Part 3
Measures Adopted for Promotion of Science and Technology

Part 3 discusses the measures adopted in FY2005 for the promotion of science and technology, in line with the Second Science and Technology Basic Plan.

3.1 Development of Science and Technology Policies

The Science and Technology Basic Law was promulgated and put into effect on November 15, 1995. Based on a recognition of the important role that science and technology should play in the development of Japan's economy and society, in the improvement of the welfare of the nation, and in the sustainable development of human society, the objective of this law is to achieve higher standards of science and technology through the promotion of such measures as the implementation of the Science and Technology Basic Plan, etc., for the comprehensive and systematic promotion of science and technology.

Article 9 of the Law stipulates that the government must draw up a basic plan for science and technology, for the purpose of the comprehensive and systematic promotion of measures for the promotion of science and technology.

3.1.1 The Science and Technology Basic Plan

The Second Science and Technology Basic Plan, approved at a Cabinet meeting in March 2001, was formulated and carried out during the period of prolonged economic stagnation in Japan following the collapse of the bubble economy. Even amid the deteriorating financial conditions, however, government research and development investment increased, and a broad range of structural reforms were carried out including: strategic priority setting in science and technology through promotion of basic research and prioritization of research and development activities covering topics of interest to the government and society; development of a competitive research and development environment by increasing competitive funds and reforming existing systems; and reorganization of national research institutes and national universities into corporations. At the meeting of the Council for Science and Technology Policy (CSTP) on December 27, 2004, the Prime Minister submitted an inquiry regarding basic policies on science and technology in order to formulate a science and technology basic plan for the five years beginning Fiscal 2006. Following examinations and discussions lasting a year, the CSTP issued a recommendation on Inquiry No. 5 "Japan's Science and Technology Basic Policy Report" at the council meeting held on December 27, 2005. Based on that recommendation, the Cabinet officially launched the Third Science and Technology Basic Plan (hereinafter referred to as the "Basic Plan") on March 28, 2006 after consultations by the CSTP (see section 1.3.1).

The Basic Plan primarily focuses on "S&T to be supported by the public and to benefit society" and "emphasis on fostering human resources and competitive research environments," and basically complies with three concepts laid down in the Second Basic Plan: "a nation contributing to the world by creation and utilization of scientific knowledge;" "a nation with international competitiveness and ability for sustainable development;" and "a nation securing safety and quality of life." Based on the concepts, the Basic Plan provides six more detailed policy goals: ① Quantum jump in knowledge, discovery, and creation; ② Breakthroughs in advanced S&T; ③ Economic growth & environmental protection; ④ Innovator Japan; ⑤ Nation's good health over lifetime; and ⑥ The world's safest country. In order to achieve the goals, the Basic Plan emphasizes high-quality basic research, and, with respect to research and development on topics of interest to the government and society, proposes that funds are preferentially allocated to four areas including life sciences, information and telecommunications, environmental sciences, and nanotechnology/materials. In addition, the Basic Plan aims at inter-sectoral prioritization, by providing promotion strategies for each of the eight areas and selecting the "strategically focused science and technology" that requires intensive investment during the period of the plan. It also states that the mission of science and technology for the next five years is to resolve a broad range of policy issues such as development of a large amount of human resources who can produce excellent research findings, creation of a competitive environment, strategic investment to promote science and create innovation on a constant basis, and removal of systematic or operational obstacles to returning the results

to society. The fiscal situation in Japan is the worst among major developed countries, and the promotion of financial structural reforms focusing on both revenues and expenditures is indispensable in creating a proactive society and dynamic economy and achieving sustainable growth. From the viewpoint of making ongoing efforts to promote science and technology following the Second Basic Plan, the Basic Plan states the target to raise the ratio of government research and development investment to GDP to the level of the U.S. and major European countries. Specifically, a total of about 25 trillion yen in government R&D investment is required in the five-year period from Fiscal 2006 to Fiscal 2010 (Figure 3-1-1).

(Note) Figures are based on the presumption that government research and development investment will be 1% of GDP during the period of the Basic Plan, with a nominal GDP growth rate of 3.1%.

