Non-official translation

The National Medium- and Long-Term Program for Science and Technology Development (2006-2020)

An Outline

The State Council

The People's Republic of China

Table of Contents

produce

(20) Integrated development and utilization of agro-forest biomass

(21) Agro-forest ecological safety and modern forestry

(22) Development and production of environment-friendly fertilizers, herbicides, and pesticides, and ecoagriculture

(23) Multifunctional farm equipment and facilities

(24) Precision farming and associated informatization

(25) Modern dairy industry

5. Manufacturing industry

(26) Basic and generic parts and components

(27) Digital and intelligent design and manufacturing

(28) Green, automated process industry and corresponding equipment

(29) Recycling iron and steel process techniques and equipment

(30) Large-scale marine engineering technologies and equipment

(31) Basic raw materials

(32) Next-generation information functional materials and components

(33) Key accessory materials and engineering processes for defense industry

6. Transportation Sector

(34) Transport infrastructure construction and maintenance technologies and equipment

(35) High-speed rail transport system

(36) Energy efficient and new energy-based Automobiles

(37) Efficient transport technologies and equipment

(38) Intelligent traffic control systems

(39) Transport safety and emergency safeguard

7. Information Industry and Modern Service Industry

(40) Enabling information technology and major application software for modern service industry

(41) Major next-generation internet technologies and services

(42) High performance, dependable computers

(43) Sensor networks and intelligent information processing

(44) Digital media content platforms

(45) High definition large flat-panel display

(46) Core application oriented information security

8. Population and Health

(47) Safe contraception and family planning, and birth defects prevention and treatment

(48) Prevention and treatment of cardiovascular and cerebrovascular diseases, malignancies, and other major non-infectious diseases

(49) Prevention and treatment of common, frequently-occurring diseases in urban and rural communities

(50) Traditional Chinese Medicine: impartation and innovation

(51) Advanced medical equipment and bio-medicinal materials

9. Urbanization and City Development

(52) Urban planning and dynamic monitoring

(53) Uplifting urban functions and space efficiency

(54) Architecture energy efficiency and green buildings

(55) Urban ecological residential environment and quality control

(56) Urban information platforms

10. Public Security

(57) National public security emergency information platforms

(58) Major workplace accidents warning and rescue

(59) Food safety and entry-exit quarantine

(60) Major public emergency prevention and quick response

(61) Biosafety measures

(62) Major natural disasters prevention and preparedness

11. National Defense

IV. Major Special Projects

V. Frontier Technologies

1. Biotechnology

(1) Target identification technology

(2) Plant-animal varieties and drug molecular design technology

(3) Gene manipulation and protein engineering technology

(4) Stem cell based human tissue engineering technology

(5) Next-generation industrial biotechnology

2. Information Technology

(6) Intelligent sensing technology

(7) Ad hoc network technology

(8) Virtual reality technology

3. Advanced Materials Technology

(9) Intelligent materials and structural technology

(10) High-temperature superconducting technology

(11) Efficient energy material technology

4. Advanced Manufacturing Technology

(12) Extreme manufacturing technology

(13) Intelligent service robotics

(14) Service life prediction technology for major products and facilities

5. Advanced Energy Technology

(15) Hydrogen and fuel cell technology

(16) Distributive energy supply technology

(17) Fast neutron reactor technology

(18) Magnetic contained fusion technology

6. Marine Technology

(19) 3-D marine environment monitoring technology

(20) Ocean floor based multi-parameter fast sounding technology

(21) Natural gas hydrate exploitation technology

(22) Deep-sea operation technology

7. Lasers Technology

8. Aerospace technology

VI. Basic Research

1. Disciplinary development

(1) Basic disciplines

(2) Cross and emerging disciplines

2. Frontier Scientific Issues

(1) Quantitative study and systematic integration of life process

(2) Condensed matters and novel effects

(3) Matters' deep inner structures and physical laws at a cosmological scale

(4) Core mathematics and its application in cross-disciplines

(5) Earth system process and associated resources, environment, and disasters effects

(6) Chemical process in creating and transforming new matters

(7) Brain and cognitive sciences

(8) Innovation in scientific experiments, observational methods, techniques, and equipment

3. Basic Research in Response to Major National Strategic Needs

(1) Biological foundations of human health and diseases
(2) Crop genetic improvement and scientific issues in sustainable agricultural development
(3) Human activities and their impacts on the Earth system
(4) Global change and regional response
(5) Complex systems, disaster formation, prediction and control
(6) Key scientific issues in sustainable energy development
(7) New principles and methodologies for materials design and fabrication
(8) Scientific basis of manufacturing under extreme environmental conditions
(9) Major mechanical issues in aeronautics and space science
(10) Scientific basis for the development of information technology

4. Major Scientific Research Programs
(1) Protein studies
(2) Quantum regulation studies
(3) Nanometer studies
(4) Growth and reproduction studies

VII. Reform of the S&T System and the Construction of a National Innovation System

1. Supporting and Encouraging Enterprises to Become the Main Player in Technological Innovation

2. Deepening the Institutional Reform and Establishing a Modern Research Institute System

3. Advancing the S&T Management System Reform

4. Vigorously Pushing Forward the Construction of a National Innovation System with Chinese Characteristics

VIII. Major Policies and Measures

1. Financial and Taxation Policies Encouraging Technological Innovation at the Enterprise Level

2. Strengthening Assimilation and Absorption of imported technologies, and re-innovation

3. Government Procurement Favoring Indigenous Innovation

The 16th National Congress of the Chinese Communist Party commissioned the formulation of an outline for a national medium- and long-term program for science

and technology development in the context of the full-fledged construction of a well-to-do society and accelerating the socialist modernization drive, and the State Council has hereby prepared the following outline in compliance with the request.

I . Preface

Since the founding of the People's Republic of China, especially since the introduction of the policy of reform and opening to the outside world, the nation's socialist modernization drive has attained universally acknowledged achievements. However, one has to be keenly aware that the nation is and will remain at a primary stage of socialism for a long time to come. In our effort to build a well-to-do society, we are faced with both rare historic opportunities and grave challenges. The nation's economic growth shows an excessive dependence on the consumption of energy and resources, with high associated environmental costs; the economic structure is irrational, characterized by a frail agricultural base and lagging high-tech industry and modern service industry; and firms lack core competitiveness and their economic returns are yet to be improved as a result of weak indigenous innovation capability. There are a whole range of problems concerning employment, distribution, health care, and national security that need prompt solution. Internationally, the nation will be for a long period of time under enormous pressures from developed nations who possess economic and S&T superiority. In order to grasp the opportunities and meet the challenges, we must make all-round efforts, including coordinated overall development, deepening the system reform, improving democracy and the rule of law, and reinforcing social management. At the same time, we need to depend even more heavily on S&T progress and innovation in order to achieve substantial gains in productivity and advance the overall economic and social development in a coordinated and sustainable manner.

As the premier productive forces, science and technology are a concentrated reflection and a major hallmark of advanced productivity. In the 21st century, the new science and technology revolution is rapidly unfolding and gestating significant new breakthroughs, which will profoundly change the economic and social visages. Advances in information science and technology, still in the ascendant, will continue to be the dominant driving force for economic growth; rapid advances in life science and biotechnology will play a key role in improving quality of life; renewed efforts in energy science and technology will open up new avenues for addressing global energy and environmental issues; and exciting new breakthroughs in nanometer science and nanotechnology will usher in a profound technology revolution. Exciting breakthroughs in basic research fields will create whole new horizons for science and technology development and economic growth. S&T achievements are being applied and transferred at an ever faster pace, thus creating new opportunities for catching up and leapfrogging**.** Therefore, we shall embrace the new era, meeting both opportunities and challenges brought on by the new S&T revolution with a global vision. In today's world, many countries have made S&T innovation a national

strategy and S&T inputs strategic investments by drastically increasing R&D spending. These nations lead the world in deploying and developing frontier technologies and strategic industries and implement important S&T programs in an attempt to enhance their national innovative capability and international competitiveness. Confronted with the new international situation, we must have a greater sense of responsibility and urgency, by making S&T progress a major driving force for the economic and social development more conscientiously and resolutely. We must place the strengthening of indigenous innovative capability at the core of economic restructuring, growth model change, and national competitiveness enhancement. Building an innovation-oriented country is therefore a major strategic choice for China's future development.

Over more than five decades since the founding of New China, the consistent and painstaking efforts of several generations have led to huge, heartening achievements in the fields of science and technology. Major S&T accomplishments hallmarked by nuclear weaponry and satellite technology, manned space flights, hybrid rice, theory of oil formation from continental moist depression and associated application, and high performance computers, have greatly enhanced the nation's comprehensive national strength, uplifted its international position, and inspired the whole nation. However, compared with the developed nations, China's overall S&T level still has a fairly big gap to close, compared with that of developed nations. This is mainly reflected in the following areas: we have a low rate of sufficiency in key technology supply and a limited number of invention patents; the technological level remains low in some regions, particularly in the rural areas of the central and western regions; the quality of scientific research still needs significant improvement due to a shortage of top notch S&T talents; and investments in science and technology are still insufficient; and there are numerous loopholes in the existing S&T system. Despite the size of economy, our country is not yet an economic power primarily because of our weak innovative capacity.

In the 21st century, China, being a large developing nation, is to accelerate its S&T development and narrow down the gaps with the developed nations. To this end, the nation must make unremitting efforts for a long period of time, while it is also blessed with numerous favorable conditions.

First, China's sustained fast economic growth and social development creates a huge demand and thus lay a solid foundation for the S&T development. Second, the nation has a fairly consummate system of academic disciplines, with a huge pool of talented people. It has developed world-class R&D capability in a number of major fields, thus positioning itself for tremendous S&T developments in the future. Third, our country's continued opening to the outside world has enhanced its S&T cooperation and exchanges with the rest of the world, allowing the country to share the fruits from the new S&T revolution. Fourth, by adhering to the socialist system, China is able to combine the political advantage of mobilizing efforts to do great

things and the basic role of market mechanism in effectively allocating resources. This provides an important system guarantee for the prosperous development of S&T activities. Fifth, ours is a country with a 5000-year history of civilization and a culture that is both broad and profound, capable of incorporating things of diverse nature, which favors the creation of a uniquely innovative culture. As long as we strengthen our national confidence, hold scientific concept of development, implement the strategies of rejuvenating the nation through science and education, work hard to catch up over the next 15 years or more, we will be able to produce brilliant S&T achievements that live up to the expectations of our times.

II. Guiding Principles, Development Goals, and General Deployment

1. Guiding Principles

The first 20 years of the century are a period of important strategic opportunities for our country's economic and social development and S&T progress. Under the guidance of Deng Xiaoping Theory and the "Three Representations" and by implementing the scientific concept of development and the strategy of rejuvenating the nation through science and education and talented people and proceeding from our own national conditions and taking people-based approach, deepening reforms and expanding the opening to the outside world, we must strive for the prosperous development of China's scientific and technological enterprise so as to realize the goals of the full-fledged construction of a well-to-do society and provide powerful S&T support for building a harmonious socialist society.

The guiding principles for our S&T undertakings over the next 15 years are: "indigenous innovation, leapfrogging in priority fields, enabling development, and leading the future". Indigenous innovation refers to enhancing original innovation, integrated innovation, and re-innovation based on assimilation and absorption of imported technology, in order improve our national innovation capability. Leapfrogging in priority fields is to select and concentrate efforts in those key areas of relative strength and advantage linked to the national economy and people's livelihood as well as national security, to strive for breakthroughs and realize leaping developments. Enabling development is an attempt to strive for breakthroughs in key, enabling technologies that are urgently needed for the sustainable and coordinated economic and social development. Leading the future reflects a vision in deploying for frontier technologies and basic research, which will, in turn, create new market demands and new industries expected to lead the future economic growth and social development. The guideline is a summary of China's practice and experience in S&T development for more than a half century, and an important choice for realizing the great renaissance of the Chinese nation.

This calls for placing the strengthening of indigenous innovation capability at the core of S&T undertakings. The Party and government have long advocated and paid close attention to indigenous innovation. To press ahead with the modernization drive under conditions of opening to the outside world, we must earnestly study and draw on all the fine achievements of human civilization. During the past two decades or so since we began to pursue the policy of reforms and opening to the outside world, our country has imported a huge amount of technologies and equipment, which played an important role in raising the overall technological level of our industries and promoting the country's economic development. However, one should be clearly aware that importation of technology without emphasizing assimilation, absorption, and re-innovation is bound to weaken the nation's indigenous R&D capability, which in turn widens the gap with world advanced levels. Facts have proved that, in areas critical to the national economy and security, core technologies cannot be purchased. If our country wants to take the initiative in the fierce international competition, it has to enhance its indigenous innovation capability, master core technologies in some critical areas, own proprietary intellectual property rights, and build a number of internationally competitive enterprises. In a word, the improvement of indigenous innovation capability must be made a national strategy that is implemented in all sectors, industries, and regions so as to drastically enhance the nation's competitiveness.

S&T talents are critical to increasing indigenous innovation capability. The first and foremost task is to create a favorite environment for cultivating and attracting S&T personnel, with high-quality talents in particular, giving full scope to the enthusiasm and creativity of the broad masses of S&T personnel, so that a constant stream of talents is ensured and the best of S&T talents is brought out. We should make unremitting efforts to build a large, well-structured, high-quality S&T workforce compatible with economic and social development and national defense work in order to ensure the talents and knowledge base for the nation's science and technology development.

2. Development Goals

The general objectives for the nation's S&T development (2006-2020) will be to: noticeably enhance indigenous innovation capability and S&T level in promoting economic and social development and in maintaining national security, in an effort to provide powerful support for the building of a well-to-do society; noticeably improve comprehensive strength in basic research and frontier technology development; and attain a series of high world impact S&T achievements and join the ranks of innovative countries, thus paving the way for becoming a world S&T power by mid 21stcentury.

Through efforts over the next 15 years, the nation will meet the following objectives in some major scientific and technological areas: 1) mastering core

technologies in equipment manufacturing and information industry that are critical to the nation's competitiveness, and bringing the technological capability of manufacturing and information industries to the world advanced levels; 2) making the nation a world leader in overall agricultural S&T capability, raising the comprehensive capacity of China's agricultural production, and ensuring the nation's food safety.; 3) achieving technological breakthroughs in energy development, energy conservation, and clean energy, and advocating optimized energy structures, with unit energy consumption of major industrial products reaching or approaching world advanced levels; 4) establishing technological development models featured with cyclic economy in major sectors and municipalities, and providing S&T support for building a resource saving and environment friendly society; 5) noticeably enhancing the level of major diseases prevention and control, curbing the spread of major diseases, including HIV/AIDS, hepatitis and other major diseases, striving for breakthroughs in new drugs and key medical equipment, and developing a technological capability for industrialization; 6) in defense science and technology, basically meeting the needs in developing modern arms and associated information technology, and providing S&T support for safeguarding national security; 7) establishing a world-caliber contingent of scientists and research teams, attaining high-impact innovative achievements in the mainstream of science development, bringing the technological level in such frontier areas as information, biology, materials, and space to world advanced levels; and 8) establishing a number of world-class research institutes and universities, and world-competitive industrial R&D centers so that a fairly comprehensive national innovation system of Chinese characteristics can take shape.

