, catalysts and bipolar plates, highly reliable supply systems and their key components.

（5） High-voltage electrical system technology: breakthroughs in wireless charging, thin-walled insulation layers with high voltage resistance levels and other technical challenges.

6.2.4 Application demonstration projects

1. Demonstration project for pure electric and plug-in hybrid vehicles.
2. Fuel Cell Vehicle Demonstration Project and Promotion.
3. Renewable energy, smart grid, smart community and new energy vehicle demonstration projects and promotion.
4. Green and intelligent manufacturing demonstration project for key components of new energy vehicles.

6.2.5 Strategic Support and Assurance

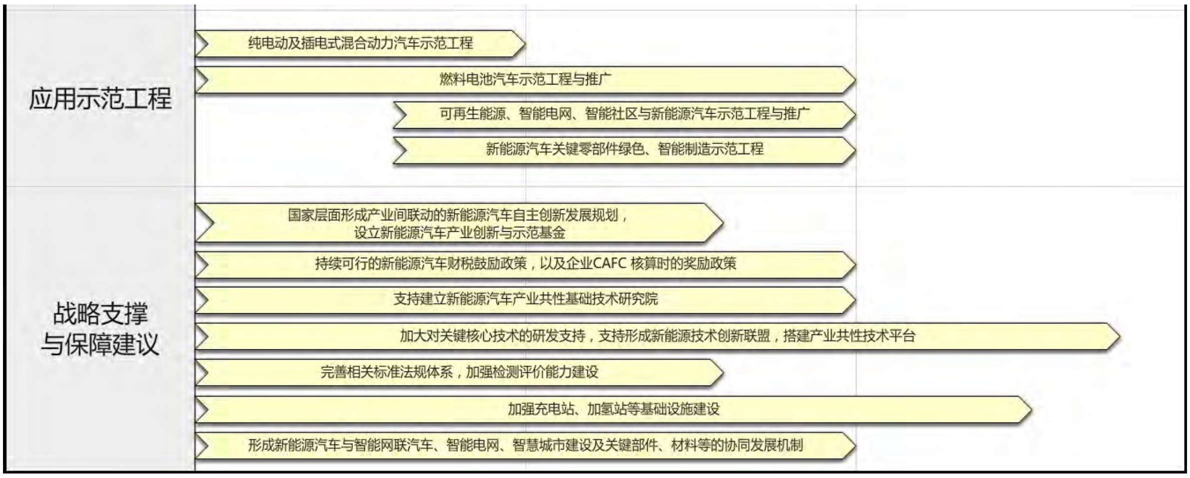
1. Form inter-industry linkages at the national level for the development of independent innovation planning for new energy vehicles, and establish a new energy vehicle industry innovation and demonstration fund.
2. A sustainable and viable fiscal and tax incentive policy for new energy vehicles and an incentive policy for companies when accounting for their average fuel consumption.
3. Support the establishment of a common basic technology research institute for the new energy vehicle industry.
4. Increase support for research and development of key core technologies, support the formation of new energy technology innovation alliances and build common technology platforms for the industry.
5. Improve the relevant standards and regulations system and strengthen the capacity building of testing and evaluation.

6. Strengthen the construction of infrastructure such as charging stations and hydrogen refuelling stations.

7. Form a mechanism for the synergistic development of new energy vehicles and smart networked vehicles, smart grids, smart city construction and key components and materials.

		2020年	2025年	2030年
需求		GB27999国家标准要求乘用车新车整体油耗降至5L/100km	乘用车新车整体油耗拟降至4L/100km	乘用车新车整体油耗拟降至3.2L/100km
		《节能与新能源汽车产业发展规划（2012-2020）》对新能源汽车提出明确的产销规模与技术水平需求	中国计划2030年左右CO2排放达到峰值，非化石能源占一次能源消费比重升至20%；国际预测表明，2020年后新能源汽车快速扩张，2025年后中国成为全球第一大市场	
		新能源汽车年销量将占汽车总体需求量的5%以上，规模为200万辆左右	新能源汽车年销量占汽车总体需求量比例将超过20%	新能源汽车年销量占汽车总体需求量比例将继续大幅提高，规模超过千万辆
		新能源汽车使用将由目前的公务用车、公交、出租等公共服务领域扩大至私人用车、客运、货运等大多数汽车使用领域		
		政策优惠下的新能源汽车销量快速提升	具有成本竞争力，集节能、环保、安全、舒适、信息与智能技术于一体的新能源汽车	
目标		自主品牌新能源汽车年销量突破100万辆，在国内市场占70%以上;生产1000辆燃料电池汽车并进行示范运行	与国际先进水平同步的新能源汽车年销量300万辆，在国内市场占80%以上;制氢、加氢等配套基础设施基本完善，燃料电池汽车实现区域小规模运行	自主品牌新能源汽车在国内市场占绝对主导地位，出口份额达到总产量的30%
		打造明星车型，进入全球销量排名前10，新能源客车实现批量出口	2家整车企业销量进入世界前10，海外销售占总销量的10%	主流自主企业的新能源汽车技术国际领先
		整车平均故障间隔里程达到2万公里	自主产品美誉度与国际品牌接轨，质量排名处于前列	
		动力电池、驱动电机等关键系统达到国际先进水平，在国内市场占有率80%;实现燃料电池关键材料批量化生产的质量控制和保证能力	动力电池、驱动电机等关键系统实现批量出口；燃料电池高品质关键材料、零部件实现国产化和批量供应	培育3家具有国际领先水平的新能源汽车零部件企业
		突破整车构型、性能控制、能量管理、轻量化等整车集成关键技术	与汽车轻量化、信息化、智能化同步规划、融合发展、协同创新，并成为新技术先导应用的载体	
重点产品	插电式混合动力汽车	在紧凑型及以上乘用车的私人用车、公务用车、以及其他日均行驶里程较短的细分市场实现批量应用	在紧凑型及以上乘用车的私人用车、公务用车、以及其他日均行驶里程较短的使用领域实现大规模应用	
		城市工况纯电行驶加速性能接近传统车水平，混合动力模式油耗相比传统车型节油25%（不包括增程式电动车）	混合动力模式下整车油耗相比2020年水平降低5%	
		关键零部件国产化率达到80%	关键零部件国产化率超过80%	
	纯电动汽车	在紧凑型及以下乘用车的城市家庭第二辆用车、租赁服务、公务车实现批量应用；在公交客车、市政卡车、短途物流车以及其他特定市场、特定用途等领域实现大批量应用	在中型及以下乘用车的城市家庭第二辆用车、租赁服务、公务车实现大批量应用	在乘用车和短途商用车上实现大批量应用
		乘用车：典型小型纯电动乘用车（整备质量1275kg）法规工况电耗小于12.8kWh/100km	乘用车：法规工况整车电量在2020年指标基础上降低10%	
		公交客车：法规工况整车电量消耗量小于3.5kWh/100km·t	公交客车：法规工况整车电量消耗量小于3.2kWh/100km·t	
		关键零部件国产化率达到80%	关键零部件国产化率超过80%	
	燃料电池汽车	在特定区域的公共服务用车领域小规模示范应用	在城市私人用车、公共服务用车领域实现区域小规模运行	实现燃料电池汽车的大批量应用
		整车耐久性到达15万公里，续驶里程500公里，加氢时间3分钟，冷起动温度达到-30℃，燃料电池堆使用寿命达到5000h	整车耐久性超过15万公里，燃料电池堆使用寿命超过5000h	整车性能达到与传统车相当，具有相对产品竞争力优势
		优化燃料电池系统结构设计，加速关键部件产业化，大幅降低燃料电池系统成本	在当期政策下优于传统动力车型整车全生命周期成本（TCO）	与传统动力车型整车全生命周期成本（TCO）相当
		开发燃料电池关键材料及部件，关键材料及部件国产化率达到30%	掌握双极板、膜电极等关键材料部件制造工艺，关键材料及电堆产品国产化率50%	全面实现燃料电池关键材料、电堆等产品国产化，国产化率达到70%
	驱动电机	乘用车20s有效比功率≥3.5kW/kg；商用车30s有效比扭矩≥18N.m/kg	乘用车20s有效比功率≥4kW/kg；商用车30s有效比扭矩≥19N.m/kg	乘用车20s有效比功率≥5kW/kg；商用车30s有效比扭矩≥20N.m/kg
		低损耗硅钢、高性能磁钢、成型绕组、汇流排、磁钢定位封装等先进工艺材料	关键材料和部件采用国内资源，自主工艺开发及生产线建设能力达到国际先进水平，先进工艺材料推动自主进步的格局基本形成	出口份额达到自主总产量20%
	电机控制器	实现功率密度≥15kW/L	自主率达到60%以上；实现功率密度≥25kW/L	实现功率密度≥35kW/L
		自主封装的绝缘栅双极型晶体管(IGBT)模块占市场总量20%以上，逆变器性能和可靠性达到国际先进水平	自主封装的绝缘栅双极型晶体管(IGBT)占市场总量60%以上，自主芯片占总量20%以上，逆变器综合性能达到国际先进水平	出口份额达到自主总产量5%
	动力电池系统	单体比能量达到300Wh/kg	单体比能量大于400Wh/kg	单体比能量大于500Wh/kg
		系统使用寿命达到10年		
		单体成本达到1元/Wh，系统成本达到1.3元Wh	单体成本达到0.8元/Wh，系统成本达到1元/Wh	单体成本低于0.6元/Wh，系统成本低于0.8元/Wh
	燃料电池系统及电堆	燃料电池系统产能超过1000套	燃料电池系统产能超过10万套	燃料电池系统满足自主整车需求
		燃料电池系统体积比功率>2.5kW/L，冷起动温度<-30℃，寿命达到5000h	燃料电池系统体积比功率>3kW/L，寿命超过5000h	冷起动温度<-40℃
		高速空压机、氢循环系统、70MPa储氢瓶等关键系统附件性能满足车用指标要求		系统部件逐步实现国产化，系统成本低于200元/kW（年产50万辆规模时）

关键零部件	机电耦合装置	纯电驱动系统最高机械传动效率大于91%	纯电驱动系统最高机械传动效率大于93%	自主品牌纯电驱动系统在国内市场占主导地位，出口份额达到总产量的20%
		机电耦合变速器，最高机械传动效率大于88%	高集成度专用机电耦合变速器，最高机械传动效率大于90%	自主品牌专用机电耦合变速器在国内市场占主导地位，出口份额达到总产量5%
	增程式发动机	发动机最低比油耗小于230g/kWh	发动机最低比油耗小于225g/kWh	发动机最低比油耗小于220g/kWh
		增程式发动机自主化率30%	增程式发动机自主化率达到80%	增程式发动机自主化率大于90%
		可靠性、安全性、振动噪声（NVH）等性能满足车用需求		
	高压总成	直流-直流变换器（DC-DC）总成效率达到92%，充电器系统效率达到92%	直流-直流变换器（DC-DC）、充电器系统效率均达到95%以上	
		高压继电器、熔断器耐压等级提高、载流能力提升	高压继电器、熔断器小型化、低成本	
		高压铝导线的技术应用，重量降低25%，成本降低30%	实现高压铝导线的大批量应用	实现新型导体材料的线束及电连接技术的应用
	整车控制器	插电式混合动力汽车、纯电动汽车整车控制器	具备与全球定位系统、地理信息系统和智能交通系统（GPS/GIS/ITS）相结合的智能行驶控制功能的插电式混合动力汽车、纯电动汽车整车控制器	与信息化、智能化融合的整车控制器
		燃料电池汽车整车控制器		
		整车控制系统自主化率达到50%，关键国产化芯片应用率达到10%，自主实时操作系统应用率达到10%	整车控制系统自主化率达到80%，关键国产化芯片应用率达到30%，自主实时操作系统应用率达到50%	整车控制系统出口20%
	轻量化车身	复合材料/混合材料技术，降低成本，提高性能，实现批量稳定生产	低成本技术，大规模生产应用	碳纤维车身制造技术与生产能力国际领先
		在新能源汽车上实现小批量应用	在新能源汽车上的应用率达到30%，自主率超过50%	在新能源汽车的应用率达到80%，自主份额90%以上
	其他部件	协调式制动能量回收系统	基于线控技术的制动能量回收系统	新型电动车制动系统
		电动助力转向系统	电动化、智能化相融合的转向系统	
		基于热泵的电动车空调系统	车室和电池一体化的电动车空调系统	新型高效环保电动车空调系统
关键共性技术	整车集成技术	动力系统电动化技术	基于专用总成的动力系统电动化技术；	基于下一代动力系统的全新概念电动汽车
		底盘系统电动化技术：电驱动系统与制动系统集成	底盘系统电动化技术：电驱动系统与底盘系统集成	
		电动车整车安全、振动噪声（NVH）、寿命等性能控制技术		
		基于高强钢、轻金属和复合材料的车身和底盘轻量化技术		新型整车轻量化技术
		以动力总成扭矩控制为核心的整车控制技术	以能量管理为核心的整车智能控制技术	与信息化、智能化相融合的整车智能控制技术
	电驱动系统技术	电机与传动装置、逆变器集成技术	轮边/轮毂电机系统技术	电机内置功率电子集成技术
		高输出密度、高效率永磁电机技术	新类型、新结构电机技术	高压化、高速化电机技术技术
		高可靠低成本逆变器技术	基于芯片技术和封装技术革新的	应用宽禁带材料功率模块的新型逆变器技术
		高速减速器及变速器技术	大速比小型化减速器技术高集成电驱动系统	新型电传动技术：电磁变速器（EMT）等
		自动化制造工艺及装备技术	数字化、智能化制造技术	
	能量存储系统技术	高容量锂离子电池材料技术	锂二次电池材料技术	新体系电池材料技术
		高比能、高安全锂离子电池技术	宽温度、长寿命、全固态子电池技术	全新材料体系电池技术
		高精度、高可靠性电池管理技术	低成本、高集成化电池管理技术	新型电池管理技术
		高比能、高安全电池总成技术	电池总成与车身、底盘结构一体化技术	
		自动化制造工艺及装备技术	数字化、智能化制造技术	
	燃料电池电堆及系统技术	高性能国产燃料电池关键材料与部件技术	国产化高耐久性燃料电池关键材料、部件及其小批量生产技术	国产化低成本燃料电池关键材料、部件及其批量生产技术
		高比功率、高耐久性燃料电池电堆产品技术		低成本燃料电池电堆产品技术
		高可靠性供给系统及其关键部件产品技术		供给系统及关键部件低成本技术
		燃料电池系统集成及优化控制技术		
		高压储氢产品技术		储氢系统低成本技术
	高压电气系统技术	整车高压触电防护技术		
		高压配电装置结构小型化、高安全性技术	高压配电部件低功耗，高可靠性技术	高压配电装置低成本技术
		车辆对车辆、家用负载及其它用电负载供电技术（V2V/V2H/V2L）	车辆与电网双向充电技术（V2G）	
		超快速充电技术（5-10min）		超快速充电技术（3min）
		无线充电产品技术	高效率，小型化无线充电产品技术	
		铝导线导体结构和压接技术 高压线缆薄壁绝缘层技术	高耐压等级薄壁绝缘层技术	新导体材料高压电连接技术


应用示范工程
纯电动及插电式混合动力汽车示范工程
燃料电池汽车示范工程与推广
可再生能源、智能电网、智能社区与新能源汽车示范工程与推广
新能源汽车关键零部件绿色、智能制造示范工程
战略支撑与保障建议
国家层面形成产业间联动的新能源汽车自主创新发展规划，设立新能源汽车产业创新与示范基金
持续可行的新能源汽车财税鼓励政策，以及企业CAFC 核算时的奖励政策
支持建立新能源汽车产业共性基础技术研究院
加大对关键核心技术的研发支持，支持形成新能源技术创新联盟，搭建产业共性技术平台
完善相关标准法规体系，加强检测评价能力建设
加强充电站、加氢站等基础设施建设
形成新能源汽车与智能网联汽车、智能电网、智慧城市建设及关键部件、材料等的协同发展机制

6.3 Smart Connected Vehicles

It can significantly improve traffic safety, achieve energy saving and emission reduction, eliminate congestion, enhance social efficiency, and stimulate the synergistic development of automobiles, electronics, communications, services and social management, and is of great strategic significance in promoting China's industrial transformation and upgrading.

Intelligent networked vehicles refer to a new generation of vehicles equipped with advanced on-board sensors, controllers, actuators and other devices, and integrating modern communication and network technologies to achieve seamless links between the in-vehicle network, the out-vehicle network and the inter-vehicle network, with information sharing, complex environment awareness, intelligent decision-making, automated cooperation and other control functions, and an intelligent travel system composed of intelligent roads and auxiliary facilities, which can achieve " A new generation of vehicles that are efficient, safe, comfortable and energy efficient. There are four levels of intelligent networked vehicles: DA, PA, HA and FA, with DA referring to driver assistance.

It includes one or more partially autonomous functions such as ESC, ACC, AEBS, etc., and can provide intelligent Netlink-based alert messages; PA refers to partially autonomous driving, where the driver can maintain control despite short periods of distraction, is alerted to loss of control for more than 10 seconds, and can provide intelligent Netlink-based guidance messages; HA refers to highly autonomous driving, where the driver can drive automatically both on the motorway and in the city, with occasional HA refers to Highly Autonomous Driving, which is autonomous on the motorway and in the city and occasionally requires the driver to take over, but has sufficient handover time and provides intelligent web-based control information; FA refers to Fully Autonomous Driving, where the driving authority is fully handed over to the vehicle.

6.3.1 Demand

With 150 million vehicles in China, four major automotive hazards of energy, pollution, congestion and safety are becoming increasingly acute. By 2020, the rate of telecommunication and interconnection terminals will reach 50%, and the rate of driver assistance (DA) and partially autonomous driving (PA) vehicles will increase.

By 2025, the entire fleet of long-range and short-range communication terminals will be equipped with a market share of approximately 30%. The market share of DA and PA vehicles remains stable, while the market share of highly autonomous vehicles (HA) is around 10-20%.

The continuous increase in consumer demand for information and intelligent products is the main driving force for the development of smart connected cars; the Chinese automotive industry is developing along with the Industrial Revolution 4.0 transformation, and the demand for the integration of industrialisation and informatisation has intensified; the integration of the two is not only a basic condition for the manufacture of smart connected cars, but also a major initiative to solve the social problems of the four major public hazards of automobiles; along with the development of information and intelligence, the need to accelerate the implementation of smart The demand for the construction of smart cities and intelligent transportation has already emerged, and smart connected cars and smart cities will be an important practice of Internet+.

6.3.2 Objectives

By 2020, an independent innovation system for intelligent network-linked vehicles will be formed with enterprises as the main body, market-oriented, close integration of government, industry, academia, research and application, and cross-industry collaborative development. The independent share of automobile information products will reach 50%, the independent share of DA and PA vehicles will exceed 40%, the key technologies of sensors and controllers will be mastered, the supply capacity will meet the independent scale demand, and the product quality will reach the international advanced level. Launch the construction of smart transportation cities, and the share of independent facilities will be over 80%.

By 2025, the autonomous intelligent networked vehicle industry chain and intelligent transportation system will be basically built. The independent share of automobile information products will reach 60%, and the independent share of DA, PA and HA vehicles will reach more than 50%; sensors and controllers will reach international advanced level, key technologies of actuators will be mastered, and there will be one supplier enterprise ranking among the top ten in the world in terms of supply volume; independent intelligent trucks will start to be exported on a large scale; digitalization, networking and intelligence of the whole life cycle of automobiles will be realized, and the transformation and upgrading of the automobile industry will be completed initially. The transformation and upgrading of the automotive industry has been completed.

Proposing vehicle-related intelligent transport solutions, traffic efficiency improvements on ordinary roads

80% higher, the number of traffic accidents reduced by 80%, the number of traffic fatalities reduced by 90% and vehicle CO_2 emissions reduced by approximately 20%.

6.3.3 Development focus

1. Key products

（1） Netlink-based in-car intelligent information service system

On the basis of the existing Telematics system, information services such as traffic, information, vehicle operation status and intelligent control are provided for driving and travelling, highlighting the upgrading of information technology and human-computer interaction. The telematics function will be gradually popularised and the V2X short-range communication function will be partially realised, so that the information can be used for intelligent control and the information equipment rate will be 80%.

（2） Driver-assist-grade smart cars

Develop Chinese version of intelligent driving assistance standards, based on in-vehicle sensing to achieve intelligent driving assistance, which can alert the driver and intervene in the vehicle, highlighting safety, comfort and convenience, and the driver should maintain continuous control of the vehicle; the number of traffic accidents should be reduced by 30% and the number of traffic fatalities by 10%, the DA intelligent equipment rate should be 40% and the autonomous system equipment rate should be 50%.

（3） Partially or highly autonomous driving class smart cars

Develop Chinese versions of urban smart driving standards for passenger cars and highway smart driving standards; gradually realise partially or highly automated driving for passenger cars, highlighting comfort, convenience, efficient mobility and safety, realising safety management of network-linked information, popularising PA-level smart cars for highways and DA-level smart cars for first-tier cities; develop Chinese versions of suburban smart driving standards for commercial vehicles and highway smart driving standards, commercial vehicles gradually realise partially or highly automatic driving, and improve the operational efficiency, economy, safety and convenience of transport vehicles, mainly through breakthroughs in network-linked intelligent management and formation control technologies.

Popularization of DA-class intelligent vehicles on highways, gradual application of PA-class intelligent vehicles; HA and PA intelligent vehicles

50% energy-equipped rate and 40%

autonomous system equipment rate.

（4） Fully autonomous driver-grade smart cars

Develop Chinese version of fully autonomous driving standards, based on multi-source information fusion, multi-network fusion, using artificial intelligence, deep mining and automatic control technology, with intelligent environment and auxiliary facilities to achieve autonomous driving, which can change travel patterns, eliminate congestion, improve road utilization, reduce comprehensive energy consumption by 10%, reduce emissions by 20%, reduce the number of traffic accidents by 80%, and basically eliminate traffic fatalities; FA intelligent Equipment rate of 10%, autonomous system equipment rate of 40%.

（5） Smart travel with a car

Develop Chinese version of intelligent transport standards, rely on the construction of smart city and intelligent transport system, to achieve intelligent management of bus and taxi, information equipment rate of 100%, intelligent equipment rate of 70%.

2.Key components

（1） On-board optical systems

Optical cameras, night vision systems, etc., with image processing and visual enhancement functions, performance and international brands and has a cost advantage, independent market share of more than 80%.

（2） Vehicle mounted radar systems

Medium and long range millimeter wave radar, near range millimeter wave radar, long range ultrasonic radar, LIDAR, etc., the effective target recognition accuracy is comparable with international brands, and has the cost advantage, independent market share of more than 40%.

（3） High precision positioning systems

Based on the BeiDou system, it has achieved an independent breakthrough, with sub-metre accuracy in vehicle positioning, gradually replacing and upgrading GPS, with an independent market share of over 60%.

Up.

（4） Connected Vehicle Terminal

The independent share of in-vehicle infotainment system reaches 70%, the independent share of remote communication module reaches 60% and the independent share of proximity communication module exceeds 90%.

（5） Integrated control systems

Development of domain controllers to achieve precise control and coordination of subsystems, and to develop technical and cost advantages, with an independent share of 50%.

3. Key common technologies

（1） Multi-source information fusion technology: breakthroughs in environmental awareness and multi-sensor information fusion, V2X communication module integration, in-vehicle and connected information fusion technology.

（2） Collaborative vehicle control technology: breakthroughs in whole vehicle integration and collaborative control technology.

（3） Data security and platform software: breakthroughs in information security, system health intelligence monitoring technology, and building the Chinese version of the vehicle embedded operating system platform software.

（4） Human-machine interaction and co-driving technologies: breakthroughs in human-machine interaction, human-machine co-driving and failure compensation technologies.

（5） Infrastructure and technical regulations: Formation of the Chinese version of the technical standard system and test and evaluation methods for advanced intelligent driver assistance, V2X and multi-network convergence, and improvement of the road infrastructure based on the V2X communication standard system.

6.3.4 Application demonstration projects

1. Research and application demonstration of smart connected vehicles and operating environments in typical cities;
2. Research and application demonstration of smart networked vehicle legislation under local regulations;
3. Demonstration of the application of intelligent networked vehicles in large logistics companies;

4. City Intelligent Bus System, Smart Public Mobility System, City Shared Use Vehicle Special

Research and application demonstrations;

5. A demonstration of web-based engineering for the integration of design, manufacturing and service.

6.3.5 Industrial clusters

1. On the basis of the existing automotive industry clusters, establish 3-6 clusters for the intelligent networked vehicle industry, taking into account regional characteristics;

2. Create 2-3 parts industry clusters around cameras, radar, navigation and positioning, RF chips, wireless communication terminals and controllers, etc.