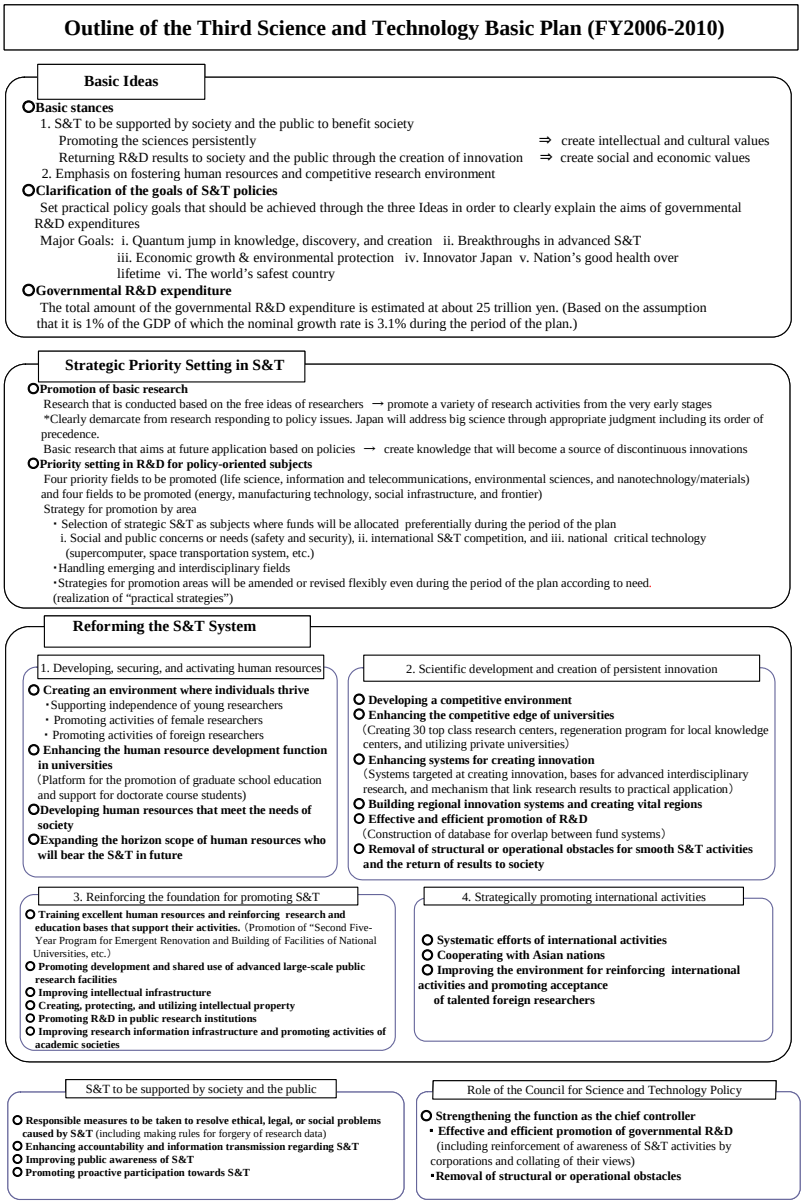


Figure 3-1-1 Main points of the Third Science and Technology Basic Plan(FY2006–FY2010)

In view of the above, while taking into consideration future social and economic trends, the necessity for the promotion of science and technology, and fiscal conditions that are even more severe than they were during the period of the Second Basic Plan, Japan should be striving to increase the funds necessary to promote the policies presented in the Basic Plan, in order to achieve the maximum possible positive impact from government R&D investment through steady implementation of science and technology system reforms laid out under that plan.

3.1.2 The Council for Science and Technology Policy

Since its establishment in January 2001, the Council for Science and Technology Policy (Figure 3-1-2, 3-1-3) has generally met once a month with the participation of the Prime Minister as council chairman (a total of 53 sessions as of March 2006). The major items discussed and ratified during Fiscal 2001 are as presented below.

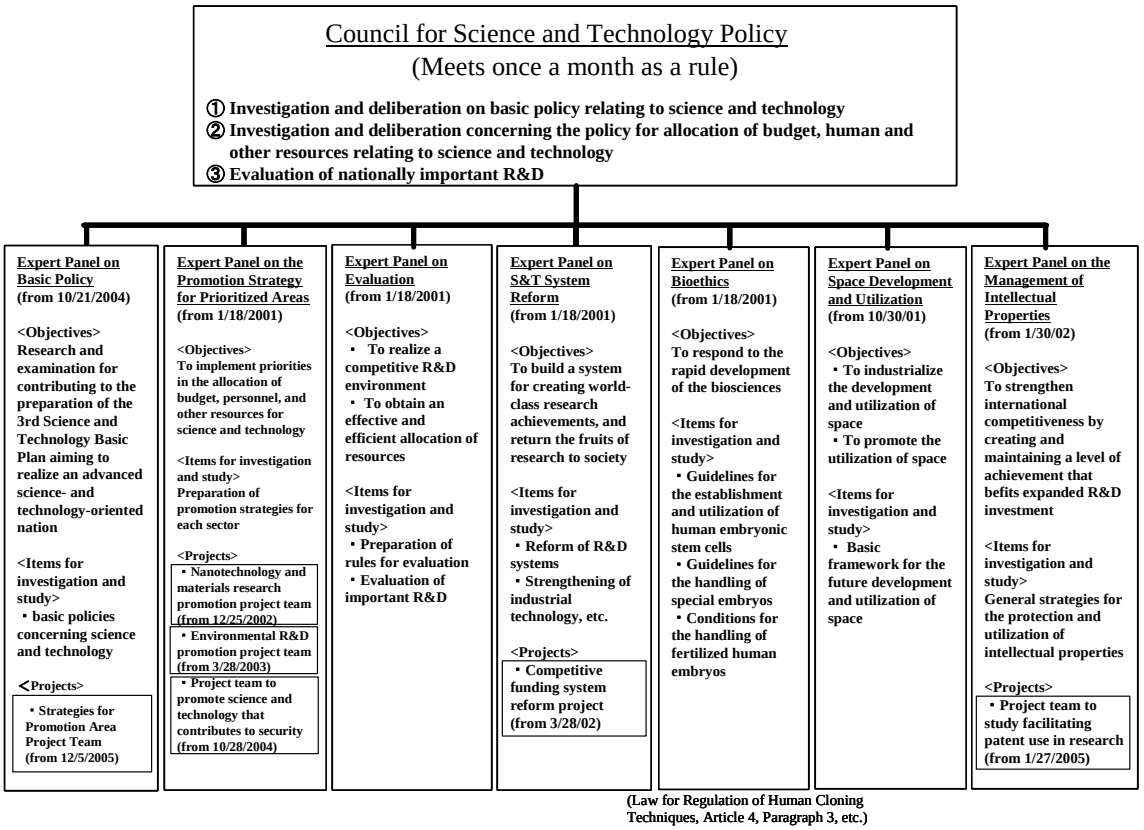


Figure 3-1-2 Organization of the Council for Science and Technology Policy

Table 3-1-3 Chairman and Members of the Council for Science and Technology Policy (as of the end of March 2006)