By 2020, the nation's gross expenditures on R&D (GERD) are expected to rise to 2.5% or above of the gross domestic product(GDP) with the rate of S&T contribution to the economy reaching 60% or above, and dependence on imported technology reduced to 30% or below, and the annual invention patents granted to Chinese nationals and the international citations of scientific papers moving into the top five countries.

3. Overall Deployment

In the next 15 years, China's S&T undertakings will be deployed as follows: 1) In light of our country's concrete conditions and needs, identify a number of priority areas, break through some major technological snags so as to raise the nation's overall S&T support capability. This Outline identifies 11 priority areas for economic and social development, from which 68 priority topics of clearly defined missions and possible technical breakthrough in near term will be selected. 2) Implement some special major projects that are in line with national objectives, and will lead to the leaping development or fill up a blank. The Outline makes the arrangement for total of 16 special major projects. 3) To respond to future challenges, advance deployment will be made for frontier technologies and basic research topics, in order to ensure

sustained innovative capability and lead future economic and social development. The Outline selects 27 frontier in 8 technological fields, and 18 basic scientific issues as priorities. It also proposes to implement four major scientific research programs. 4) Deepen the S&T system reform by perfecting relevant policies and measures, increasing S&T investment, strengthening the buildup of S&T talents, and promoting the creation of a national innovation system in order to provide reliable support for the nation to become an innovation-oriented society

.

Strategic priorities are identified according to the urgent needs for building a well-to-do society, international S&T development trends, and the nation's overall strength. 1) Energy, water resources, and environmental protection related technologies are selected as priorities, in an effort to address major bottleneck issues in the economic and social development. 2) Efforts should be made to grasp the rare opportunities presented by continued strong development of information technology and advanced materials, making proprietary intellectual property rights in equipment manufacturing and information industries a major breakthrough point for enhancing the nation's industrial competitiveness. 3) Biotechnology is selected as a priority for the future development of the high-tech industry together with enhanced biotechnological applications to agriculture, industry, population and health. 4) Accelerate the development of aerospace and marine technologies. 5) Strengthen basic research and frontier technology development, particularly interdisciplinary research.

III. Main Areas and Priority Topics

The nation's S&T development shall be planned and deployed according to the principle of coordinated arrangement and advancement, with due consideration to priority areas and topics, so as to provide full and forceful support for addressing urgent issues in economic and social development".

Priority areas refer to such industries and sectors that are both critical to economic and social development and national security and in dire need of S&T support. Priority topics within the priority areas are defined as urgently needed technology clusters that have clearly defined missions, sound technical foundations, and promising prospects for breakthroughs in the near term. The principles for selecting priority topics are: 1) topics that are desirable for breaking up bottleneck constraints and for enhancing the sustainability of economic growth; 2) topics that are desirable for mastering key and enabling technologies and for improving core industrial competitiveness; 3) topics that are desirable for addressing major public good S&T issues and raising the capability in providing public services; and 4) topics that are desirable for the development of dual-use technologies designed to enhance the capability in ensuring national security.

1. Energy

Energy is of crucial strategic importance to the national economy. Our country is currently suffering from sharp discrepancies between energy supply and demand, an irrational energy structure, and low energy efficiency, with a predominantly coal-based primary energy consumption, resulting in severe environmental pollution. Over the next 15 years, meeting the fast growing demand for energy and for its clean and efficient utilization constitutes a major challenge for the development in energy-related science and technology.

Development paths: 1) Take energy saving as a top priority and reduce energy consumption. Overcoming technological snags critical energy saving in major energy consuming sectors and vigorously develop technologies for energy saving buildings so as to significantly improve efficiency in primary and end use of energy. 2) Increase energy supply by promoting a diversified energy structure. While raising the technological level of oil-gas utilization and hydroelectric power, it is encouraged to vigorously develop nuclear energy technology to acquire indigenous technology development capability in nuclear power systems. Strive for breakthroughs in renewable energy, including wind energy, solar energy, and biomass energy, and associated scale applications. 3) Promote clean and efficient use of coal in order to reduce environmental pollution. It is encouraged to vigorously develop clean, efficient, and safe coal exploration and aim at the world advanced levels. 4) Strengthen the assimilation and absorption of imported energy technologies and associated re-innovation. Master core technologies in building major equipment for coal-fired and nuclear power generation. 5) Raise the technological capability of optimizing regional energy distribution. Priorities will be given to developing advanced and reliable power transmission and distribution technologies to realize large volume, long distance, and efficient power transmission.

Priority topics:

(1) Industrial energy efficiency

Priorities will be given to research on and development of energy-saving technologies and equipment for major high energy consumption sectors, including process industries, such as metallurgical, chemical industry, and transportation industries. Developing energy-saving technologies for mechanical and electronic products, highly energy-efficient, long-life cycle LED products. Develop comprehensive utilization technologies at different energy gradients.

(2) Clean, efficient coal development and utilization, coal liquefaction, and gasification-based co-generation

Priorities will be placed on developing efficient mining technologies and equipment, and efficient power generation technology and equipment, including

heavy duty gas turbines, integrated gasification combined cycle (IGCC), high-parameter supercritical generators, and large supercritical circulating fluidized beds (CFB). It is also encouraged to develop transformation technologies for coal liquefaction, coal gasification, coal chemistry, coal gasification based polygeneration, and technologies and equipment for comprehensive control and utilization of pollutants derived from coal burning.

(3) Oil and gas prospecting, development, and utilization under complex geological conditions

Priorities will be given to the development of technologies for oil-gas prospecting in complex environment and rock strata, technologies for efficient and scale development of low grade oil-gas resources, technologies for increasing oil recovery in old oil fields, and technologies for prospecting and mining deep oil-gas reserves.

(4) Low-cost, large-scale development and utilization of renewable energy resources

Emphasis will be on the development of large wind power generators, construction technologies and equipment for coastal and inland wind fields as well as wind energy intensive areas in Western China, cost-effective technologies for solar photovoltaic batteries, technologies for solar-based power generation, technologies for built-in solar energy building structures, and technologies for developing and utilizing biomass and geothermal energy.

(5) Safeguards of super large electricity transmission and distribution networks

Priorities will be to develop technologies and equipment for long distance and large volume DC transmission, and for super high voltage AC transmission. Developing technologies for batch power grid and associated transmission and distribution, power quality monitoring and control, and safe power supply for large Internet networks.，key technologies for west-to-east electric power diversion project, technologies for automated grid dispatch system, and technologies and systems for efficient transmission and distribution management.

2．Water and Mineral Resources

Water and mineral resources constitute an important material basis for the sustainable economic and social development. Our country suffers from serious shortage of water and mineral resources, a low rate of comprehensive utilization of resources such as mineral resources and irrigation water which far below that of internationally advanced levels. With complex geological conditions for resources prospecting and increasing difficulties, there is an urgent need for technologies that can improve resources prospecting and utilization and raise the level of resources utilization.

Development paths: 1) Assign priority to resources saving. The focus will be research on technologies for agricultural water saving and urban cyclic water utilization, and technologies for trans-basin water diversion, rainfall and flood water utilization, and sea water desalination. 2) Overcome barriers of complex geological conditions so as to expand the existing resources reserves. Priorities will be placed on studying mine formation mechanism, and develop technologies for deep-mine evaluation and efficient prospecting, and fast prospecting technologies for mineral deposits under complex geological conditions in regions such as the Qinghai-Tibet Plateau. Striving to discover a number of large backup resource bases for additional resources supply. Develop technologies for efficient mining and comprehensive utilization in order to enhance comprehensive utilization of water and mineral resources. 3) Vigorously develop and utilize non-traditional resources. Master key technologies for the development and utilization of coal-bed methane and marine minerals so as to raise the research and development capability of novel resources utilization. 4) Strengthen innovative capability in developing equipment for resource prospecting. Vigorously develop technologies for high precision prospecting and drilling equipment, large mining machinery, and marine development platforms, to bring major resources prospecting equipment and facilities to world advanced levels.

Priority topics:

(6) Optimized distribution and comprehensive development and utilization of water resources

Priorities will be given to developing technologies for the conversion and optimal distribution of atmospheric moisture, surface water, soil moisture, and underground water, technologies for the utilization of contaminated water and rainfall and flood water, technologies for artificial rain enhancement, and key technologies for water control projects in major river systems, including the Yangtze River and Yellow River, and for major hydrological projects such as the south-to-north water diversion project.

(7) Comprehensive water conservation

Priorities will be to developing technologies for industrial cyclic utilization of water and water efficient production activities. Developing outfitting technologies for water saving in irrigation, dry land farming, and biological water efficiency. Strive for major breakthroughs in precision irrigation technology, and intelligent farming water management technology and equipment. Develop water saving technologies and devices for daily life applications.

(8) Seawater desalination

Priorities will be given to developing technologies for seawater pre-handling, nuclear energy coupling and electricity-heat cogeneration, low-cost membrane-based desalination and critical materials, and comprehensive utilization of salty water. Develop seawater desalination-based heating equipment for scale applications,

seawater desalination facilities, and integrated coupling.

(9)Resources prospecting for additional reserves

Priorities shall be placed on studying the law of mineral formation mechanisms and prediction technologies, developing air-born geophysical survey techniques, and fast, comprehensive and in-depth prospecting technologies such as 3-D high-resolution earthquake and high-precision geomagnetism and geochemistry.

(10) Efficient development and utilization of mineral resources

Priorities will be on studying comprehensive technologies for deep and complex mining and wasteless mining; developing new processes and large equipment for automated ore preparation and smelting; and developing technologies for the utilization of low grade and complex mineral resources.

(11) Development and utilization of maritime resources

Priorities shall be placed on: developing prospecting technologies for offshore oil-gas deposits and comprehensive recovery technologies for thick-oil oilfields; developing technologies for the protection and effective utilization of marine biological resources; and developing technologies for direct seawater utilization and comprehensive exploitation of seawater chemical resources.

(12) Comprehensive zoning of resources

Priorities will be given to: research on technologies for comprehensive optimization of water and soil resources, farming activities, and ecological and environmental protection; developing analytical techniques for the optimization of multi-variable based large area resources distribution corresponding to regional distributions of water and land resources; and establishing decision-making models for optimized development of water and land resources in different areas.

2. The Environment

Ecological and environmental improvement constitutes a major issue concerning the sustainable economic and social development and the quality of people’s livelihood. The country is confronted with serious environmental pollution problems, with an increasingly degraded ecosystem and a weak capability of handling pollutants. Global environmental issues have become an international concern. China needs to enhance its capability in being involved in the global efforts for environmental change. Sustaining rapid economic growth under the prerequisite of overall environmental improvement imposes major strategic demands for innovation in environment science and technology.

Development paths: 1) Guiding and supporting the development of cyclic economy. Vigorously develop integrated clean production technologies for highly polluting industries, intensify the reduction of wastes and safe treatment of wastes,

and strengthen the development of common technologies for the cyclic economy; 2) comprehensive control of regional environment. Conduct comprehensive control and treatment of water environment in drainage areas and regional atmospheric pollution, establish technical integration and demonstration for comprehensive control of typical ecologically degraded areas, and develop technologies for drinking water safety and pre-warning for ecological and environmental monitoring, so as to drastically increase the S&T capability for environmental quality improvement. 3) promoting the development of environmental protection industry. Priorities will be given to developing major environmental protection equipment and facilities in line with the country's concrete conditions, securing more market share for domestic environmental protection products, and raising the technical level of environmental protection equipment. 4) Vigorously participate in international cooperation in the field of the environment. Strengthen research on response strategies in implementing the global environment convention and on scientific uncertainties of climate change and their implications, develop technologies for global environmental change watch and greenhouse gases emission reduction, and enhance the capability in responding to environmental changes and in implementing the international convention.

Priority topics:

(13) Comprehensive pollutant control and waste recycling

Priorities will be to develop pre-warning technologies for regional environmental quality monitoring; master key technologies for urban atmospheric pollution control, develop technologies for non-conventional pollutants, technologies for turning wastes into useful resources, and integration technologies for clean production in heavily polluting sectors; establish technical demonstration models for the cyclic economy.

(14) Functional restoration and reconstruction of ecosystems in ecologically vulnerable areas

Priorities will be given to developing dynamic monitoring technologies for typical vulnerable ecological areas, including Karst areas, the Qinghai-Tibet Plateau, the middle and upper reaches of the Yangtze River and Yellow River, Loess Plateau, deserts and desertification lands, farming-grazing areas, and mining areas; developing technologies for pasture degradation and rodents control, and technologies for restoring and reconstruction of degraded ecosystems; developing ecological protection and restoration technologies for major engineering works such as the Three-Gorge Dam project and the Qinghai-Tibet Railway, and complex mining areas; establishing technical support models for restoring the functions of diverse ecosystems and maintaining the improvement; and establishing a comprehensive evaluation and technical assessment system for the functionality of ecosystems.

(15) Maritime ecological and environmental protection

Priorities will be given to developing technologies and equipment for marine ecological and environmental monitoring, strengthening the study of marine ecological and environmental protection, developing technologies for offshore ecological and environmental protection and repair, and sea emergency response and handling, and developing high-precision digital technologies for marine dynamic environment prediction.

(16) Global environmental change watch and response strategies

Priorities will be placed on developing technologies for accurate monitoring of large scale environmental changes, greenhouse gases emission control and utilization, including carbon dioxide and methane utilization in major industries, biological carbon fixation and carbon fixation engineering, climate change study, biodiversity protection, ozone layer protection, and sustainable organic pollutants control.

3. Agriculture

Agriculture is the foundation of the national economy. Our country is increasingly constrained by natural resources, with its per capita arable land and water resources noticeably lower than the world average. The growing demand for major agricultural produces, including grains and cotton, and pressures of yield increase, increasing farmers' income, and intensified competition of agricultural products will be a long standing phenomenon. China's agricultural structure remains irrational, with a low industrialization level and low value-added agricultural products. The poor ecological and environmental conditions impose serious constraints on the sustainable agricultural development, coupled with thorny food and ecological safety problems. With the country's basic situation and tough challenges it has to face, scientific and technological progress constitutes a fundamental approach through which major agricultural problems can be addressed. It includes raising the agricultural scientific and technological level, enhancing the diffusion of advanced appropriate technologies, alleviating the constraints of resources, improving comprehensive agricultural productivity in a sustainable manner, and accelerating the pace of agricultural modernization.