6.3.6 Strategic Support and Assurance

1. Formulate and implement the Chinese version of the national plan for advanced intelligent driver assistance and V2X, formulate and introduce a mechanism for the synergy and co-construction of intelligent networked vehicles with new energy vehicles, the Internet of Things, intelligent transport networks, smart grids and smart cities, and roll out and update the Chinese version of the development plan for independent innovation of intelligent networked vehicles that is linked to multiple fields;

2. Establishing national institutes and innovation centres for common basic technologies for intelligent networked vehicles

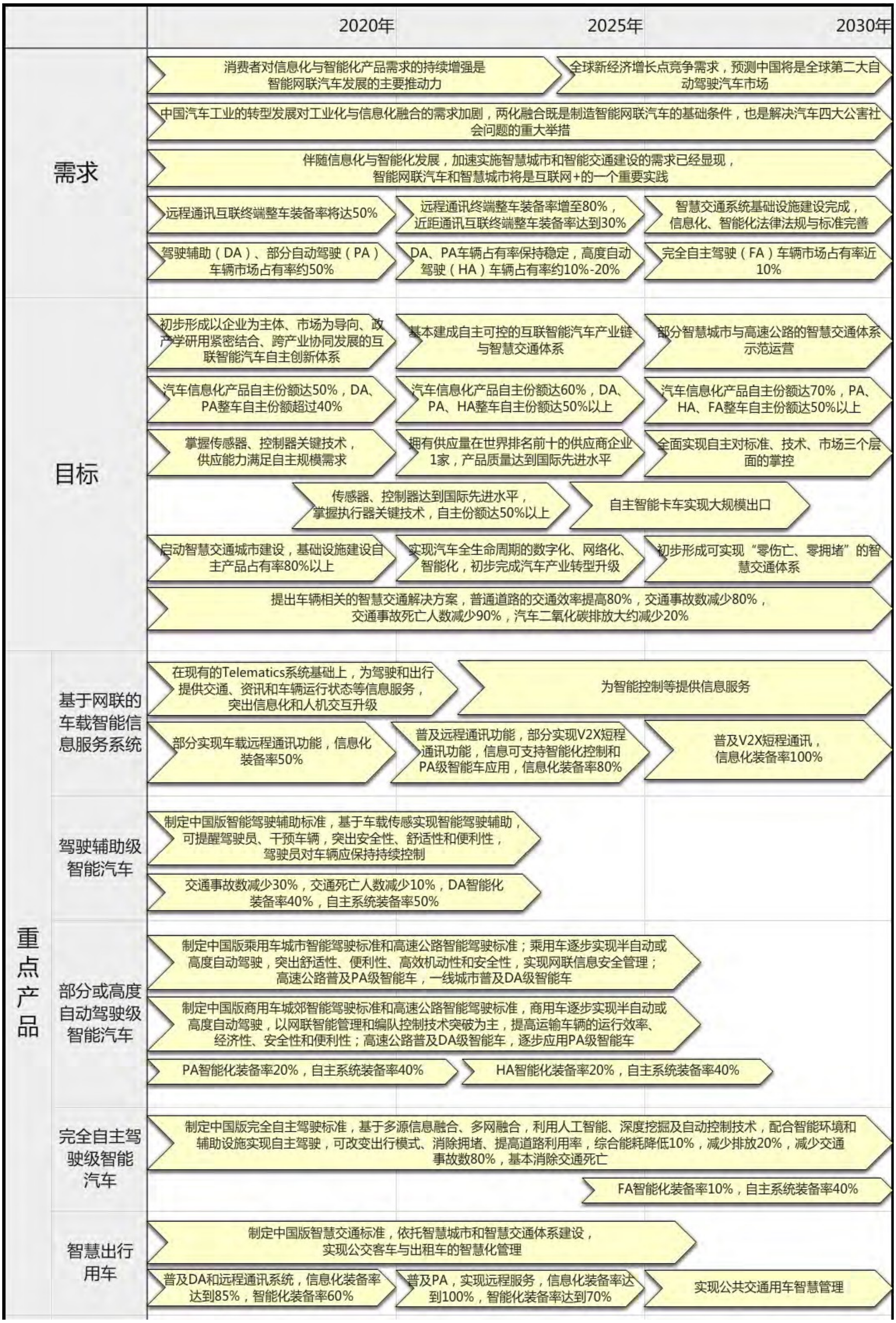
and supporting the development of key component enterprises;

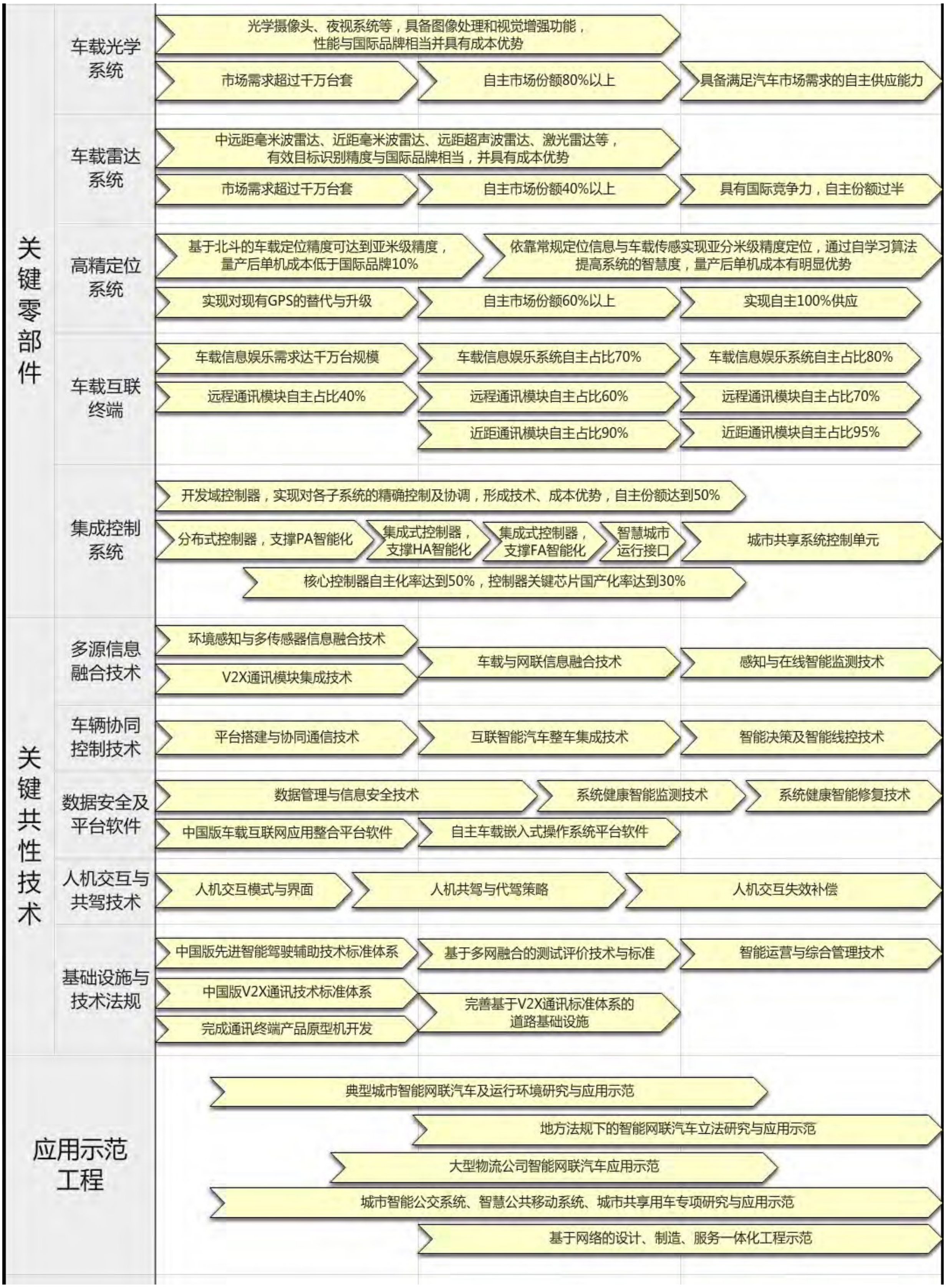
3. Setting up special funds for smart connected vehicles to support the technological development and industrial promotion of smart connected vehicles;

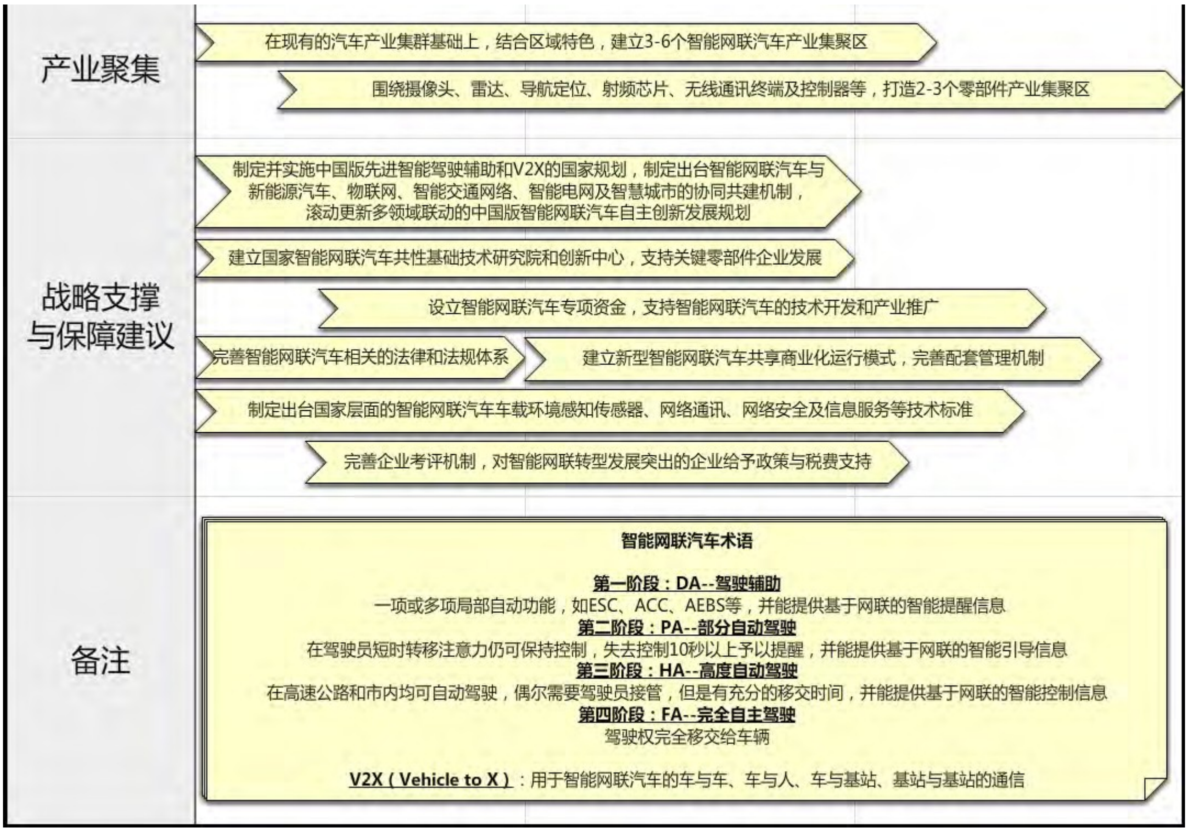
4. Improve the legal and regulatory system related to smart vehicles, establish a new type of commercial operation model for sharing smart connected vehicles, and improve the supporting management mechanism;

5. Develop and introduce national-level technical standards for in-vehicle environmental awareness sensors, network communications, network security and information services for smart connected vehicles;

6. Improve the enterprise appraisal mechanism, and give policy and tax support to enterprises with outstanding development of intelligent network transformation.


2020年
2025年
2030年
需求
消费者对信息化与智能化产品需求的持续增强是智能网联汽车发展的主要推动力
全球新经济增长点竞争需求，预测中国将是全球第二大自动驾驶汽车市场
中国汽车工业的转型发展对工业化与信息化融合的需求加剧，两化融合既是制造智能网联汽车的基础条件，也是解决汽车四大公害社会问题的重大举措
伴随信息化与智能化发展，加速实施智慧城市和智能交通建设的需求已经显现，智能网联汽车和智慧城市将是互联网+的一个重要实践
远程通讯互联终端整车装备率将达50%
远程通讯终端整车装备率增至80%，近距通讯互联终端整车装备率达到30%
智慧交通系统基础设施建设完成，信息化、智能化法律法规与标准完善
驾驶辅助（DA）、部分自动驾驶（PA）车辆市场占有率约50%
DA、PA车辆占有率保持稳定，高度自动驾驶（HA）车辆占有率约10%-20%
完全自主驾驶（FA）车辆市场占有率近10%
目标
初步形成以企业为主体、市场为导向、政产学研用紧密结合、跨产业协同发展的互联智能汽车自主创新体系
基本建成自主可控的互联智能汽车产业链与智慧交通体系
部分智慧城市与高速公路的智慧交通体系示范运营
汽车信息化产品自主份额达50%，DA、PA整车自主份额超过40%
汽车信息化产品自主份额达60%，DA、PA、HA整车自主份额达50%以上
汽车信息化产品自主份额达70%，PA、HA、FA整车自主份额达50%以上
掌握传感器、控制器关键技术，供应能力满足自主规模需求
拥有供应量在世界排名前十的供应商企业1家，产品质量达到国际先进水平
全面实现自主对标准、技术、市场三个层面的掌控
传感器、控制器达到国际先进水平，掌握执行器关键技术，自主份额达50%以上
自主智能卡车实现大规模出口
启动智慧交通城市建设，基础设施建设自主产品占有率80%以上
实现汽车全生命周期的数字化、网络化、智能化，初步完成汽车产业转型升级
初步形成可实现“零伤亡、零拥堵”的智慧交通体系
提出车辆相关的智慧交通解决方案，普通道路的交通效率提高80%，交通事故数减少80%，交通事故死亡人数减少90%，汽车二氧化碳排放大约减少20%
重点产品
基于网联的车载智能信息服务系统
在现有的Telematics系统基础上，为驾驶和出行提供交通、资讯和车辆运行状态等信息服务，突出信息化和人机交互升级
为智能控制等提供信息服务
部分实现车载远程通讯功能，信息化装备率50%
普及远程通讯功能，部分实现V2X短程通讯功能，信息可支持智能化控制和PA级智能车应用，信息化装备率80%
普及V2X短程通讯，信息化装备率100%
驾驶辅助级智能汽车
制定中国版智能驾驶辅助标准，基于车载传感实现智能驾驶辅助，可提醒驾驶员、干预车辆，突出安全性、舒适性和便利性，驾驶员对车辆应保持持续控制
交通事故数减少30%，交通死亡人数减少10%，DA智能化装备率40%，自主系统装备率50%
部分或高度自动驾驶级智能汽车
制定中国版乘用车城市智能驾驶标准和高速公路智能驾驶标准；乘用车逐步实现半自动或高度自动驾驶，突出舒适性、便利性、高效机动性和安全性，实现网联信息安全管理；高速公路普及PA级智能车，一线城市普及DA级智能车
制定中国版商用车城郊智能驾驶标准和高速公路智能驾驶标准，商用车逐步实现半自动或高度自动驾驶，以网联智能管理和编队控制技术突破为主，提高运输车辆的运行效率、经济性、安全性和便利性；高速公路普及DA级智能车，逐步应用PA级智能车
PA智能化装备率20%，自主系统装备率40%
HA智能化装备率20%，自主系统装备率40%
完全自主驾驶级智能汽车
制定中国版完全自主驾驶标准，基于多源信息融合、多网融合，利用人工智能、深度挖掘及自动控制技术，配合智能环境和辅助设施实现自主驾驶，可改变出行模式、消除拥堵、提高道路利用率，综合能耗降低10%，减少排放20%，减少交通事故数80%，基本消除交通死亡
FA智能化装备率10%，自主系统装备率40%
智慧出行用车
制定中国版智慧交通标准，依托智慧城市和智慧交通体系建设，实现公交客车与出租车的智慧化管理
普及DA和远程通讯系统，信息化装备率达到85%，智能化装备率60%
普及PA，实现远程服务，信息化装备率达到100%，智能化装备率达到70%
实现公共交通用车智慧管理


关键零部件
车载光学系统
光学摄像头、夜视系统等，具备图像处理和视觉增强功能，性能与国际品牌相当并具有成本优势
市场需求超过千万台套
自主市场份额80%以上
具备满足汽车市场需求的自主供应能力
车载雷达系统
中远距毫米波雷达、近距毫米波雷达、远距超声波雷达、激光雷达等，有效目标识别精度与国际品牌相当，并具有成本优势
市场需求超过千万台套
自主市场份额40%以上
具有国际竞争力，自主份额过半
高精定位系统
基于北斗的车载定位精度可达到亚米级精度，量产后单机成本低于国际品牌10%
依靠常规定位信息与车载传感实现亚分米级精度定位，通过自学习算法提高系统的智慧度，量产后单机成本有明显优势
实现对现有GPS的替代与升级
自主市场份额60%以上
实现自主100%供应
车载互联终端
车载信息娱乐需求达千万台规模
车载信息娱乐系统自主占比70%
车载信息娱乐系统自主占比80%
远程通讯模块自主占比40%
远程通讯模块自主占比60%
远程通讯模块自主占比70%
近距通讯模块自主占比90%
近距通讯模块自主占比95%
集成控制系统
开发域控制器，实现对各子系统的精确控制及协调，形成技术、成本优势，自主份额达到50%
分布式控制器，支撑PA智能化
集成式控制器，支撑HA智能化
集成式控制器，支撑FA智能化
智慧城市运行接口
城市共享系统控制单元
核心控制器自主化率达到50%，控制器关键芯片国产化率达到30%
关键共性技术
多源信息融合技术
环境感知与多传感器信息融合技术
V2X通讯模块集成技术
车载与网联信息融合技术
感知与在线智能监测技术
车辆协同控制技术
平台搭建与协同通信技术
互联智能汽车整车集成技术
智能决策及智能线控技术
数据安全及平台软件
数据管理与信息安全技术
系统健康智能监测技术
系统健康智能修复技术
中国版车载互联网应用整合平台软件
自主车载嵌入式操作系统平台软件
人机交互与共驾技术
人机交互模式与界面
人机共驾与代驾策略
人机交互失效补偿
基础设施与技术法规
中国版先进智能驾驶辅助技术标准体系
基于多网融合的测试评价技术与标准
智能运营与综合管理技术
中国版V2X通讯技术标准体系
完善基于V2X通讯标准体系的道路基础设施
完成通讯终端产品原型机开发
应用示范工程
典型城市智能网联汽车及运行环境研究与应用示范
地方法规下的智能网联汽车立法研究与应用示范
大型物流公司智能网联汽车应用示范
城市智能公交系统、智慧公共移动系统、城市共享用车专项研究与应用示范
基于网络的设计、制造、服务一体化工程示范


产业聚集
在现有的汽车产业集群基础上，结合区域特色，建立3-6个智能网联汽车产业集聚区
围绕摄像头、雷达、导航定位、射频芯片、无线通讯终端及控制器等，打造2-3个零部件产业集聚区
战略支撑与保障建议
制定并实施中国版先进智能驾驶辅助和V2X的国家规划，制定出台智能网联汽车与新能源汽车、物联网、智能交通网络、智能电网及智慧城市的协同共建机制，滚动更新多领域联动的中国版智能网联汽车自主创新发展规划
建立国家智能网联汽车共性基础技术研究院和创新中心，支持关键零部件企业发展
设立智能网联汽车专项资金，支持智能网联汽车的技术开发和产业推广
完善智能网联汽车相关的法律和法规体系
建立新型智能网联汽车共享商业化运行模式，完善配套管理机制
制定出台国家层面的智能网联汽车车载环境感知传感器、网络通讯、网络安全及信息服务等技术标准
完善企业考评机制，对智能网联转型发展突出的企业给予政策与税费支持
备注
智能网联汽车术语
第一阶段：DA--驾驶辅助
一项或多项局部自动功能，如ESC、ACC、AEBS等，并能提供基于网联的智能提醒信息
第二阶段：PA--部分自动驾驶
在驾驶员短时转移注意力仍可保持控制，失去控制10秒以上予以提醒，并能提供基于网联的智能引导信息
第三阶段：HA--高度自动驾驶
在高速公路和市内均可自动驾驶，偶尔需要驾驶员接管，但是有充分的移交时间，并能提供基于网联的智能控制信息
第四阶段：FA--完全自主驾驶
驾驶权完全移交给车辆
V2X（Vehicle to X）：用于智能网联汽车的车与车、车与人、车与基站、基站与基站的通信

VII. Electrical equipment

7.1 Power generation equipment

Power generation equipment is the fossil energy, nuclear energy, water, wind, solar and other primary energy conversion into electrical energy equipment, including large advanced coal, nuclear, hydropower, gas and renewable energy equipment, is the country to achieve energy restructuring and energy conservation and emission reduction strategy is an important guarantee.

7.1.1 Demand

Clean and efficient power generation equipment will become the mainstream technology in China's power generation sector, and it is expected that by 2020, the installed capacity of coal power will reach about 1.12 billion kilowatts, accounting for about 1.5 billion kilowatts of the total installed power generation capacity.

The installed capacity of nuclear power reached 58%; the installed capacity of nuclear power reached 58 million kilowatts and the capacity under construction reached 30 million kilowatts or more, accounting for about 4% of the total installed power generation capacity; the installed capacity of natural gas turbine power generation reached 120 million kilowatts, accounting for about 6% of the total installed power generation capacity; the installed capacity of conventional hydropower reached

The installed wind power capacity reached 200 million kilowatts, accounting for about 10% of the total installed power generation capacity.

7.1.2 Objectives

2020 target: the scale of advanced power generation equipment industry reaches 100 million kW per year to meet the needs of China's energy structure adjustment and major project construction, the overall technical level reaches the international advanced level and enters the ranks of world powers. Domestic power generation equipment domestic market share of 90%, the proportion of exports accounted for 30% of the annual output.

Target 2025: Formation of three international enterprise groups with capital, scale, technology, quality, brand advantages and core competitiveness. With the ability of continuous innovation, large thermal power, hydropower, nuclear power and other complete sets of equipment to reach the international leading level, with independent intellectual property rights of new and renewable energy equipment and energy storage devices market share of more than

80%.

7.1.3 Development focus

1. Key products

（1）Clean and efficient coal power equipment

--1200MW class ultra-supercritical units

25-28MPa/ 600°C/620°C , Power generation efficiency 45%; 32-35 MPa/ 600°C/620°C/620°C (secondary reheat) power generation efficiency 48%.

--Higher parameter advanced ultra-supercritical units

38-40 MPa/700°C/700°C, power generation efficiency 52%.

--600MW-1000MW super (super) critical circulating fluidised bed boilers with high coal type adaptability, clean combustion and low emissions.

--1000MW class super (ultra) critical air-cooled units are suitable for coal-rich and water-scarce areas.

--Efficient ultra-clean flue gas emission device and carbon capture equipment

Soot is less than 10 mg/Nm3, SO2 is less than 35 mg/Nm3 and NOx emissions are less than 50 mg/Nm3.

--Large-scale coal gasification gas-steam combined cycle (IGCC) F-class gas turbine IGCC combined cycle output 460MW, net efficiency 48%.

（2） Heavy duty gas turbine power generation equipment

--50-70MW gas turbine power generation equipment

For distributed generation, the combined cycle efficiency should not be less than 45%.

–F class 300MW heavy duty gas turbine power generation equipment with a combined cycle output of 450MW and 58% power generation efficiency.

--G/H Class 400MW Heavy Duty Gas Turbine Power Generation Equipment

Combined cycle capacity 600MW，60% efficiency.

（3） Large-scale advanced nuclear power equipment

--Third Generation Large Advanced Pressurised Water Reactor Nuclear Power Sets

Formation of 1000MW, 1500MW and 2000MW series of complete sets of equipment with independent intellectual property rights. The design life is 60 years and the availability rate is not less than 93%.

--High temperature gas-cooled reactors, fast reactors, thorium-based molten salt reactor nuclear power packages

200MW for high temperature gas-cooled reactors; 600MW for fast reactors and 100MW for thorium-based molten salt reactors.

（4） Large-scale advanced hydropower equipment

--Capacity pumped storage units

Capacity 150-400MW, speed range ±10% variable speed pumped storage units; 700m head section fixed speed pumped storage units.

--1000MW class hydroelectric generating units

A leading international super-large hydro generator set with a rated head of 202m and a maximum efficiency of 96%.

--High head high capacity impulse turbine units

600-2000m head section, 400-1000MW class impulse turbine units.

（5） Renewable energy generation equipment

1）Large-scale wind power generation equipment and intelligent control systems

--5MW class wind turbines

Advanced and highly reliable wind turbine with a wind energy conversion efficiency (CP value) of 0.48 and availability of 97%.

--Large offshore wind turbines

Advanced superconducting wind turbines with a 10MW rating.

--An intelligent control system for wind power clusters

A system with remote data transmission and fault diagnosis, intelligent management and control of wind power clusters, etc.

2）Advanced Solar Power Equipment

--Large-scale solar thermal generating sets

Solar single tower power 50-150MW, molten salt storage heat exchange steam power generation system. 3)

Biomass and distributed (renewable) energy equipment

--Biomass and waste clean combustion and gasification equipment

Biomass and waste efficient and clean incineration power generation plants; biomass and waste gasification power generation plants.

2. Key components

（1） High temperature components and controls for heavy duty gas turbines.

（2）Large nuclear power pressure vessels, steam generators, coolant main pumps, control rod drive mechanisms, in-stack components, large nuclear power turbine welded (complete forging) rotors,2000mm class final stage long blades, large half-speed turbine generator rotors.

（3） Variable speed pumped storage unit generator, variable speed pump turbine runner, high capacity generator protection circuit breaker.