●Chairman: Junichiro Koizumi, Prime Minister

●Members

Six cabinet ministers: Shinzo Abe, Chief Cabinet Secretary; Iwao Matsuda, Minister of State for Science and Technology Policy; Heizo Takenaka, Minister of Internal Affairs and Communications; Sadakazu Tanigaki, Minister of Finance; Kenji Kosaka, Minister of Education, Culture, Sports, Science, and Technology; and Toshihiro Nikai, Minister of Economy Trade, and Industry

Seven executive members: Hiroyuki Abe, Professor Emeritus, Tohoku University; Taizo Yakushiji, Visiting Professor, Keio University; Tadamitsu Kishimoto, Visiting Professor, Osaka University; Ayao Tsuge, Former Representative Director & Managing Director, Mitsubishi Heavy Industries, Ltd.; Reiko Kuroda, Professor, The University of Tokyo; Etsuhiko Shoyama, President, Chief Executive Officer and Director, Hitachi, Ltd.; Yuko Harayama, Professor, Management of Science and Technology Department, Graduate School of Engineering, Tohoku University

One head of a government institution: Kiyoshi Kurokawa: President of the Science Council of Japan

(1) Reform of Science- and Technology-Related Budget for Fiscal 2006

As Fiscal 2006 is the first year of the Third Science and Technology Basic Plan and in order to achieve the various objectives for realizing an advanced science- and technology-oriented nation as set forth in the Plan, the Council strengthened efforts for high-quality measures by promoting the reform of the science- and technology-related budget, including thorough implementation of "core business concentration," in order to make the budget appropriate for the first year of the Basic Plan.

●Improvement of prioritization(SABC, etc.)

In formulating the Fiscal 2006 budget, the Minister of State for Science and Technology Policy and the eminent members of the Council, with the cooperation of outside experts, prioritized (in 4 levels: S, A, B, and C) the science- and technology-related measures for which relevant ministries and agencies made budget requests, and then, with regard to independent administrative institutions, etc., summarized opinions on their main projects related to science and technology. (October 18, 2005). The prioritization results were as follows:

S: 24 items (12%) — Particularly important research topics that require aggressive implementation

A: 72 items (37%) — Important research topics that require steady implementation

B: 78 items (40%) — Items for which problems must be solved and that need effective and efficient implementation

C: 19 items (10%) — Items requiring review of research details, plans, and promotion systems

28% of the total budget was allocated to the S group, 34% to the A group, 35% to the B group, and 3% to the C group.

In addition, working to enhance the science and technology budget, the CSTP made a summary of "Toward Formation of the Fiscal 2006 Science and Technology-Related Budget (Opinion)," and submitted its opinion to the Prime Minister and the relevant ministers (November 28, 2005).

With the recognition that the promotion of science and technology is "investment in the future," expenses for the promotion of science and technology were increased 1.1% in the Fiscal 2006 budget from the previous fiscal year, despite the fact that the general expenditures for the fiscal year were reduced drastically. Incidentally, the total science- and technology-related budget, including expenses other than for the promotion of science and technology, was reduced by 0.1%.

●Comprehension of science and technology activities conducted by independent administrative institutions and national universities, and the publication of opinions offered regarding the activities

In Fiscal 2005, the CSTP began to compile the "Comprehension of Science and Technology Activities Conducted by Independent Administrative Institutions and National Universities, and the Publication of Opinions Offered Regarding the Activities" in order to grasp science and technology-related activities conducted by independent administrative institutions and national universities, which operate mainly based on grants for administration that are difficult to specify the detailed use during the compilation of the budget. Specifically, this report aims to present the CSTP's opinions on issues such as compliance with the Science and Technology Basic Plan, based on the examination and analysis of various indicators including the number of theses released by such entities.

●Promotion of the coordination program of science and technology projects

As a new method to remove the harmful effects of sectionalism and enhance collaboration between relevant ministries and agencies, the Coordination Program for Science and Technology Projects was promoted for the following eight themes that are important nationally and socially and that should be promoted with collaboration between ministries and agencies: ① Post-genome - Promotion of health sciences -, ② New or revived infectious diseases, ③ Ubiquitous Networks - RFID tags and technologies, - ④ Next-Generation Robots –Shared platform technology-, ⑤ Biomass utilization, ⑥ Hydrogen and fuel cell technology, ⑦ Nano-biotechnology, ⑧ Regional Cluster.

●Thorough reform and focused expansion of competitive research funding

In order to promote creative R&D activities, it is necessary to develop a competitive R&D environment. To this end, institutional reform has continued to be implemented thoroughly to maximize the effect of competitive research funding, and focused expansion of funding has been carried out along with more effective distribution of funds through elimination of unnecessary duplication of resource use and prevention of excessive concentration on R&D projects.

As a result, 470.1 billion yen was appropriated for competitive funding purposes (up 0.6% over the previous year) in the Fiscal 2006 budget.

(2) Resources Allocation Guidelines for Science and Technology Budget/ Human Resources

As shown in the Basic Plan, the CSTP relies on the Basic Plan and the sectoral promotion strategy, etc., examines the science and technology measures set forth for the next fiscal year, and presents opinions to the Prime Minister regarding those measures that it believes merit particular priority, and then clarifies its ideas regarding the next fiscal year's important measures and allocation of resources, and presents those ideas to the relevant ministers. Furthermore, to ensure that the resource allocations settled upon in the CSTP are carried out, the council coordinates when necessary with the finance authorities during the budget formulation process.