Development paths: 1) Transform conventional farming technologies through the introduction of high technologies so as to enhance comprehensive agricultural productivity in a sustainable manner. Priorities will be placed on carrying out research on applied biotechnology, strengthening the integration and compatibility of agricultural technologies, overcoming technological problems in crop breeding, efficient production, animal and aquatic breeding and production and diseases control, developing diversified compound agricultural operations, improving the quality of agricultural products, and sustaining yield increase. 2) Extend agricultural production chain in order to achieve an overall improvement of agriculture related industrialization and comprehensive agricultural returns. Priorities shall be given to developing technologies for precision and deep processing of agricultural produce,

post-production loss reduction, and commercial applications of green supply chains. Developing advanced technology and equipment for food processing and food safety monitoring. Developing a food processing industry featured with healthy foods, and a modern circulation industry, and creating more room for increasing farmers' income. 3) Develop technologies for comprehensive agricultural and forestry development while ensuring ecological safety. Priorities will be to develop technologies for environment friendly fertilizers and pesticides, precision farming operations, resources-oriented utilization of agricultural and forestry residues, comprehensive agricultural environment control, promote the development of new farming industries, and raise the ecological environment quality of agriculture and forestry. 4) Develop a factory-like agriculture in order to increase labor productivity of farming activities. Priorities will be given to developing farming facilities related technologies, including farming environment regulation and efficient crop cultivation with super high yield, developing modern farm machinery with multiple functions, and accelerating the integration and application of agriculture related information technology.

Priority topics:

(17) Germplasm development, preservation, and innovation in and targeted cultivation of new varieties

Priorities will be assigned to research on and development of fine agricultural crop, tree, pasture, and aquatic species, molecular evaluation of germplasm, animal and plant molecular breeding and targeted hybrid breeding, scale seed breeding, reproduction, and comprehensive processing.

(18) Healthy farming practices in domestic animals, poultry, and aquatic products, and associated epidemic disease prevention and control

Priorities will be on developing technologies for producing safe and high quality feedstuffs and facilities for scale healthy breeding; developing valid specific vaccines, and safe veterinary drugs and instruments; developing technologies for monitoring, diagnosing, preventing, treating and eradicating epidemic diseases affecting both humans and animals; developing technologies for offshore and freshwater aquaculture and technologies and equipment for ocean-going fishery and storage and processing.

(19) Deep processing and advanced storage and shipping of farm produce

Priorities will rest on developing technologies and equipment for clean and deep processing of agricultural produce and specialty agricultural and forestry products, post-production loss reduction for grains and edible oils, green storage, fresh-keeping and delivery of live agricultural produce, and cold chain delivery.

(20) Integrated development and utilization of ago-forest biomass

Priorities will be on: developing key technologies for efficient, scale and low-cost cultivation, collection, and conversion of agricultural and forestry biomass;

developing key technologies for biomass energy production, including methane, fixed and liquid fuels, and new biomaterials; developing technologies for resource-oriented utilization of rural garbage and contaminated water, methane-based power generation, and new biomaterial equipment possessing proprietary intellectual property rights.

(21) Agro-forest ecological safety and modern forestry

Priorities will be placed on: developing technologies for establishing agriculture and forestry ecosystems, technologies for regulating forestry and pasture ecosystems, technologies for monitoring, prevention and control of forest and pasture fires, and agriculture and forestry related diseases and pest control; developing technologies for combating biological invasion and ecological and meteorological disasters, technologies for the sustainable operation of ecological forestry economy, technologies for artificial grassland improvement and high quality grass breeding, and technologies for producing environment friendly composite materials made of bamboo or wood.

(22) Development and production of environment-friendly fertilizers, herbicides, and pesticides, and eco-agriculture

Priorities will be given to: developing key technologies for environment friendly fertilizers and pesticides, technologies and equipment for slow-release fertilizers, and technologies for comprehensive prevention and control of hazardous organisms featured with efficient, long lasting, and safe functions; establishing a quarantine pre-warning system n response to invasion of hazardous organisms; and developing environment friendly farming technologies that can improve soil fertility, reduce soil contamination and soil erosion, and restore the functions of degraded grassland.

(23) Multifunctional farm equipment and facilities

Priorities will be given to: research on and development of key multifunction equipment suitable for our country’s farming operations, developing economical agriculture and forestry machinery, intelligent machinery with positioning and quantity adjustment functions, technologies and equipment for healthy breeding, farming machinery and technologies with protection functions, greenhouse facilities, and support equipment.

(24) Precision farming and associated informatization

Priorities will be given to developing digital technologies for collecting animal-plant growth and ecological environment related information, and technologies for real-time monitoring of soil elements, including moisture, fertilizer, light, and temperature; developing technical systems for precision operation and management and digital technology dedicated to remote rural areas; developing technologies and equipment for viewable information service, agriculture and forestry ecosystem monitoring, and virtual farm technology.

(25) Modern dairy industry

Priorities will be assigned to research on and development of technologies for fast breeding of high quality stud bulls, and industrialized production of dairy cow fetus; developing advanced technologies for cow feeds, cultivation and effective utilization of pasture; developing technologies for diseases prevention and control, and scale breeding, and technologies and equipment for dairy products deep processing.

4. Manufacturing Industry

Manufacturing industry makes a mainstay of the national economy. China is a large manufacturing economy, but not yet a manufacturing power. China's manufacturing technology has a weak foundation, with a limited innovation capability, primarily low-end products, high consumption of resources and energy, and serious pollution.

Development paths: 1) raising the capability of equipment design, manufacturing, and integration. With promoting industrial technological innovation as a starting point, realizing proprietary design and manufacturing of high-end programmed machine tools, major set equipment, key materials, and key components; 2) developing environment friendly manufacturing. Accelerating application of proven technologies in the entire manufacturing cycle of products, including materials and products development and design, processing, manufacturing, sale, service, recovery, and utilization. Developing environment friendly cyclic manufacturing techniques featured with energy efficiency. Making China's manufacturing industry part of the internationally advanced, in the context of resources consumption and environmental loads; 3) transforming and upgrading manufacturing industry using high technology. Promoting information process in the industry, developing basic raw materials, raising the grade, technology content, and added values of products, and uplifting the overall technical level of manufacturing industry.

Priority topics:

(26) Basic and generic parts and components

Priorities will be to develop key technologies for major basic and generic parts and components and associated design, manufacturing, and mass production; develop advanced moulding and processing technologies for large and special parts and components; develop design and manufacturing technologies for generic parts and components as well as precision test instruments.

(27) Digital and intelligent design and manufacturing

Priorities will be on given to research on digital design, manufacturing, and integration technologies, and establish a number of industrial platforms for digital product design and manufacturing. Develop product-cycle oriented innovative and

network-based digital and intelligent design approaches and technologies, computer-aided engineering analysis and process design and integration technologies.

(28) Green, automated process industry and corresponding equipment

Priorities will be to develop environment friendly processes and manufacturing technologies as well as techniques, processes and equipment for efficient and clean utilization of resources; develop technologies for process scale-up, ecological industry concept-based system integration and automation; develop sensors and intelligent testing and control technologies, equipment, and control systems needed by process industries. Develop large cracking furnace technology, large steam ethylene cracking technology and set equipment, and large energy efficient chemical fertilizer process and equipment.

(29) Recycling iron and steel process techniques and equipment

Priorities will be given to research on and development of new generation circular iron and steel processes based on smelting reduction and optimized utilization of resources, and with the combination of production, energy conversion, and recycling of wastes, which will be made a role model for the circular economy. Develop technologies for cyclic utilization of secondary resources, cogeneration technology for metallurgical processes, and gradient utilization technology for low thermal value steam. Develop technologies for efficient and low-cost clean steel production, non-adhesive coking, integration design, manufacturing, and system coupling technologies for large continuous plate casters and continuous rollers.

(30) Large-scale marine engineering technologies and equipment

(31) Basic raw materials

To meet the needs of the primary industry, priorities will be placed on developing technologies for manufacturing high-performance composite materials and super large compound components, high-performance engineering plastics, light high-intensity metals and inorganic non-metal structural materials, high-purity materials, rare earth materials, petrochemicals, precision chemicals, catalysts, separating materials, light textile materials and associated applications, and environment friendly green and healthy materials.

(32) Next-generation information functional materials and components

(33)Key accessory materials and engineering processes for the defense industry

5. Transportation

Transportation represents the lifeline of the national economy. Currently, the country’s existing major transport facilities and core technologies **deplore** a large gap from the world advanced levels, as characterized by inadequate transport capability,

lagging construction of comprehensive transport systems, poor coordination of various means of transportation, and high energy consumption and severe environmental pollution. The construction of a full-fledged well-to-do society imposes greater demand for the transportation sector, calling for significant improvement of transport science and technology.

Development path: 1) enhance indigenous innovative capability in aircraft, automobile, ship, and rail transport; 2) aim at providing a smooth, convenient and humanized transport services by strengthening coordinated planning, developing technologies for traffic information system and intelligent process, and safe and high-speed transport systems, improving transport networks' capability and efficiency, realizing traffic information sharing and effective connection among different traffic means, uplifting the technical level of traffic operation management, and developing an integrated transport system; 3) promote the development of transportation in the direction of energy efficiency, environmental protection, and safety by striving for major breakthroughs in key technologies necessary for such improvement; 4) master key technologies for the construction and maintenance of major national transport infrastructure while improving construction quality and cost-effectiveness.

Priority topics:

(34) Transport infrastructure construction and maintenance technologies and equipment

Priorities will be given to developing critical technologies and equipment with respect to rail transport, cross-bay routes, offshore deep water harbors, large airports, large bridges and tunnels, integrated 3-D traffic hubs, deep-sea oil-gas pipelines, and other sophisticated transportation infrastructure.

(35) High-speed rail transport systems

Priorities will be given to research on and development of key technologies for high speed rail transport control and speed regulation systems, locomotive building, rail line construction, and system integration in order to acquire set technologies. Carry out operation tests so as to master technologies for operation control, rail line construction, and system integration.

(36) Energy-efficient and New Energy-based automobiles

Priorities will be assigned to research on and development of key technologies for design, integration, and manufacturing of hybrid, alternative fuel, and fuel cell automobiles, power system integration and control technologies, automobile computation platform technologies, and technologies for high-efficiency and low-emission internal combustion engines, fuel cell engines, accumulator batteries, driving motors, and other critical components, and technologies for developing experiment and test techniques and infrastructure for automobiles using new energy.

(37) Efficient transport technologies and equipment

Priorities will be given to research on and development of heavy duty passenger cars, large power locomotives, special heavy duty vehicles, urban rail transit systems, large high-tech ships, large ocean-going fishing boats, scientific expedition ships, and novel shipping tools, including lower-altitude multipurpose aircrafts, and high **viscosity** crude oil and multiphase flow pipeline transport systems.

(38) Intelligent traffic control systems

Priorities will be to develop technologies for traffic information platforms, information sharing, modern logistic systems, urban traffic control systems, intelligent automobiles, and new -generation air traffic control systems.

(39) Transport safety and emergency safeguards

Priorities will be to develop technologies for traffic accident prevention and pre-warning, emergency handling, active/passive safety for transport tools, techniques for traffic accident reconstruction, fast traffic emergency response system, and quick search and rescue missions.

6. Information industry and Modern Service Industry

The development of information industry and modern service industry constitutes a key link in advancing the new industrialization drive. The increasingly information technology-based national economy and modern service industry impose a higher demand for the development of information technology.

Development paths: 1) strive for breakthroughs in core technologies that constrain the development of information industry and master core technologies for integrated circuits and key components, major software, high performance computers, broadband mobile telecommunication, and the next generation internet, in order to upgrade indigenous development capability and overall technological level; 2) strengthen integrated innovation in information technology products and improve design and manufacturing capability so as to ensure scalability, user friendliness, and cost-effectiveness of information technology products, nurture new technologies and businesses, and enhance the competitiveness of information industry; 3) driven by market demand, attach more importance to and strengthen integrated innovation and develop technologies and products that support and lead the development of modern service industry while promoting the transformation and technological upgrading of the traditional industries; 4) with attention focused on creating highly credible networks, develop network information security technologies and products, establish technical support systems for information security, and develop the technological capability in handling information security emergencies.

Priority topics:

(40) Enabling information technology and large application software for modern service industry

Priorities will be given to developing highly credible online software platforms, large enabling application software, mediumware, built-in software, grid computation platforms and infrastructure, software system integration, and overall solutions required by modern service industry, including finance, logistics, online education, media, health care health, tourism, e-government, and e-commerce.

(41) Major next-generation internet technologies and services

Priorities will be to： develop key technologies for high performance core network equipment, transmission equipment, and connecting equipment; develop key technologies for scalability, security, mobility, service quality, and operation management; establish a credible network management system; develop intelligent terminals and household network equipment, and develop broadband related new businesses and applications such as multimedia and network computation.

(42) High performance, dependable computers

Emphasizing the development of computation methods and theories that embody new concept, efforts will be made to develop new concept-based super trustworthy computer with at least a thousand trillion floating-point operations per second and the next generation server systems, and develop a range of key technologies for innovative system structures, mass storage, and fault tolerance.

(43) Sensor networks and intelligent information processing

Priorities will be assigned to: developing new sensors and technologies for advanced automatic barcode identification, radio frequency tags, and multiple sensor information-based intelligent information processing; developing low-cost sensor networks and real-time information processing systems; and providing more convenient and more powerful information service platforms and environment.

(44) Digital media content platforms

Priorities shall be to develop critical technologies concerning digital media content processing for a range of business sectors, including the cultural and entertainment market, radio and TV broadcasting, and audio-video information services, developing comprehensive media information content platforms featuring easy accessibility, interaction, copyright protection, and effective management.

(45) High definition large flat-panel display

Priorities will be given to developing a range of flat-panel and projection display technologies, including high definition large flat-panel display products, organic electroluminescent display, field emission display, and laser display, with a view to establishing an industrial chain for flat-panel display materials and components.

(46) Core application-oriented information security

Priorities shall be to develop security technologies concerning national infrastructure information network and important information systems, develop novel **coding** technologies for network survival under complex large systems, active real-time protection, safe storage, network virus control, prevention of vicious attacks on web pages, and network credit systems.

7. Population and Health

Building a harmonious society calls for stabilizing a low birth rate, raising population quality, and effectively preventing and controlling major diseases. Controlling population and improving population quality and health all depend on powerful support from science and technology.

Development paths: 1) Birth rate control and population capacity building. Priorities will be given to acquiring key technologies for birth rate monitoring and reproductive health, developing a series of drugs, instruments, and health products for reproductive health to ensure that the country's population is below 1.5 billion and birth defect rate is below 3%. 2) While adhering to the principle of prevention first and combining health improvement and diseases control and treatment, carry out studies on critical technologies for disease prevention and early diagnosis, thus ensuring markedly improved capability in the diagnosis and prevention and treatment of major diseases. 3) Strengthen **inheritance** and innovation in Traditional Chinese Medicine(TCM) and promote TCM modernization and internationalization. While **inheritin**g and developing TCM theory, efforts shall be made to establish technical approaches and standard regulatory systems for TCM through technological innovation and multi-disciplinary interaction so as to improve clinical treatment and promote a sound development of TCM. 4) Develop major new drugs and advanced medical equipment. While overcoming key technological snags in developing new drugs, large medical equipment, medicinal materials, and drug release systems, accelerate the establishment of a national technical platform for drug development and propel indigenous innovation in major new drugs and novel medical equipment.