（4） Extra-long blades for large wind turbines, intelligent control systems.

3. Key common technologies

（1） Clean and efficient coal power technology

Determination and evaluation of coal quality, ash and coal combustion characteristics of Juntung High Alkali Coal; Juntung High

Mechanism of slagging, staining and ash accumulation in alkali coal; control of slagging, staining and ash accumulation in Juntan high alkali coal

Control and removal techniques.

（2） Common Technologies for Nuclear Power

Design, verification and manufacturing technology for nuclear and conventional island main equipment.

（3） Gas turbine technology

Development of high temperature and high strength super alloy materials for advanced gas turbine high temperature components; high pressure ratio high flow rate compressor design and manufacturing technology; dry low NOx combustion chamber design and manufacturing technology; high temperature turbine blade cooling technology.

（4） Large-scale advanced hydropower equipment technology

Pumped storage variable speed motor and pump turbine design and verification technology; overall design and hydraulic design and verification of large hydro generator sets, high efficiency cooling technology; hydraulic design and verification technology of high head large capacity impulse turbine sets.

（5） Renewable energy generation equipment

Blade design technology for wind turbines of 5MW or above, intelligent control technology for wind turbines; technology and overall structure design for superconducting wind turbines of 10MW class.

Solar energy high-efficiency heat collection, storage and heat exchange systems and equipment development, intelligent control technology, system integration technology.

Biomass and waste gasification processes, dioxin removal and ash vitrification technology

Technique.

7.1.4 Application demonstration projects

1. Clean and efficient power generation application demonstration project

1200MW class ultra-supercritical units, 600MW-1000MW ultra (super) critical fluidized bed boilers, 1000MW class ultra (super) critical air-cooled units, high efficiency ultra-supercritical units

The mechanism demonstration project. 50-70MW class, 300MW class F heavy duty gas turbine and other self

Main brand gas turbine demonstration project.

2. Large-scale advanced nuclear power application demonstration project

1000M, 1500MW, 2000MW nuclear power sets and 200MW high temperature gas-cooled reactor and 600MW sodium-cooled fast reactor demonstration projects.

3. Pumped storage and large hydropower application demonstration project

150-400MW variable speed pumped storage units and 1000MW class hydro turbine generator demonstration projects.

4. New Energy Application Demonstration Project

50MW and 100MW solar thermal power generation demonstration projects, 5-10MW wind power generation demonstration projects.

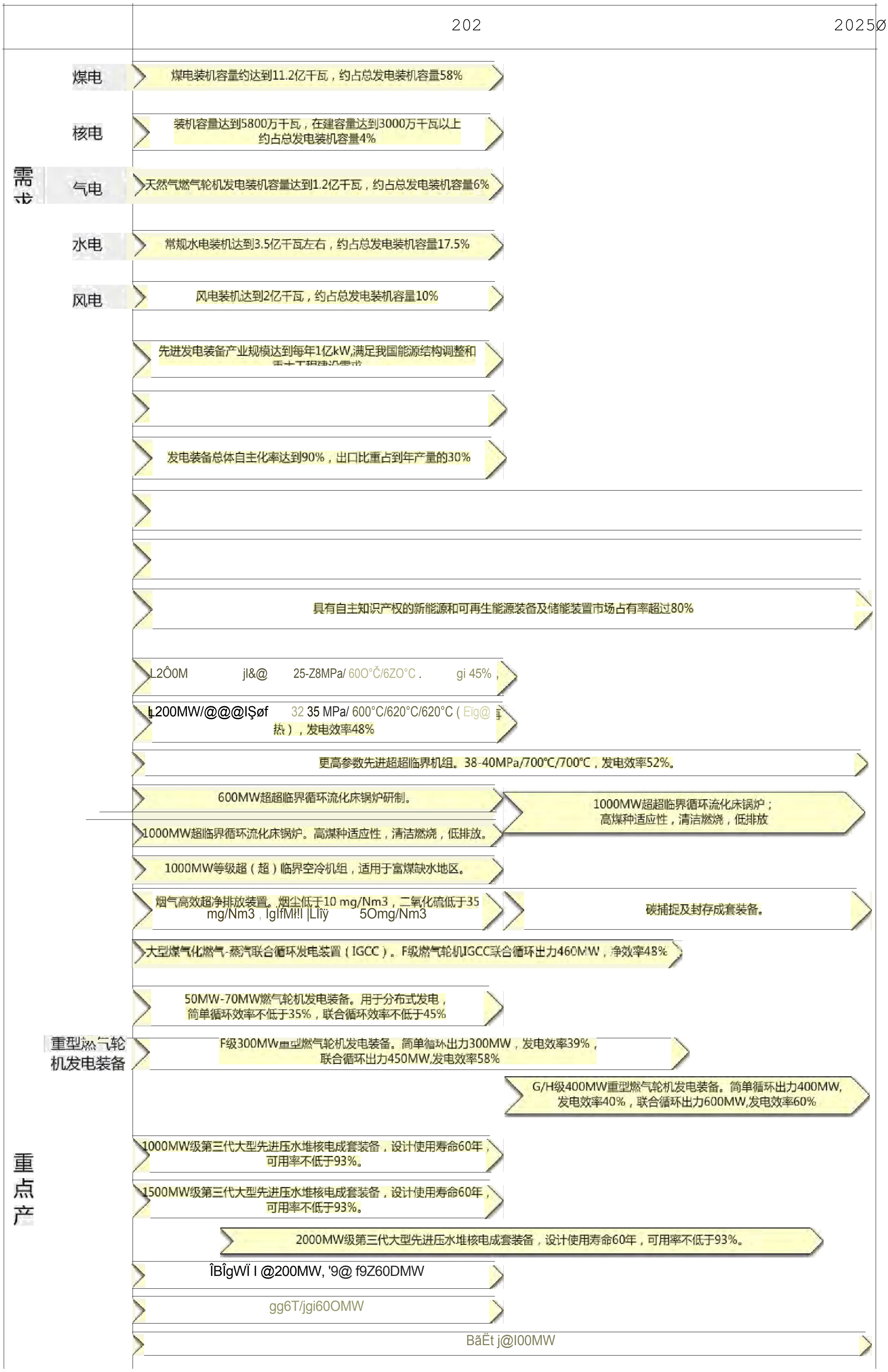
7.1.5 Strategic Support and Assurance

1. Improve policy measures and actively create an environment that supports the development of clean and efficient power generation equipment industry

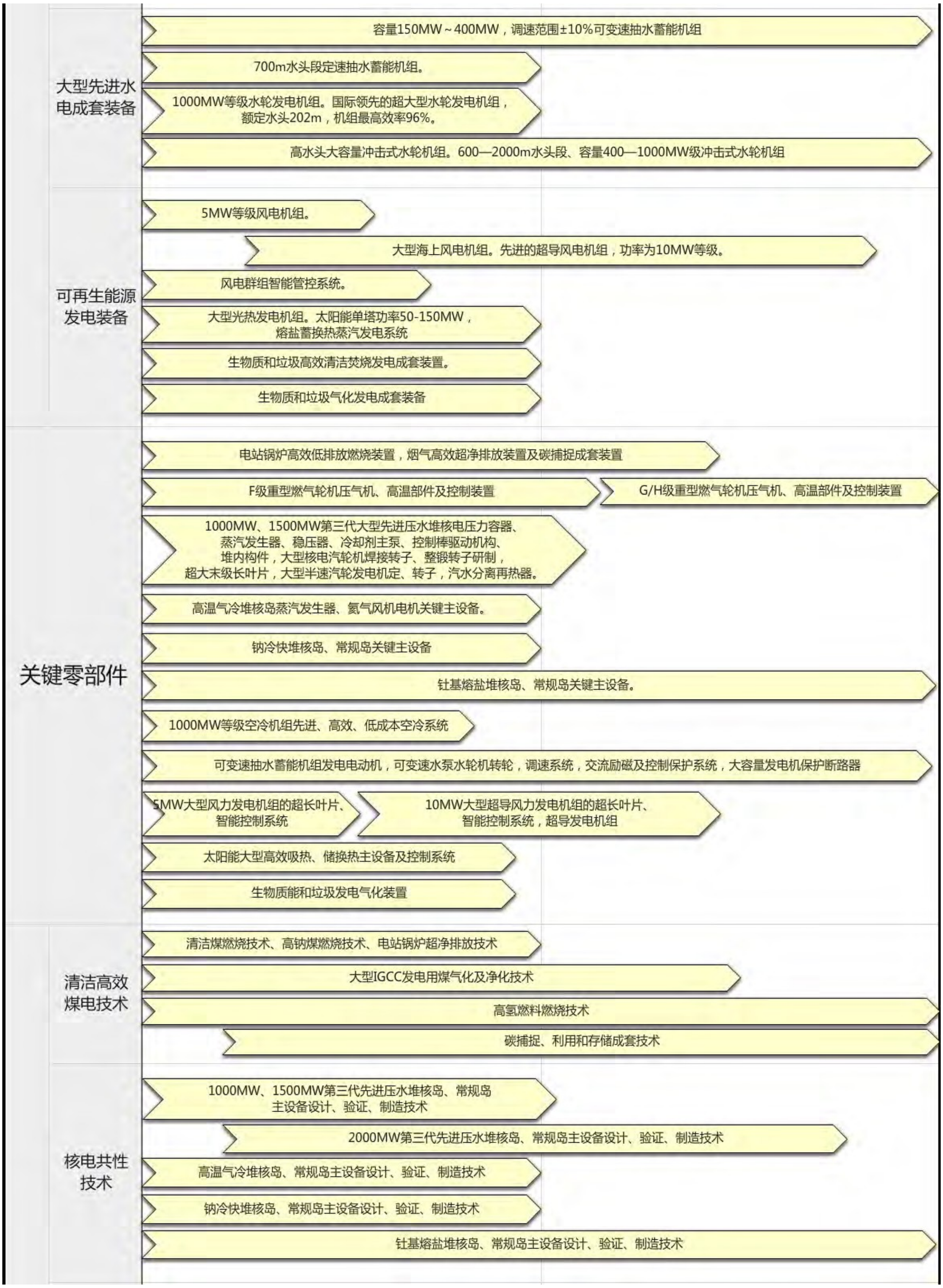
Make full use of market economic instruments such as taxation, finance and necessary administrative means to study and formulate financial and taxation policies that are conducive to the healthy development of the industry and support the technological progress and industrialisation of clean and efficient power generation equipment.

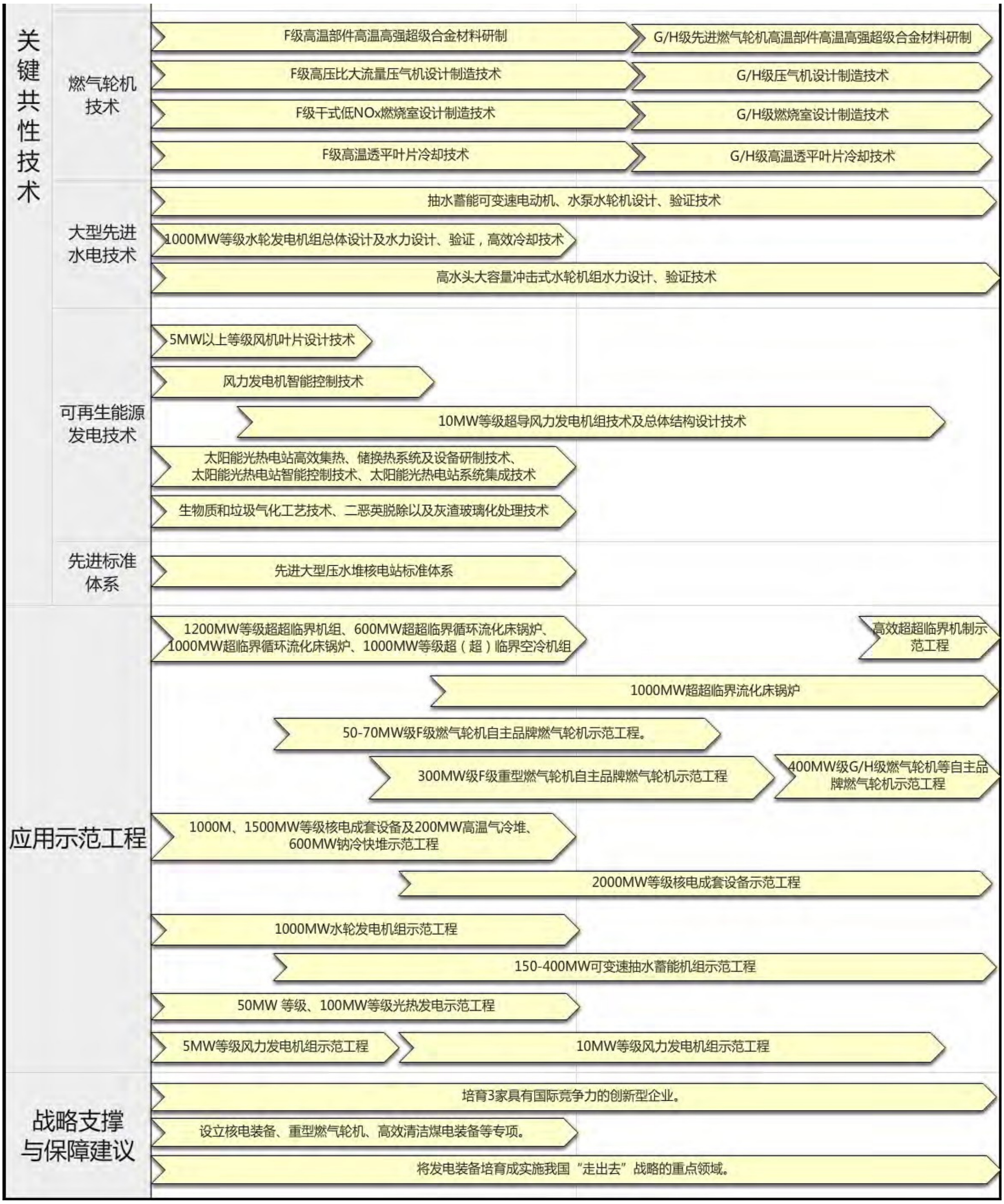
2. Building a national major innovation base for clean and efficient power generation technologies

Taking the existing national engineering research centres as the basis of innovation carriers, optimise and integrate innovation resources, further exploit the overall advantages of various innovation carriers in the innovation chain, and organise and implement collaborative innovation oriented towards national goals in a new organisational form, across fields, departments and regions.



202
2025
需求
煤电
煤电装机容量约达到11.2亿千瓦，约占总发电装机容量58%
核电
装机容量达到5800万千瓦，在建容量达到3000万千瓦以上
约占总发电装机容量4%
气电
天然气燃气轮机发电装机容量达到1.2亿千瓦，约占总发电装机容量6%
水电
常规水电装机达到3.5亿千瓦左右，约占总发电装机容量17.5%
风电
风电装机达到2亿千瓦，约占总发电装机容量10%
先进发电装备产业规模达到每年1亿kW,满足我国能源结构调整和
发电装备总体自主化率达到90%，出口比重占到年产量的30%
具有自主知识产权的新能源和可再生能源装备及储能装置市场占有率超过80%
L2Ô0M jl&@ 25-Z8MPa/ 60O°Č/6ZO°C . gi 45%
L200MW/@@@lŞøf 32 35 MPa/ 600°C/620°C/620°C (Eig@
热），发电效率48%
更高参数先进超超临界机组。38-40MPa/700℃/700℃，发电效率52%。
600MW超超临界循环流化床锅炉研制。
1000MW超超临界循环流化床锅炉；
高煤种适应性，清洁燃烧，低排放
1000MW超临界循环流化床锅炉。高煤种适应性，清洁燃烧，低排放。
1000MW等级超（超）临界空冷机组，适用于富煤缺水地区。
烟气高效超净排放装置。烟尘低于10 mg/Nm3，二氧化硫低于35
mg/Nm3，IglfM!l |Llÿ 5Omg/Nm3
碳捕捉及封存成套装备。
大型煤气化燃气-蒸汽联合循环发电装置（IGCC）。F级燃气轮机IGCC联合循环出力460MW，净效率48%
50MW-70MW燃气轮机发电装备。用于分布式发电，
简单循环效率不低于35%，联合循环效率不低于45%
重型燃气轮机发电装备
F级300MW重型燃气轮机发电装备。简单循环出力300MW，发电效率39%，
联合循环出力450MW,发电效率58%
G/H级400MW重型燃气轮机发电装备。简单循环出力400MW,
发电效率40%，联合循环出力600MW,发电效率60%
重点产
1000MW级第三代大型先进压水堆核电成套装备，设计使用寿命60年，
可用率不低于93%。
1500MW级第三代大型先进压水堆核电成套装备，设计使用寿命60年，
可用率不低于93%。
2000MW级第三代大型先进压水堆核电成套装备，设计使用寿命60年，可用率不低于93%。
ÎBÎgWÏ I @200MW, '9@ f9Z60DMW
gg6T/jgi60OMW
BãËt j@I00MW


大型先进水电成套装备
容量150MW～400MW，调速范围±10%可变速抽水蓄能机组
700m水头段定速抽水蓄能机组。
1000MW等级水轮发电机组。国际领先的超大型水轮发电机组，额定水头202m，机组最高效率96%。
高水头大容量冲击式水轮机组。600—2000m水头段、容量400—1000MW级冲击式水轮机组
可再生能源发电装备
5MW等级风电机组。
大型海上风电机组。先进的超导风电机组，功率为10MW等级。
风电群组智能管控系统。
大型光热发电机组。太阳能单塔功率50-150MW，熔盐蓄换热蒸汽发电系统
生物质和垃圾高效清洁焚烧发电成套装置。
生物质和垃圾气化发电成套装备
关键零部件
电站锅炉高效低排放燃烧装置，烟气高效超净排放装置及碳捕捉成套装置
F级重型燃气轮机压气机、高温部件及控制装置
G/H级重型燃气轮机压气机、高温部件及控制装置
1000MW、1500MW第三代大型先进压水堆核电压力容器、蒸汽发生器、稳压器、冷却剂主泵、控制棒驱动机构、堆内构件，大型核电汽轮机焊接转子、整锻转子研制，超大末级长叶片，大型半速汽轮发电机定、转子，汽水分离再热器。
高温气冷堆核岛蒸汽发生器、氦气风机电机关键主设备。
钠冷快堆核岛、常规岛关键主设备
钍基熔盐堆核岛、常规岛关键主设备。
1000MW等级空冷机组先进、高效、低成本空冷系统
可变速抽水蓄能机组发电电动机，可变速水泵水轮机转轮，调速系统，交流励磁及控制保护系统，大容量发电机保护断路器
5MW大型风力发电机组的超长叶片、智能控制系统
10MW大型超导风力发电机组的超长叶片、智能控制系统，超导发电机组
太阳能大型高效吸热、储换热主设备及控制系统
生物质能和垃圾发电气化装置
清洁高效煤电技术
清洁煤燃烧技术、高钠煤燃烧技术、电站锅炉超净排放技术
大型IGCC发电用煤气化及净化技术
高氢燃料燃烧技术
碳捕捉、利用和存储成套技术
核电共性技术
1000MW、1500MW第三代先进压水堆核岛、常规岛主设备设计、验证、制造技术
2000MW第三代先进压水堆核岛、常规岛主设备设计、验证、制造技术
高温气冷堆核岛、常规岛主设备设计、验证、制造技术
钠冷快堆核岛、常规岛主设备设计、验证、制造技术
钍基熔盐堆核岛、常规岛主设备设计、验证、制造技术


关键共性技术
燃气轮机技术
F级高温部件高温高强超级合金材料研制
G/H级先进燃气轮机高温部件高温高强超级合金材料研制
F级高压比大流量压气机设计制造技术
G/H级压气机设计制造技术
F级干式低NOx燃烧室设计制造技术
G/H级燃烧室设计制造技术
F级高温透平叶片冷却技术
G/H级高温透平叶片冷却技术
大型先进水电技术
抽水蓄能可变速电动机、水泵水轮机设计、验证技术
1000MW等级水轮发电机组总体设计及水力设计、验证，高效冷却技术
高水头大容量冲击式水轮机组水力设计、验证技术
可再生能源发电技术
5MW以上等级风机叶片设计技术
风力发电机智能控制技术
10MW等级超导风力发电机组技术及总体结构设计技术
太阳能光热电站高效集热、储换热系统及设备研制技术、
太阳能光热电站智能控制技术、太阳能光热电站系统集成技术
生物质和垃圾气化工艺技术、二恶英脱除以及灰渣玻璃化处理技术
先进标准体系
先进大型压水堆核电站标准体系
应用示范工程
1200MW等级超超临界机组、600MW超超临界循环流化床锅炉、
1000MW超临界循环流化床锅炉、1000MW等级超（超）临界空冷机组
高效超超临界机制示范工程
1000MW超超临界流化床锅炉
50-70MW级F级燃气轮机自主品牌燃气轮机示范工程。
300MW级F级重型燃气轮机自主品牌燃气轮机示范工程
400MW级G/H级燃气轮机等自主品牌燃气轮机示范工程
1000M、1500MW等级核电成套设备及200MW高温气冷堆、
600MW钠冷快堆示范工程
2000MW等级核电成套设备示范工程
1000MW水轮发电机组示范工程
150-400MW可变速抽水蓄能机组示范工程
50MW 等级、100MW等级光热发电示范工程
5MW等级风力发电机组示范工程
10MW等级风力发电机组示范工程
战略支撑与保障建议
培育3家具有国际竞争力的创新型企业。
设立核电装备、重型燃气轮机、高效清洁煤电装备等专项。
将发电装备培育成实施我国“走出去”战略的重点领域。

7.2 Power transmission and transformation equipment

Transmission and transformation equipment is to achieve the transmission and conversion of electrical energy and to ensure the safe, reliable and stable operation of the power system equipment. It includes ultra-high voltage transmission and transformation equipment, intelligent transmission and transformation equipment, and smart grid client equipment.

7.2.1 Demand

In 2014, China's total electricity consumption was 5.52 trillion kilowatt hours, and it is expected to maintain an average annual growth rate of more than 5.5% from 2015 to 2020, and more than 3% from 2020 to 2030. The development of power transmission and transformation equipment will show intelligent, integrated, green features, and for the implementation of the "Belt and Road" development strategy to provide power transmission and transformation equipment support.

7.2.2 Objectives

By 2020, the output value of the power transmission and transformation industry will reach RMB 2.2 trillion; the domestic market share of key components will reach over 80%; the proportion of exports of complete power transmission and transformation devices will exceed 20%; and ultra-high voltage power transmission and transformation technology will be internationally leading and enter the ranks of world powers.

In 2025, the output value of the power transmission and transformation industry will reach RMB 3.0 trillion; an international standard system for UHV AC and DC transmission equipment will be formed with China as the leader; the domestic market share of key components will reach over 90%; the proportion of exports of power transmission and transformation equipment will exceed 25%; the reliability and technical indicators of products will reach international advanced level.

7.2.3 Development focus

1. Key products

(1) UHV transmission and transformation equipment

--Extra-high voltage AC power transmission and transformation equipment

Field assembled transformers: voltage 1000 kV, capacity 1000 MVA - 1500 MVA. shunt reactor series (including controlled reactors) series products covering

Voltage 1000kV, Capacity 120Mvar-400Mvar Full range.

--Extra high voltage DC transmission sets

Field assembled converter transformers: capacities 200MVA－ 560MVA.

Converter valves: ±800kV/6250A converter valve, ±1100kV/5000A converter valve. Flow control protection system.

--Generator protective circuit breaker sets

SF6 generator protective circuit breaker: for CAP1000 nuclear units, rated short-circuit breaking current 210kA; for CAP1400 nuclear units, rated short-circuit breaking current 250kA.

Vacuum generator protection circuit breaker: suitable for pumped storage, rated short-circuit breaking current 120kA.

（2）Intelligent power transmission and transformation equipment

--Smart substation packages

Intelligent transformers: voltage 110kV-1000kV, capacity 50MVA-1000MVA. intelligent switchgear: 126kV-1100kV gas insulated metal enclosed intelligent switchgear Equipment.

Intelligent substation monitoring system: realises intelligent sharing of station-wide information and provides support for the management and operation and maintenance of equipment throughout its life cycle.

--Smart distribution network kits

Intelligent distribution switches, intelligent distribution transformers, intelligent components and power electronics. Microgrid equipment: microgrid control and management equipment and energy conversion equipment.

Energy storage systems: In response to the development needs of new energy grid-connected and distributed micro-grids, battery storage devices, high-temperature superconducting energy storage devices and battery management systems are developed.

--Flexible DC transmission equipment

±100kV-±500kV transformers.

±500kV/3000MW converter valve.

500kV/6kA high voltage DC

circuit breaker.

--Energy-saving and environmentally friendly power transmission and transformation equipment

Environmentally friendly high-voltage switchgear: choose environmentally friendly gases instead of SF6 as insulation and breaking medium.

Low-loss, environmentally friendly transformers.

Superconducting transmission and transformation equipment: superconducting transformers, superconducting current limiters and other equipment.

（3） Smart grid client-side devices

--Customer-side

electrical

components 1)

Intelligent

distribution

appliances

Intelligent frame circuit breaker

7400A/150kA.

intelligent miniature circuit

breaker 100A/15kA. intelligent

moulded case circuit breaker

1600/200kA.