●Adoption of Fiscal 2006 resources allocation guidelines for science and technology budget/human resources and presentation of opinions thereon (June 16, 2005)

As Fiscal 2006 is the first year of the Third Science and Technology Basic Plan, the Fiscal 2006 guidelines aim at strategic priority setting based on thorough implementation of "selection and concentration" in compliance with the directions such as ① science and technology to be supported by the public and to benefit society, ② concepts of the Third Science and Technology Basic Plan and policy goals, ③ importance of human resource development and the competitive environment – shift in emphasis from "hard" to "soft", e.g. human resources; greater significance of individuals at institutions.

Specifically, the guidelines presented principles to be emphasized with regard to ① strategic priority setting in science and technology (promotion of basic research and prioritization of research and development on policy issues, etc.,) ② promotion of science and technology system reforms, and ③ science and technology to be supported by the public and society.

(3) Major Efforts of the Council for Science and Technology Policy in Fiscal 2005

●Examination of promotion measures in priority areas

Based on the prioritized strategies determined in the Basic Plan, in Fiscal 2001 the CSTP prepared the "Sectoral Promotion Strategy" for eight major areas, which are the Life sciences, Information and communications, Environmental sciences, Nanotechnology/Materials, Energy, Manufacturing technology, Social infrastructure and Frontier – outer space and the oceans (Figure 3-1-4). CSTP promotes measures based on the promotion strategies for these areas (see section 3.2.2).

Figure 3-1-4 Strategies for the Promotion of Each of the Four Priority Sectors (September 21, 2001)

Four Priority Sectors: the sectors that receive particular priority and preferential allocation of R&D resources.
Each section below features the current situation and issues, thoughts on prioritizing and areas of priority, five-year R&D objectives, and promotion measures for one of these sectors.

Life Sciences Area

1. Current Situation, and Issues

The 21st century is being called the "Century of Life." While Japan had a late start in analysis of the genome, the country is using its leading-edge R&D performance in SNPs, proteins, etc., to catch up in post-genome research and industrial applications.

2. Thoughts on Prioritizing, and Areas of Priority

Strive to extend the "healthy life expectancy" in an aged society with fewer children, and seek to overcome the infectious diseases, allergies and stress-related illnesses that are now coming to the fore as social problems. Furthermore, achieve a prosperous lifestyle by utilizing diverse bio-resources and bio-functions, and strengthening industrial competitiveness.

(1) Develop technologies to "protect the people's health"
- Technologies for the prevention and treatment of diseases that utilize genome-related technologies to achieve active, long lives
- Elucidation of physiological defense mechanisms and technologies for prevention and medical treatment in relation to infectious diseases and environmental factors
- Promotion of basic research and technologies for the treatment and prevention of mental health and brain diseases

(2) Develop technologies for "competitiveness" and "sustainable development"
- Materials production and environmental response technologies that utilize bio-functions
- Food sciences and technologies that contribute to the improvement of food supply capabilities and to the peoples' diet

(3) Emerging and interdisciplinary areas and the development of advanced analyzing technologies. Build systems and structures that accelerate the return of the fruits of research to society.

3. Five-Year R&D Objectives

(1) Realize healthy, secure lives by:
- Developing countermeasures for "lifestyle related diseases," and ailments that lead to "dementia" and "bed-ridden status": Analyze tens of million of SNPs each year/Perform structural and functional analysis of large-scale, highly purified proteins/Identify approximately 10 genes related to each ailment/Shorten drug development times/Realize effective treatment using medicines tailor-made to the constitution of individual patients, etc.
- Developing countermeasures for infectious diseases and environmental factors such as toxic substances: Elucidate the mechanism for the incidence of hepatitis C infections, etc./Use vaccines, etc., to prevent infections and control incidence, etc.
- Developing countermeasures for mental and nervous system diseases: Promote brain science/ Set out to develop new diagnostic and treatment methods for Alzheimer's and other nervous system diseases/Develop non-invasive diagnostic technologies for the measurement of brain functions

(2) Advance technologies for the production of useful substances and technologies for separating environmental pollutants, utilizing genome-related technologies and microorganisms and other plants and animals/Develop crops resistant to environmental stresses to improve food supply capabilities

(3) Promote research into interdisciplinary sectors such as bio-informatics and nanobiology/Promote clinical research/Arrive at consensus in bio-ethics/Promote social acceptance of genetically modified organism/ Promote accumulation of intellectual properties, etc.

4. Promotion Measures

(1) Build up comprehensive systems of promotion for the evaluation of, and guidance on, measures proposed by various ministries that serve to strengthen national efforts

(2) Develop effective collaboration among industry, academia and government, the development of systems and structures that return the fruits of research to society, etc.

(3) Develop education and research centers for developing human resources for such interdisciplinary sectors as bio-informatics, advanced analysis, and medical treatment device development, in which engineering, physical sciences, medical science, agriculture, etc., are utilized and integrated

Information and Communications Area

1. Current Situation and Issues

While the gap between Japan and the United States in information and communications technology continues to widen, R&D investment growth in the private sector is stalling, and collaboration among industry, academia, and the government remains insufficient. Since Japan's economy relies heavily on the information and communications industry, strengthening international competitiveness is an urgent task.