Priority topics:

(47) Safe contraception and family planning, and birth defects prevention and treatment

Priorities will be to develop new technologies and products for safe and effective contraception and for the prevention of sexually transmitted diseases, develop technologies for efficient and safe early screening, test and diagnosis of birth defects and for biological treatment of inherited diseases.

(48) Prevention and treatment of cardiovascular and cerebrovascular diseases, malignancies, and other major non-infectious diseases

Priorities will be given to developing key technologies for early warning and diagnosis of major diseases, including cardiovascular and cerebrovascular diseases and tumors, and for early intervention in disease risk factors while developing key technologies and solutions for standardized, individualized and integrated treatment.

(49) Prevention and treatment of common, frequently-occurring diseases in urban and rural communities

Priorities will be given to research on and development of technologies for monitoring, preventing, diagnosing, and treating frequently occurring and common diseases in addition to developing compact mobile medical service equipment and distance diagnosis and technical service systems.

(50) Traditional Chinese Medicine: impartation and innovation

Priorities will be given to encouraging innovation in basic TCM theory, and inheriting and tapping on TCM experience, studying TCM diagnosis and therapy and associated assessment techniques and standards, carrying out research on and development of modern TCM and manufacturing technologies. These efforts are designed to protect and utilize TCM resources in an effective and rational manner while strengthening the protection of intellectual property rights and establishing international cooperation platforms.

(51) Advanced medical equipment and bio-medicinal materials

Priorities will be to develop novel therapeutic equipment and conventional diagnostic and therapeutic equipment, digital medical technologies, and individualized medical engineering technologies and equipment in addition to studying nanotechnology-based biological drug release systems and tissue engineering and developing innovative bio-medicinal materials such as including proxy human tissues and organs.

9. Urbanization and City Development

China has entered a phase of rapid urbanization. Urbanization process and coordinated urban development are in earnest need of science and technology.

Development paths: 1) By stressing scientific urban planning in cities and towns, efforts will be made to promote rational layout of urban and rural areas and associated scientific development. Develop key technologies for modern urban planning and dynamic monitoring and control so as to realize an organic combination of urban development planning and regional economic planning in response to the sustaining capacity of regional resources and environment. 2) In light of energy and water efficiency, establish resource saving cities, strive for technological breakthroughs in urban energy efficiency and rational development and utilization of new energy, and develop resource efficient, long durability, green construction materials so in order to raise urban resources and energy efficiency. 3) Raise

comprehensive urban management level by strengthening the application of information technology. Develop integrated digital urban management technology in order to establish an efficient, multifunctional, and integrated technical system for urban management. 4) Develop urban ecological residential environment and green building structures and noticeably improve urban living environment by utilizing technologies for hazardless handling and recycling of urban sewages and garbage and developing environment friendly technologies for improving urban residential areas and indoor environment, and noticeably raising the quality of urban living environment.

Priority topics:

(52) Urban planning and dynamic monitoring

Priorities will be set up to develop technologies for urban layout design and system design, and urban infrastructures and public service facilities planning and design. Developing technologies for integrated configuration and associated sharing, and interactive simulating prediction and dynamic monitoring of a range of urban elements, including urban planning, population, resources, environment, and economic development.

(53) Uplifting urban functions and space efficiency

Priorities will be to develop a range of technologies involving urban traffic system, intelligent urban public transit management, urban utility infrastructures, and disaster prevention and mitigation, studying the formation mechanism of urban hot-island effect and artificial control technology,. Developing technologies for land mapping and resource saving, simulation prediction of urban spatial changes, and urban underground development and utilization.

(54) Architecture energy efficiency and green buildings

Priorities will be to develop green architecture design technologies, architecture energy-saving technology and equipment, renewable energy devices, and integrated application technology, precision construction technologies and equipment, energy efficiency and green construction materials, and energy efficiency architecture standards.

(55) Urban ecological residential environment and quality control

Priorities shall be given to developing technologies for indoor pollutants monitoring and cleanup, ecological control of urban environment, and recycling of urban garbage, cyclic utilization of water, urban pollution control, minimal emission in residential areas, and intelligent management of ecological residential areas.

(56) Urban information platforms

Priorities will be to develop technologies for sharing urban online information, urban basic data acquisition and updating, urban data consolidation and mining,

multi-dimensional urban construction modeling and simulation, urban dynamic monitoring systems and associated application, standards for urban online information sharing, and urban emergency response services.

10. Public Security

Public security constitutes a footstone for national security and social stability. The country's public security is facing severe challenges, which in turn raises major strategic demands for scientific and technological support.

Development paths: 1) Strengthen technical support for quick response to and handling of emergency events. With application of information and intelligent technologies at the core, efforts will be made to develop a national public security system featured with multifunction and integrated emergency response support. Establish a public security technical system consisting of scientific prediction, effective prevention and control, and quick response mechanism. 2) Improve the capability of early detection and prevention. Priorities will be given to studies on technologies for monitoring, warning, and preventing coalmine and other production-related accidents, social emergency events, natural disasters, nuclear safety, and biosecurity. 3) Enhance comprehensive response and rescue capability. Focus shall rest on developing rescue technologies for coalmine disasters, major fires, major natural disasters, leakage of hazardous chemicals, and mass poisoning. 4) Accelerate the modernization of public security equipment and facilities. Develop major equipment for production safety, food safety, biosecurity and public safety, and associated protection products and the relevant industries.

Priority topics:

(57) National public security emergency information platforms

Priorities will be to develop technologies for all-round and obstacle-free risk source detection and monitoring, precision positioning, and information acquisition. Develop technologies for multi-scale dynamic information analysis and handling, and decision making. Develop integration technology for a national public security emergency command platform and establish an integrated emergency decision-making platform featured with early monitoring, quick advance warning, and efficient handling.

(58) Major workplace accidents warning and rescue

Priorities will be to develop pre-warning and control technologies and associated equipment for mine gas, water bursting, power failures, and major industrial accidents, including open burning, explosion, and hazardous leakage.

(59) Food safety and border entry-exit inspection and quarantine

Priorities shall be to work on a range of key technologies concerning food safety and entry-exit quarantine related risk assessment, pollutants tracking, safety

standard formulation, and quarantine monitoring and testing, and develop intelligent technologies for food contamination prevention and control and high flux quarantine monitoring.

(60) Major public emergency prevention and quick response

Priorities will be set to work on technologies involving individual biological characteristic identification, evidence gathering, quick screening, ratification, and simulation prediction, technologies and equipment for distance positioning and tracking, real-time monitoring, evidence identification, and quick handling, fire-fighting in high-rise buildings and underground structures, distance probe of explosives, illegal drugs, and nuclear and biological sources of terrorism, and on-site handling and protection.

(61) Biosafety measure

Priorities will be to produce a range of technologies involving fast, sensitive, and specific monitoring and detecting, including technologies capable of detecting in-body toxic chemicals, advanced disinfectors and fast disinfection, hazardous medium identification and control, biological invasion prevention and control, and vaccines, immunoadjuvant , antitoxin, and other drugs.

(62) Major natural disasters prevention and preparedness

Priorities will be to develop key technologies for monitoring, warning, and emergency handling of earthquakes, typhoons, torrential rains, floods, and geological disasters; develop monitoring and warning technologies for forest fire, dam breakage and leakage, and risk assessment techniques for major natural disasters.

11. National defense

IV. Major Special Projects

Historically, the implementation of major special projects represented by A-bomb, H-bomb, satellites, manned space flights, and hybrid rice has played a crucial role in enhancing China’s comprehensive strength. The United States, Europe, Japan, Korea, and others have all made the implementation of major special projects to meet national goals an important measure in raising their national competitiveness.

In the course of defining priority topics in the main areas, a number of major special projects involving strategically important products, critical common technologies, and major engineering projects, are identified in line with national objectives. These major special projects are designed to strive for breakthroughs, taking full advantage of the socialist system in pooling up resources to do big things and the role of the market economy system as well. These major special projects are expected to spring from scientific and technological progress in limited areas to a leapfrogging development in

overall productivity while helping fill up the country's strategic blanks. The basic principles under which major special projects are screened out are as follows:

1) strategic industries that are closely linked to the major demands of the nation's economic and social development, capable of coming up with core proprietary intellectual property rights, and having a major impact on indigenous innovative capacity at the enterprise level; 2) key enabling technologies that have an overarching bearing on raising the overall industrial competitiveness; 3) efforts that are aimed at overcoming major bottlenecks to economic and social development; 4) activities that combine both civilian and defense efforts or make defense part of the civilian industry and have a major strategic importance to maintaining national security and strengthening comprehensive national strength; 5) efforts that are in line with the nation's development status and within the reach of its strength. It is according to the above-mentioned principles that a number of major special projects are selected to address a range of issues involving high tech industry development, traditional industry transformation, bottlenecks to the nation's economic development, raising people's health level, and safeguarding national security. These major special projects will be implemented upon a further review and approval case by case in light of ranking priority of the nation's development requirement and necessary conditions for implementation.

In addition, dynamic readjustment will be made to pace the implementation of these major special projects as determined by the nation's strategic needs and changing situation. For the major special projects aiming at strategic products, enterprises are expected to be the principal player in terms of research and development and investment. They will start from research on and development of major equipment so as to take advantage of allocating S&T resources through market mechanism while the starting fund appropriated by the state will be mainly used to address key and core technological snags.

Major special projects are major strategic products, critical common technologies, and major engineering projects which are selected for realizing national objectives and must be completed by massing resources and making breakthroughs in core technologies within a set period of time, thus being the top priority in the nation's science and technology development. The Outline has defined 16 major special projects, including core electronic devices, high-end generic chips and basic software, super large-scale integrated circuit manufacturing technology and associated techniques, the next generation broadband mobile telecommunication, high-end numerically controlled machine tools and basic manufacturing technology, the development of large oil-gas fields and coal-bed methane, large advanced pressurized water reactors and high temperature gas-coolant reactor nuclear power stations, water body contamination control and treatment, new genetically modified varieties, major new drugs, prevention and treatment of major infectious diseases such as HIV/ADIS and viral hepatitis, large passenger aircrafts, high resolution earth

observation systems, manned space flights, and the moon probe. The major special projects cover a range of strategic sectors including information and biotechnology, major pressing issues concerning energy, resources, the environment, and public health, dual-use technologies, and defense technologies.

V. Frontier Technologies

Frontier technologies refer to major visionary, pioneering, and exploratory technologies in the realm of high technology. Frontier technologies constitute an important basis on which future high technologies stem out and emerging industries grow. They represent a nation's comprehensive high-tech innovation capability. Frontier technologies are selected in accordance with the following principles: 1) representing the development direction of world high-tech frontiers; 2) having a pioneering role in shaping and developing new industries in the future; 3) being conducive to industrial technology upgrading and for realizing the leapfrogging development; and 4) possessing a strong team of talented personnel and a sound R&D basis. Under the above-mentioned principles, a number of frontier technologies will be pre-deployed in an attempt to lead the future S&T development and raise the nation's high-tech R&D capability and international competitiveness.

1. Biotechnology

Biotechnology and life science will become an important force triggering a new round of S&T revolution in the 21st century. Genomics and proteomics studies are leading advances in biotechnology in the direction of systemized research. Genome sequencing and genetic structure analysis have turned in the direction of functional genomic studies and the discovery and application of functional genes. Drugs and animal-plant based directional molecular design and construction have become an important direction for species and drug-related studies. Development and application of frontier technologies, including biochips, stem cells, and tissue engineering, breeds major breakthroughs in diagnosis, therapeutic treatment, and regenerative medicine. Critical breakthroughs are required in the fields of functional genome, proteomics, stem cells, and therapeutic cloning, tissue engineering, biocatalysis, and conversion technologies.

Frontier technologies:

(1) Target identification technology

Target identification is important for developing new drugs, biodiagnostics, and biotreatment. Efforts shall be focused on studying scale identification of key genetic functions and their regulatory networks in the physiological and pathological process, making breakthroughs in techniques for identification of functions of disease-causing

genes, expression manipulation, target screening, and verification, and innovative new drug manufacturing from “gene to drug”.

(2) Plant-animal varieties and drug molecular design technology

Plant-animal species and drug molecular design technology is made up of molecul docking, molecule simulation, and molecule design based on biomacromolecules’ 3-D structures. Priorities shall be given to studying protein and dynamic cellular process and associated bioinformatic analysis, consolidation, and simulation. Develop virtual plant-animal species and drug design technology, simulation technology for plant-animal species growth and pharmaceutical metabolism engineering, computer aided composite bank design, synthesizing, and screening.

(3)Gene manipulation and protein engineering technology

Gene manipulation technology is a key link to the utilization of genetic resources. Protein engineering constitutes an important approach to efficient utilization of genetic products. Efforts will be focused on developing technologies for highly effective expression and regulation, chromosome structuring and positioning, coded protein gene design and transformation technology, protein peptide chain decoration and restructuring technology, protein structure analyzing technology, and scale protein isolation and purification technology.

(4) Stem cell based human tissue engineering technology

Stem cell technology is a process that can be used to develop in-vitro stem cells, or harvest different tissues or cells clinically needed through directional induced differentiation or isolation. It also can construct in-vitro human organs for replacement and repairing treatment. Priorities shall be to develop therapeutic cloning technology, in-vitro stem cells construction and directional induction technology, in-vitro human tissue construction and associated scale production technology, multiple human cell-based sophisticated tissue construction and dysfunction repairing technology, and biomanufacturing technology.

(5) New-generation Industrial biotechnology

Biocatalysis and biotransformation constitute the mainstream of the new generation industrial biotechnology. Priorities will be to develop scale screening technology for functional strains, directional biocatalyst upgrading technology, biocatalysis technology system for scale industrial production, clean transformation media manufacturing technology, and associated industrialized transformation process.

2. Information Technology

As information technology will continue to develop in the direction of high performance, low-cost, pervasive computation, and intelligent process, seeking new

and innovative computing and processing approaches and associated physical realization represents a major for the future development of information technology. The crossing and integration of nanotechnology, biotechnology, and cognitive science will induce advances in information technology that are human-centered, image and natural language comprehension-based, and featuring biological characteristics, thus promoting innovation in numerous fields. Priorities will be to develop low-cost ad hoc networks, individualized intelligent robots and human-machine interactive systems, high-flexibility attack free data networks, and advanced information security systems.

Frontier technologies:

(6) Intelligent sensing technology

Research will be focused on intelligent information processing and control technologies based on biological characteristics and image and natural language comprehension and centered on humans, while developing processing systems for Chinese language information, systematic technologies involving biological characteristics identification, and intelligent traffic systems.

(7) Ad hoc network technology

Priorities will be to develop technologies for ad hoc mobile networks, ad hoc computing networks, ad hoc storage networks, and ad hoc sensor networks, low-cost real-time information processing systems, multi-sensor information integration, individualized interactive interface, high-flexibility attack **free** data networks, advanced information security systems, and ad hoc intelligent system and intelligent personal system.