Automatic transfer switch

appliance 6300A/176kA. 2) Intelligent

control appliance

Contactor 2600A.

Motor control and protection switchgear 125A.

Arc fault protector: 63A/10kA/GFCI=5mA.

surge protector limp/In=30Ka/If=50kA.

--Consumer electrical packages

Real-time network communication and remote monitoring, self-operation in harsh environments, self-healing and other functions Energy, optimised energy distribution, load balancing and reduced equipment maintenance and overhaul time.

--Client system solutions

It supports access to various forms of distributed power supply and EV charging systems, multiple communication protocols and networked remote monitoring software, and has micro-grid management functions such as power consumption statistics and analysis, demand response and demand control, multi-power throwing and switching coordination control and power consumption prediction.

2. Key components

（1）Key component

casing for EHV.

Transformer outlet unit.

（2）Components for intelligent power transmission and transformation equipment

High voltage high power IGBT modules: 3.3kV/1500-2000A, 4.5kV/1200-2000A, 6.5kV/1000-1500A and above.

Large capacity vacuum interrupters: 110~220kV.

（3）User-side components

Actuator: 6A to 7500A; mechanical life > 50,000 operating cycles; withstands electric shocks > 135kA/1s short term withstand current.

Contact and arc extinguishing system: $I_{cu}=I_{cs}$ greater than (400/690V) 200kA/100kA. controller: selective protection with full current range, fault warning, life indication and other functions.

Busbar system for customer-side electrical installations: with safe and reliable protection against electric shock

Design.

Remote monitoring software for the client system: with system monitoring and power management functions. **3.**

Key common technologies

（1） Intelligent Technology

The focus is on sensing technology, control technology, online monitoring technology and integrated diagnostic expert system application technology.

（2） Reliability technology

Through reliability studies of equipment, management, evaluation and standard systems are established for the whole process of design, manufacture, testing and use.

（3） Digital simulation technology

The focus is on arc, electromagnetic, structural, fluid and motion simulation techniques.

（4） Application technology for new electrical materials

Technologies for the application of nanotechnology in electrical insulation materials;

Research and application techniques for lightweight, high-strength, highly conductive electrical alloy materials;

Advanced Functional Materials - Development of carbon materials and high temperature superconducting materials application technology

Technique

（5） Standards and testing techniques

Establish a comprehensive standards system and build a platform for experimental research and testing related to key performance indicators.

（6） High efficiency distribution transformer technology

Manufacturing of wide amorphous alloy strips, research on the technical economy and applicability of vegetable insulating oil applications, and automated production processes for three-dimensional rolled core transformers.

7.2.4 Application demonstration projects

1.±1100kV UHV DC project with complete sets of equipment demonstration application

Development and demonstration of key technologies and complete sets of equipment for ±1100kV UHV DC power transmission, including converter valves, converter transformers, flat wave reactors, DC lightning arresters, DC measuring devices, DC bypass switches, DC transfer switches, DC disconnect switches, grounding switches and dry bushings.

2.1000kV UHV AC complete sets of equipment engineering field assembly demonstration application

We provide products for use in accordance with the requirements of extra-high voltage projects; continuously improve product quality and reliability through refined management and process improvement; and enhance our casing testing capability through laboratory certification work.

3. Demonstration of client-side devices in smart microgrids and distributed power systems

Use

Carry out the technical transformation of agricultural network, urban network, new generation communication base station power supply system and

Equipment renewal, establishment of a remote monitoring system, reduction of maintenance and overhaul time for power supply equipment, and improved safety and reliability of electricity consumption.

4. Triple convergence project and demonstration application of client-side equipment

Carry out the refinement, informatization and automation of the value chain links of product design, production, sales and logistics at the user's end, and comprehensively improve the level of intelligent product manufacturing.

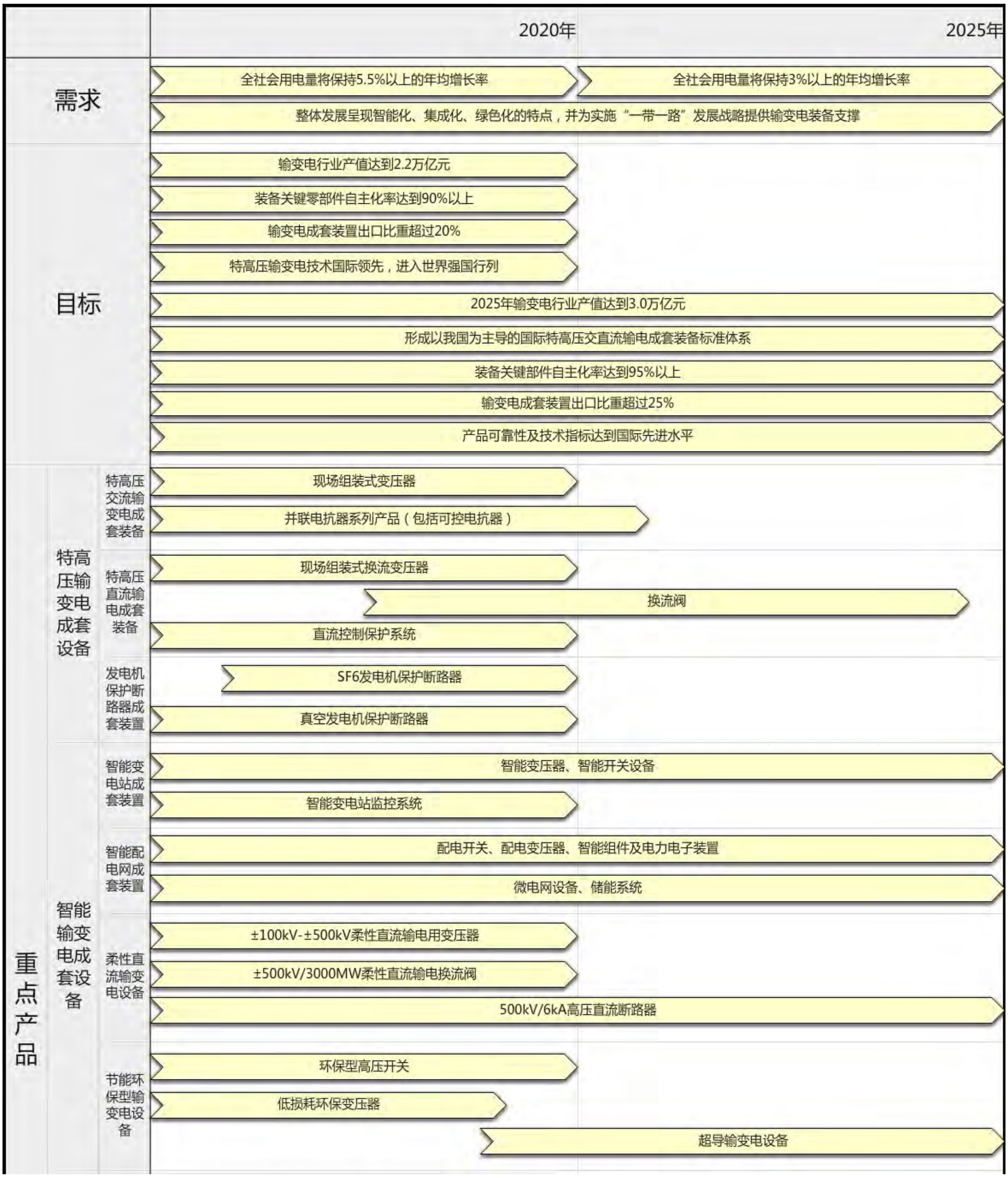
7.2.5 Strategic support and assurance

1. Create a complete system for research and development, manufacturing, testing, inspection and certification of power transmission and transformation equipment, and achieve mutual recognition with international laboratories.

2. The central research institute for the component industry provides planning, standards, testing and certification, product fault analysis and diagnosis, reliability evaluation, industry management and information consulting around industrial development.

consultancy, as well as basic, forward-looking and common technology development and services.

3. To establish an innovation alliance between government, industry, academia, research and use in the power transmission industry, focusing on breaking through bottlenecks in key common technologies and major application technologies for smart grids.



关键零部件	智能电网用户端设备	用户端电器元件	智能框架断路器7400A/150kA、智能微型断路器100A/15kA 智能塑壳式断路器1600A/200kA
关键零部件	智能电网用户端设备	用户端电器元件	自动转换开关电器6300A/176kA
关键零部件	智能电网用户端设备	用户端电器元件	接触器2600A
关键零部件	智能电网用户端设备	用户端电器元件	电动机控制与保护开关电器125A
关键零部件	智能电网用户端设备	用户端电器元件	电弧故障保护电器：63A/10kA/GFCL=5mA
关键零部件	智能电网用户端设备	用户端电器元件	电涌保护器 limp/in=30kA/If=50kA
关键零部件	智能电网用户端设备	用户端电气成套装置	具有实时网络通信与远程监控、恶劣环境自运行、自愈等功能，能优化能耗分配、均衡负载、减少设备维护和检修时间。
关键零部件	智能电网用户端设备	用户端系统解决方案	支持各种形式的分布式电源、EV充电等系统的接入，支持多种通信协议和网络化远程监控软件，具有电能消耗统计和分析、需求响应与需量控制、多电源投切协调控制和用电量预测等微电网管理功能
关键零部件	特高压用关键零部件		套管、变压器出现装置
关键零部件	智能输变电装备用零部件		高压大功率IGBT模块、大容量真空灭弧室
关键零部件	智能电网用户端用零部件		执行机构：6A～7500A；机械寿命大于50000次操作循环；可耐受大于135kA/1s短时耐受电流的电动冲击力
关键零部件	智能电网用户端用零部件		触头及灭弧系统：Icu=Ics大于（400/690V) 200kA/100kA
关键零部件	智能电网用户端用零部件		控制器：具有全电流范围选择性保护、故障预警、寿命指示等功能
关键零部件	智能电网用户端用零部件		用户端电气成套装置母线系统：具有安全可靠的防触电保护设计
关键零部件	智能电网用户端用零部件		用户端系统远程监控软件：具有系统监控及电能管理功能
关键共性技术			智能化技术
关键共性技术			可靠性技术
关键共性技术			数字仿真技术
关键共性技术			新型电工材料应用技术
关键共性技术			标准及试验检测技术
关键共性技术			高效配电变压器
应用示范工程			±1100kV特高压直流工程用成套装备示范应用
应用示范工程			1000kV特高压交流成套装备工程现场组装示范应用
应用示范工程			用户端设备在智能微电网、分布式电源系统中的示范应用
应用示范工程			用户端设备三化融合工程及示范应用
战略支撑与保障建议			建立完整的输变电装备研发、制造、试验、检测和认证体系，实现与国际实验室互认
战略支撑与保障建议			打造行业中央研究院
战略支撑与保障建议			加快推进精益生产、智能制造、质量提升的“三融合”工程
战略支撑与保障建议			设立智能电网成套装备专项
战略支撑与保障建议			打造输变电装备成为国家“走出去”战略的重点领域

VIII. Agricultural equipment

8.1 Agricultural equipment

Agricultural equipment is a blend of biological and agronomic technology, integrated mechanical, electronic, hydraulic, information and other high-tech automation, information technology, intelligent advanced equipment, development focus is grain, cotton, oil, sugar and other bulk food and strategic economic crops breeding, plowing, planting, management, harvesting, transportation, storage and other major production processes using the equipment. Agricultural equipment is to continuously improve the land output rate, labor productivity, resource utilization, to achieve the most basic material assurance and core support of agricultural modernization.

8.1.1 Demand

In recent years, China's rapid development of agricultural equipment industry, has become the world's largest agricultural equipment production and use of large countries. However, accounting for more than 90% of the market demand for domestic agricultural equipment for low-end products, can not fully meet the needs of modern agricultural development, information technology, the rapid application of intelligent technology has further widened the gap with developed countries. New industrialization, information technology, urbanization, agricultural modernization, "four" synchronization, to ensure food, food, ecological security, change the mode of agricultural development, one, two, three industries integrated development, requires agricultural equipment industry to expand the field, increase the variety, and accelerate the development of automation, information technology, intelligence.

8.1.2 Objectives

In 2020, the development and coordination of testing and testing of core functional components and complete machines will be established.

The same supporting capacity. The total output value of the agricultural machinery industry reached 600 billion yuan, and the market share of domestic agricultural machinery products exceeded 90%. The industrialisation of variable application technology and the effective utilisation rate of fertilisers and pesticides will reach 40%. Mastering the key technologies of core parts manufacturing and reliability, tractors

The average trouble-free time for the harvester and combine increased to 250 hours and 60 hours respectively.

By 2025, there will be a complete range of machinery for the whole production process of large grain and strategic cash crops, and the capacity of agricultural machinery and equipment for information collection, intelligent decision-making and accurate operation will be significantly improved, resulting in an overall solution of informationization for agricultural production. The total output value of the agricultural machinery industry will reach 800 billion yuan, the market share of domestic agricultural machinery products will be over 95%, and the market share of high-end products such as large tractors of over 200 horsepower and cotton pickers will reach 60%. Intelligent sowing and fertilising, plant protection and harvesting machinery will be put into use, and the effective utilisation rate of chemical fertilisers and pesticides will reach over 50%. The key technologies of core device manufacturing and machine reliability were comprehensively mastered, and the average trouble-free time of tractors and combine harvesters reached 350 hours and 100 hours respectively.

8.1.3 Development focus

1. Key products

(1) New high-efficiency tractors

200 hp and above, 8-speed and above powershift tractors, CVT tractors with electronically controlled main transmission and electro-hydraulic control of the main clutch. The key components such as engine, transmission system and control system will be independently supplied in China.

(2) Variable fertiliser and seeding machines

Variable fertiliser sowers for rice, wheat, maize and soybeans with 100 hp and above, pneumatic seeding, no-till, variable stratified fertiliser application and integrated operation with navigation, missed sowing and blockage monitoring.

(3) Precision plant protection machinery

Large upland clearance, light waterfield self-propelled spray bar sprayer with ground clearance of 800 mm and above, hydrostatic drive, adjustable ground clearance wheelbase, with automatic anti-skid and variable operating functions.

(4) High performance harvesting machinery

Large grain combine harvesters with a feeding capacity of 10 kg/s and above, high throughput rice combine harvesters with a feeding capacity of 8 kg/s and above, as well as new maize seed harvesters, cotton pickers, sugar cane harvesters, oilseed rape harvesters and forage harvesters. Hydrostatic drive, with navigation and positioning, fault diagnosis, real-time collection of main parameters and automatic monitoring.

(5) Seed breeding and fine sorting machinery

Fine seed bed preparation, parental precision staggered sowing, de-pollination and clean harvesting machinery for maize, wheat, rice and vegetable plots; equipment for CNC drying, fine sorting, intelligent pelletising, activity and health testing, counting and packaging and traceability of seeds.

(6) Energy saving and quality preserving transport and storage machinery

Large grain energy saving drying machinery with precise online moisture monitoring and precise automatic temperature and humidity control. Grain, fruit and vegetable and other agricultural products physical environment, microbial breeding time course marking and other intelligent transportation and storage equipment.

(7) Livestock farming machinery

Intelligent equipment for precise environmental regulation, intelligent identification of individual livestock and poultry behaviour and growth health conditions, individual precision feeding and livestock product collection.

(8) Agricultural processing machinery

Intelligent and automated processing equipment for wheat, rice and other grains and oilseeds. High efficiency and low loss cleaning, multi-size cutting, grading and automatic functional packaging equipment for fruit and vegetables. Automatic equipment for the slaughtering of cattle and sheep, and for the dividing and stripping of livestock, poultry and aquatic products. High throughput testing and grading and packaging equipment for poultry eggs. Dairy quality non-destructive testing, high-speed aseptic filling and other equipment. Equipment for green and diversified utilisation of by-products of agricultural products processing.

2. Key components

(1) Agricultural diesel engines

Off-road National IV emissions, torque reserve of 35% or more, 3 or more power output interfaces, noise level not higher than 114 dB; electric control system and after-treatment system of domestic independent support.

(2) Steering drive axles and electro-hydraulic suspension systems

The steering drive axle is designed for tractors of 200 hp and above and combine harvesters with a feed rate of 10 kg/s and above. The electro-hydraulic suspension system is based on the CAN bus control and has the functions of force adjustment, position adjustment, height adjustment and integrated adjustment of force and position ratio.

(3) Sensors for agricultural machinery

Fertiliser and seeding machinery operating depth, travel speed, operating quality and other measurement and control sensors. Plant protection machinery forward speed, spray volume, pressure, spraying area and other measurement and control sensors. Harvesting machinery, feeding volume, cleaning and entrainment losses, cutting table height, drum speed, yield flow and grain moisture.

(4) Agricultural machinery navigation and intelligent

control operating devices

Tractor and combine harvester navigation and positioning, object tracking devices, positioning accuracy of not less than centimetre level; intelligent control operation devices such as seed and seedling transport and automatic identification of planting and sowing.

3. Key common technologies

(1) Experimental verification technology for digital design of agricultural machinery

Breakthroughs in digital modelling, virtual design, dynamic simulation and verification of key components of agricultural machinery and complete machines to address the integration and development of innovative design and advanced manufacturing.

(2) Reliability technology for agricultural machinery

Breakthroughs in reliability test methods, testing and control technologies for key products such as tractors and combine harvesters, and the application of active reliability design technologies for service environments.

(3) Standard validation technology for key components of agricultural machinery

Breakthroughs in the standardization of key components of agricultural machinery, series, general technology, and promote the development of agricultural machinery product portfolio, modularization.

(4) Sensing and control technology for agricultural machinery

Breakthroughs in sensing, monitoring and control and data management technologies for soil, plants, environment and water, fertiliser, seeds and medicine, animal behaviour and environment, agricultural machinery and its operating conditions, to achieve the integration of mechanisation, automation, information and intelligence.

8.1.4 Application demonstration projects

1. Intelligent agricultural machinery production line application demonstration project

Integrate digital design, manufacturing process planning, manufacturing process control and other technologies for agricultural machinery, develop tractor speed change systems, combine harvester chassis and threshing and cleaning key assembly s y s t e m s , and apply them in tractor and combine harvester enterprises for demonstration.

2. Smart Farm Application Demonstration Project

The integration of intelligent machinery for seed, fertiliser and medicine application and harvesting, as well as farming equipment for individual livestock feeding and milk collection, forms an overall solution for the integration of information technology in the production of major food and cash crops, livestock farming and livestock product collection, and is applied for demonstration on large farms.

8.1.5 Strategic Support and Assurance

1. Support the establishment of a national innovation centre for the agricultural equipment industry. Establish data platforms for research and development, design, testing, standards, etc.; carry out collaborative innovation in basic frontier technologies, key commonalities, major strategic equipment, etc.; carry out public technical services such as research and development and design, scientific and technological services, inspection and testing, information services, etc.; build an agricultural equipment industry innovation system that adapts to national conditions, is based on industry, is collaborative and efficient, and supports development.

2. Support the implementation of agricultural equipment manufacturing development actions. Promote basic frontier, key common technology and major key equipment research and development and industrialization; promote enterprise "two" integration, the development of intelligent manufacturing, green manufacturing; promote the globalization of agricultural equipment enterprise research and development layout and industrial international development; improve the key parts and components of agricultural machinery and machine tax incentives, agricultural machinery new product purchase subsidies and other policies.

		2020年	2025年	2030年
需求		新型工业化、信息化、城镇化、农业现代化“四化”同步推进，保障粮食、食品、生态“三大”安全		
		转变农业发展方式，实现高产高效生产、提质增效和可持续发展		
		信息、生物、新材料、新能源等技术广泛渗透，要求农机装备提升水平、完善功能、增加品种、拓展领域		
目标		国内市场占有率90%，大型拖拉机和采棉机市场占有率达30%	国内市场占有率95%，大型拖拉机和采棉机市场占有率达60%	国内市场占有率95%以上，高端农机装备市场占有率30%以上
		化肥和农药施用有效利用率达40%	化肥和农药施用有效利用率达50%以上	
		播种、施肥、施药、灌溉实现变量作业	耕整、种植、灌溉、植保、收获主要生产环节实现智能化作业，饲喂、挤奶机器人化	
		拖拉机和联合收割机平均无故障时间分别达到250小时和60小时	拖拉机和联合收割机平均无故障时间分别达350小时和100小时	主要农业装备产品平均无故障时间达到国际先进水平
		产值6000亿元，支撑主要农作物耕种收综合机械化水平达到70%左右	产值8000亿元，支撑主要农作物耕种收综合机械化水平达到80%左右	产值达到1万亿元左右，支撑主要农作物全面全程机械化
重点产品	新型高效拖拉机	150～200马力动力负载变速拖拉机产业化		
			200～400马力无级变速拖拉机产业化	
	变量施肥播种机械	稻麦变量施肥播种机产业化		稻麦、玉米、大豆等智能施肥播种机产业应用
		玉米、大豆等变量施肥播种机产业化		
	精量植保机械	大中型高地隙喷杆喷雾机产业化		智能植保机械产业应用
		轻型水田自走式喷杆喷雾机产业化		
	高效能收获机械	大喂入量智能化谷物联合收割机产业化		谷物联合收割机智能化应用，产业化
		采棉机智能化应用，产业化	采棉打包一体采棉机智能化应用	
		新型玉米、甘蔗、油菜、饲草料收获机产业化	玉米、甘蔗、油菜、饲草料收获机智能化应用，产业化	
	种子繁育与精细选别机械	精细种床整备、去雄授粉机械产业化		种床整备、播种、去雄授粉、洁净收获机智能化应用，产业化
			精量交错播种、洁净收获机械产业化	
		种子数控干燥、智能丸化、计数包装与溯源设备产业化	精细分选、活性和健康检测设备产业化	种子干燥、丸化、分选、活性检测、包装、溯源等种子加工智能成套设备产业应用
	节能保质运贮机械	大型粮食节能烘干机械产业化	粮食烘干机械智能化应用，产业化	
		粮食、果蔬等智能控温控湿运贮设备产业化	农产品物理环境、微生物滋生时间标示等智能设备应用	
	畜禽养殖机械	环境精准调控、个体精准饲喂设备普遍应用	智能设施、饲喂、行为监测、环境调控等智能设备产业应用	
		畜产品采集智能化设备普遍应用		挤奶机器人产业应用
	农产品加工机械	谷物及油料智能化、自动化加工成套设备		谷物、果蔬、禽蛋等品质检测、干燥、分级、包装、溯源等智能成套设备产业应用
		果蔬低损清洁、多规格切制设备产业化		
		果蔬分等分级、自动化功能包装设备产业化		
		禽蛋高通量检测分级包装设备产业化		畜禽、水产品屠宰、剥制、分割、分级、包装、溯源，及乳品检测、灌装等智能成套设备产业应用
		牛羊屠宰自动化设备产业化		
			畜禽、水产品分割自动化设备产业化	
		乳品品质无损检测、高速无菌灌装等设备产业化		
		农产品加工副产物绿色多元化利用设备应用		


关键零部件
农用柴油机
电控系统、后处理系统国产化开发
排放达非道路IV标准
满足大型拖拉机、联合收获机配套需要
转向驱动桥及电液悬挂系统
大型拖拉机、联合收获机转向驱动桥国产化开发
总线控制的电液悬挂系统国产化开发
农业机械专用传感器
施肥播种机械作业深度、行走速度、作业质量等测控传感器产业应用
植保机械前进速度、喷量、压力、喷洒面积等测控传感器产业应用
收获机械喂入量、清选与夹带损失、割台高度、滚筒转速、产量流量和谷物水分等测控传感器产业应用
农业机械导航及智能化控制作业装置
农业机械导航定位装置产业应用
农业机械对象跟踪装置产业应用
种苗输送、栽播智能化自动控制作业装置产业应用
关键共性技术
农业机械数字化建模、虚拟设计、动态仿真验证，关键零部件标准验证，技术可靠性与价值工程开发技术
植物生长状况、动物行为及健康状况、环境调控技术
农业机械动力换挡、CVT无级变速技术，播种、植保、收获等作业智能监控，导航定位、远程运维技术
农业机械多机协同作业、远程操控作业技术
应用示范工程
建立拖拉机变速箱、联合收割机底盘、脱
在拖拉机、联合收割机企业示范推广
农机主要骨干企业智能制造应用
建立种植、养殖2个智能化农场示范
示范推广种养结合智能化农场
面向农业生产的信息化整体解决方案示范应用
战略支撑及保障建议
建立国家农业装备产业创新中心
构建适应国情、立足产业、协同高效、支撑发展的农业产业创新体系
实施农业装备制造发展行动
持续实施农业装备制造发展行动，推进重大技术装备研发及产业化、“两化”融合与智能制造、国际化发展

IX. New Materials

9.1 Advanced Basic Materials

Advanced basic materials refer to new materials with excellent performance, large quantity and "multi-purpose", mainly including iron and steel, non-ferrous, petrochemical, building materials, light industry, textiles and other basic materials in the high-end materials, the national economy, national defense and military construction plays a fundamental support and security role.

9.1.1 Demand

The basic materials industry is an indispensable basis for the development of the real economy. China's output of more than 100 kinds of basic materials has reached the first in the world, but it is large but not strong, facing three outstanding problems such as overall overcapacity, unreasonable product structure, and high-end application areas not yet fully self-sufficient, etc. It is urgent to develop advanced basic materials with high performance, differentiation and functionality, and promote the transformation and upgrading of the basic materials industry and sustainable development.