2. Thoughts on Prioritizing and Areas of Priority

Prioritize from the viewpoints of strengthening international competitiveness in the core technologies in which Japan has an advantage, such as mobile, optical and device technologies, the achievement of safe, secure and comfortable lives, strengthening the foundation for next-generation information and communications technologies and R&D infrastructure.

○ Building a "high-speed, highly reliable information systems" suitable for a society with a ubiquitous information-network, and the creation of a global market
- Technologies that realize an ultra-high-speed mobile internet system, in which vast amounts of information can be exchanged and utilized with high quality through wireless and optical networks anywhere and anytime, whether at home, in the office or on the move
- Technologies for devices with advanced-function and low-power-consumption
- Technologies for improved convenience, security, and reliability, for software and content, for the flexible and safe utilization of distributed computing power, etc.

○ Next-generation information and communications technologies, including next-generation human interfaces, quantum information and communication, and advanced traffic information systems (ITS, etc.), and so on

○ R&D infrastructures including science and technology databases, supercomputer networks, computational sciences, etc.

○ Human resource development in software, the Internet, interdisciplinary sectors, etc.

3. Five-Year R&D Objectives

(1) Information and communications system with high-speed and highly reliability.
- Realize wireless access in the class of tens of megabits per second, fully optical networks at 10 terabits per second, ultra-large scale connections (nodes) with IPv6, and high-quality real-time transmissions, and mobile terminals with 1-gigahertz-class high-speed and advanced functionality that do not require recharging for a week at a time, etc.
- Realize databases that can be accessed by approximately 100,000 people at the same time, advanced coding and authentification technologies, the establishment of development methods for the improvement of software reliability and productivity, digital authorization control systems, etc.

(2) Next-generation information and communications technologies: Realize technologies that can understand user intention by considering surrounding conditions, quantum code key distribution over relatively short distances, advanced ITS using next-generation Internets, gigabit-class high-speed space communications, etc.

(3) R&D infrastructure: Realize electronic science and technology information and search systems, and joint supercomputer networks linking national research institutions and universities, etc.

4. Promotion Measures

(1) Promotion of R&D applications: Strengthen collaboration among industry, academia, and government, etc., to promote R&D activities specifically intended for practical use, promote international standardization, and promote technology development in test beds for real environments

(2) R&D systems: Promote greater movement of researchers between institutions, support and develop venture companies, utilize excellent universities and research institutions as R&D bases, develop high-level instructors in the information and communications field, and expand the scale of human resource development capabilities

(3) Investigation of effects on society: Research the effects of information and communications development on society, coordinate with IT strategy headquarters, form strategic international collaborations to encourage international standardization and technology transfers, etc.

Environmental Area

1. Current Situation, and Issues

With environmental problems becoming both broader in geographical scope and more complex, research is requested to coordinate individual projects and develop planned and integrated programs. Other issues also requiring attention from a comprehensive viewpoint are research on human-environment interactions, and forecasting and preventive research (scenario-driven environmental research).

2. Thoughts on Prioritizing, and Areas of Priority

Engage in research that contributes to the solution of urgent and serious environmental problems, and to the building of sustainable societies. Perform research promoted by scenario-driven initiatives in which natural sciences, humanities and social sciences are merged under inter-ministerial collaboration.

[Important issues]

- ○ Research into global warming
- ○ Research into waste-free and resource recycling technologies
- ○ Research into eco-harmonious river basin and urban area regeneration
- ○ Research into chemical substance risk management
- ○ Research into global water cycle
- ○ Development of intellectual infrastructure such as standard materials and environmental biological resources
- ○ Advanced research

3. Five-Year R&D Objectives

(1) Research into global warming: Seek possibilities for controlling the emission of greenhouse gases into the atmosphere so as not to endanger mankind and ecosystems, and examine obtaining and systemizing scientific knowledge, developing and advancing remedy technologies and creating scenarios for the control of global warming.

(2) Research into waste-free and resource recycling technologies: Develop technologies and systems that contribute to the reduction of waste volumes, improvement of recycling and reutilization rates, and reduction of environmental risks from toxic wastes.

(3) Research into eco-harmonious river basin and urban area regeneration: Propose measures for the resolution of such environmental problems as high environmental loads in urban areas and the retreat or deterioration of natural environments, and systematically develop riparian district and urban renewal technologies and systems in order to contribute to the preparation of specific plans for coexistence with nature in major urban areas

(4) Research into chemical substance risk management: While determining the chemical substances that are expected to need risk management, urgently build up the technological infrastructure, knowledge systems, and intellectual infrastructure for comprehensive management of chemical substances, to ensure "safety and security"

(5) Research into global water cycle: Provide the scientific knowledge and technological infrastructure required for assessing the effects on human society of water resource supply and demand and changes in the water cycle, and for establishing water management methods that lead to sustainable development

(6) Intellectual infrastructure for the environmental area: Broaden and upgrade the intellectual infrastructure for environmental research

(7) Promotion of advanced research: Develop innovative knowledge for the resolution of environmental problems, and build new paradigms

4. Promotion Measures

(1) Improvement of R&D quality: (1)Establish promotion and evaluation systems for initiatives, Foster international cooperation, (2)Disseminate R&D results, reflected in environmental policies, and basic efforts on societal understanding, (3) Define roles and foster cooperation among industry, academia, and government, (4) Cooperate with initiatives by local governments and NGOs, etc.