(8) Virtual reality technology

Research will be focused on technologies for integrating different disciplines, including electronics, psychology, cybernetics, computer graphics, database design, real-time distribution system, and multimedia technology in addition to studying virtual reality technologies and associated systems for related fields, including medicine, entertainment, arts, education, military affairs, and industrial manufacturing management.

3. Advanced Materials Technology

Advanced material technology will go for composite structural functions, intelligent functional materials, integration of materials and components, and environment- friendly manufacturing and applications. Efforts will be made in seeking breakthroughs in material design, assessing, and characterizing, and in advanced manufacturing and processing technologies. Based on studies in nano-science, develop nanomaterials and nanocomponents, special functional materials such as superconductor materials, intelligent materials, energy materials, super structural materials, and new generation optoelectronic information materials.

Frontier technologies:

(9) Intelligent materials and structural technology

Intelligent materials and intelligent structures constitute a smart or intelligent structural systems that integrate sensors, control, and drive (execution) and other functions. Priorities will be to develop technologies for intelligent material manufacturing and processing, intelligent structure design and manufacturing, key equipment monitoring, and failure control.

(10) High-temperature superconducting technology

Research will be focused on novel high-temperature superconducting materials and associated manufacturing technology, superconducting cables, superconducting motors, and high performance superconducting electric devices while studying a range of sensitive detecting devices such as superconducting biomedical elements, high-temperature superconducting filters, high-temperature superconducting injury-free detectors, and scanning magnetic microscopes.

(11) Efficient energy material technology

Research will be focused on critical technologies for solar cell related materials and associated key technologies, critical technologies for fuel cell materials, high volume hydrogen storage material technology, efficient rechargeable cell materials and associated key technologies, key super capacitor materials and associated manufacturing technology, and efficient energy conversion and storage material systems.

4. Advanced Manufacturing Technology

Advanced manufacturing technology will be increasingly based on information, extremism, and environmental friendliness. Such a tendency will create a foundation on which future manufacturing industry will survive, and a key link to its sustainable development. Efforts will be focused on overcoming difficulties in extreme manufacturing technology, system integration, coordination technology, intelligent manufacturing and application technology, set equipment and system design and verification technology, high reliability-based large sophisticated systems and equipment design technology.

Frontier technologies:

(12) Extreme manufacturing technology

Extreme manufacturing refers to the manufacturing components or functional systems at an extreme scale (extremely large or extremely small) or with extremely powerful functions under extreme conditions or environment. Research will be focused on design, manufacturing, and test technologies for micro and nanometer

electro-mechanic systems, and technologies for micro and nanometer manufacturing, super precision manufacturing, giant system manufacturing, and intense field manufacturing.

(13) Intelligent service robots

An intelligent service robot is an intelligent equipment integrated with a number of high-tech elements, able to provide diverse services needed by humans, in a non-structural environment. The focus will be on service robots and dangerous operation robots in order to study common basic technologies, including design approaches, manufacturing techniques, intelligent control, and application system integration.

(14) Service life prediction technology for major products and facilities

Service life prediction technology for major products and facilities represents a key technology for improving operational reliability, safety, and maintainability. Efforts will be made to study prediction control and optimization technology for elements design for components and prototyping process, knowledge-based prototyping and simulation technology, onsite manufacturing process test and evaluation technology, component service life prediction technology, and reliability, safety, and service life prediction technology for major products, complex systems, and large facilities.

5. Advanced Energy Technology

Advances in energy technology in the future will mainly be characterized with cost-effectiveness, efficiency, and clean utilization in addition to novel energy sources. Technology development with respect to the fourth generation nuclear energy system, advanced nuclear fuel cycle, and fusion energy has drawn increasing attention. Hydrogen, an ideal energy carrier that can be obtained through diverse approaches, will bring about new changes tor clean energy utilization. Fuel cell and distributive energy supply technology, featured with cleanness and flexibility, will eventually become an important form of terminal energy application. Research efforts will be focused on hydrogen utilization and distributive energy systems, advanced nuclear energy, and fuel cycle technology in addition to developing technologies for fossil fuel energy utilization, featured with efficiency, cleanness, and near-zero emissions, and low-cost and efficient new renewable energy applications.

Frontier technologies:

(15) Hydrogen and fuel cell technology

Research efforts will focus on technologies for making hydrogen through the use efficient low-cost fossil fuel energy and renewable energy, cost-effective hydrogen storage and transport, technologies for manufacturing basic key fuel cell components, thermopile integration, fuel cell applications to power generation and

automobile propulsion systems. Efforts will also be made to develop technical standards for hydrogen energy and fuel cell technology.

(16) Distributive energy supply technology

Distributive energy supply technology constitutes an important means of providing comprehensive energy services featured with flexibility and energy efficiency. The focus will be on mastering technologies for fossil fuel-based mini gas turbines and energy conversion such as innovative thermal cycle, energy storage, and triple-generation technology, with view to establishing renewable energy based distributive terminal energy supply systems made up of mini gas turbines and fuel cells, supplemented by fossil fuel energy.

(17) Fast neutron reactor technology

A fast neutron reactor is a nuclear reactor where fission chain reaction is triggered by fast neutrons to realize nuclear fuel breeding. It is capable of full utilization of uranium resource in addition to handling long-life span radioactive wastes. Conduct research on and master fast neutron reactor design and core technologies, nuclear fuel and structural materials, while striving for major technological breakthroughs in sodium cycle, developing a 65MW experimental fast reactor for critical and grid power generation.

(18) Contained magnetic fusion technology

Taking advantage of participating in research on and construction of the International Thermal-nuclear Experimental Reactor project, focus our research on technologies concerning large superconducting magnets, microwave heating and driving, neutral beam injection heating, blanketing, large real-time tritium isolation and purification, diverters, numerical modeling, plasma control and diagnosis, and key materials for an experimental reactor. Deepen the study of high-temperature plasma physics and exploring non-Tokamak approaches for some energy applications.

6. Marine Technology

More attention will be given to developing comprehensive marine development technology featured with multifunction, multi-parameter, and long lasting operation in order to raise the nation’s comprehensive technological level of deep-sea operations. Research will focus on developing technologies involving natural gas hydrates exploitation, sea-floor metal and mineral resources gathering and transport, on-site extraction, and large marine engineering projects.

Frontier technologies:

(19) 3-D marine environment monitoring technology

3-D marine environment monitoring is a technology designed for synchronized monitoring of marine environmental elements from space, offshore stations, water

surface, and in-water. Research will be focused on remote marine sensing technology, acoustic probe technology, buoy technology, shore-based long-range radar technology, and marine information processing and application technology.

(20) Ocean floor-based multi-parameter fast sounding technology

Sea-floor based multi-parameter sounding is a technology for synchronized collection of different parameters, including sea-floor geophysics, geochemistry, and biochemicals, capable of transmitting information and data on a real-time basis. Research priority will be on sensor technology, automatic sensor positioning technology, and sea-floor information transmission technology under abnormal environment and conditions.

(21) Natural gas hydrates exploitation technology

Natural gas hydrate is a **carbon nitrate** bedded at the deep seafloor or underground. Research will focus on prospecting theory and exploitation technology for such a compound, geophysics and geochemistry based gas hydrate prospecting and assessing technology. Strive for breakthroughs in gas hydrate drilling technology and safe mining technology.

(22) Deep-ocean operation technology

Deep-ocean operation technology is an under-water process for deep seafloor engineering operation and mining activities. Research focus will be on underwater carrying technology at a large depth, life maintaining system technology, high-power dynamic device technology, high fidelity sample collection and distance information transmission technology, deep-sea operational equipment manufacturing technology, and deep-sea space station technology.

7. Lasers Technology

7. Aerospace Technology

VI. Basic Research

Basic research constitutes an important source for high-tech development, a cradle for nurturing innovative personnel, a foundation for building an advanced culture, and an inner driving force for the future S&T development through profound understanding of natural phenomena, unveiling natural laws, and acquiring new knowledge, new principles, and new methodology. The development of basic research shall adhere to the principle of combining meeting the national objectives and encouraging free exploration. In addition, basic research activities shall observe the law of scientific development, respect scientists' exploratory spirit, and pay more attention to the long term value of sciences, with stabilized support, visionary

deployment, and dynamic readjustment in line with new trends of scientific development. The Outline has made deployment in four major areas, involving basic and major scientific research activities that are in line with disciplinary development, scientific frontiers, and major national strategic demands.

1. Disciplinary Development

An overall deployment is made for basic disciplines, taking into account a range of characteristics of basic research activities, including long term efforts for limited breakthroughs, exploratory nature, and difficulties in predicting progress. The deployment is made as such that different disciplines are allowed to cross and infiltrate one another in an effort to bring out new growing points for disciplines. It is expected that long-term and in-depth academic studies and accumulations will eventually lead to improved capability in original innovation and to advancing coordinated multi-discipline based development.

(1)Basic disciplines

Pay more attention to capacity building in basic theories and disciplines, with a coordinated development of mathematics, physics, chemistry, astronomy, earth sciences, and biology.

(2) Cross and emerging disciplines

Encourage interweaving and melting between basic disciplines, between basic disciplines and applied disciplines, and between natural science and social science. Such a combination, more often than not, will lead to the birth of major scientific discoveries and new disciplines. It is one of the most active parts in scientific researche. In this context, it is worth a raised attention and well-thought deployment.

2. Frontier Scientific Issues

The unity of micro and universal worlds, the combination of Reductionism and Entirety, the interwoven multidisciplinary practice, the infiltration of basic sciences such as mathematics into diverse other areas, and application of advanced technologies and means, all hallmark the major characteristics of modern frontier scientific development. They are conceived with major scientific breakthroughs, which makes people’s knowledge of objective world deeper and better. Frontier scientific issues are selected in line with the following principles: having a spurring role for the development of basic sciences, having a solid foundation, able to make a full display of China’s strength and specialty, and desirable for raising China’s international position in basic sciences.

(1)Quantitative study and systematic integration of life process

Main research directions: gene language and regulation, model biology,

epigenetics, untranslated RNA, life structural function and regulation network, life reconstruction, bioinformatics, computational biology, life characteristics in extreme environment, origin and evolution of life, systematic development, and evolutionary biology.

(2)Condensed matters and novel effects

Main research directions: strongly correlated systems, soft condensed matters, condensed matters of novel quantum properties, self-similar cooperative growth, Open Complex Giant System (OCGS), Bose-Einstein Condensation, superfluid-superconducting mechanism, structural phase transformation emissions, condensed matters under extreme conditions, electronic structure, and diverse primary excitation processes.

(3)Matters' deep inner structures and physical laws at cosmological scale

Main research directions: matter structures and physical laws at micro or universal scale and under extreme conditions, such as high-energy, high-density, super high pressure, and super intense magnetic field, the theory of unifying all physical laws, basic frontier issues of particle physics, substances of dark matter and dark energy, origin and evolution of the universe, formation and evolution of black holes and diverse celestial bodies and structures, impacts of solar activities on earth environment and disasters and associated prediction.

(4) Core mathematics and its application in cross disciplines

Main research directions: major issues concerning core mathematics, intercrossing between mathematics and other disciplines, and new mathematic problems in scientific research and practical applications such as discrete problems, random problems, quantum problems, and mathematical theories and methodologies in a range of non-linear problems.

(5) Earth system process and associated resources, environment, and disaster effects

Main research directions: interactions between different earth systems (atmosphere, hydrosphere, biosphere, earth crust, mantle and core), in-depth earth drilling, physical, chemical, and biological processes in the earth system and associated resources, environment, and disasters effects, theory of continental and marine origin of mineral reserves, land, sea, air, and space based earth observation and probe systems, earth simulation systems, and earth system theory.

(6) Chemical processes in creating and transforming new matters

Main research directions: function design, controllable synthesis, preparation and transformation of new specific molecules of defined structures, condensed molecules, and polymeric molecules, environment friendly new chemistry system, formation and transformation of matters at different temporal and spatial scales, relationship between chemical properties, performance, and structures of complex

systems such as life process and ecological environment, and associated rules for transformation.

(7) Brain and cognitive sciences

Main research directions: cellular and molecular mechanism of brain functions, genesis and development mechanism of major brain diseases, relationship between brain development, plasticity and human intelligence, the process of higher cognitive functions, including learning memory and thinking, and associated neuroscience basis, expression of brain information and brain-like information processing system, and dialogue between human brain and computer.

(8) Innovation in scientific experiments, observational methods, techniques, and equipment

Main research directions: life science related tests, imaging, analysis, and manipulation, featured with dynamic, timing, no-injury, sensitivity, and high definition; new technologies for acquiring matter composition, function, and structure related information, and associated characterizing technology, new observational means and approaches for information acquisition in earth and space research.

3.Basic Research in Response to Major National Strategic Needs

A knowledge based society has intense needs for the development of science. The competition for comprehensive national strength appeals to basic research with an ascending tendency. Being a developing nation enjoying fast economic growth make it all the more necessary to stress that basic research must serve to meet the national objectives and help address key and bottleneck issues in future development. In this context, basic research directions are defined according to the following principles: having strategic, overall, and long term importance to the national economic and social development and to the national security; capable of playing a critical role in future development; and able to result in a combination of basic sciences and technology sciences, thus leading the future high tech development.

(1) Biological foundations of human health and diseases

Priorities will be selected to study the genesis and development process of major diseases, and associated molecular and cellular basis for interference; the role of nervous system, immune system, and endocrine system in health and major diseases; dissemination and mutation of pathogens and associated diseases causing mechanism; drug effects at molecular, cellular, and co-regulating levels; interference of environment in physiological process; and theoretical system of traditional Chinese medicine.

(2) Crop genetic improvement and scientific issues in sustainable agricultural development

Priorities shall be given to studying crop genes, functional genomes, and the

alike; biodiversity and genetic basis for new species breeding; crop stress resistance and mechanism for efficient utilization of moisture, nutrients, and sunshine; interactions between crops and ecological environment; and agro-biological safety and principles of major crop diseases control.

(3) Human activities and their impact on the Earth system

Research will be focused on disaster and risk prediction for resources prospecting and development activities; extensive human activities in major river basins and their ecological implications, adaptability, and regional ecological safety; energy cycle of major ecosystems and associated regulation; biodiversity protection models; land use and changes in land cover; regional water demand and ecological equilibrium; genesis of environmental pollution and control principles; and sustainable marine resources utilization and marine ecological environment protection.

(4)Global change and regional response

Priorities will be given to studying global climate change and its impact on China; large scale hydrological cycle and its response to global change; global change and its impact on regional water resources; interactions between human activities and monsoon systems; sea-land-air interactions and mutation of Asian monsoon systems and associated prediction; carbon cycle process in China's offshore-land ecosystem; the Qinghai-Tibet Plateau and polar regions and their response to global change, and associated climate and environment effects; climate system modeling and associated simulation and prediction; greenhouse effect and associated mechanism; genesis and evolution of aerosols and its impacts on climate change, and associated control.