9.1.2 Objectives

By 2020, the overall scale of the basic materials industry will be effectively controlled, the industrial structure will be adjusted with initial effect, and advanced basic materials will be self-sufficient in general, with a certain export capacity.

By 2025, the industrial structure will be significantly adjusted, the product structure of basic materials will be upgraded and replaced, and the share of the domestic market will exceed 90%.

9.1.3 Development focus

1. Advanced Steel Materials

（1） Steel for basic components for advanced manufacturing

Breakthrough in materials, design, manufacturing and application evaluation of a series of key technologies for advanced equipment with high-performance bearings, gears, industrial moulds, springs, fasteners and other steel, energy efficient motors, high-end engines, high-speed railways, high-end precision machine tools, high-grade automobiles and other advanced

The domestic self-sufficiency rate of steel materials for key components for equipment will reach 80% in 2020, strive for full self-sufficiency in 2025, with the life of key components increasing by more than one times.

（2） High performance offshore steel

Through the research and development, production, application technology and specification standards of 690MPa grade low preheat welded extra thick plate and seamless pipe (100mm) or more, 420-460MPa grade thick plate with large linear energy welding, R6 grade large specification anchor chain steel, to achieve engineering demonstration assessment, to meet China's 400 feet or more jack-up platform, heavy conduit frame platform and a new generation of semi-submersible platform for domestic materials. The domestic market share of high-end offshore steel will increase from less than 50% to more than 90%, and the procurement cost will be reduced by more than 20% compared with that of imported materials.

（3） New high-strength automotive steel

Development of new ultra-high tensile automotive steels including Q&P, δ-TRIP, medium manganese, TWIP and low Mn-TWIP steels with a 20-50 GPa% strength-plasticity product.

（4） Steel for high-speed, heavy-duty rail transport

High fracture toughness, high fatigue performance wheel steel above 350km/h, 30-40 tonnes axle weight heavy-duty wagon wheel steel, 200-400 million tonnes load life fast heavy-duty railway rails, new heat-treated bainite rails (tensile strength ≥ 1400MPa, elongation ≥ 10%)

（5） A new generation of functional composite building steel

Thickness above 100mm, yield strength 600-1000MPa, yield strength ratio below 0.8-0.85, yield strength at 600°C higher than 2/3 of room temperature strength index, modulus of elasticity higher than 75% at room temperature.

（6） Steel for ultra-high volume oil and gas pipelines

X90/100 ultra-high tensile line steel, and X80 grade in thicknesses above 33mm

Pipeline steel.

（7）Rolled laminates

Develop key technologies for rolling composite plates in line with the group billet process, efficient welding and online solution, solve the technical difficulties of low output rate and high energy consumption in the production of high-quality billets of thickness 500-900mm, and develop a series of composite plate products to meet the special requirements for materials in the chemical industry, seawater desalination, energy and other special industries.

（8）Ultra-high strength stainless steel for special equipment

The development of yield strength 1400-2200MPa, the enterprise has high stress resistance Fausto high strength stainless steel series varieties, to meet the aviation, deep-sea drilling, oilfield chemical, special ships and other industries.

2. Advanced Non-Ferrous Materials

（1）High performance light alloy materials

Research and development of 650MPa level of new high toughness, low quenching sensitivity, thickness of 200mm above the aluminum alloy pre-drawing plate; development of ≥ 700 ℃ high temperature titanium alloy and 1300MPa above the high toughness of titanium alloy, diameter ≥ Φ 450mm super large specifications of the bar. Processing into a 10% increase in the rate of material.

（2） Non-ferrous metal key supporting materials for functional components

The purity of rare and precious metals and high-purity metals will be increased by 1-2N on the basis of the existing ones, and the utilization rate will be increased by 10% by focusing on the recycling and efficient use of materials.

3. Advanced Petrochemical Materials

（1） Lubricating grease

Focus on the development and utilization of base oils, and increase the development of hydrogenated base oils, GTL base oils and The application of high-grade base oils such as biodegradable engine oils and hydraulic oils, turbine oils, greases, etc.; increase the development and application of additives, for the new environmental protection regulations proposed low sulfur, low phosphorus, low ash, low toxicity, biodegradable, long life and other special performance requirements of antioxidants, viscosity index improvers, clean dispersants, friction improvers and other additives products for molecular design, development and Application. To achieve the development of independent intellectual property rights in the formulation of general-purpose products for hydraulic fluids, industrial gear oils, turbine oils, greases and most common industrial lubricants and greases; to develop high-performance long-life space lubricant products.

（2） High performance polyolefin materials

Breakthroughs in industrial production technologies for high melt index polypropylene, ultra-high molecular weight polyethylene, expanded polypropylene and polybutylene-1 (PB) for large-scale applications.

(3) Polyurethane resins

Focus on the development of environmentally friendly polyurethane materials such as water-based polyurethane materials, and accelerate the development of aliphatic isocyanates and other raw materials.

(4) Fluorosilicone resins

The focus is on the development of polyvinylidene fluoride, PET, other fluorine resins as well as silicone resins and silicone oils.

(5) Special synthetic rubber

Focus on the development of isoprene rubber and supporting the development of isobutylene synthetic isoprene; the development of silicone rubber, solvated styrene butadiene rubber and rare earth paraben rubber; the development of halobutyl, hydrogenated nitrile and other rubber with special properties, etc.

(6) Bio-based synthetic materials

Focus on breakthroughs in bio-based rubber synthesis technology, bio-based aromatics synthesis technology, bio

Key technologies for the preparation of nylon-based nylon, key technologies for the synthesis and application of new bio-based plasticizers, the

Key technologies for the preparation of bio-based polyurethane, key technologies for the preparation of bio-based polyester, key basic technologies for the preparation of basic chemical raw materials by biological methods, etc.

4. Advanced Building Materials

（1） Cementitious materials for major projects in extreme environments

Cementitious materials for repair of scouring and abrasion, cavitation damaged concrete, non-penetrating cracks and leakage in hydropower projects; low carbon cementitious materials with high erosion resistance for marine engineering, ultra-high strength, high toughness and low carbon cementitious composites; cement preparation technology for cementing in ultra-low temperature marine oil fields, cementitious materials for cementing (high temperature, acidic gas erosion) in complex geological environments; cementitious materials for road and bridge repair for rail transportation Cementitious materials for ultra-rapid repair of concrete structures.

（2） Energy efficient green structures - functionally integrated building materials

The utilization rate of solid waste in the product is ≥70%, the compressive strength of the product is ≥20MPa, the flexural strength is ≥7MPa, the surface density is ≤50kg/m2, and the structure-functional integrated building material that integrates heat insulation, thermal insulation, waterproofing, fire prevention and decoration.

（3） Environmentally friendly non-metallic mineral functional materials

The development of permeability coefficient ≤ 5.0 × 10-11m / s of impermeable materials, insoluble potassium conversion rate ≥ 80% and antibacterial ≥ 2.5 × 1013 / kg of soil remediation agents, suspended SS < 30mg / L, COD < 100mg / L of water treatment agents, specified friction coefficient 0.4 ± 0.06 friction materials, thermal conductivity ≤ 0.05W / m -K of thermal insulation materials, flame retardants with an oxygen index of ≥35% and typical new materials such as high-strength gypsum, high-efficiency metallurgical protection slag, high-end graphite products, high-efficiency catalysts, filter aids, slow-release drugs and fertilizers, high-performance polymers, etc.

5. Advanced Light Materials

（1） Bio-based light materials

The key monomers of PLA (polylactic acid), polybutylene succinate (PBS), polyethylene terephthalate (PET, PTT), polyhydroxyalkanoic acid (PHA), polyamide (PA), etc. are being developed. The key monomer of PTT, 1,3-propanediol, is produced by fermentation of non-food raw materials such as tapioca starch and glycerol, and the polymerization and spinning of PTT fibres has been industrialized.

（2） Industrial Biocatalysts

The focus is on the development of enzymes for the food industry such as lipase, lipoxygenase, glucose oxidase, asparaginase and ethyl carbamate degrading enzymes; enzymes for the light textile industry such as laccase, alkaline xylanase, keratinase, trypsin and PVA degrading enzymes; enzymes for bio-organic synthesis such as lipase, amino acid deaminase, natural product glycosylase and hyaluronidase. The enzyme activity of key products has been increased by 100-300% on the basis of the existing ones; under extreme conditions (temperature, pH) the enzyme activity reaches or exceeds that of similar products from abroad.

（3） Special Engineering Plastics

Focus on the development of thermoplastic polyimide (PI) engineering plastic resins, heteronaphthalene biphenyl type polyether sulfone ketone copolymer resins (PPESK), high-end fluoroplastics for processing and molding of special fibers, filter materials, high temperature resistant functional films, high-performance resin-based composites, high temperature resistant insulation materials, high temperature resistant functional coatings, high temperature resistant special adhesives. Thermoplastic polyimide engineering plastic resin, viscosity 0.38dL/g, Tg=230-310℃,Td5%>500℃, tensile strength>100MPa, bending strength>150MP, cost<150,000/ton; Heteronaphthalene biphenyl type polyether sulfone ketone copolymer resin, Tg=263-305℃, tensile strength 90-122MPa , tensile

Tensile modulus 2.4-3.8GPa, volume resistivity 3.8-4.8×1016Ω ·cm, cost reduced to 50-70% of PEEK. High-end fluoroplastics main performance indicators: ultra-pure fluoroplastics products: PTFE solid performance density SSG ≤ 2.147g/cm3, PTFE resin tensile strength

> It meets the requirements of C12 in SEMI standard; high and low temperature fluorine material functional film, special fluorine fiber and filtration products: meet the requirements of high-end environmental protection, PTFE resin requires compression ratio >3000, tensile strength >28MPa, elongation >360%; oil and gas and chemical fluid transmission pumps, valves and pipes with PVDF resin. and piping with PVDF resin density 1.75-1.77g/cm3, melting point 0.5-2.0g/10min, melting point 156-165℃, thermal decomposition temperature ≥390℃, water content

≤ 0.10%, glass transition temperature ≤ -35°C, embrittlement temperature ≤ -62°C.

6. Advanced Textile Materials

(1) High-end technical textiles

In 2020, the independent industrialisation of absorbable sutures and haemodialysis materials will be realised, partially replacing foreign imported products; functional protection requirements such as thermal, biochemical, electrostatic and radiation will be met; the performance of high temperature filtration and water filtration products will meet the requirements of various application fields; geotechnical materials will meet the construction requirements of complex geological environments; in 2025, multifunctional composite protection requirements will be met, while light weight, comfort and partial intelligence will be achieved. In addition, the life and stability of filtration products will be further improved, and the combination of low-cost applications and intelligent monitoring and early warning functions will be realized.

（2） New functional textile materials

2020, flame retardant limit oxygen index>32, no molten drops, drip diffusion time<

By 2025, the company will be self-sufficient in high-end products.

（3） Bio-based chemical fibres

2020 PTT fibre raw material 1,3-propanediol > 99.5% purity, cost control

The system in 15,000 yuan / ton below; PLA heat-resistant temperature ≥ 110 ℃, monomer purity ≥

The cost of producing PLA fibres in 2025 will be close to that of PET production.

9.1.4 Strategic support and security conditions

1. The establishment of major special funds to focus on supporting innovation alliances between industry, academia, research and use, strengthening the close integration of new materials research and development with advanced manufacturing, and developing and breaking through a number of common key technologies and major application technologies for the transformation and upgrading of various basic materials industries.

2. Backbone enterprises or major projects with driving or outstanding contributions to industrial development are strongly supported by financial post-subsidies, and key personnel are given heavy awards.

3. Strengthen the research and development of basic common standards, key technical standards and key application standards; actively participate in international standardization work.

4. Establish public service platforms such as third-party testing and evaluation, a new material technology maturity evaluation

发展重点	先进钢铁材料	先进制造基础零部件用钢	高效节能电机、高端发动机、高速铁路、高端精密机床、高档汽车等先进装备用关键零部件用钢自给率达到80%。	力争全面自给，关键零部件寿命提高1倍以上。
			产业化规模达到800万吨。	产业化规模达到2000万吨。
		高性能海工钢	690MPa级低预热焊接特厚板及无缝管、355-460MPa级可大线能量焊接厚板、R6级大规格锚链钢。	
			产业化规模达到100万吨。	产业化规模达到200万吨。
		新型高强韧汽车钢	研发包括Q&P、δ-TRIP、中锰钢、TWIP及低Mn-TWIP钢等在内的等新型超高强韧汽车用钢，强塑积达到20-50GPa%。	
		高速、重载轨道交通用钢	包括350km/h以上高断裂韧性、高疲劳性能车轮钢，30-40吨轴重重载货车车轮用钢，承载寿命2-4亿吨级快速重载铁路用钢轨，新型热处理贝氏体钢轨（抗拉强度≥1400MPa，延伸率≥10%）。	
		新一代功能复合化建筑用钢	厚度100mm以上、屈服强度500-1000MPa、屈强比低于0.8-0.85、600℃时的屈服强度高于室温强度指标的2/3，弹性模量高于室温时75%以上。	
		超大输量油气管线用钢	X90/100超高强管线钢，以及33mm以上厚度规格X80级别管线钢。	
	先进有色金属	高性能轻合金材料	研发650MPa级新型高强韧、低淬火敏感性、厚度200mm以上铝合金预拉伸板。研制≥700℃高温钛合金和1300MPa以上高强韧钛合金、直径≥Φ450mm超大规格棒材等。加工成材率提高10%。	
			产业规模达到500亿元以上。	
		功能元器件用有色金属关键配套材料	稀有稀贵及高纯金属在现有基础上纯度提高1-2N，注重材料的循环再生与高效利用，利用率提高10%。开发600mm以上高纯无氧铜压延铜箔等配套材料。	
			产业规模达到300亿元。	
	先进石化材料	润滑油脂	加大对加氢基础油、GTL基础油、可生物降解等高档基础油在内燃机油和液压油、汽轮机油、润滑脂等领域的应用。针对新的环保法规提出的低硫、低磷、低灰分、低毒性、生物可降解、长寿命等特种性能要求添加剂产品进行分子设计，开发与应用。实现在液压油、工业齿轮油、透平油、润滑脂最常见工业润滑油脂的通用型产品的自主知识产权配方开发。开发高性能长寿命空间润滑剂产品。满足风电、太阳能等新能源领域对润滑油脂的特殊要求。	
		高性能聚烯烃材料	突破高熔融指数聚丙烯、超高分子量聚乙烯、发泡聚丙烯、聚丁烯-1（PB）等工业化生产技术，实现规模应用。	
		生物基石化材料	重点开发石油基生产相对受限（如异戊二烯）的重要化学单体、中间体和材料。	
	先进建筑材料	极端环境下重大工程用水泥基材料	开发出满足水电工程的冲刷磨损、气蚀破坏混凝土，非贯穿裂缝、渗漏修补水泥基材料；满足海洋工程用高抗侵蚀低碳水泥基胶凝材料，超高强、高韧低碳水泥基复合材料；满足超低温海洋油田固井水泥制备技术，复杂地质环境下固井（高温、酸性气体侵蚀）自修复水泥基材料；满足轨道交通用道桥混凝土结构超快速修复水泥基材料。	
		节能绿色结构功能一体化建筑材料	开发出固体废弃物在产品中利用率≥70%，产品抗压强度≥20MPa，抗折强度≥7MPa，面密度≤50kg/m2，并集保温、隔热、防水、防火、装饰于一体的结构-功能一体化建筑材料。	
		环境友好型非金属矿物功能材料	渗透系数≤5.0×10--11m/s的防渗材料，难溶钾转化率≥80%及生防菌≥2.5×1013个/kg的土壤修复剂，悬浮物SS<30mg/L、COD<100 mg/L的水处理剂，指定摩擦系数0.4±0.06的摩擦材料，导热系数≤0.05 W/m•K的保温材料，氧指数≥35%的阻燃剂及高强石膏、高效冶金保护渣、高端石墨制品、高效催化剂、助滤剂、缓控释药物和化肥、高性能聚合物等典型新材料。	
	先进轻工材料	生物基轻工材料	重点发展聚乳酸（PLA）、聚丁二酸丁二酯（PBS）、聚对苯二甲酸二元醇酯（PET、PTT)、聚羟基烷酸（PHA)、聚酰胺（PA)等产品。PLA关键单体L-乳酸和D-乳酸的光学纯度达99.9%以上，成本下降20%；PBS关键单体生物基丁二酸、1,4-丁二醇提高生物转化率达5-10%；PTT关键单体1,3-丙二醇以木薯淀粉、甘油等非粮原料发酵生产，PTT纤维聚合纺丝实现产业化； PA关键单体戊二胺硫酸盐成品纯度高于99%，成本下降20%。	
		工业生物催化剂	重点发展脂肪酶、脂肪氧合酶、葡萄糖氧化酶、天冬酰胺酶、氨基甲酸乙酯降解酶等食品工业用酶；漆酶、碱性木聚糖酶、角蛋白酶、胰蛋白酶、PVA降解酶等轻工纺织用酶；脂肪酶、氨基酸脱氨酶、天然产物糖基化酶和透明质酸酶等生物有机合成用酶。关键产品酶活在现有基础上提升100-300%；极端条件下（温度、PH）酶活达到或超过国外同类产品。	
		特种工程塑料	重点发展基于热塑性聚酰亚胺（PI）工程塑料树脂、杂萘联苯型聚醚砜酮共聚树脂（PPESK）的加工成型的特种纤维、耐高温功能膜、高性能树脂基复合材料、耐高温绝缘材料、耐高温功能涂料、耐高温特种胶粘剂。	

	先进纺织材料	高性能纤维	碳纤维（T800级）拉伸强度 ≥ 5.8GPa,CV≤4%），拉伸模量（294GPa）CV≤4%）；对位芳纶断裂强度20 - 22cN/dtex，断裂伸长率3 - 4%；聚酰亚胺纤维单丝纤度为2.0dTex,强度＞4cN/dTex，极限氧指数为38%。	
			碳纤维产能3万吨，芳纶产能4.5万吨，聚酰亚胺纤维产能1万吨。	碳纤维产能5.6万吨，芳纶产能7.2万吨，聚酰亚胺纤维产能2.5万吨。
		高端产业用纺织品	实现可吸收缝合线、血液透析材料的自主产业化；研制能满足特殊领域复杂环境使用要求的产品。	满足多功能复合防护要求，同时实现轻质、舒适和部分智能化，过滤产品寿命和稳定性进一步提升，实现低成本应用和智能化监测预警等功能结合。
			实现原料自主化生产，中端产品和部分高端产品替代进口。	自主知识产权的产品性能达到国际先进水平。
		功能纺织新材料	阻燃极限氧指数＞32，无熔滴，滴水扩散时间＜1s，能耗降低20%。	高端产品完全实现自给。
			产量达到300万吨。	产量达到600万吨。
		生物基化学纤维	PTT纤维原料1,3-丙二醇纯度大于99.5%；聚乳酸耐热温度≥110℃，单体纯度≥99.9%，PLA纤维断裂强度大于3.5g/d，断裂伸长30%-35%。	PLA纤维生产成本接近PET生产成本。
			PTT纤维15万吨，PLA纤维5万吨，生物基新型纤维素纤维55万吨。	PTT纤维35万吨，PLA纤维13万吨，生物基新型纤维素纤维120万吨。
关键技术及装备	先进钢铁材料		复杂、极端服役环境下材料行为研究、洁净化冶炼技术、组织性能精细控制和精确成形、生态钢铁材料高效、绿色制备关键技术及装备等关键技术。	
	有色金属材料		低能耗短流程、高效高精度加工新技术、新工艺及装备。	
			高性能大规格材料制备及精密成形工艺与控制、服役性能评价等技术。	
			高纯金属、稀有稀贵金属材料制备、粉末冶金材料及制品低成本化等应用技术与成套工艺。	
	先进石化材料		生物基橡胶合成技术，生物基芳烃合成技术，生物基尼龙制备关键技术，新型生物基增塑剂合成及应用关键技术，生物基聚氨酯制备关键技术，生物基聚酯制备关键技术，生物法制备基础化工原料关键基础技术。	
	先进建筑材料		1.水泥绿色制造成套关键技术及装备；2.建筑玻璃绿色智能化制造技术和成套装备；3.建材工业智能化制造技术。	
	先进轻工材料		工业生物催化剂挖掘与性能改造、制备、提取技术；高效生产菌株的构建与表达、高效色谱分离纯化工艺；低成本制备聚酰亚胺树脂、聚醚砜酮共聚树脂（PPESK）工艺及技术；高端特种工程塑料改性技术及装备。	
	先进纺织材料		碳纤维、对位芳纶、聚酰亚胺等及其复合材料设计、加工、制造一体化技术。	
			产业用纺织品织造、非织造成型技术，多工艺复合技术，功能化后整理技术等。	
			高效柔性化纤维材料制备技术，阻燃、高舒适等功能材料设计、制备以及纺织染整技术。	
			生物二元醇产业化及应用技术，纤维素溶解、溶剂回收等新型纤维素纤维核心关键技术，实现低成本化生产。	
战略支撑与保障建议			设立重大专项资金，重点支持产学研用创新联盟，加强新材料研发与先进制造紧密结合，开发和突破一批面向各基础材料行业转型升级的共性关键技术和重大应用技术。	
			对产业发展具有带动性或突出贡献的骨干企业或重大项目给予财政后补贴强力支持，关键人员给予重奖。	
			加强基础共性标准、关键技术标准和重点应用标准的研究制定;积极参与国际标准化工作。	
			建立第三方检测评价等公共服务平台、新材料技术成熟度评价体系和新材料产品认定体系，构建国家基础新材料数据库。	

9.2 Key strategic materials

Key strategic materials mainly include special alloys for high-end equipment, high-performance separation membrane materials, high-performance fibers and their composite materials, new energy materials, electronic ceramics and artificial crystals, biomedical materials, rare earth functional materials, advanced semiconductor materials, new display materials and other high-performance new materials, is an important material basis for achieving the innovation-driven development strategy of strategic emerging industries.

9.2.1 Demand

Key strategic materials, is the key core materials to support and guarantee the high-end applications in the field of marine engineering, rail transportation, naval vehicles, nuclear power, aerospace engines, aerospace equipment, etc., but also the implementation of intelligent manufacturing, new energy, electric vehicles, smart grid, environmental governance, health care, a new generation of information technology and defense cutting-edge technology and other major strategic needs of the key guarantee materials, at present, in the national economy needs At present, of the more than 100 key materials in the national economy needs, about one-third of the domestic completely blank, about half of the performance stability is poor, part of the product by foreign tight control, breakthrough subject to the key strategic materials, has a very important strategic significance.

9.2.2 Objectives

By 2020, the industrialization and application demonstration of more than 30 kinds of key strategic materials will be realized. To effectively address the urgent needs of the development of new generation information technology, high-end equipment manufacturing and other strategic emerging industries, with the domestic market share of key strategic materials exceeding 70%; to initially form an upstream and downstream synergistic strategic new materials innovation, application demonstration system and public service science and technology conditions platform.

By 2025, the problem of strategic materials required in key areas of high-end manufacturing will be basically solved, and the domestic market share of key strategic materials will exceed 85%. Some products will enter

International supply system, key varieties to fill domestic gaps and achieve independent intellectual property rights system.

9.2.3 Development focus

1. Special alloys for high end equipment

（1） Advanced deformed, powdered, single crystal high temperature alloys

Breakthrough in low-cost and large-scale production technology of high-temperature alloys; breakthrough in key technology of new-generation high-temperature alloys such as fourth-generation powder, single crystal and dot matrix materials; breakthrough in advanced high-temperature alloy preparation process. Formation of stable supply capacity for domestic high generation turbine discs and single crystal blades and other high temperature alloy products to meet the demand for high temperature alloy materials for major special projects for aero engines and gas turbines.

（2） Special corrosion-resistant steels and heat-resistant alloys for ultra-supercritical power stations at 700°C

Research and development of steel materials resistant to corrosion in atmospheric, marine, oil and gas, high temperature, complex stress states and other environments, to comprehensively improve the technical level of China's corrosion-resistant steel industry, increase the corrosion resistance of typical steel grades by more than one time, and build up a system of corrosion-resistant steel materials with independent intellectual property rights. Develop super nickel-based alloys, boiler tubes, high and medium pressure rotor forgings, steam generator heat transfer tubes, main pump motor materials, containment, special welding materials, etc. to support the construction of demonstration projects for 700°C ultra-supercritical power stations.

（3） Special aluminium, magnesium and titanium alloys

Development of special specifications of aluminum, magnesium, titanium alloy material preparation and precision forming process and control, service performance evaluation and other technologies, research and development of 650MPa level of new high toughness, low quenching sensitivity, thickness of 200mm above aluminum alloy pre-drawing plate; 500MPa level of high toughness, heat-resistant 250 ℃ above the magnesium alloy and fatigue, creep resistance, impact resistance, high plasticity and other series of magnesium alloy; development ≥ 700 ℃ High-temperature titanium alloys and 1300MPa above high-strength titanium alloys, diameter ≥ Φ 450mm ultra-large-size bars, etc.. Processing into a 10% increase in the rate of material.

2. High performance separation membrane materials

(1) Desalination Reverse Osmosis Membrane Products

The desalination rate is greater than 99.8%, the water flux is increased by 30%, the desalination project reaches 2 million tonnes/day, and the equipment localisation rate is greater than 80%.