(2) Necessary resources: (1) Enhance and expand competitive funding,
(2) Assure and develop human resources, strengthen international research networks, improve systems for accepting foreign researchers, and support and actively utilize environment-related university institutions, (3) Cooperate with other sectors: actively utilize new methods and technologies in other sectors in order to engender reform of environment research paradigms, (4) Develop important large-scale facilities and equipments specific to environmental research

Nanotechnology and Materials Area

1. Current Situation, and Issues

Nanotechnology offers great possibilities for technological innovation in a wide range of industries. Nations everywhere are actively engaged in strategic efforts. In materials technology, competitiveness arises from high value-added functional materials.

2. Thoughts on Prioritizing, and Areas of Priority

Assign priorities from the perspectives of "strengthening industrial competitiveness and forming the basis for sustainable economic growth," "responses to environmental and energy problems, and to an aged society with few children," and "assurance of safe and secure lives for the people, and retention of strategic technologies." Clarify the timetable for technological development, and steadily implement basic measurement, evaluation, and processing technologies, as well as materials technologies, etc.

- ○ Nano-devices and materials for next-generation information and communication systems
- ○ Materials for environmental preservation and advanced energy utilization
- ○ Ultra-small medical systems and materials, and nano-biology utilizing and controlling biological mechanisms
- ○ Basic technologies such as measurement, evaluation, processing, numerical analysis and simulations, and areas spreading from them
- ○ Substance and materials technologies that can generate innovative properties and functions

3. Five-Year R&D Objectives

- ○ Nano-devices and materials for next-generation information and communication systems
  - – Ensure international competitiveness in high-speed and high IC density device technologies
  - – Use the competitive development of various devices based on new principles, to select and focus next-generation, cutting-edge core technologies
- ○ Materials for environmental preservation and advanced energy utilization
  - – Realize materials for the reduction of CO2 emission volumes required to meet the COP3 objectives, and encourage the use of these materials into society
  - – Realize technologies for the reduction and elimination of risks arising from chemical substances, and incorporate them into society and national life
- ○ Ultra-small medical systems and materials, and nano-biology utilizing and controlling biological mechanisms
  - – Establish the groundwork for bio-functional materials, pinpoint therapies, and other technologies to extend healthy life expectancy
  - – Elucidate the basic principles to construct the systems that utilize the motive principles, etc., of bio-molecules
- ○ Basic technologies for measurement, evaluation, processing, numerical analysis and simulations, and areas spreading from them
  - – Realize highly precise measurement and processing technologies, improved by at least one order of magnitude compared to the levels required by the above three objectives
  - – Utilize simulations in the development of new materials and new devices
- ○ Substance and materials technologies that can generate innovative properties and functions
  - – Develop new materials through R&D activities that go beyond the boundaries of traditional materials classification
  - – Build up research and production methods that lead to the rapid resolution of social issues

4. Promotion Measures

- ○ Encourage competition at daily R&D activities, and prepare environments suitable for that purpose
  (Emphasis on competitive funding, promotion that goes beyond the boundaries of government ministries/agencies or systems, and the strategic acquisition of intellectual property)
- ○ Promote cooperation between different areas and researchers
  (Support for cooperative efforts among different areas building up networks among researchers and among institutions, etc.)
- ○ Build a system for the industrialization of R&D results, and promote collaboration among industry, academia, and the government
  (Acceleration of technology transfers, improvement of incentives such as support measures, and promotion of human resources mobility)
- ○ Ensure and develop human resources
  (Personnel capable of working in interdisciplinary areas, research assistants, and personnel capable of research evaluation and management).

Four Other Fundamental Areas: areas that are fundamental to the existence of the nation, and that are emphasized as areas in which it is essential for Japan to be involved:

Energy Area

1. Areas of Priority and Five-Year Objectives..

(1) R&D that brings about a reform of the total energy system, including supply, transportation, conversion, and consumption
Vigorous and efficient efforts to fulfill 3E goals
(2) R&D essential for upgrading the energy infrastructure
Energy infrastructure-related R&D; upgrades in efficiency and environmental soundness
(3) R&D for safe and secure energy
R&D that reassures people by ensuring safety in all aspects of energy
(4) R&D that comprehensively evaluates and analyzes energy both socially and economically
R&D that comprehensively analyzes and evaluates social, economic, and environmental facets, and deepens social understanding; R&D with the aim of creating industries
* Five-year objectives have been established for the above items.

2. Promotion Measures..

1. Important items for improving the quality and efficiency of R&D:
(1) Creation of results that are transferable to developing countries, and active use of international cooperation through participation in international joint research
(2) R&D efforts and evaluation under the conditions of the level of social understanding of R&D results and the diffusion of them
(3) To recognize each role for, and collaboration among, industry, academia and the government in order to promote the efficient development of system technologies
(4) Efficient promotion through inter-ministerial coordination of cross-ministerial themes
(5) Consistent efforts for short-, mid-, and long-term R&D themes

2. Points of concern relating to necessary R&D resources:
Securing and fostering personnel; enhancement of education on energy utilization and safety

Infrastructure Area

1. Areas of Priority and Five-Year Objectives

○ Building of Safety
Mechanisms for the generation of abnormal natural phenomena; immediate response systems for disasters (disaster prevention IT, emergency rescue systems, etc.); measures to reduce massive disaster damage to densely populated urban areas; systems for the protection of core functions and cultural assets; ultra-advanced disaster prevention support systems; intelligent transport systems (ITS); measures for land, sea, and air traffic safety; countermeasures against deteriorating social infrastructure; and safety measures in response to toxic or dangerous substances, or to criminal activity
○ Regeneration of the beauty of Japan, and the establishment of a basis for high-quality lives
Rebuilding beautiful living spaces in co-existence with nature; wide-area local topics; restoration of drainage area water cycles and general water management; transportation systems consonant with modern traffic and physical distribution; barrier-free systems and universal designs; and information infrastructure technologies and systems for society
■ A policy of proactive R&D cooperation for social infrastructure building in developing countries is indispensable.
* Five-year objectives have been established for the above items.