(5) Complex systems, disaster formation, prediction, and control

Research will focus on the relationship between micro-mechanisms and macro-phenomena in engineering projects, nature, and socioeconomic complex systems; mechanism and evolution of structure formation, and relationship between structure and system behavior in a complex system; movement of complex systems and associated system mutation and regulation; relativity between behaviors at different scales in a complex system, and new theory and methodology concerning complex systems.

(6)Key scientific issues in sustainable energy development

Research will be focused on the physical and chemical basis of efficient and clean fossil fuel energy utilization and transformation; high performance thermal energy transformation and key scientific issues in efficient energy storage; scale utilization of renewable energy and associated principles and new approaches; theory of safe, stable, and economic operation of power grids; and scientific basis of large-scale basic nuclear energy technologies and hydrogen technology.

(7) New principles and methodologies for materials design and fabrication

Priorities will be given to studying the physical and chemical basis of optimizing basic materials; phase change and structure control mechanism; principles of multi-enhanced treatment; physical and chemical properties of new materials; new physical mechanisms, new effects, and new material design, including artificial structures, minimization, and multifunction based integration; new principles and techniques of material manufacturing; new principles of structure and performance characterizing; interactions between material service and the environment and associated performance evolution, failure mechanism, and service life prediction.

(8) Scientific basis of manufacturing under extreme environmental conditions

Research will focus on deep matters and energy interactions; micro-scale transmission of high-density energy and matters; precision expression and measuring of micro-structural shape; scale effects on manufacturing prototyping, property formation and system integration and associated interfacing science; smooth movement certainty of a complex manufacturing system, and uniqueness of manufacturing subjects.

(9) Major mechanical issues in aeronautics and space science

Priorities shall be placed on studying the mechanical issues involving supersonic propulsion systems and super high-speed collision; multidimensional propulsion systems and theory of complex movement control; theory of compressible turbulent flows; high temperature thermodynamics; magnetic fluid and plasma dynamics; microfluid and microsystem dynamics; and structural dynamics of new materials.

(10) Scientific basis for the development of information technology

Priorities will be given to studying new algorithms and basic software theory; mechanisms of virtual computation environment; theory and methods for mass information processing and knowledge mining; interactive theory; network security and credible and controllable information security theory.

4. Major Scientific Research Programs

Four major scientific research programs are identified and deployed in line with the world S&T development trends and China’s major national strategic needs. These programs are qualified for playing a strong role in S&T development, triggering a rapid improvement of sustainable innovation capacity, and possessing a high-caliber research contingent. Breakthroughs in these directions will noticeably raise the nation’s international competitiveness, advance its sustainable development, and realize leapfrogging development in selected areas.

(1) Protein studies

Protein is a principal carrier of life activities and an executor of different functions. An in-depth study of protein’s diverse sophisticated structures and

functions, interactions and dynamic changes can unveil the nature of life phenomena at molecular, cellular, and biological levels, which constitute the main mission for the post-genome era. In the meantime, protein-related research findings will result in a range of new biotechnological activities, spur up the development of pharmacy, agriculture, and the so-called “green industry”, and lead the future development of bioeconomy. In this context, protein study is an area of life science that sees fierce competition among developed nations.

Research will be focused on transcriptomics, proteomics, metabonomics, structural biology, biological functions of proteins and associated interactions, protein-related computational biology and systems biology, methodologies for protein research, and relevant applied basic research.

(2) Quantum regulation studies

Microelectronics-based information technology will soon reach its limit. Hence, the development of information technology is facing severe challenges: mankind has to find a new way out. In this context, quantum effects-based new information means brings up a new hope, and has become a new competition target among the developed nations. The so-called quantum manipulation explores new quantum information, and develops a range of related sciences, including quantum informatics, correlated electronics, quantum communication, confined small-scale quantum system and artificial photonic crystal. These will constitute a theoretical basis for the future information technology development. As a visionary discipline, quantum technology may produce an inestimable impact on the economic and social development over the next 20 to 30 years.

Priorities will be to study carriers of quantum communication and associated manipulation principles and methodologies; quantum computation, charge-spin-phase-trajectory relevancy, and new quantum manipulation methods; new quantum effects of confined small scale quantum system; macro quantum effects of photonic material; and new principles and technical basis for quantum manipulation characterizing and measuring.

(3) Nanometer studies

Matters at a nanometer scale can produce a bizarre phenomenon or rule, which will eventually change the existing framework of relevant theories, allowing people to have a brand new knowledge of the matter world. This, in turn, will give birth to a new technology revolution, and create huge development space for materials, information, green manufacturing, biology, and medicine. Nanoscience and nanotechnology have become a strategic alternative for raising a nation’s core competitiveness. It is also one of the areas where China expects to realize the leapfrogging ing development.

Research will be focused on controllable preparation and self-assembly of

nanomaterials and associated functionality; nanomaterial structure, special properties, and manipulation mechanism; principles of nanoprocessing and associated integration; conceptual and principle-demonstrating nanocomponents; nanoelectronics, nanobiology, nanomedicine; optical, electronic, and magnetic properties of molecular aggregates and biomolecules, and associated information transmission; single molecule behavior and associated manipulation; molecular machine design, assembly, and control; characterizing and measuring at a nanoscale; and applications of nanomaterials and nanotechnology in the fields of energy, the environment, information, and medicine.

(4) Growth and reproduction studies

A range of eye catching scientific accomplishments, including animal cloning and stem cells, has brought about huge opportunities for the future development of life and medical sciences. However, most of these findings remain unready to directly serve humans as a result of lacking a systematic and in-depth knowledge of reproduction and development process and associated mechanisms. China has a high population growth rate and a high birth defect rate. Confronted with a serious shortage of replacement organs, compounded by the coming peak of an aging population, the nation is in dire need of breakthroughs and technological innovation in reproduction and growth-related theories.

Research will focus on stem cell breeding, isolation, and manipulation; generation, maturity, and fertilization of reproductive cells; manipulation mechanism for fetus development; somatic dedifferentiation and animal cloning mechanism; degeneration of human reproductive functions and regressive mechanism; and safety and ethics of aided reproduction and stem cells technology.

VII. Reform of the S&T System and the Construction of a National Innovation System

Since the introduction of the policy of reform and opening up, the nation's S&T system reform has made important breakthroughs and substantial strides as it has strictly positioned around forging close links with the economy, aimed at strengthening technological innovation and conversion and industrialization of S&T achievements, stressed structural realignment and mechanism shift, and adopted a series of major reformative measures. Nevertheless, one has to be keenly aware that China's existing S&T system remains inadequate in meeting the needs of the socialist market economy and that of greater economic and S&T development. First, our enterprises are yet to become a principal player in technological innovation as their innovative capability remains weak. Second, the S&T sector is compartmentalized, resulting in dispersion and duplication of efforts and low overall performance level. S&T innovation capability in the public good sector is especially weak. Third, S&T management at the macro level is terribly uncoordinated, with an S&T resources allocation pattern and evaluation system falling short of accommodating the needs for

the new S&T development and government mandate shift. Fourth, mechanisms for rewarding outstanding personnel and encouraging innovation and pioneering activities are not yet consummate. These problems have seriously compromised the nation's innovation capacity building.

Guiding thoughts for deepening the S&T system reform are defined as follows: promoting the full-fledged construction of a national innovation system with Chinese characteristics, focusing on S&T resources distribution efficiency and comprehensive integration, and effecting a breakthrough in building an enterprise-centered technological innovation system featuring the integration of industry, academia, and research, so as to greatly advance the construction of a uniquely Chinese national innovation system and drastically enhance the nation's indigenous innovation capability.

At present and over a period of time in the future, the S&T system reform will strive to accomplish the following major missions:

1. Supporting and Encouraging Enterprises to Become the Main Player in Technological Innovation

Market competition is an important driving force behind technological innovation while technological innovation is the ultimate route to enhanced enterprise competitiveness. Along with deepened reform and opening up, Chinese enterprises are playing an increasingly important role in technological innovation. To substantially enhance the motivity and vitality of technological innovation at the enterprise level, more agreeable conditions need to be provided, a better environment created, and reforms deepened.

Firstly, let economic and S&T policies play a guiding role in order to enable enterprises to become the major R&D spender. Efforts must be accelerated to create a unified, open, competitive, and orderly environment for the market economy by way of fiscal, taxation, and monetary policies so that enterprises, particularly large enterprises, are induced into increasing their R&D spending and establishing their own R&D bodies. National engineering laboratories and sectoral engineering centers should be established at transformed research institutes or large enterprises possessing fairly strong R&D and technology spin-off capabilities, in collaboration with universities and research institutes. Encourage technology innovation consortia of various forms initiated by enterprises, in collaboration with universities and research institutes, for the purpose of technology innovation capacity building. Secondly, reform the modality of S&T programs to enable enterprises to undertake national R&D missions. National S&T programs shall reflect more of the major industrial needs for science and technology, and attract more enterprises to be part of such programs. In the fields of obvious market application prospects, establish an enterprise-led mechanism with the involvement of universities and research institutes.

Thirdly, perfect the technology transfer mechanism to facilitate the integration and application of industrial technologies. Establish and perfect intellectual property rights related incentive mechanism, and an IPR trading system. Vigorously develop various kinds of S&T intermediary service organizations to meet the needs of enterprises, facilitating knowledge flow and technology transfer between enterprises, and between enterprises and universities and research institutes. National key laboratories and engineering (technology research) centers shall be made more accessible to enterprises. Fourthly, accelerate the establishment of a modern enterprise system so as to enhance the innate drive for enterprise technology innovation. Technology innovation capacity building shall be taken as important indicator in measuring the performance of state-owned enterprises while technology factor-based distribution be made an important part of property rights reform destined for the high- tech industry. Stick to the direction in which application-oriented R&D institutes are transformed into enterprises and deepen the reform of property rights at such institutes. This will not only lead to an improved management system and the establishment of a rational and effective incentive mechanism, but will also enable the transformed R&D institutes to play a major role in high technology industrialization and sectoral technology innovation. Fifthly, create a fine innovation environment to spur innovative activities at small- and medium-sized enterprises(SMEs). As SMEs, particularly technology-based SMEs, are highly innovative but frail in risk-taking ventures, a more favorable policy environment should be created for such enterprises by drafting and formulating preferential laws and policies, particularly in the context of market accessibility and anti-unfair competition. Vigorously develop an S&T investment and financing system and a venture capital mechanism and quicken the construction of S&T intermediary service bodies, so as serve the needs for technology innovation at SMEs.

3. Deepening Institutional Reform and establishing a Modern Research Institute System

Research institutes engaged in basic research, frontier technology development, and public good research constitute a major force in the nation’s S&T innovation activities. Establish a stable, high caliber research contingent that serves national objectives and is devoted to S&T undertakings is crucial for the future and destiny the nation’s S&T enterprise. Thanks to efforts in restructuring and personnel diversion, a number of high quality research institutions have merged, to which stable support from the government is critical. While giving ample scope to the important roles played by these research institutes, innovation capacity building must be taken as an objective, mechanism improvement a focal point, management system reform deepened, so as to accelerate the establishment of a modern research institute system under the principle of “clearly defined terms of reference, scientific evaluation, orderly open access, and regulated management”.

Firstly, strengthen the capacity building of research institutes in keeping with

the terms of reference defined by the state. Earnest efforts must be made to address the problem where some research institutes suffer from undefined terms of reference, uncoordinated research efforts, and weak innovative capability. The allocation of resources should be optimized in order to make concerted efforts in creating disciplines and research bases with clear superiority. Public good research institutes shall take advantage of technical strength in their respective fields, raising S&T innovation and service capability, and addressing major S&T issues in the social development. Basic science and frontier technology-oriented research institutes shall take advantage of their disciplinary strength in uplifting research levels, striving for theoretical innovation and technology breakthroughs, and addressing major S&T issues. Secondly, establishing a stable S&T investment mechanism designed to support innovation activities at research institutes. Given the fact that disciplinary capacity building and major innovation achievements are the results of tireless efforts over a long period of time, state treasury should provide fairly stable appropriation support to research institutes engaged in basic research, frontier technology development, and public good research. Per capita overhead expenditure level will be raised in line with different types of research institutes in support of disciplinary capacity building, basic research activities, and cultivation of talented S&T personnel. Thirdly, establish an operational mechanism conducive to original innovation at research institutes. Freely selected research topics are extremely crucial for raising the original innovation capability and for nurturing high caliber personnel. The support for free research topic selection based research should therefore be strengthened. While perfecting the system under which the director assumes all power and responsibility at research institutes, delegate more autonomous decision-making power to research institutes in S&T expenditure and personnel affairs so as to ensure greater capability in coordinating and integrating innovation activities at the institute level. Fourthly, work will be carried out to establish a system to assess the overall innovation capability of research institutes. Accordingly, a scientific and rational system will be established to make an overall assessment of institutional innovation capability in terms of the quality of S&T achievements, the buildup of S&T talents, and management/operation mechanisms, in order to raise the management level and enhance innovation capability. Fifthly, efforts will be made to put in place an effective mechanism for opening up and collaboration. Establish a personnel management system featuring the combination of permanent staff and temporary or contract personnel by introducing a retainer and vacancy management mechanism for full-fledged open recruitment of research and management personnel. For the purpose of promoting knowledge flow, personnel mobility, and S&T resource sharing, effective mechanisms should be put in place to facilitate various forms of collaboration between research institutes, enterprises, and universities.

Universities are not only an important base for nurturing high caliber innovative talents but also a principal player in basic research and original technology innovation activities and a commendable force in addressing major S&T issues in the national economy, materializing technology transfer, and effecting technology spin-off and

commercialization. Accelerating the establishment of high caliber universities, particularly world-class research universities, is a prerequisite for enhancing the nation's S&T innovation and establishing a national innovation system. At present, our country has already built a number of high-caliber universities with appropriate scales, comprehensive disciplines, and assembled talents, and these universities should be given full scope for their important roles in S&T innovation**.**

Vigorous support and encouragement need to be provided for university-based original innovation in basic research, frontier technology development, and public good research. Universities should be encouraged to enter full-fledged cooperation with enterprises and research institutes so that they can provide better and more extensive services to economic development at the national, regional, and sectoral levels. The capacity building of major academic disciplines and S&T innovation platforms at universities will be accelerated in order to nurture and assemble a number of world-class academic leaders and build up a faculty contingent with high ethical standards, strong innovative spirit, and international competitiveness. Further accelerate the reform of university internal management system by optimizing education structure, S&T related organizational structure, and innovation mechanism and associated management system. Establish a scientific, rational evaluation system and an operational mechanism conducive to the nurturing of high quality talents and the improvement of innovative capability, so that every talent finds ample scope for his abilities and a constant stream of talents is sustained. Vigorous efforts should be made to explore ways and means of building a modern university system with Chinese characteristics.

3. Advancing the S&T Management System Reform

In view of the protuberant problems in our country's S&T management at the macro level, the reform of the S&T management system must be advanced, and be centered on improving the national S&T decision-making mechanism, overcoming systemic and institutional barriers, strengthening inter-ministerial, inter-province, ministry/province, defense/civilian overall planning and coordination, so that our ability can be substantially enhanced in mustering S&T resources for initiating major S&T undertakings.