(2) Ceramic Membrane Products

The filling density exceeds $300 m^2/m^3$, cost drops by 20%, demand reaches 200,000 m^2, breakthrough in low-temperature co-sintering technology, formation of gas-lift membrane separation equipment, energy consumption drops by 30%.

(3) Ion exchange membrane products

Membrane performance increased by 20%, chlor-alkali industry application exceeded 10 million tonnes scale, breakthrough in new technology and complete sets of plants for full membrane chlor-alkali production.

(4) Hollow fibre membrane products

Over 10 million tonnes per day in water production and wastewater treatment, with a membrane area of over 20 million m^2.

(5) Permeable vapourisation membrane products

The permeate flux will be increased by 20%, the membrane area will reach 100,000 m^2, breakthroughs will be made in large scale membrane assemblies and membrane integration application technology, and the scale of application will be promoted to over one million tonnes of solvent dewatering and recovery, with energy saving of over 30%.

3. High Performance Fibres and Composites

（1）High performance carbon fibres and their composites

In 2020, the technical maturity of domestic high-strength carbon fibers and their composites will reach level 9, and they will be used in automobiles, high-tech ships and other fields on a large scale; in 2025, the technical maturity of domestic high-strength medium-mode and high-mode high-strength carbon fibers and their composites will reach level 9; and

By 2025, in conjunction with the research and development process of the domestic large aircraft, we aim to have the carbon fiber compound for aviation

Some of the key components of the composite material have obtained CAAC/FAA/EASA airworthiness certification. Carbon Fibre (T800 grade) Tensile strength ≥ 5.8 GPa, CV ≤ 4%, tensile modulus 294 GPa, CV ≤4%.

(2) High performance para-aramid fibres and their composites

In 2025, the technological maturity of domestic para-aramid fibres and their composites reaches level 9.

The establishment of a unified standard high-performance fiber material technology system, to overcome the series of high-performance fibers and efficient preparation of industrial technology, to carry out and domestic high-performance fibers to match the composite matrix materials, design technology, molding process, performance characterization, application verification and recycling research to ensure that major equipment needs. Para-aramid fracture strength 20-22 cN/dtex, elongation at break 3-4%; polyimide fibre monofilament slenderness of 2.0 dTex, strength >4 cN/dTex, ultimate oxygen index of 38%.

(3) Other high performance fibres and their composites

Focus on the development of metal-based, ceramic-based advanced composite materials, components and related process equipment; polyimide fiber monofilament slenderness of 2.0dTex, strength > 4cN/dTex, ultimate oxygen index of 38%; ultra-high molecular weight polyethylene fiber, basalt fiber, polyphenylene sulfide fiber, high strength and high modulus polyvinyl acetal fiber, polytetrafluoroethylene fiber, silicon carbide fiber and other important varieties; the development of High performance PBO fibres with a tensile strength of 5.8 GPa, modulus of 270 GPa and an ultimate oxygen index of 68%.

4. New energy materials

（1） Solar Cells

Crystalline silicon cell efficiency ≥ 25%, silicon-based thin film cell efficiency ≥ 15%, PV system on

Grid tariff ≤ 0.5 yuan/kWh; organic solar cell energy conversion efficiency ≥ 20%; dyeing
Photoelectric conversion efficiency of data-sensitised solar cells ≥ 15%.

(2) Lithium batteries

Energy lithium battery specific energy ≥ 300Wh/kg, power lithium battery specific power ≥ 4000W/kg; power battery ≤ 1.5 yuan / Wh, energy storage battery ≤ 1.0 yuan / Wh, materials and battery production equipment to achieve all localization.

(3) Fuel cells

Fuel cell system ≤ 0.3 million yuan/kW,membrane electrode cost ≤ 50 yuan/kW,high temperature composite membrane cost ≤ 0.3 million yuan/m2.

5. New generation of biomedical materials

(1) Regenerative Medicine Products

Development of 5-10 bioreactors for regenerative repair of bone, skin, nerve and other tissues
The annual production scale of high-end regenerative medicine products is RMB 5 billion.

(2) Functional implants/interventional products

Develop 5-10 biomedical materials for cardiovascular, artificial joint, dental implant, vision restoration and other clinical treatments, with an annual production scale of 3 billion RMB for high-end functional implant/interventional products.

（3） Medical raw materials

To achieve the localization of important raw materials, to support a large number of medical supplies, permeable membranes, biodegradable devices and other products, to achieve an annual production scale of 3 billion yuan.

6. Electronic ceramics and artificial crystals

（1） Electronic Ceramics

Focus on the development of high-k dielectrics with dielectric constants above 10,000 and dielectric losses below 0.1

Quality ceramics.

（2） Artificial Crystals

Develop large size, high quality and low cost artificial crystal materials; breakthrough in key technologies for industrialisation of large size non-linear crystals (mid and far infrared, ultraviolet and deep ultraviolet) high optical yield scintillation crystals, low defect sapphire, etc., and apply them on a large scale.

7. Rare earth functional materials

（1） Rare earth magnetic materials

Sintered magnets have a combined performance (magnetic energy product (MGOe) + coercivity (kOe)) of 80; the magnetic energy product is >40 MGOe for a Ce content of 40% of the total rare earths.

（2） Rare earth optical functional materials

White LED phosphor application devices with luminous efficacy >200lm/W for a wide colour gamut (>100% NTSC) display application requirements.

（3） Rare earth catalytic materials

Gasoline olefins and sulphur content, motor vehicle catalysts and devices meet National VI emission standards.

（4） Rare earth hydrogen storage materials

Development of new power and energy storage battery materials with high energy density and low cost; formation of a platform for automated control, industrial production, complete sets of equipment capabilities and testing and evaluation of battery materials and products.

（5） Ultra-pure rare earth materials

Rare earth oxide purity 6.5N, rare earth metal purity 4.5N.

Focus on breakthroughs in new rare earth material composition design and high throughput preparation technology, rare earth

Microstructure control preparation technology for functional materials, high-temperature and high-pressure synthesis of rare-earth phosphors and surface

Common key technologies such as overlay technology and efficient separation and purification technology for rare earths.

8. Advanced Semiconductor Materials

（1） Third generation semiconductor single crystal substrates

6-8 inch SiC, 4-6 inch GaN, 2-3 inch AIN single crystal substrate preparation technology; can produce large size, high quality third-generation semiconductor single crystal substrate of the localization of equipment.

（2） Third generation semiconductor optoelectronic devices, modules and applications

LED epitaxy and chip fabrication technologies with luminous efficacy above 200 lm/W; AIGaN-based UV LEDs above 50mW.

（3） Third Generation Semiconductor Power Electronics Devices, Modules and Applications

Key technologies for the preparation of SiC power electronics devices above 15kV; design and preparation of high quality, low cost GaN power electronics devices; applications in high voltage power grids, high speed rail transportation, consumer electronics, new energy vehicles, new generation general power supplies, etc.

（4） Third Generation Semiconductor RF Devices, Modules and

Applications

GaN-based HEMT microwave RF devices and modules above 100Mhz; applications in 5G mobile and satellite communications.

(5) 450mm large diameter silicon wafers

Key technologies for the preparation of 450mm silicon materials; guide lines for the production of more than 50,000 wafers of 450mm silicon per year

9. Display materials

（1） Print display

60-inch class, 4K2K high resolution printed OLED displays by 2020 and 100-inch class, 8K4K ultra-high resolution printed AMOLED displays by 2025.

（2） Flexible displays

In 2020, 300 PPI resolution small to medium sized flexible AMOLED displays, bendable <1cm in diameter, and in 2025, 100 inch class, reelable 8K4K flexible displays, small to medium sized foldable displays.

（3） Laser displays

100-inch class HD laser home cinema with a colour gamut space of 160% NTSC, and by 2025, 200-inch UHD laser display products with a 200% NTSC colour gamut space.

9.2.4 Strategic support and assurance

1. The establishment of a special programme for key strategic materials; focus on breaking through the constraints of advanced core engineering process technologies and enhancing the level of technological innovation in common processes in the key strategic materials industry.

2. Create a number of national-level joint innovation centres for the new materials industry in key areas, formed by new materials producers, key users and research institutes, to carry out upstream and downstream collaborative innovation. Encourage the establishment of industry-university-research innovation alliances to carry out the development and application of key strategic materials.

3. Strengthen the research and development of key strategic material standards and application standards.

4. Deepen the development of civil-military integration and realize the two-way transfer of new material technology.

5. Establish a risk compensation mechanism for the "first batch" of new material applications, improve comprehensive supporting policies such as insurance, finance and taxation, and strengthen the cultivation and support for the initial market of new materials. Carry out evaluation and recognition of the maturity of new materials technology.

		2020年	2025年
需求		高端装备用特种合金、高性能分离膜材料、高性能纤维及其复合材料、新型能源材料、电子陶瓷和人工晶体、新一代生物医用材料、稀土功能材料、先进半导体材料、新型显示材料等关键战略材料，是支撑和保障海洋工程、轨道交通、舰船车辆、核电、航空发动机、航天装备等领域高端装备用的关键核心材料，也是实施智能制造、新能源、电动汽车、智能电网、环境治理、医疗卫生、新一代信息技术和国防尖端技术等重大战略需求的关键保障材料，目前，在国民经济需求的百余种关键材料中，约三分之一国内完全空白，约一半性能稳定性较差，部分产品受到国外严密控制，突破受制于人的关键战略材料，具有十分重要的战略意义。	
目标	总体目标	实现30种以上关键战略材料产业化及应用示范。有效解决新一代信息技术、高端装备制造业等战略性新兴产业发展急需，关键战略材料综合保障能力超过70%。初步形成上下游协同的战略新材料创新、应用示范体系和公共服务科技条件平台。	高端制造业重点领域所需战略材料制约问题基本解决，关键战略材料综合保障能力超过85%。部分产品进入国际供应体系，关键品种填补国内空白，实现自主知识产权体系。
	高端装备用特种合金	解决高端应用急需的品种问题；关键高温合金形成稳定供应能力，GH4169盘件达到5000件、GH4698盘件达到300件、FGH4097制件300件，自给率达50%以上；超超临界机组材料产业规模150亿元，高端特种钢产业规模达到2000亿元；特种铝镁钛合金产业规模达到100亿元。	高端装备用特种合金制约问题基本解决，关键领域取得原创性突破，有效满足下游产业发展的当前与长远需求；关键急需的高温合金品种性价比与欧美相当，自给率达70%以上；特种铝镁钛合金产业规模达到150亿元，全面满足交通工具、海洋工程等领域对高端轻质合金的应用需求。
	高性能分离膜材料	膜分离性能提高20%，成本下降10-30%；膜法净化水用装备的国产化率超过70%，海水淡化用反渗透膜材料的市场占有率超过30%；高温气体分离膜实现工程化应用，尾气除尘率大于99.9%；渗透汽化膜材料的渗透通量提高20%，节能30%以上。	水处理膜材料的成本下降20%以上，特种分离膜和气体分离膜能耗下降20%，以分离膜材料为核心的分离装备成为石油化工、煤化工等行业的主要分离手段，分离效率提高30%，国产化率将超过50%。
	高性能纤维及复合材料	国产碳纤维复合材料满足大飞机等重要装备的技术要求，在海洋与建筑工程、新能源整车制造示范应用，国产碳纤维年用量达到4000吨以上。	高性能纤维基本实现自主保障，高性能纤维复合材料在工业装备上的应用占比超过50%；在新一代航天装备上实现批量应用，在民机领域实现示范应用，并取得适航认证。
	新能源材料	光伏产业技术全面突破，新型太阳能电池性能达到国际水平,锂电池产业规模居世界前列，成本降低50%，安全和寿命满足市场要求；燃料电池系统及关键材料形成批量化生产能力，贵金属用量降低50%。	光伏产业国际领先，光伏发电平价上网，新型太阳能电池大规模应用；锂电池产业规模居世界首位，性能和成本达到电动汽车和规模储能市场化应用要求；新型低成本高能量电池体系进入规模应用阶段；燃料电池系统及关键材料实现商业化生产和销售，实现规模应用。
	生物医用材料	产业规模达到8000亿元，占国际市场份额22%，高端产品国产化率达20-30%。	产业规模到达2万亿元，占市场份额30%，高端产品国产化率达40-50%。
	电子陶瓷和人工晶体	电子陶瓷产业规模达500亿元，国内市场份额占到10%以上，突破高端产品。	电子陶瓷产业规模约800亿元，市场份额达到20%以上。开展卓有成效的新型晶体材料的基础研究和产业化关键技术研发。
	稀土功能材料	建成2-3个5-10万吨级稀土永磁材料、催化材料等产业基地，稀土功能材料产量45万吨（REO 16万吨），产业规模达800亿元，市场份额>85%，出口比例30%，自给率70%。	建成3-5个10万吨级稀土磁、光、催化等功能材料产业基地，稀土功能材料产量66万吨（REO 23万吨），年产值1000亿元，市场份额>90%，出口比例40%，自给率85%；稀土磁、光等功能材料达到世界先进水平。
	先进半导体材料	第三代半导体材料制备关键技术，达到国际先进水平，在移动通信、高效电源管理国产达30%，在光伏逆变器、移动通讯领域实现规模应用，在通用照明市场渗透率达到60%。450mm硅单晶月产能2吨以上。	在5G移动通信、高效电源管理中国产化率达到50%；在新能源汽车、消费类电子领域实现规模应用，在通用照明市场渗透率达到80%。开发14nm线宽集成电路用450mm硅片，并实现商业化应用。
	新型显示材料	关键印刷显示材料国产化率达到45%，产业规模超500亿元/年，柔性显示材料产业规模达100亿元/年，激光显示材料创造新增产值30亿元/年。	关键印刷显示材料国产化率达到55%，产业规模超1500亿元/年，柔性显示材料产业规模达500亿元/年，激光显示材料创造新增产值100亿元/年。
高端装备用特种合金	高温合金	国产高代次涡轮盘和单晶叶片等高温合金产品形成稳定供应能力，满足航空发动机与燃气轮机重大专项对高温合金材料的需求。	
	特种耐蚀钢及700℃超超临界电站用耐热合金	研发耐大气、海洋、油气、高温、复杂应力状态等环境腐蚀的钢铁材料，全面提高我国耐蚀钢产业技术水平，典型钢种耐蚀性能提高1倍以上，并构建起自主知识产权的耐蚀钢材料体系。开发超级镍基合金、锅炉管材、高中压转子锻件，蒸汽发生器传热管、主泵电机材料、安全壳、专用焊接材料等，支撑700℃超超临界电站示范工程建设。	
	特种铝镁钛合金	开发特种规格铝、镁、钛合金材料制备及精密成形工艺与控制、服役性能评价等技术，研发650MPa级新型高强韧、低淬火敏感性、厚度200mm以上铝合金预拉伸板；500MPa级高强韧、耐热250℃以上镁合金以及抗疲劳、抗蠕变、耐冲击、高塑性等系列镁合金；研制≥700℃高温钛合金和1300MPa以上高强韧钛合金、直径≥Φ450mm超大规格棒材等。加工成材率提高10%。	
高性能分离膜材料	海水淡化反渗透膜	脱盐率达到99.8%，水通量提高30%，海水淡化工程达到200万吨/日，装备国产化率大于80%。	
	陶瓷膜	装填密度超过300m2/m3，成本下降20%，膜面积超过20万m2，能耗下降30%。	
	离子交换膜	性能提高20%，氯碱工业应用超过1000万吨规模。	
	中空纤维膜产品	在自来水生产、污水处理等领域应用超过1000万吨/日，膜面积超过2000万m2。	
	渗透汽化膜产品	渗透通量提高20%，膜面积达到10万m2，突破大型膜组器和膜集成应用技术，推广应用规模超过百万吨溶剂脱水和回收，节能30%以上。	

发展重点	高性能纤维及复合材料	高性能碳纤维及其复合材料	国产高强碳纤维及其复合材料技术成熟度达到9级。	国产高强中模、高模高强碳纤维及其复合材料技术成熟度达到9级。
			航空用碳纤维复合材料部分关键部件取得CAAC/FAA/ EASA等适航认证。	
			开发低成本高性能碳碳复合材料。	
		高性能对位芳纶纤维及其复合材料	国产对位芳纶纤维及其复合材料技术成熟度达到9级。	
	新能源材料	太阳能电池材料	晶硅电池效率≥20%，硅基薄膜电池效率≥12%，有机太阳能电池能量转换效率≥15%；染料敏化太阳能电池光电转换效率≥11%。	晶硅电池效率≥25%，硅基薄膜电池效率≥15%，有机太阳能电池能量转换效率≥20%；染料敏化太阳能电池光电转换效率≥15%。
		锂离子电池材料	能量型锂电池比能量≥200 Wh/kg，功率型锂电池比功率≥3000 W/kg；动力电池≤2.0元/Wh;储能电池≤1.5元/Wh。	能量型锂电池比能量≥300 Wh/kg，功率型锂电池比功率≥4000 W/kg；动力电池≤1.5元/Wh，储能电池≤1.0元/Wh。
		燃料电池材料	SOFC单电池功率密度≥1W/cm2，电堆功率≥5kW，独立发电系统功率≥5kW，成本≤0.6万元/kW，PEMFC系统，低成本膜电极达到1W/cm2，膜性能≥30S/cm2，金属双极板成本<550元/kW。	燃料电池系统≤0.3万元/kW，膜电极成本≤50元/kW，高温复合膜成本≤0.3万元/m2。
	新一代生物医用材料	再生医学产品	研制出5-10种应用于骨、皮肤、神经等组织再生修复的生物活性材料，形成高端再生医学产品，建成3条以上规模化生产线，实现产业规模50亿元。	
		功能性植/介入材料	开发出5-10项应用于心血管、人工关节、种植牙、视觉恢复等临床治疗的生物医用材料，形成高端功能性植/介入产品，建成4条以上规模化生产线，实现产业规模30亿元。	
		医用原材料	实现重要原材料的国产化，支撑量大面广的医用耗材、渗透膜、可降解器械等产品，实现产业规模30亿元。	
	电子陶瓷和人工晶体	电子陶瓷	重点开发介电常数高于1万且介电损耗低于0.1的高k电介质陶瓷。	
		人工晶体	开发大尺寸、高质量、低成本的人工晶体材料；突破大尺寸非线性晶体（中远红外、紫外、深紫外）、高光产额闪烁晶体，低缺陷蓝宝石等产业化关键技术，并规模应用。	
	稀土功能材料	稀土磁性材料	烧结后综合性能（磁能积MGOe)+矫顽力(kOe)）>75。	磁体综合磁性能≥80；Ce含量占稀土总量的40%时磁能积 >40MGOe。
		稀土光功能材料	白光LED荧光粉应用器件光效大于200lm/W。	新型稀土荧光粉满足广色域（>100% NTSC）显示屏应用需求。
		稀土催化材料	机动车催化剂满足国VI排放标准，贵金属及稀土用量减少20%以上。	汽油烯烃和硫含量、汽车尾气净化器件满足国VI标准。
		稀土储氢材料	开发高能量密度、低成本的新型动力和储能电池材料；形成电池材料及制品的自动化控制、工业生产、成套装备能力与测试评价平台。	
		超纯稀土材料	稀土氧化物纯度大于6N，稀土金属纯度大于4N。	稀土氧化物纯度达到6.5N，稀土金属纯度大于4.5N，满足稀土晶体材料及器件的应用要求
	先进半导体	第三代半导体光电子应用	LED器件光效超过200lm/W	
			通用照明市场渗透率达到60%	在通用照明市场渗透率达到80%
		第三代半导体电力电子应用	15kV以上SiC电力电子器件制备关键技术；高质量、低成本GaN电力电子器件的设计与制备；在高压电网、高速轨道交通、消费类电子产品、新能源汽车、新一代通用电源等领域的应用。	
		第三代半导体射频应用	100Mhz以上GaN基HEMT微波射频器件和模块；5G移动通信和卫星通信领域中的应用。	
		450mm大直径硅片	450mm硅材料制备关键技术；年产5万片以上450mm硅片的引导线。	
	新型显示材料	印刷显示	掌握60英寸级、4K2K高分辨率OLED显示屏的印刷制备技术。	掌握100英寸级、8K4K超高分辨率印刷AM-OLED显示屏的制备技术。
			国产化45%，产业规模500亿元。	国产化55%，产业规模1500亿元。
		柔性显示	掌握300PPI分辨率柔性中小尺寸AMOLED显示技术，可弯曲直径<1cm。	掌握100英寸级、可卷绕式8K4K柔性显示,中小尺寸可折叠显示屏。
			产业规模达100亿元/年。	产业规模达500亿元/年。
		激光显示	研制出100英寸级高清激光家庭影院，色域空间达到160% NTSC。	研制出200英寸超高清激光显示产品，色域空间提高2倍以上，达到200%NTSC。
			创造新增产值30亿元/年。	2025年，创造新增产值100亿元/年。
	高端装备用特种合金		高温合金的低成本规模化生产技术；突破第四代粉末、单晶、点阵材料等新一代高温合金关键技术；打通先进高温合金制备工艺流程。	
			深海工程用特种钢和耐蚀合金部件自主制造技术；700℃超超临界电站用耐热合金成分设计及其大型部件制造成套技术。	
			开发特种规格、复杂截面型材、管材、锻件等，全面掌握大规格材料稳定批量制备技术以及表面防护、连接等多种应用技术。	

关键技术及装备	高性能分离膜材料	混合基质膜制备技术；低温共烧结技术 ；全膜法氯碱生产新技术。
		16吋的大型膜组器；气升式节能膜分离装备；全膜法氯碱生产全套装备。
	高性能纤维及复合材料	高强碳纤维制造技术；国产高强中模及高模高强碳纤维制造技术；碳纤维复合材料低成本设计和制造技术。
		24K以上丝束碳纤维大规模生产装备（宽幅高温超高温碳化炉等）；碳纤维复合材料连续自动化智能制造装备（生产效率达到6-12件/min）。
	新能源材料	高纯硅材料低成本规模化制备技术。
		动力电池及其关键材料低成本规模化制备技术。
		低铂催化剂及低成本膜材料规模化制备技术。
	生物医用材料	组织再生材料的活性化技术。
		植/介入材料的功能化表界面构建技术。
		可吸收高分子及绿色环保医用耗材可控制备技术。
	电子陶瓷和人工晶体	MLCC的流延成型及低温共烧技术。
	稀土功能材料	新型稀土材料成分设计与高通量制备技术；稀土功能材料微观组织可控制备技术； 稀土发光材料高温高压合成及表面包覆技术；稀土高效分离提纯技术。
		智能连续急冷快淬炉；高温高压连续氮化与荧光粉合成装备；高温超高真空稀土金属规模提纯装备。
	先进半导体	大尺寸单晶衬底制备及核心装备技术；大尺寸衬底上第三代半导体高质外延及核心装备技术； 第三代半导体材料及前沿器件技术；450mm硅材料核心技术。
		GaN衬底HVPE装备，GaN材料高温MOCVD，SiC衬底PVT单晶炉，SiC材料外延炉
	新型显示材料	可印刷发光/反射显示材料体系、可印刷TFT关键材料体系、INK技术、印刷显示关键工艺与器件技术。
		柔性基板材料与加工工艺、低温TFT工艺技术、低温快速干燥/退火工艺、柔性器件封装工艺技术。
		InGaP 红光 LD 量子阱材料和器件技术、InGaN 绿光 LD材料和器件技术、InGaN 蓝光 LD材料和器件技术、视频图像与光机器件技术。
战略支撑与保障建议		设立关键战略材料专项计划和专项资金。集中力量突破先进核心工程化工艺技术制约，提升关键战略材料产业共性工艺技术创新水平。
		重点支持产学研用创新联盟，建立若干国家级关键战略材料创新平台。
		加强关键战略材料标准及应用标准的研究制订。
		深入推动新材料产业军民融合发展，实现新材料技术双向转移。

9.3 Frontier New Materials

The invention and application of revolutionary new materials have been leading the global technological innovation, promoting the transformation and upgrading of high-tech manufacturing industries, while giving birth to many new industries. In terms of bringing into play cutting-edge new materials to lead industrial development, China's independent innovation capability is seriously lacking, and there is an urgent need to increase innovation in cutting-edge directions of new materials such as 3D printing materials, superconducting materials, intelligent bionic and metamaterials, graphene, etc., to accelerate the layout of independent intellectual property rights and seize development opportunities and strategic high points.

9.3.1 Demand

In the next 10 years, in order to meet the demand for personalized and customized complex-shaped metal products in the fields of aerospace, biomedical, automotive and motorcycle, and consumer electronics, the demand for 3D printing metal powder will grow at an average annual rate of 30%, reaching 800 tons by 2020.

2,000 tonnes by 2025. China is interested in superconductivity in smart grids, large scientific devices

Demand for the material continues to grow, with demand set to reach $10 billion by 2020 and $10 billion by 2025

The market size of smart bionic and metamaterials is expected to reach $15 billion in 2020. Smart bionic and metamaterials are the core materials for smart manufacturing and smart sensing, and it is extremely urgent to achieve large-scale manufacturing and application. Graphene is a super material that will dominate future high-tech competition and is widely used in the fields of electronic information, new energy, aerospace and flexible electronics, etc. It can greatly promote the rapid development and upgrading of related industries and has a huge market prospect, which is expected to give rise to a 100 billion yuan scale industry.