2. Promotion Measures..

○ Enhancement of policy studies on the development of infrastructure
○ Promotion of collaboration between the science and technology community and the humanities and social science community
○ Enhancement of R&D in cross-governmental areas
○ Stimulation of exchanges among industry, academia, and government researchers (including academic societies)
○ Establishment of international scheme of science and technology for infrastructure, particularly in the east Asia region
○ Promotion of R&D to support developing countries for infrastructure buildup

Manufacturing Technology Area

1. Areas of Priority and Five-Year Objectives..

○ Strengthening competitiveness through manufacturing technology innovations
Dramatic progress in productivity through high utilization of IT; changes to manufacturing processes through breakthroughs in technology; upgrading of quality control, safety, and maintenance technologies
○ Pioneering new areas of manufacturing technology
High value added commercialization technology (nanotechnology applications, etc.); technologies for cultivating new demand
○ Manufacturing technology to minimize the environmental burden
Manufacturing systems adapted to the formation of an environmentally-based society; minimization of harmful substances; prevention of global warming
* Five-year objectives have been established for the above items.

2. Promotion Measures..

(1) Develop human resources; improve environments that encourage creativity
(2) Accumulate fundamental knowledge, technology, and know-how
(3) Intellectual property rights-related strategies
(1) Incentives for the acquisition of intellectual property rights; (2) Support measures for launching businesses based on patents; (3) A society and system that pay due recognition to inventors
(4) Review the status of collaboration among industry, academia, and government
(1) Collaborate and clarify the sharing of responsibilities among industry, academia, and the government from the initial stages of research; (2) Promote personnel mobility; (3) Promote matching funds at times of collaboration among industry, academia, and the government; (4) Clarification of the relations of rights in conflict of interest issues
(5) Promote the development and standardization of the intellectual infrastructure
(6) Promote practical applications such as through the formation of venture businesses
(1) Support measures for the market entry of venture business in the field of new manufacturing technologies; (2) Smooth the transfer of university research results into the manufacturing world through active utilization of TLOs; (3) Actively utilize subvention systems for practical applications

Frontier Area

1. Areas of Priority and Five-Year Objectives..

○ Ensuring security Information-gathering technology using satellites (including transport capability); advanced positioning and surveying technology
○ Technology innovations enabling global market entry
Low-cost, reliable transportation technology; next-generation satellite technology; technology for the utilization of marine resources
○ International contributions to human intellectual creation, and securing international status
International projects that give people, and particularly the next generation, dreams, hope, and pride; construction of a worldwide network for global environmental information
* Five-year objectives have been established for the above items.

2. Promotion Measures..

○ Restructure the space development and utilization scheme so that it can be promoted by the nation as a whole
○ Establishment of public-private burden sharing and cooperation systems needed for nurturing space-related activities into a key industry
○ Promotion of marine utilization through collaboration with other sectors
○ Return to society of the fruits of research activities on global environmental change
○ Strategic promotion of basic research and training/securing human resources
○ Continual and seamless acquisition, processing, and accumulation of information, and the establishment of a system to transmit it to the world
○ Establishment of R&D methods and systems incorporating the latest advanced information technology
○ Clarification of international relationships in each cooperative project in order to promote smooth interaction
○ Nurturing interpreters who can explain things to the public in an easy to understand manner, and the stimulation of public relations activities
○ Significant progress in the efficiency of R&D, especially in big projects

●Promotion of the nanotechnology and materials area

In order to promote R&D and industrialization in the nanotechnology and materials areas, the Council has been implementing projects for the "utilization of structural materials in the construction market" as "collaborative projects" among ministries and agencies based on the "Report on the Promotion of Industrial Development in the Nanotechnology and Materials Area" (opinions presented on July 23, 2003). Furthermore, the Council has been promoting R&D on technologies to combine nanotechnology and biotechnology, with the reclassification of the R&D into "nano-biotechnology" in the Coordination Program for Science and Technology Projects.

●Evaluations

1) Follow-up study of evaluations of large scale R&D projects (August 4, 2005)

The Council conducted follow-up studies on the evaluations of large-scale R&D projects (research on genome network, observations of the South Pole, the ALMA Plan, advanced metrological analysis technology and equipment development, R&D based on the Tertiary Comprehensive Ten-year Strategy to Overcome Cancer) implemented in Fiscal 2005 and presented improvements, etc. to relevant ministries.

2) Examination of the state of implementation of midterm evaluations of R&D (September 1, 2005)

The Minister of State for Science and Technology Policy and the eminent members of the Council examined the state of midterm evaluations by each ministry and agency regarding ongoing R&D projects with funding of 1 billion yen or more in the Fiscal 2005 budget. As a result, proactive efforts by ministries and agencies were observed like in the previous year, and a comparison with the previous year's research results revealed an increase in the number of cases for which midterm evaluations were conducted, as well as a decrease in the number of cases for which long-term evaluations were not implemented. The Minister and Council members instructed ministries and agencies to conduct midterm evaluations within an appropriate timeframe, in accordance with the purpose and theme of each of the R&D issues and measures.