Firstly, a national S&T decision-making mechanism should be created and then constantly improved. The business discussions procedures for the nation's major S&T decision-making should be improved so that a normative consultation and decision-making mechanism is in place. Efforts should be made to expand government roles in overall configuration and macro management of S&T development, strengthen coordination in formulating major S&T policies, implementing major S&T programs, and in constructing S&T infrastructures. Secondly, establish and improve a macro S&T coordination mechanism at the national level. Define the basic status of S&T policies as a national public policy and develop

an interactive policy coordination system between national S&T policies and national economic policies, in response to the objectives of promoting S&T innovation and indigenous innovation capability. Create a mechanism to coordinate inter-agency allocation of S&T resources. Accelerate government mandate shift at the government agencies in charge of S&T management, practice governance according to the law, and upgrade the macro management and service level. Ways by which programs are managed must be improved to bring into full play the role of government agencies and local authorities in program management and project implementation. Thirdly, the S&T review and evaluation system must be reformed to reflect principle of fairness, impartiality, openness, and encouraging competition, thereby creating conditions for the springing up of various types of talented people, especially the young. The review of major projects must be brought in line with national objectives. The peer review system should be improved by creating a reviewer credibility system and a review mechanism involving international peers, by strengthening the supervision of the review process, and by expanding the openness of review activities and ensuring reviewees' access to appropriate information. Special attention and support shall be given to highly innovative small projects, uncommon projects, and interdisciplinary projects, with emphasis on the evaluation of quality, capability, and research level of individuals or teams, and on whether it is encouraging original innovation. Establish an independent review system to evaluate the implementation of major national S&T programs, the Knowledge Innovation Program(KIP), and projects funded by the National Natural Science Foundation. Fourthly, reform the S&T achievements evaluation and award system. Perfect the research assessment and indicator systems in light of different characteristics of S&T innovation activities and in accordance with the principle of openness, fairness, rule abiding, and streamlined procedures. Avert excessive evaluation or desires for quick success and short-term behavior. For innovation activities involving market-oriented applied research and experiments, evaluation shall be conducted mainly on the obtaining of proprietary intellectual property rights and the contribution to industrial competitiveness. Public good research activities shall be evaluated in line with public needs and social benefits derived, while basic research and frontier scientific exploration shall be evaluated in line with scientific significance and academic value. Establish a personnel assessment system capable of judging personnel qualifications in different S&T fields. Reform the national S&T award system by reducing the number and levels of awards. Give prominence to government conferred awards by focusing on talented individuals while rewarding prize-winning projects. In addition, the creation of non-governmental awards should be encouraged and regulated.

4. Vigorously Pushing Forward the Construction of a National Innovation System with Chinese Characteristics

The objective for deepening S&T system reform is to advance and enhance the construction of a national innovation system. The national innovation system is a government-led public system which gives full play to the basic role of the market in

resource allocation while letting various innovation players forge close links and interact with one another. Currently, the construction of the national innovation system with Chinese characteristics shall emphasize the following:

Firstly, build an enterprise-led technology innovation system featuring the combination of enterprises, universities, and research institutes, which will be a breakthrough point for the full-fledged construction of the national innovation. Only when such a system is led by enterprises, it can ensure the market orientation of technology innovation and effectively combine industry-university-research strengths for the enhancement of national competitiveness. Only when enterprises, universities, and research institutes work together, can S&T resources be efficiently allocated, the vitality of research institutes be activated, and enterprises acquire capabilities in sustaining innovation. While drastically improving enterprises' technology innovation capability, it is imperative to establish new mechanism allowing research institutes and universities to provide services tailored to the needs of enterprises' technology innovation activities. Secondly, with creating an open, mobile, competitive, and collaborative operational mechanism at the core, efforts should be made to promote the collaboration and resource sharing between research institutes and with universities. Strengthen the construction of public good scientific research system. Develop research universities and a number of top-notch, resource sharing basic science and frontier technology bases. Thirdly, establish a national defense S&T innovation system highlighting the combination of both the defense and civilian needs as well as a civilianized defense industry by making defense S&T part of the civilian operations. Promote the close combination of civilian and defense S&T findings in a range of areas, including macro management, development strategies and planning, R&D activities, and commercial applications of S&T findings. Strengthen the development of dual-use technologies, creating an environment where high caliber civilian S&T personnel provide services to defense S&T innovation, while defense related S&T achievements find quick conversion to civilian applications. Fourthly, establish regional innovation systems with diverse characteristics and strengths. Regional innovation system planning and associated innovation capacity building shall be made in a unified and coordinated manner, taking into account the characteristics and strengths of the regional economic and social development. Deepen the reform of the local S&T system, with a view to mustering S&T forces at the central and local levels. Take full advantage of the important roles played by universities, research institutes, and national high-tech industrial parks in establishing regional innovation systems in order to enhance S&T innovation support for the local economic and social development. Reinforce S&T capacity building in the country's central and western regions while earnestly strengthening the construction of grassroots S&T systems at the county (city) level. Fifthly, establish a socialized, networked S&T intermediary service system. In view of the fact that the S&T intermediary service sector is small in size, unitary in function, and weak in providing services, efforts should be made to vigorously nurture and develop S&T intermediary service organizations in diverse forms while taking full advantage of the important

roles played by universities, research institutes, and social organizations and groups in providing S&T intermediary services. S&T intermediate service organizations should be guided in the direction of professionalism, scale, and standardization.

VIII. Major Policies and Measures

To ensure the implementation of the missions defined in the Outline, efforts should be made formulate more effective policies and measures, in addition to addressing system and mechanism related issues. All policies and measures shall be made as such that they are conducive to enhancing indigenous innovation capability, spurring the enthusiasm and creativity of S&T personnel, making full use of S&T resources both at home and abroad, supporting economic and social development through science and technology. The S&T policies and measures listed in the Outline are designed to address major discrepancies and protuberant problems we are facing today, but will be adjusted and perfected in line with changing situations and progress in the implementation of the Outline.

1. Financial and Taxation Policies Encouraging Technological Innovation at the Enterprise Level

Encourage enterprises to increase R&D spending and strengthen technology innovation capability. Accelerate the imposition of a consumption based value added tax, and make the industrial payment to equipment procurement favored with a deductible value added tax. On the basis of further implementing a range of taxation holiday policies aimed at spurring technology innovation and accelerating S&T findings spin-off and equipment upgrading, encourage and support enterprises to develop new products, new techniques, and new technologies, by raising the level of incentive policies, including pre-tax deduction of enterprise R&D expenditure, in an effort to provide taxation holidays for the development of high tech businesses**.** Along with the reform of corporate income tax and corporate financial system, encourage enterprises to establish special funds earmarked for R&D activities. Enterprises shall be allowed to accelerate the depreciation of the instruments and equipment used in R&D activities. Enact taxation holiday policies for procuring advanced scientific instruments and equipment. Enhance foreign exchanges and fund raising support for enterprises establishing R&D facilities overseas, and provide convenience and quality service for Chinese enterprises' investment overseas.

Implement the PRC Law on Promoting Small- and Medium-Sized Enterprises, and support the establishment of various types of SMEs, in order to take full advantage of their vitality in technology innovation. Encourage and support SEM initiated collaborative R&D efforts in the form of joint venture or consignment by providing policy support for the commercialization of innovation achievements.

2. Strengthening assimilation and absorption of imported technologies, and re-innovation

Adjust and improve national policies on industrial technology so as to reinforce the assimilation and absorption of imported technologies and re-innovation. Policies should be developed to encourage indigenous innovation and restrict blind and duplicative technology importation.

Readjust the structure and priorities of government appropriations and establish special funds that can be used to support assimilation and absorption of imported technologies and re-innovation, and support the development of major technologies and equipment and critical common industrial technologies. Proactive policies and measures should be formulated increase investments through multiple channels in support of enterprise-centered efforts in the assimilation and absorption of imported technologies and re-innovation, in collaboration with universities and research institutes.

Major national construction projects should be taken as major carriers of uplifting indigenous innovation capability. Through the implementation of major national construction projects, assimilate and absorb a series of advanced technologies, master a number of critical technologies concerning the nation's strategic interests, and develop a range of major equipment and key products that possess proprietary intellectual property rights.

3. Government Procurement Favoring Indigenous Innovation

Formulate implementing regulations of the "PRC Government Procurement Law" to encourage and protect indigenous innovation. Establish a coordination mechanism for government procurement of indigenous innovative products. Government practices a first-buy policy for major domestically made high-tech equipment and products that possess proprietary intellectual property rights. Provide policy support to enterprises in procuring domestic high-tech equipment. Develop relevant technology standards through government procurement.

4. Intellectual Property Rights Strategy and Technology Standards Strategy

Protecting intellectual property rights and safeguarding the interests of IPR owners is not only necessary for perfecting the nation's market economy system and promoting indigenous innovation, but also important for establishing the nation's credibility and image in international cooperation. It is important to further perfect the nation's IPR system, and create an agreeable legal environment that respects and protects IPR, increase public awareness of IPR, uplift the nation's IPR management level, enhance IPR protection, and crack down on various IPR piracy activities according to law. In the meantime, it is necessary to establish a special IPR

examination process for major economic activities, including mergers and acquisitions and technology trade, in order to **avoid** the loss of proprietary IPR. Prevent the abuse of IPR intended to unfairly restrict market competition or obstruct the diffusion and application of innovation and S&T achievements. Make IPR management part of the entire S&T management process to raise the nation's S&T innovation level. Reinforce S&T personnel's IPR awareness while enabling enterprises, research institutes, and universities to attach more importance to and strengthen IPR protection. Give ample scope to the important role of industrial associations in IPR protection. Establish and perfect a professional employment qualification system and public credit system that are conducive to IPR protection.

In line with the nation's strategic demands and industrial development needs, cultivate a number of inventions and creations of major importance to economic, social, and S&T development in order to produce indigenous IPR. Organize enterprise-led collaborative efforts involving universities and research institutes in overcoming technological snags while providing support for patent application, standard formulation, and international trade.

The development of technology standards should be made an important objective of national S&T programs. Government agencies concerned and industrial associations shall strengthen guidance and coordination for the development of major technology standards, which are to be adopted as a priority. Promote the system construction for technology laws and regulations and technology standards, and the integration of the development standards with scientific research, development, design, and manufacturing, in order to ensure the advanced nature and validity of standards. Encourage industry-academia-research collaboration in studying and developing major national technology standards, and associated priority adoption. Take an active part in international efforts for standards development, and strive to make our country's technology standards international standards. Strengthen the development of system construction for technology trade measures.

5. Financial Policies Encouraging Innovation and Pioneering

Establish and perfect venture capital investment mechanism for innovation and pioneering activities, and prepare and formulate laws, regulations and policies to promote the healthy development of venture capital investment destined for pioneering activities. Advance the development of the second board stock exchange, and establish a multi-level capital market system that accelerates commercial applications of S&T achievements. Encourage qualified high-tech enterprises to be listed on the main and second board stock exchange while creating agreeable conditions for small and medium-sized high-tech enterprises to be listed abroad. Create more relaxed banking and foreign exchange policy environment for high-tech venture capital firms. Carry out experiment on circulating unlisted high-tech corporate real options at national high tech industrial parks and gradually establish a technology

property rights trade market. Explore to establish a fund raising modality guided by state treasury appropriations, and mainstreamed by the investment from policy oriented banks and commercial banks, in an attempt to attract more capital into venture capital investment market. Establish a nationwide self-regulating organization for S&T venture capital investments while encouraging banking institutions to provide favorable loans to major national S&T industrialization projects, and S&T commercialization activities. Create intellectual property credit and other credit assurance systems, in order to encourage technology innovation at small and medium-sized enterprises, and create a healthy fund raising environment for them. Establish science and technology related financial cooperation platforms in diverse forms. Government shall encourage banking institutions and private capital become part of S&T development and to improve and strengthen their services for high-tech enterprises, especially for small and medium-sized S&T businesses. Encourage insurance companies to enhance products and service innovation so as provide an overall risk guarantee for S&T innovation activities.

6. Accelerating the Industrialization of High Technologies and the Diffusion of Advanced Appropriate Technologies

High-tech industrialization shall be deemed as a priority in economic restructuring and changing economic growth modalities. Vigorously develop the high-tech industries that can lead to breakthroughs in driving economic growth.

Optimize the environment for high-tech industrialization. Efforts should be continued to strengthen the capacity building of high-tech industrialization bases, including national high-tech industrial parks, by formulating policies conducive not only to the development of national high-tech industrial parks but also to helping spur the development of adjacent areas. Establish information platforms for technology exchange and trade information, and provide policy support for technical development and associated service provided by S&T intermediary services, including university S&T parks, S&T business incubators, productivity promotion centers, and technology transfer centers.

Enhance the support for the diffusion of agricultural technology in order to establish new mechanisms for diffusing advanced appropriate technologies to rural areas. The dissemination of agricultural S&T achievements should be made an important factor for qualifying for an S&T award, while efforts will be made to create a qualification attestation system for agricultural technology diffusion personnel, and encouraging S&T personnel to be part of front line diffusion efforts in different forms. Establish special funds for agriculture S&T achievements related spin-off and diffusion, promoting the diffusion of advanced appropriate technologies in rural areas, and supporting technology innovation, invention and creation made by rural residents. The state shall provide a classified guidance and support for the diffusion of agricultural S&T findings, encouraging and supporting the development of diffusion

organizations in different forms, and created diversified diffusion systems.

Support industrial sector-oriented applications of critical enabling technologies . Effective policies and measures will be worked out to support the development, diffusion, and application of pre-competitive industrial technologies, particularly the diffusion and application of key technologies in the fields of electronics and information, biology, information technology-based manufacturing, advanced materials, environmental protection, and energy efficiency. Promote the transformation and upgrading of traditional industries, and strengthen the capacity building of technology engineering platforms, industrialization demonstration bases, and intermediate pilot bases.

7. Perfecting the Mechanism for Combining Defense and Civilian Sectors, and Making Defense Part of the Civilian Sector

Strengthen the overall planning and coordination in integrating the defense and civilian sectors. The S&T management system that separates the defense from the civilian must be reformed to allow for the creation of a new S&T management system embracing both the defense and civic sectors. Encourage defense-related research institutes to work on civilian research topics, while defense-related R&D activities be made open to civilian research institutes and industries. Expand the scope of defense procurement from civilian research institutes and industries. Reform the management system to ensure fair competition between non-defense and defense research institutes for defense-related research and production contracts while establishing public platforms for the integration of the defense and civilian sectors, and for dual-use applications.

Establish a new mechanism adapting to the characteristics of both defense and civic scientific research activities. Coordinate the deployment of basic research in defense and civilian sectors, and strengthen the integration of research and development efforts in both sectors. Establish an interactive mechanism between the defense and civic sectors, coordinating the development and production of defense and civilian products, and fostering an organic combination of S&T efforts in both sectors.