9.3.2 Objectives

By 2020, we will have accumulated a number of core technology patents for cutting-edge new materials, achieved mass production of some products, and realized application demonstrations in key areas.

To achieve an effective layout of cutting-edge new materials technologies, standards and patents by 2025;

Frontier new materials have made important breakthroughs and achieved large-scale applications, with some areas reaching world-leading levels.

9.3.3 Development focus

1. Materials for 3D printing

(1) Low-cost titanium alloy powder

Meet the requirements of aerospace 3D printing of complex parts with low-cost titanium alloy powder cost 50-60% lower than the existing equivalent titanium alloy powder.

(2) Iron-based alloy powder

The physical properties of metal products densified using the 3D printing process are comparable to those of fine cast products of the same alloy composition.

(3) High temperature alloy powder

Development of densification technology for metal powders and establishment of an evaluation standard system for products.

(4) Other 3D printing specialities

Breakthroughs in industrial preparation technologies for 3D printing materials and the establishment of a standard system for related materials products.

2.Superconducting materials

（1） High performance superconducting wire for strong magnetic fields

Mastery of high performance superconducting wire structure design and batch processing control techniques.

（2） Low-cost kilometre YBCO-coated conductors

Mastery of coated conductor weaving substrates, functional layer deposition technology and MOCVD and PLD manufacturing equipment.

（3） Products for applications such as superconducting current limiters at high voltage levels

Knowledge of electromagnetic design for applications such as superconducting current limiters at high voltage levels, ultra-high voltage

Key technologies such as insulation, assembly construction and grid-hanging operation.

The overall breakthroughs are in high performance and low cost superconducting wire cluster drawing and shaping processing technology, large scale high efficiency and long life refrigeration machine technology and low heat leakage low temperature vessel preparation technology, superconducting application product preparation technology for different wavelength bands and frequencies.

3.Intelligent bionics and metamaterials

（1） Controlled metamaterials and equipment

Enables the controlled conversion of electromagnetic waves in a specific frequency band from absorbing to transmitting, or the conversion of absorbing or transmitting waves in a specific frequency band to radiating electromagnetic waves.

（2） Biomimetic Bioadhesion Modulation and Separation Materials

Achieve long-lasting anti-adhesion of marine organisms (3 years, less than 5％)with no environmental toxicity; achieve efficient adhesion regulation and enrichment separation of more than 99%; obtain 2-3 types of long-lasting bionic anti-adhesion coating materials and bionic efficient separation technology and equipment.

（3） Flexible smart materials and wearable devices

The production of flexible bionic intelligent materials "roll-to-roll", electromagnetically adjustable, intelligent sensing, 0-360 degrees of arbitrary bending, and compatible with the human body.

Overall breakthroughs in large-area preparation and coating adhesion technologies for biomimetic bioadhesion regulation and separation materials; flexible, large-area preparation and biocompatible technologies for smart materials; and joint design technologies for adaptive controllable metamaterials with intelligent and biomimetic properties.

4.Graphene materials

（1） Graphene-based electrode materials for electric vehicle lithium batteries

More than 1x shorter charging time and 1x longer range than existing materials.

（2） Graphene-based anti-corrosion coatings for marine engineering, etc.

More than 1x longer life than conventional anti-corrosion coatings.

（3） Graphene films for flexible electronics

With a price/performance ratio that exceeds that of ITO and excellent flexibility, it can be used in a wide range of applications in flexible electronics.

（4） Graphene-based high-performance thermal interface materials for optical/electrical applications

Graphene-based heat sinks offer more than 2 times the performance of existing products.

Overall breakthrough in graphene scale preparation technology, graphene powder dispersion technology, graphene-based electrode material composite technology.

9.3.4 Strategic support and assurance

1. The establishment of a special programme and special funds for frontier new materials.
2. Focus on establishing a number of national cutting-edge new materials innovation centres.
3. Strengthen the research and development of standards for cutting-edge new materials and their applications.
4. Priority is given to supporting the demonstration application of cutting-edge new materials.
5. Establish a long-term mechanism to match production and

demand, and build a number of cutting-edge new material industry bases.

		2020年	2025年
需求	3D打印材料	航空航天、医疗、汽车摩配、等个性化、复杂形状金属制品对3D打印金属粉末的需求量约800吨。	年均增长30%，需求达到2000吨。
	超导材料	我国在智能电网、大科学装置方面对超导材料的需求将持续增长，市场需求量达到100亿元。	需求达到150亿元。
	智能仿生新材料	全球智能材料的市场,到2020年，其市场需求将达到650亿美元。	全球仿生超材料市场将以40%的年复合增长率健康成长。
	石墨烯材料	石墨烯材料集多种优异性能于一体，是主导未来高科技竞争的超级材料，广泛应用于电子信息、新能源、航空航天以及柔性电子等领域，可极大推动相关产业的快速发展和升级换代，市场前景巨大，有望催生产业规模千亿元。	
	总体目标	积累一批前沿新材料核心技术专利，部分产品实现量产，在关键领域实现应用示范。	实现前沿新材料技术、标准、专利等有效布局；前沿新材料取得重要突破并实现规模化应用，部分领域达到世界领先水平。
	3D打印材料	3D打印金属粉末年产达到200吨的水平，形成具有自主知识产权的国际先进制备技术，满足国家航空航天和生物医疗等领域的重大需求。	3D打印金属粉末原料达到年产600吨的水平，占国内市场的80%份额，出口200吨，形成在成本和技术方面均具备国际竞争力的产品。

目标	超导材料		超导材料整体水平达到国际先进，实现超导材料、超导强电和弱电应用产品系列化，超导线材产量500吨/年，超导强电和弱电应用装置100台/年，国内市场份额超过80%。	超导材料技术水平达到国际领先，全面进入国际市场，超导线材产量600吨/年，超导强电和弱电应用装置150台/年，国际市场份额超过30%。
			强磁场用高性能超导线材产业规模达到50亿元。	强磁场用高性能超导线材产业规模达到100亿元。
			低成本千米级YBCO涂层超导体产业规模达到20亿元。	低成本千米级YBCO涂层超导体产业规模达到40亿元。
			高电压等级超导限流器产业规模达到20亿元。	高电压等级超导限流器产业规模达到50亿元。
	智能仿生新材料		形成3-5个发明专利群、3-5件国家级技术标准。产业规模达到20亿元。	满足国民经济和国防建设的需要，关键材料及核心产品达到世界领先水平，产业规模达100亿元，材料自给率超过80%。
			可控超材料相关产业规模达20亿元。	可控超材料相关产业规模50-60亿元。
			仿生生物粘附调控与分离材料实现产业规模10-15亿元。	
			柔性智能材料与可穿戴设备产业规模达到15-25亿元。	
	石墨烯材料		规模制备及电化学储能、印刷电子、航空航天用轻质高强复合材料、海洋工程防腐等应用领域的技术水平达到国际领先，大幅提升相关产品性能，形成百亿元产业规模。	高质量石墨烯粉体年产达万吨级以上，薄膜年产达上亿平方米，实现8英寸石墨烯芯片批量生产，突破石墨烯在电子信息领域应用的技术瓶颈，整体产业规模突破千亿。
			电动汽车锂电池用石墨烯基电极材料产业规模达万吨级。	
			海洋工程等用石墨烯基防腐蚀涂料产业规模达十万吨级。	
			柔性电子用石墨烯薄膜产业规模达上亿平方米。	
重点产品	3D打印材料	低成本钛合金粉末	满足航空航天3D打印复杂零部件用粉要求，低成本钛合金粉末成本相比现有同等钛合金粉末降低50%～60%。	低成本钛合金粉末批量应用于航空航天3D打印复杂零部件。
		铁基合金粉末	利用3D打印工艺致密化后的金属制品，其物理性能与相同合金成分的精铸制品相当。	利用3D打印工艺致密化后的金属制品，其物理性能与相同合金成分的精铸制品相当。
		高温合金粉末	开发金属粉末的致密化技术，建立制品的评价标准体系。	3D打印用高温合金粉末批量用于关键零部件的3D打印制造。
	超导材料	强磁场用高性能超导线材	临界电流等主要性能满足20T大型超导磁体应用要求。	主要性能满足25T大型超导磁体应用需求。
		低成本千米级YBCO涂层导体	性价比达到150元千安米。	性价比达到100元千安米。
		高电压等级超导限流器	限流峰值达到100kA。	限流峰值达到150kA。
	智能仿生新材料	可控超材料	实现特定频段内电磁波从吸波与透波的可控转换，或者将特定频段内的吸波或透波转换为辐射电磁波。	超材料在特定领域获得典型应用。
		仿生生物粘附调控与分离材料	实现长效抗海洋生物粘附（3年，低于5%），环境无毒害；实现高效的粘附调控富集分离99%以上。	仿生生物粘附调控与分离材料得到规模化应用。
			实现仿生生物粘附调控与分离材料的应用示范。	实现仿生生物粘附调控与分离材料的规模化生产和规模化应用。
		柔性智能材料与可穿戴设备	柔性仿生智能材料实现电磁可调、智能传感、0-360度任意弯曲、与人体兼容。	实现柔性仿生智能材料"卷对卷"的生产，产品得到实际应用。
			完成柔性仿生智能材料在智能传感、健康诊断上的应用示范。	柔性仿生智能材料实现产业化，在智能传感、健康诊断等领域得到规模化应用。
	石墨烯材料	电动汽车锂电池用石墨烯基电极材	较现有材料充电时间缩短1倍以上，续航里程提高1倍以上。	石墨烯基电极材料电动汽车用动力锂电池等领域上得到规模化应用。
		海洋工程等用石墨烯基防腐蚀涂料	较传统防腐蚀涂料寿命增1倍以上。	石墨烯基防腐蚀涂料实现产业化并在海洋工程等领域得到规模化应用。
		柔性电子用石墨烯薄膜	性价比超过ITO，且具有优异柔性。	石墨烯薄膜实现产业化并在柔性电子等领域得到规模化应用。
		光电领域用石墨烯基高性能热界面	石墨烯基散热材料较现有产品性能提高2倍以上。	石墨烯基高性能热界面材料在光电领域得到应用。

关键技术及装备	3D打印材料	低成本钛合金粉末的制备技术、3D打印球形金属粉末雾化制粉技术、3D打印用金属粉末的评价技术、金属粉末的致密化技术。	球形金属粉末粉体在3D打印领域获得应用。
		核心自主知识产权3D打印粉末雾化制粉装备、低成本钛合金粉末制造集成装备。	3D打印粉末雾化制粉装备、低成本钛合金粉末制造装备得到应用。
	超导材料	突破高性能低成本超导线材集束拉拔塑形加工技术、大型高效长寿命制冷机技术和低漏热低温容器制备技术、面向不同波段和频率的超导滤波器制备技术。	超导线材、大型高效长寿命制冷机、低漏热低温容器、超导滤波器等关键技术得到应用。
	智能仿生新材料	仿生生物粘附调控与分离材料的大面积制备与涂层黏合技术。	仿生生物粘附调控与分离材料及涂层黏合技术得到实际应用。
		智能材料的柔性化、大面积的制备和生物兼容技术。	智能仿生材料得到应用。
		具有智能化和仿生特性的自适应可控式超材料的联合设计技术。	智能化仿生自适应可控式超材料得到实际应用。
	石墨烯材料	石墨烯的规模制备技术，石墨烯粉体的分散技术，石墨烯基电极材料的复合技术。	石墨烯基电极材料在动力电池等领域得到规模化应用。
战略支撑与保障建议		设立前沿新材料专项计划和专项资金。	
		集中力量建立若干国家级前沿新材料创新中心。	
		加强前沿新材料标准及应用标准的研究制订。	
		优先支持前沿新材料的示范应用。	
		建立产需对接长效机制，建设若干前沿新材料产业基地。	

X. Biomedical and high performance medical devices

10.1 Biomedical

Biopharmaceuticals is a general term for biotechnology-based products and systems technologies for disease control and health care, including genetic drugs, monoclonal/protein drugs, vaccines, small molecule chemical drugs and traditional Chinese medicine.

10.1.1 Demand

China is the second largest drug consumption market in the world, and according to the National Pharmaceutical Statistics Annual Report, the net sales of China's drug market exceeded RMB 15,000,000 in 2014. In 2014, China's pharmaceutical industry generated sales of RMB 245.32 billion. However, China's independent research and development products are weak, drug production is mainly generic, and there are few original new drugs, and there are obvious gaps in key biopharmaceutical technologies. Therefore, improving the overall technological content and economic added value of the biopharmaceutical industry, focusing on developing a number of innovative drugs and fostering strategic emerging industries in biopharmaceuticals are the keys to improving the competitiveness of China's pharmaceutical industry.

10.1.2 Objectives

By 2020, we will promote a large number of enterprises to align their drug quality standards and systems with international standards, including at least 100 pharmaceutical preparation enterprises to obtain US, European, Japanese and WHO certifications and export their products; develop and promote the registration of 10-20 chemical drugs and their high-end preparations, 3-5 new Chinese medicines and 3-5 new biotechnological drugs in Europe, the US and other developed countries in accordance with international drug standards. Accelerate the international development of domestic drugs.

More than 90% of heavyweight drugs with expired international patents are manufactured in generic form by 2020. Breakthroughs
10-15 major core key technologies and the initial establishment of a national drug innovation system and innovation team.

By 2025, we will basically achieve the alignment of drug quality standards and systems with international standards; develop new chemical, traditional Chinese medicine and biotechnology drugs for ten major diseases, and industrialize 20-30 innovative drugs; 5-10 new drugs with China's own property rights will be certified by the FDA or the EU and enter the international market; build a national drug innovation system that completes and supports foreign services, and form a high-level innovation team with an international perspective. We will also build a national drug innovation system to improve and support foreign services, form high-level innovation teams with international vision, and promote the international development strategy of China's medicine.

10.1.3 Development focus

1. Key products

New chemical, traditional Chinese medicine and biotechnology drugs for major diseases, with emphasis on new mechanisms and new targets for molecular targeting drugs, antibody drugs and antibody cross-linked drugs

(ADC), protein and peptide drugs, novel vaccines, novel cell therapy agents, innovative Chinese medicines with outstanding clinical advantages and personalised therapeutic drugs.

（1） Development of new chemical, Chinese and biotechnological drug products for major diseases

To develop and promote 10-20 chemical drugs and their high-end production in accordance with international pharmaceutical standards

The company has developed a number of new drugs such as multi-target receptor tyrosine kinase inhibitors, targeted anti-tumour class 1.1 drug famitinib, class 1.1 drug HSH-971 for Alzheimer's disease and colistin for the treatment of drug-resistant pathogenic infections; 3-5 new Chinese medicines such as anti-tumour acoradin, anti-depressant Olsenoxet and diabetic nephropathy rhubarb acid; 3-5 new biological drugs such as menadione insulin and long-acting GLP-1. GLP-1, etc.

（2） Focus on the development of novel mechanisms and targets for antibody drugs, recombinant protein drugs and Immune cell therapy preparations

The main focus is to independently develop 20-30 therapeutic antibodies and antibody cross-linked drugs with strong innovation, high technological content, good market prospect and independent intellectual property rights for major diseases such as malignant tumours, cardiovascular and cerebrovascular diseases, metabolic diseases and autoimmune diseases

（The programme will include the development of a number of new drugs, such as the Anti-CD22 and Anti-CD147 humanised monoclonal antibodies, G-CSF long-acting protein drugs, recombinant high potency anti-tumour and anti-viral protein injections and genetically modified T-cell therapeutic agents (T-cell receptor TCR and chimeric antigen receptor CAR), of which 10-15 will be original, as well as the development of matching genetic tests for these antibody drugs. The development of genotype detection kits for these antibodies will lead to the development of personalised and precision therapeutic drugs.

（3） Development of bio-3D printing technology for tissue engineering and regenerative medicine therapeutic products

To explore the application of bio-3D printing technology in drug screening, tissue engineering and regenerative medicine; to develop 10-20 tissue engineering and regenerative medicine therapeutic products using bio-3D printing technology in combination with macromolecular drugs, new modified immune cell therapeutic drugs, stem cells and iPS cells.

（4） Accelerating the generic launch of drugs with expired patents

In order to meet the urgent needs of clinical use, we will develop 20-30 clinically important products by combining generic innovation and system integration, and effectively solve the problem of industrialisation.

2. Key common technologies

（1） New drug target discovery based on disease target networks, reverse molecular docking with corroboration techniques

It uses computer methods to model the cellular signalling network of a disease, describe the dynamic changes in the network during the development of the disease, conduct virtual molecular screening, docking and validation to determine the effectiveness of drug candidates for specific disease subtypes, and ultimately identify effective new targets to achieve innovative drug discovery using dynamic networks as targets.

（2） Cell and target-based pharmacokinetics and pharmacokinetic/pharmacodynamic/toxicity trinity for drug development evaluation

The PK-PD and TK-TD models were developed using human-derived cells and humanised animal models, combined with the molecular pathology of the target, to enhance the triad of pharmacogenesis/pharmacodynamics/toxicity.

（3） New technologies for the development of innovative biotechnological drugs based on new targets/structures/ functions such as antibodies, proteins, peptides, nucleic acids and immune cell therapy

Breakthroughs in antibody preparation technology systems with synergistic enhancement of the same target; development of ADC antibody drug screening technology systems and bispecific antibody drug production and quality control technologies; strengthening the development of slow-release platforms for protein and peptide drug-related nanotechnology and 3D printing technology; breakthroughs in key technologies for drug-forming research of protein drugs; preparation of low-immunogenicity, targeted, non-toxic and efficient gene therapy vectors/delivery systems. delivery systems. Encourage original innovation to diversify and mature innovative biological drugs.

（4）Antibody/protein drug industrialisation engineering chain technology

Build a GMP production technology platform for eukaryotic cell mass culture, including the development of serum-free culture medium, engineering cell line building, protein drug purification, product preparation, lyophilisation process and other technologies, improve GMP management level, so that the mass production technology of biotechnology drugs can reach the international advanced level.

(5) Drug delivery systems such as magnetic targeting-based drug delivery and drug delivery-related technologies

A series of new key technologies with common characteristics

Advancing drug delivery systems in the direction of precision, controlled release and targeting intelligence. To build new environmentally responsive delivery systems, develop magnetic-based targeted drug release systems and drug delivery-related technologies to improve drug performance and its efficacy.

(6) A common technology system for precision therapy based on individual genetic information and molecular markers

Develop drugs based on individualised specific molecular markers and establish a technology system from genetic testing to individualised precision immunotherapy. Establish precision target screening technologies based on whole-genome sequencing of tumour tissues and normal tissues, exon and target resequencing, transcriptome sequencing, etc. Combining changes in disease target networks and new nodes of proteins for key network targets, we will achieve targeted drug interventions and improve the precision treatment of drugs.

(7) Enhancing the quality of chemical generics and improving the controllability of Chinese medicine quality

To improve the GMP production, quality testing and quality assurance capabilities of chemical generic drugs and Chinese medicines in China through the construction of technical systems, and to enhance the controllability of the quality of chemical generic drugs and Chinese medicines. Establishing proprietary quality evaluation methods and technologies and forming technical guidelines for the quality evaluation of chemical generic drugs, and Chinese medicines to ensure the safety, efficacy and stability of drugs.

10.1.4 Application demonstration projects

By 2020, 3-5 universities and colleges with a good foundation will be promoted to jointly build large R&D bases, national translational science centres and collaborative innovation centres with high technological levels and R&D capabilities. 2025, the number will grow to 5-10, with 3-5 of these collaborative bodies reaching international advanced levels in terms of technological innovation capabilities, major innovative products and pharmaceutical industrial systems, with annual main sales revenues exceeding The annual main sales revenue will exceed RMB 50 billion, and the synergistic centre will become an internationally competitive centre.

The company is a major biopharmaceutical backbone enterprise with a strong presence in the world.

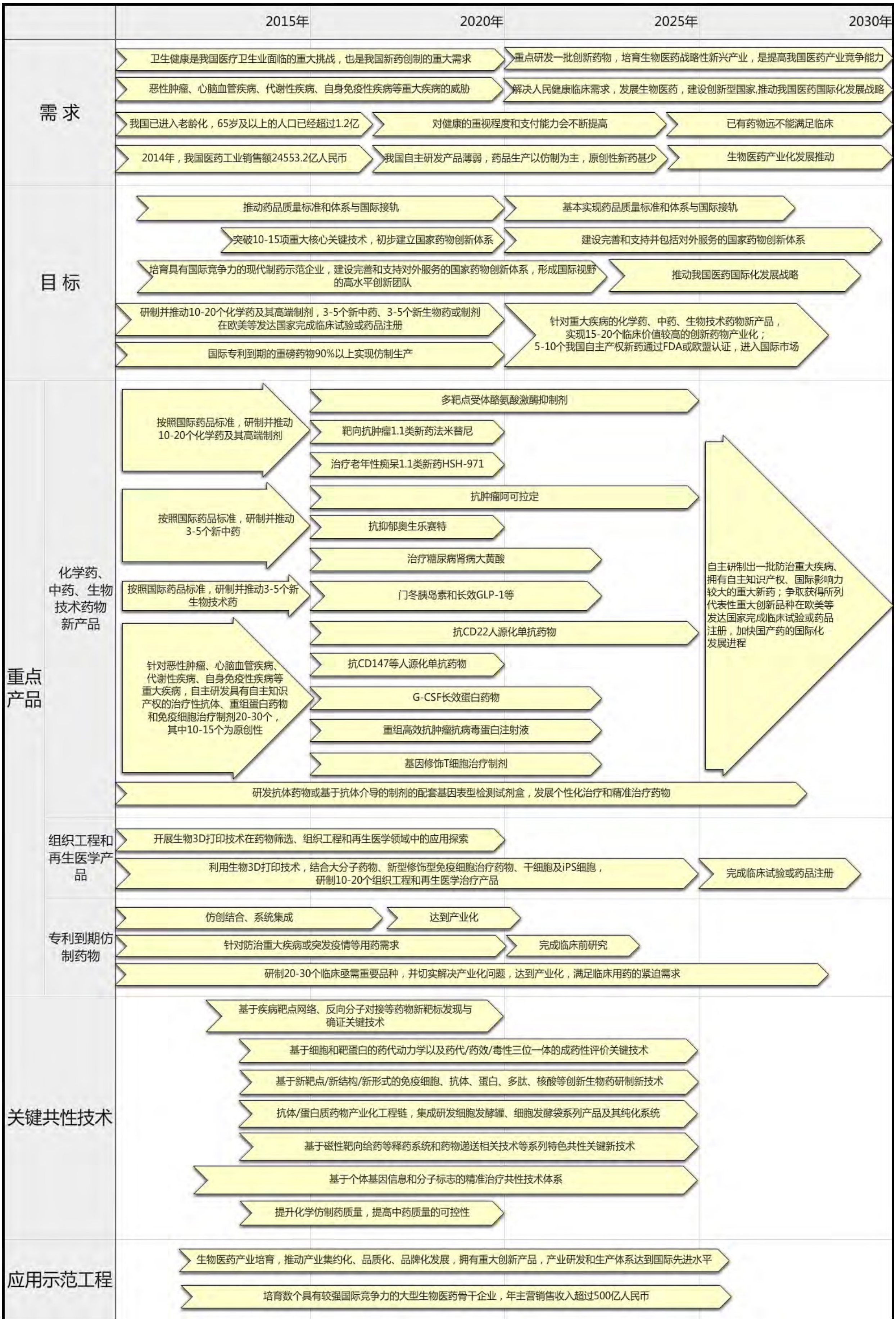
10.1.5 Strategic Support and Assurance

1. To establish or standardise key platforms for the pre-clinical and clinical evaluation of new drugs in line with international standards for the quality management of drug clinical trials (GCP) and non-clinical drug studies (GLP)

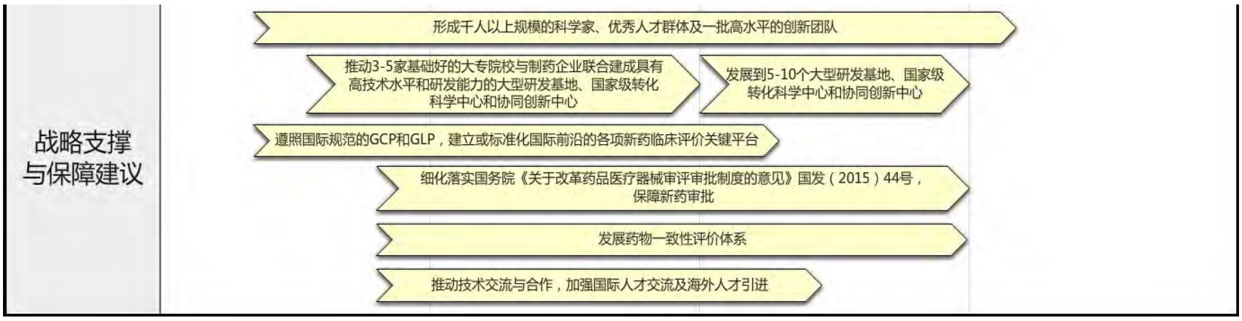
2. Optimise and improve the policy of priority review and fast-track approval, and strengthen the construction of an expanded team of review and inspection personnel.

3. Refine the implementation of the State Council's Opinions on Reforming the Review and Approval System for Pharmaceuticals and Medical Devices Guo Fa (2015) No. 44 to safeguard the approval of new drugs.