8. Expanding International and Regional S&T Cooperation and Exchanges

The improvement of the nation’s indigenous innovative capability calls for taking full advantage of the merits derived from opening to the outside world, and a significantly higher level of international and regional S&T cooperation and exchanges in various forms.

Encouraging research institutes and universities to establish joint laboratories or R&D centers with overseas research institutes; support the implementation of

international cooperation projects under bilateral or multilateral S&T cooperation frameworks; and establish a collaborating S&T mechanism between the mainland and Hong Kong, Macao and Taiwan, to strengthen communications and exchanges.

Support our country's enterprises in their "going out" efforts. Expand the export of high technologies and products, encouraging and helping them to establish R&D centers or industrialization bases overseas.

Participate actively in large international scientific projects and international academic organizations. Supporting our scientists and research institutes to be part of or take the lead in large international and regional scientific projects. A training system should be established in order to increase the ability of our scientists to engage in international academic exchanges and to take up senior positions at major international academic organizations. Encourage multinational corporations to establish their R&D centers in our country while offering favorable conditions for making our country the physical location of international academic organizations or their regional offices.

9. Improving Scientific and Cultural Literacy of the Entire Nation and Building a Social Environment Conducive to S&T innovation

Implement a nationwide scientific literacy action plan. Improve the scientific and cultural literacy of the entire nation with a view to advancing people's overall development. Advocate scientific spirit, spread scientific thinking and practices, and diffuse scientific knowledge. Strengthen popular science activities in rural areas, gradually establishing a training system that helps raise farmers' farming technologies and vocational skills. Organize systematic scientific exploration and experiencing activities in different forms both on and off campus. Strengthen innovation oriented education, and raising teenagers' innovation awareness and capability. Strengthen science and technology related training for public servants at different levels.

Strengthen the national capacity building in the field of popular science by rationally distributing and building popular science facilities and improving the quality of existing popular science sites. Establish a system making research institutes and universities accessible to the public on a regular basis, while strengthening communications and exchanges with the public through the implementation of S&T programs and projects. In order to bring about a flourishing development in popular science writings and creating popular science brand names, encourage renowned scientists and other experts and scholars to become involved in popular science writings, developing major popular science topics, and fostering original popular science writings. Establish S&T communications as a major at universities, in order to strengthen basic theoretical studies concerning popular science and train popular science professionals.

Establish a sound operational mechanism for popular science activities. Strengthen concerted efforts of government agencies, private groups, and large enterprises, facilitating interaction and collaboration between the S&T and education communities and the mass media. Encourage the development of business oriented popular science activities by relaxing restrictions to allow private and overseas capital to access popular science activities and by formulating preferential policies for establishing diversified investment mechanisms. Advance the reform of public good popular science system in order to activate vitality, increase service conscientiousness, and enhance sustainable development capability.

IX. S&T Input and S&T Infrastructure Platforms

S&T input and basic facilities platforms constitute a material basis for S&T innovation, and an important prerequisite and a fundamental guarantee for sustainable S&T development. Today's S&T input is literally an investment in the future national competitiveness. Since the adoption of reform and opening up policy, the nation has seen continued increases in S&T input. However, to meet the major demand in greater S&T development and in the full-fledged construction a well-to-do society, and compared with the developed and emerging industrialized nations, the nation's total and intensity of S&T input remains insufficient, with irrational aspects in the investment structure, and a weak S&T infrastructure. Given the fact that both developed and emerging industrialized nations around the world have made the increase of S&T input a strategic measure to raise their national competitiveness, our country should respond to the trend and need for enhancing the nation's indigenous innovation and core competitiveness by drastically increasing its input in S&T activities and strengthening the construction basic S&T facilities, so as to ensure the fulfillment of the missions defined in the Outline.

1. Establishing a Diversified, Multi-channel S&T Input System

Taking full advantage of the guiding role played by the government in enhancing S&T input, efforts are to be made to enhance government capability in mobilizing nationwide S&T resources through diverse financial means such as direct appropriations and referential taxation breaks. State treasury appropriations will be mainly used to support public S&T activities that cannot be effectively covered by the current market system, including basic research, frontier technology development, public good research, and development of major key enabling technologies, in addition to its role in guiding industry and private sectors to enhance their S&T input. Government agencies at both central and local levels shall increase the proportion of S&T input in both annual budgeting and distribution of extra budgets, according to the PRC Law on S&T Progress, in an attempt to ensure an S&T expenditure growth noticeably higher than that of regular financial revenues, and in an effort to gradually raise the weight of state treasury S&T appropriations in GDP. Coordinate expenditure

needs for implementing planned S&T activities in line with the national strength, to ensure the smooth implementation of major special projects. The central government will continue to increase its investment in the construction of major S&T infrastructure, with a weighted appropriation support for construction activities at both central and local levels. While increasing government appropriated S&T input, efforts should be made to strengthen the principal position of enterprises in S&T input. In a word, these concerted efforts of all sectors are expected to bring about an increased R&D expenditure year by year, which will reach 2% by 2010 and 2.5% or above by 2020 as a percentage of GDP.

2. Readjusting and Optimizing Input Structures, and Raising the Cost-effectiveness of S&T Expenditures

Support will be strengthened for basic research, frontier technology development, public good research, S&T infrastructure, and popular science activities. Make appropriate funds available for regular expenditures needed by research institutes (bases), research projects, and S&T infrastructure construction. Steadily enhancing the investment in basic research and public good oriented research institutes, making popular science expenditures part of the financial budgeting at an equivalent level, and gradually raising the input in popular science activities. Establish and perfect an S&T expenditure management system, in line with the rules of scientific research and characteristics of S&T activities. Regulate the use of S&T appropriations in accordance with relevant state regulations on budgeting, and improve the safety and effectiveness of appropriations. Increase the openness, transparency, and fairness of national S&T program management, gradually establishing an S&T expenditure assessment system, and corresponding evaluation and supervision mechanism.

3. Strengthening the Construction of S&T Infrastructure Platforms

S&T infrastructures platforms are an enabling system consisting of research and experiment bases, large scientific facilities, instrumentation, and equipment, scientific data and information, and natural S&T resources, supported by information and network technologies and shared by the public in their innovation activities. The construction of S&T infrastructure platforms will focus on the following:

National research and experiment bases. Establish, in line with the nation’s major strategic needs, a number of national laboratories and scientific research and experiment bases, featuring a strong interdisciplinary research team and advanced level, in emerging fields or in the fields where China has a specialty or strength. Strengthen the capacity building of national key labs, and consistently raise its operation and management capability. Establish a national network for field scientific observation and research activities.

Large scientific projects and facilities. Pay more attention to the role played by scientific instruments and equipment in scientific research, and strengthen the proprietary research and development of scientific instruments and equipment and associated test techniques. Establish a number of large scientific projects and infrastructures, including high performance computers, large aerodynamic research and experiment, and scientific experiments under extreme conditions. Advance sharing and construction of large scientific instruments, equipment , and facilities, gradually forming up a nationwide sharing network.

Scientific data and information platforms. Establish digital platforms ridden with S&T conditions and resources related information, by taking full advantage of modern information technology and means, facilitating sharing of scientific data and literatures, building an online scientific research environment, providing relevant services to the whole society, and promoting the reform of means and approaches used in scientific research.

Natural S&T resources service platforms. Establish a complete conservation system for plant and animal germplasm, microbes and bacteria species resources, and human genetic resources, and create a protection and utilization system for natural S&T resources, including experimental materials, specimens, and mineral fossils.

National technical system for standards, metrology, and test. Develop and formulate high accuracy and high-stability metrological bench standards and standard specimen system. Establish technology standards for major fields, and improve test lab systems, attestation and certification systems, and associated technical measures for technology trade.

4. Establishing a Mechanism for Sharing S&T infrastructure Platforms

The establishment of an effective sharing system and mechanism constitute a key link and prerequisite for the development of S&T infrastructure platforms. Under the principle of “consolidating, sharing, perfecting, and upgrading”, and taking into account successful foreign experience, formulate standards and regulations involving different S&T resources, and establish a policy and law system promoting S&T resources sharing. Encourag flexible sharing modalities in line with different S&T resources and conditions, and break up the existing divided, closed, and redundant pattern.

X. Talented Workforce Buildup

S&T innovation is rooted in S&T personnel. Human resource has become a most important strategic resource. It is important to advocate the strategy of national

capacity building with talented people, strengthening the capacity building of S&T personnel, and providing human resource support for the implementation of the Outline.

1. Accelerating the Nurturing of a Contingent of world caliber experts

Reinforce the nurturing of disciplinary leaders and advancing the buildup of innovative teams, through major scientific research and construction projects, at major disciplines and research bases, and through international academic exchanges and cooperation projects. Pay close attention to discovering and nurturing strategic scientists and S&T management personnel. Formulate special policies to attract high caliber experts in the core areas. Further break up the old practice that ranks a person according to seniority, overcoming the desire for quick results. Lose no time in nurturing young and middle-aged high caliber experts. Improve and perfect a range of high caliber personnel systems, including the job title system, academician system, special government allowance system, and postdoctoral system. Establish a high caliber expert screening system, in an effort to let more talented people come out.

2. Bring into Full Play the Important Role of Education in Cultivating Innovative Talents

Strengthen the organic combination of S&T innovation and personnel nurturing, encouraging research institutes to nurture research oriented personnel, in collaboration with universities. Encourage undergraduates to take part in research activities, in order to cultivate their exploration enthusiasm and scientific spirit in innovation activities. Universities shall make a rational distribution of interdisciplines and emerging disciplines, and restructure subject composition accordingly, in line with the nation's S&T development strategies and market demand for innovation personnel. Strengthen vocational education, continuing education and training, and paying more attention to the training of technicians for diverse technical applications, in response to the needs of the economic and social development. Deepen the reform of the curriculum design of primary and middle schools, promoting quality-centered education, and raising studnets' scientific and cultural literacy.

3. Supporting Enterprises' Efforts in Nurturing and Attracting S&T Talents

The state encourages enterprises to recruit and nurture high caliber S&T personnel, with corresponding policy support. Encourage and guide S&T personnel at research institutes and universities to work on innovation or create their own S&T businesses. S&T personnel at research institutes and universities are allowed to take extra jobs for technology development at enterprises. Encourage university graduates to work for firms. Encourage enterprises to nurture technology talents, in collaboration with universities and research institutes. High caliber engineering talents can be nurtured through multiple channels and diverse modalities. State-owned

high-tech businesses are allowed to introduce a range of incentive policies, including real options in honor of high caliber technicians and management personnel. Explore ways to establish a distribution system made up of diverse elements, including knowledge, technology, and management. Support industry to attract and recruit foreign scientists and engineers.

4. Intensifying Efforts in Attracting High Caliber Talents From Overseas

Formulate and implement programs to attract returned service of high caliber overseas Chinese students, with priorities on attracting high caliber personnel and expertise in shortage. Establish talents attracting centers tailored to the characteristics of overseas Chinese students, through diverse approaches. Enhance the financing of the return of high caliber personnel. Strengthen the construction of pioneering centers for overseas Chinese students. Perfect the policies and measures in favor of returned service of overseas Chinese students. Create more open recruitment opportunities for high caliber innovation talents. Gradually open up the recruitment of senior post vacancy before overseas candidates, including lab directors, academic leaders of major research institutes. Adopt attractive policies and measures to attract high caliber overseas S&T personnel or teams to work in China.

5. Creating a Culture Environment Conducive to the Nurturing of Innovative Talents

Advocate the patriotism featuring hardworking and dedication, and a teamwork spirit of pragmatism, innovation, collaboration and indifference to fame and wealth. Encourage rational skepticism and criticism, respecting individuality, tolerating failures, encouraging academic freedom and democracy, supporting exploration and standing out among peers, and respecting new theories and concepts. Stimulate innovative thinking, activate academic atmosphere, and strive to create a tolerant, harmonious, healthy, and upbeat innovation culture. Strengthen the ethics building in research activities while curbing flippancy and unethical practices in scientific research activities.

The implementation of the outline of the National medium and long term S&T development plan calls for a strengthened leadership and coordination as it has a broad coverage, long time span, and demanding requirements. Effective measures shall be adopted to ensure the implementation of the missions defined in the Outline. 1) Strengthening the interface between the Outline and the national economic and social development plan for the 11th five-year period. The Outline shall be implemented, according to the priority list, abreast with the implementation of the national economic and social development plan for the 11th five-year period, in an attempt to increase the feasible implementation of the Outline. The implementation will cover a sequence of efforts, including priority topics, major special projects, cutting-edge technology, basic research, construction of infrastructure platform, and

S&T system reform, from which priorities will be selected to start immediately, or to be dealt with within the 11th five-year period. Working out matching arrangements and deployment in the national economic and social development plan for the 11th five-year period. 2) Formulating practical and feasible supporting policies. Development objectives, major missions, and policies and measures defined in the Outline are direction pointing and guiding in nature, and need practical and feasible supporting policies to go along with. These policies will cover: supporting industry to be the mainstream of technology innovation, promoting digestion, absorption, and re-innovation of imported technologies, government procurement tilting to proprietary innovations, increasing S&T input, S&T fund efficiency, deepening the reform of S&T system, establishment of national innovation system, accelerating high tech industrialization, capacity building for S&T personnel, and promoting the combination of defense and civic sectors and making defense part of the civic applications. The above-mentioned policies shall be prepared and enacted in such a manner that authorities concerned will take a lead, with the participation of involving government agencies. The policies shall be prepared based on a thorough survey and investigation, in an attempt to make them closely associated and coordinated with other policies concerning industry, banking, finance, taxation, and economy. The policies shall be made and implemented in a prompt manner. 3) Establishing a dynamic readjustment mechanism for implementing the Outline. It is important to establish a dynamic readjustment mechanism for implementing the Outline, based on economic and social analysis, technology prediction, and regular evaluation, in an attempt to keep abreast with the fast S&T development in the world, and changes brought up by the domestic economic and social development. It is also meaningful to make a timely and necessary readjustment of the development objectives and major missions defined in the Outline, in line with new trends and breakthroughs of S&T development both at home and abroad, and with the new demands rising from China's economic and social development. Some of the missions will possibly be strengthened and enhanced, while some others readjusted. 4) Strengthening the organizing and supervision of the implementation. It is necessary to take full advantage of the initiatives of localities, government agencies, and private groups to organize the implementation, under a unified leadership of the Central Committee of the Chinese Communist Party and the State Council. Government agencies, in particular, national authorities in charge of S&T management, development and reform, and finance, shall live up to their respective responsibility through a close coordination, and strengthen concrete guidance. Provinces, municipalities, and autonomous regions shall implement the Outline in line with local development status.

The implementation of the Outline is associated with the full-fledged construction of a well-to-do society, the success of socialist modernization drive, and the great renaissance of the Chinese nation. Under the leadership of the Party Central Committee headed by Secretary General Hu Jingtao, and with the guidance of Deng Xiaoping Theory and the important doctrine of "Three Representations", the

nation will go all out to materialize the grand blueprint of science and technology development, and build an innovation-oriented nation with steadfast confidence and determination.