4. Development of a consistency evaluation system for drugs.



2015年
2020年
2025年
2030年
需求
卫生健康是我国医疗卫生业面临的重大挑战，也是我国新药创制的重大需求
重点研发一批创新药物，培育生物医药战略性新兴产业，是提高我国医药产业竞争能力
恶性肿瘤、心脑血管疾病、代谢性疾病、自身免疫性疾病等重大疾病的威胁
解决人民健康临床需求，发展生物医药，建设创新型国家,推动我国医药国际化发展战略
我国已进入老龄化，65岁及以上的人口已经超过1.2亿
对健康的重视程度和支付能力会不断提高
已有药物远不能满足临床
2014年，我国医药工业销售额24553.2亿人民币
我国自主研发产品薄弱，药品生产以仿制为主，原创性新药甚少
生物医药产业化发展推动
目标
推动药品质量标准和体系与国际接轨
基本实现药品质量标准和体系与国际接轨
突破10-15项重大核心关键技术，初步建立国家药物创新体系
建设完善和支持并包括对外服务的国家药物创新体系
培育具有国际竞争力的现代制药示范企业，建设完善和支持对外服务的国家药物创新体系，形成国际视野的高水平创新团队
推动我国医药国际化发展战略
研制并推动10-20个化学药及其高端制剂，3-5个新中药、3-5个新生物药或制剂在欧美等发达国家完成临床试验或药品注册
针对重大疾病的化学药、中药、生物技术药物新产品，实现15-20个临床价值较高的创新药物产业化；5-10个我国自主产权新药通过FDA或欧盟认证，进入国际市场
国际专利到期的重磅药物90%以上实现仿制生产
重点产品
化学药、中药、生物技术药物新产品
按照国际药品标准，研制并推动10-20个化学药及其高端制剂
多靶点受体酪氨酸激酶抑制剂
靶向抗肿瘤1.1类新药法米替尼
治疗老年性痴呆1.1类新药HSH-971
按照国际药品标准，研制并推动3-5个新中药
抗肿瘤阿可拉定
抗抑郁奥生乐赛特
治疗糖尿病肾病大黄酸
按照国际药品标准，研制并推动3-5个新生物技术药
门冬胰岛素和长效GLP-1等
针对恶性肿瘤、心脑血管疾病、代谢性疾病、自身免疫性疾病等重大疾病，自主研发具有自主知识产权的治疗性抗体、重组蛋白药物和免疫细胞治疗制剂20-30个，其中10-15个为原创性
抗CD22人源化单抗药物
抗CD147等人源化单抗药物
G-CSF长效蛋白药物
重组高效抗肿瘤抗病毒蛋白注射液
基因修饰T细胞治疗制剂
自主研制出一批防治重大疾病、拥有自主知识产权、国际影响力较大的重大新药；争取获得所列代表性重大创新品种在欧美等发达国家完成临床试验或药品注册，加快国产药的国际化发展进程
研发抗体药物或基于抗体介导的制剂的配套基因表型检测试剂盒，发展个性化治疗和精准治疗药物
组织工程和再生医学产品
开展生物3D打印技术在药物筛选、组织工程和再生医学领域中的应用探索
利用生物3D打印技术，结合大分子药物、新型修饰型免疫细胞治疗药物、干细胞及iPS细胞，研制10-20个组织工程和再生医学治疗产品
完成临床试验或药品注册
专利到期仿制药物
仿创结合、系统集成
达到产业化
针对防治重大疾病或突发疫情等用药需求
完成临床前研究
研制20-30个临床亟需重要品种，并切实解决产业化问题，达到产业化，满足临床用药的紧迫需求
关键共性技术
基于疾病靶点网络、反向分子对接等药物新靶标发现与确证关键技术
基于细胞和靶蛋白的药代动力学以及药代/药效/毒性三位一体的成药性评价关键技术
基于新靶点/新结构/新形式的免疫细胞、抗体、蛋白、多肽、核酸等创新生物药研制新技术
抗体/蛋白质药物产业化工程链，集成研发细胞发酵罐、细胞发酵袋系列产品及其纯化系统
基于磁性靶向给药等释药系统和药物递送相关技术等系列特色共性关键新技术
基于个体基因信息和分子标志的精准治疗共性技术体系
提升化学仿制药质量，提高中药质量的可控性
应用示范工程
生物医药产业培育，推动产业集约化、品质化、品牌化发展，拥有重大创新产品，产业研发和生产体系达到国际先进水平
培育数个具有较强国际竞争力的大型生物医药骨干企业，年主营销售收入超过500亿人民币


战略支撑与保障建议
形成千人以上规模的科学家、优秀人才群体及一批高水平的创新团队
推动3-5家基础好的大专院校与制药企业联合建成具有高技术水平和研发能力的大型研发基地、国家级转化科学中心和协同创新中心
发展到5-10个大型研发基地、国家级转化科学中心和协同创新中心
遵照国际规范的GCP和GLP，建立或标准化国际前沿的各项新药临床评价关键平台
细化落实国务院《关于改革药品医疗器械审评审批制度的意见》国发（2015）44号，保障新药审批
发展药物一致性评价体系
推动技术交流与合作，加强国际人才交流及海外人才引进

10.2 High performance medical devices

Medical devices are equipment, devices, materials and products that are used in the whole life cycle of hygiene and health protection. High-performance medical devices refer to medical devices that can meet higher clinical requirements in terms of function and performance among similar medical devices, and their development is of strategic significance in meeting clinical needs and driving the development of the entire medical device industry.

10.2.1 Demand

In 2014, the total value of China's medical device market was about 300 billion yuan, with an annual growth rate of

More than 15% of the products in the field of high-performance medical devices are foreign brands, which is one of the reasons for the high cost of medical care in China. In recent years, health needs have developed rapidly, but the current situation of the domestic medical device industry is extremely incompatible with this.

10.2.2 Objectives

Industry Development Objective 2020:

1. An annual industry size of $600 billion;
2. 50% share of domestic medium and high-end medical devices in county hospitals

3. Domestic market share of core components reached 60%.
4. More than 5 engineering platforms and collaborative innovation centres for scientific and technological achievements were established nationwide.
5. Formation of 20 demonstration application sites.
6. More than 3 internationally renowned brands are formed.

Industry Development Objectives 2025:

1. Annual industry size reached $1.2 trillion.
2. The share of domestic medium and high-end medical devices in county hospitals reached 70%.
3. Domestic market share of core components reached 80%.

4. More than 10 engineering platforms and collaborative innovation centres for scientific and technological achievements were established nationwide.
5. Formation of 6 provincial-level industrial clusters with an output value of over RMB 100 billion.
6. Formation of 30 demonstration application sites.
7. More than five internationally renowned brands in each of the major product areas.

10.2.3 Development focus

1. Key products

（1）Medical imaging equipment

3T and above superconducting magnetic resonance systems (MRI), open superconducting systems, 128-row X-ray computed tomography (CT) machines, positron emission tomography (PET) /The following new imaging devices are available: X-ray computed tomography (PET-CT), positron emission tomography/magnetic resonance imaging (PET-MRI), colour Doppler ultrasound (128 or more physical channels), miniature ultrasound, digital subtraction angiography (DSA), X-ray phase contrast imaging, electrical impedance imaging, magnetoencephalography, etc. The Centre has a wide range of equipment including

（2）Clinical testing equipment

High throughput clinical testing equipment, rapid bedside testing, integrated and full laboratory automated line testing and analysis systems, molecular diagnostic equipment, automated microbiological testing systems, high resolution microscopic optical imaging systems, etc.

（3）Advanced treatment equipment

Large-scale heavy ion/proton tumour therapy equipment, image-guided radiotherapy equipment, high-definition electronic endoscopes, high-resolution confocal endoscopes, digital minimally invasive and implant interventional systems, surgical robots, anaesthesia machine workstations, adaptive mode ventilators, electrosurgical instruments, intraoperative imaging equipment, brain pacemakers and vagus nerve stimulators, and other neuromodulation series

products, digital integrated operating theatres, biodegradable vascular stents, orthopaedic and dental material implants
Injections, foldable IOLs, etc.

（4）Health monitoring, telemedicine and rehabilitation equipment

Intelligent rehabilitation aids, computer-assisted rehabilitation therapy equipment, screening equipment for major diseases and common and chronic diseases, health monitoring products (including wearable), health big data and health Internet of Things, telemedicine and related standards, etc.

2. Key components

Large thermal capacity X-ray tubes (above 8MHU), new X-ray photon detectors, ultrasound diagnostic single crystal probes, surface array probes (above 2000 array elements), miniature high frequency ultrasound probes (vascular or endoscopic detection), high field strength superconducting magnets above 3T, multi-channel spectrometers for MRI (above 64 channels), CT detectors, PET detectors (based on silicon photomultiplier tubes), biodegradable vascular stent materials, dialysis materials, medical-grade polymer materials, implantable electrodes, standard substances for clinical test quality control and other core components.

3. Key common technologies

（1）Reliability assurance technology

This includes reliability analysis, computer simulation, reliability testing techniques for hardware, software and machinery, and electromagnetic compatibility related techniques.

（2） Health Internet Technologies and Standards

Study the health internet standards system, establish relevant standards in a hierarchical and step-by-step manner, and establish the necessary technical conditions for testing and test methods.

（3） Health Big Data Technology

The creation and management of health databases, analytical techniques based on big data technology and behavioural guidance standards for health management.

（4）Medical additive manufacturing technology (3D printing technology)

Implantable materials and modifications for 3D printing technology, carbon nano and graphene medical materials technology, comprehensive solutions for personalised manufacturing, including inspection, computer-aided design and manufacturing technology, etc.

10.2.4 Application demonstration projects

1.Innovative Medical Device Application Demonstration Project

Promote the implementation of innovative product application demonstration projects, which include application training, maintenance training, data collection and product evaluation in medical institutions. Through the demonstration project, evaluation work will be carried out in the dimensions of reliability, suitability, functional indicators, technical performance and technical services, and evaluation specifications will be formed to establish group standards that are suitable for China's national conditions and meet higher product requirements, thus forming a group certification brand, so that China's high-level products can have the brand "created in China" and compete with foreign well-known brands at a higher level. This will enable China's high-level products to have the brand name "Created in China" and compete with foreign brands at a higher level.

2. Demonstration project of joint O&M services for medical equipment based on big data and global orientation

Through alliances and other forms, based on big data technology and market-based mechanisms, a quality assurance system for the operation of medical equipment is established, and relevant standards and codes of practice are gradually established, etc.

10.2.5 Industrial clusters

A cluster of innovative medical devices in the Beijing-Tianjin-Hebei region, making full use of the intellectual and medical resources of the Beijing-Tianjin-Hebei region, featuring innovation, transformation of results and technology export.

An advanced medical device cluster in the Yangtze River Delta region, making full use of the rich human resources and industrial strengths within the region, featuring globalisation, innovation, advanced manufacturing and product application services.

A digital medical device cluster in the Pearl River Delta region, making full use of the region's open,

Innovation, entrepreneurial foresight and an industrial base featuring engineering innovation, advanced manufacturing and export.

10.2.6 Strategic Support and Assurance

1. Establishment of the Institute of Medical Device Industry Technology

The Institute will carry out research on the reliability of medical devices, standards research, basic common technology research and health big data technology research and development; and carry out basic work on industry basic information, competitive intelligence, patent analysis, industry research and strategic planning.

2. Building a public platform for medical device industry development

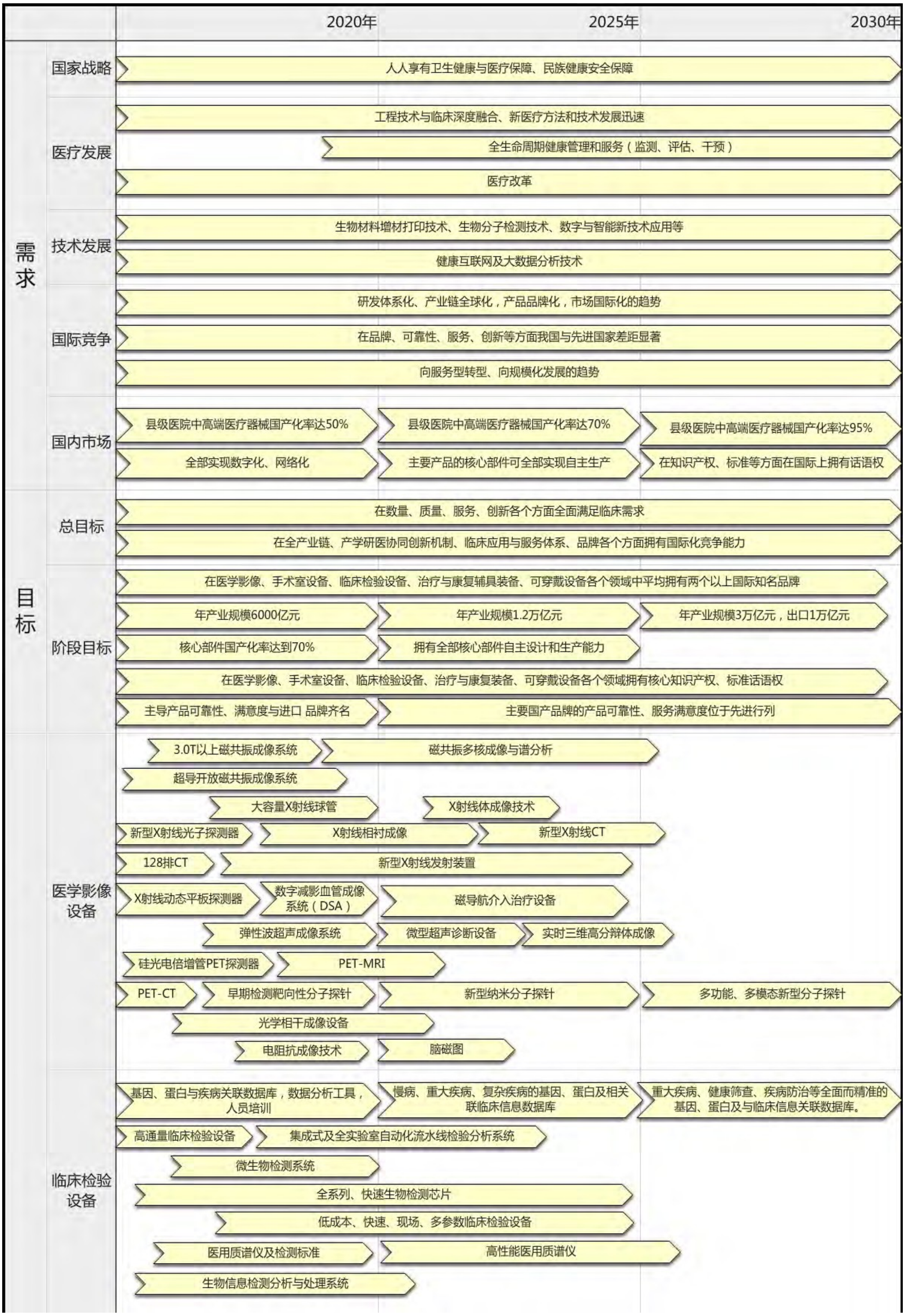
The public platform carries out science and technology services, including: innovation and entrepreneurship coaching, promoting engineering of results, public testing, clinical trials and collaborative innovation, and providing a full range of development advice for enterprise product development.

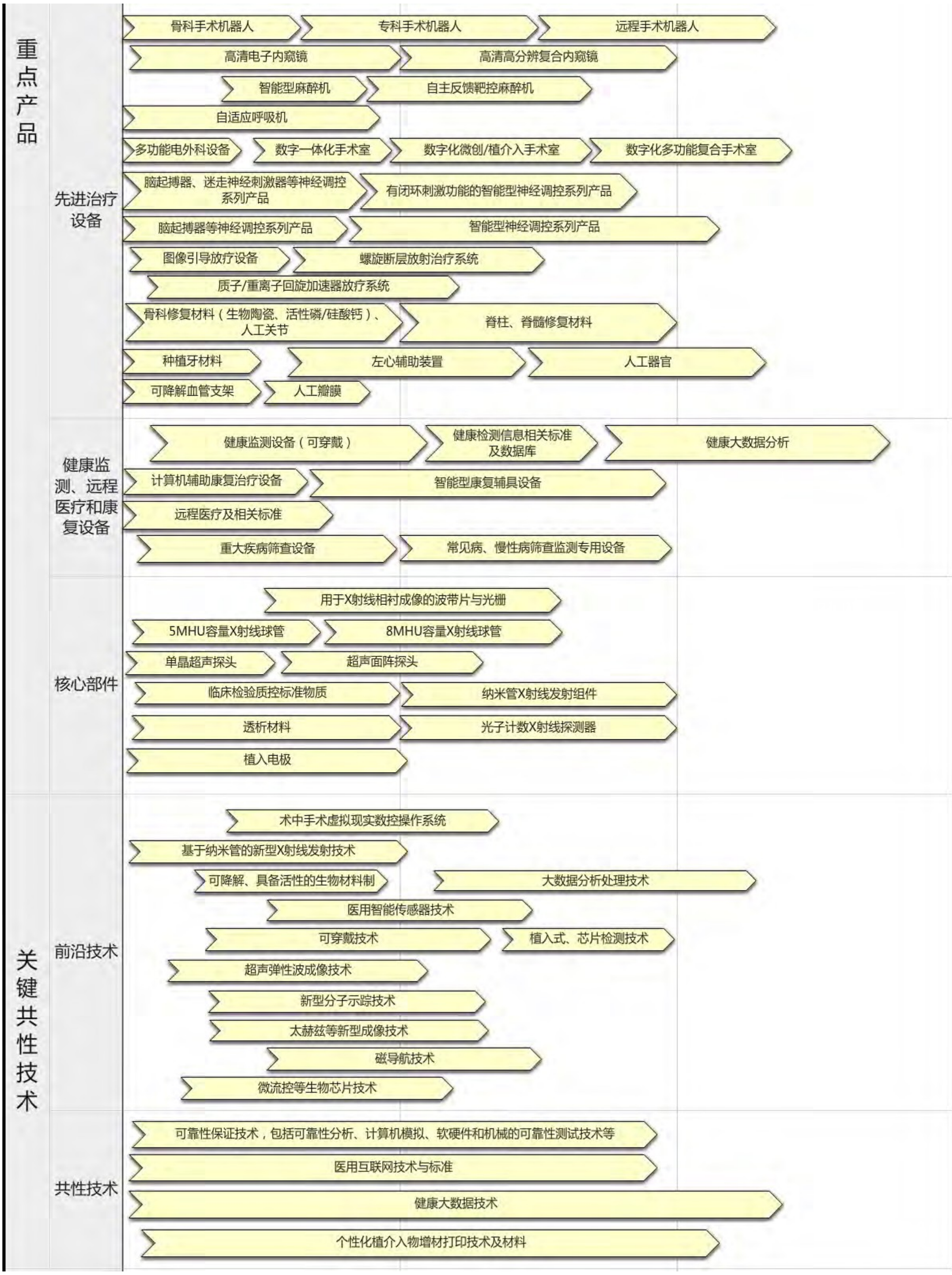
3. Reinforcing the development of professional talents

Build an education and training system for medical device professionals and physiotherapists, and gradually establish a corresponding qualification certification system and induction qualification requirements.

4. Creating a policy environment that encourages innovation

Further improve regulatory policies to encourage technological innovation. Increase policy support for industry-university-research-medical integration and the application of innovative medical devices.


2020年
2025年
2030年
需求
国家战略
人人享有卫生健康与医疗保障、民族健康安全保障
医疗发展
工程技术与临床深度融合、新医疗方法和技术发展迅速
全生命周期健康管理和服务（监测、评估、干预）
医疗改革
技术发展
生物材料增材打印技术、生物分子检测技术、数字与智能新技术应用等
健康互联网及大数据分析技术
国际竞争
研发体系化、产业链全球化，产品品牌化，市场国际化的趋势
在品牌、可靠性、服务、创新等方面我国与先进国家差距显著
向服务型转型、向规模化发展的趋势
国内市场
县级医院中高端医疗器械国产化率达50%
县级医院中高端医疗器械国产化率达70%
县级医院中高端医疗器械国产化率达95%
全部实现数字化、网络化
主要产品的核心部件可全部实现自主生产
在知识产权、标准等方面在国际上拥有话语权
目标
总目标
在数量、质量、服务、创新各个方面全面满足临床需求
在全产业链、产学研医协同创新机制、临床应用与服务体系、品牌各个方面拥有国际化竞争能力
阶段目标
在医学影像、手术室设备、临床检验设备、治疗与康复辅具装备、可穿戴设备各个领域中平均拥有两个以上国际知名品牌
年产业规模6000亿元
年产业规模1.2万亿元
年产业规模3万亿元，出口1万亿元
核心部件国产化率达到70%
拥有全部核心部件自主设计和生产能力
在医学影像、手术室设备、临床检验设备、治疗与康复装备、可穿戴设备各个领域拥有核心知识产权、标准话语权
主导产品可靠性、满意度与进口 品牌齐名
主要国产品牌的产品可靠性、服务满意度位于先进行列
医学影像设备
3.0T以上磁共振成像系统
磁共振多核成像与谱分析
超导开放磁共振成像系统
大容量X射线球管
X射线体成像技术
新型X射线光子探测器
X射线相衬成像
新型X射线CT
128排CT
新型X射线发射装置
X射线动态平板探测器
数字减影血管成像系统（DSA）
磁导航介入治疗设备
弹性波超声成像系统
微型超声诊断设备
实时三维高分辨成像
硅光电倍增管PET探测器
PET-MRI
PET-CT
早期检测靶向性分子探针
新型纳米分子探针
多功能、多模态新型分子探针
光学相干成像设备
电阻抗成像技术
脑磁图
临床检验设备
基因、蛋白与疾病关联数据库，数据分析工具，人员培训
慢病、重大疾病、复杂疾病的基因、蛋白及相关联临床信息数据库
重大疾病、健康筛查、疾病防治等全面而精准的基因、蛋白及与临床信息关联数据库。
高通量临床检验设备
集成式及全实验室自动化流水线检验分析系统
微生物检测系统
全系列、快速生物检测芯片
低成本、快速、现场、多参数临床检验设备
医用质谱仪及检测标准
高性能医用质谱仪
生物信息检测分析与处理系统


重点产品
先进治疗设备
骨科手术机器人
专科手术机器人
远程手术机器人
高清电子内窥镜
高清高分辨复合内窥镜
智能型麻醉机
自主反馈靶控麻醉机
自适应呼吸机
多功能电外科设备
数字一体化手术室
数字化微创/植介入手术室
数字化多功能复合手术室
脑起搏器、迷走神经刺激器等神经调控系列产品
有闭环刺激功能的智能型神经调控系列产品
脑起搏器等神经调控系列产品
智能型神经调控系列产品
图像引导放疗设备
螺旋断层放射治疗系统
质子/重离子回旋加速器放疗系统
骨科修复材料（生物陶瓷、活性磷/硅酸钙）、人工关节
脊柱、脊髓修复材料
种植牙材料
左心辅助装置
人工器官
可降解血管支架
人工瓣膜
健康监测、远程医疗和康复设备
健康监测设备（可穿戴）
健康检测信息相关标准及数据库
健康大数据分析
计算机辅助康复治疗设备
智能型康复辅具设备
远程医疗及相关标准
重大疾病筛查设备
常见病、慢性病筛查监测专用设备
核心部件
用于X射线相衬成像的波带片与光栅
5MHU容量X射线球管
8MHU容量X射线球管
单晶超声探头
超声面阵探头
临床检验质控标准物质
纳米管X射线发射组件
透析材料
光子计数X射线探测器
植入电极
关键共性技术
前沿技术
术中手术虚拟现实数控操作系统
基于纳米管的新型X射线发射技术
可降解、具备活性的生物材料制
大数据分析处理技术
医用智能传感器技术
可穿戴技术
植入式、芯片检测技术
超声弹性波成像技术
新型分子示踪技术
太赫兹等新型成像技术
磁导航技术
微流控等生物芯片技术
共性技术
可靠性保证技术，包括可靠性分析、计算机模拟、软硬件和机械的可靠性测试技术等
医用互联网技术与标准
健康大数据技术
个性化植介入物增材打印技术及材料

战略支撑与保障建议
创新体系
建立5个产学研医协同创新中心试点
建立10个产学研医协同创新中心
建立5个科技成果工程化平台试点
建立10个科技成果工程化平台
分领域建立10个公共测试平台试点
分领域建立20个公共测试平台
临床试验基地
产业链
面向医疗器械的数字化设计与配套加工/标准化的智能生产/全球化合格供应商
基于云的医疗器械工程化设计、采购信息、产业化服务
产业基础
国家和国际标准、团体标准
医疗器械产业基础应用研究院（产业基础数据库构建、产业发展研究、医疗器械可靠性研究、标准体系及标准研究、基础共性技术研究、健康大数据技术研发）
示范应用
基于大数据、面向全球的医疗设备联合运维保障服务示范工程
创新医疗器械示范应用基地，包括应用培训、维养培训、应用评价、协同研发
国际化
5 - 10家国际知名品牌
30家以上国际化研发基地、技术服务基地建设
人才
人才培养及人才引进
创新/创业辅导、竞赛、评估、咨询、培训（政策、法规、标准、技术）
政策环境
鼓励创新的产品监管政策
促进产学研医结合、创新医疗器械应用的鼓励性政策