3) Revision of the evaluation framework for nationally important R&D projects conducted by the Council for Science and Technology Policy (October 18, 2005)

With respect to new large-scale R&D projects, the Council determined to conduct midterm evaluations, ex-post evaluations, and follow-up evaluations, in addition to conventional ex-ante evaluations.

4) Evaluation of new large-scale R&D projects (opinions presented on November 28, 2005)

The Council conducted the ex-ante evaluation of three large R&D projects starting in Fiscal 2006 with total national expenditures of about no less than 30 billion yen (development and adoption of state-of-the art general-purpose computers of high performance, development and sharing of X-ray free electron lasers, and the Project for Strategic Promotion of Advanced Basic Technologies), and presented the results to relevant ministers.

●Management of intellectual properties "Report on the Management of Intellectual Properties" (opinions presented on May 31, 2005)

The Council presented its opinions to relevant ministers, with regard to the ideal proactive use of intellectual property by universities and colleges. These opinions were reflected in the "Intellectual Property Strategic Program 2005" compiled by the Intellectual Property Policy Headquarters in June 2005 (See Section 3.3.6.4).

●Fostering and ensuring S&T related personnel resources "On Utilization of Science- and Technology-Related Personnel Resources" (opinions presented on July 23, 2004)

Investigations and examinations were conducted in regards to fostering and ensuring the availability of the scientists, technologists, and specialists who are needed for promoting world-class research results and their utilization. The Council then presented its opinions to the relevant ministers. The report calls for ① fostering human resources capable of exercising international leadership, ② higher education of a world-class standard and elementary and secondary education that fosters children's di-

versity and creativity, and ③ establishment of research and education environments conducive to the creation of innovative values (See Section 3.3.4).

●Response to bioethics "Basic Conceptual Approach Relating to the Treatment of Human Embryos" (July 23, 2004)

Based on Article 2 of the Supplementary Provisions of the "Law Concerning Regulation Relating to Human Cloning Technologies and Other Similar Technologies," the Council started a discussion on the basic conceptual approach relating to the treatment of human embryos. The Council then presented its opinions to the relevant ministers. While the report in principle prohibits treating human embryos in a way that would damage the embryos, it has set forth social norms concerning the treatment of human embryos, saying that there are cases where it is necessary to approve exceptional treatment of human embryos in order to respond to people's requests in the pursuit of happiness with regard to health and welfare (See Section 3.2.2.1.2).

●Promotion of space development and utilization "Basic Strategy for Space Development and Utilization in Japan" (opinions presented on September 9, 2004)

The Council presented its opinions on the significance of space development and utilization in consideration of recent changes in the domestic and overseas situations surrounding space development and utilization, such as importance as a national strategic technology, contribution to overall national security, and sustainable development of the earth and mankind. The report also calls for promoting space development and utilization under the basic policy of strengthening basic technologies by maintaining Japan's capability of launching satellites when necessary and by giving top priority to ensuring reliability. (See Section 3.2.2.8)

●Promotion of science and technology conducive to safety

With various events that represent a threat to the safety of the public, such as large-scale disasters, various types of terrorism, violent crimes, and emerging and re-emerging infectious diseases becoming increasingly common in recent years, strengthening the country's crisis management system and building a safe society have become pressing national issues. For this reason, the Project Team for Promotion of Science and Innovation for Security and Safety, established under the Expert Panel on the Promotion Strategy for Prioritized Areas in October 2004, has been conducting research and examination on science and technology to construct a safe society where people can live without anxiety, and issued the "Midterm Report on Science and Technology Conducive to Safety" in April 2005 and the "Second-half Report on Science and Technology to Conducive to Safety" in October 2005.

●Special Coordination Funds for Promoting Science and Technology

The Special Coordination Funds for Promoting Science and Technology (Chosei-hi) is a competitive research fund for promoting the systematic reform of science and technology by taking on policies which become policy initiatives for each of the other administrative agencies, based on policies laid down by the CSTP. In Fiscal 2005, the Special Coordination Funds for Promoting Science and Technology supported four topics as meriting emergency R&D efforts, -- "Emergency Survey Research on Damage Caused by the Sumatran Earthquake and the Indian Ocean Tsunami" (March 23, 2005), "Emergency Survey Research on Countermeasures against Health Problems Caused by Asbestos" (November 2, 2005), "Emergency Survey Research on Production of New Influenza Vaccine" (November 24, 2005), and "Emergency Survey Research on Countermeasures against Snow Damage Caused by Heavy Snowfall in 2005-2006, Winter Term" (January 31, 2006). (See Section 3.3.1.1.5).

(4) Efforts towards Formulation of the Third Science and Technology Basic Plan

●Follow-up to the Second Science and Technology Basic Plan

"Progress of Scientific and Technological Policies Based on the Science and Technology Basic Plan (Fiscal 2001~2005) (opinions presented on May 26, 2004)

With regard to the state of implementation of measures laid down in the Second Science and

Technology Basic Plan, the Council conducted a detailed follow-up study mainly on the state of measures implemented during the three years from Fiscal 2001 to Fiscal 2003 and worked out a list of basic problems that should be dealt with in the future.

Also, as a follow-up study on the First and Second Science and Technology Basic Plan, the "Survey for Evaluation of Effects Achieved in the Basic Plan" was conducted by the National Institute of Science and Technology Policy by using Fiscal 2003-2004 Special Coordination Funds for Promoting Science and Technology (published in March 2005).

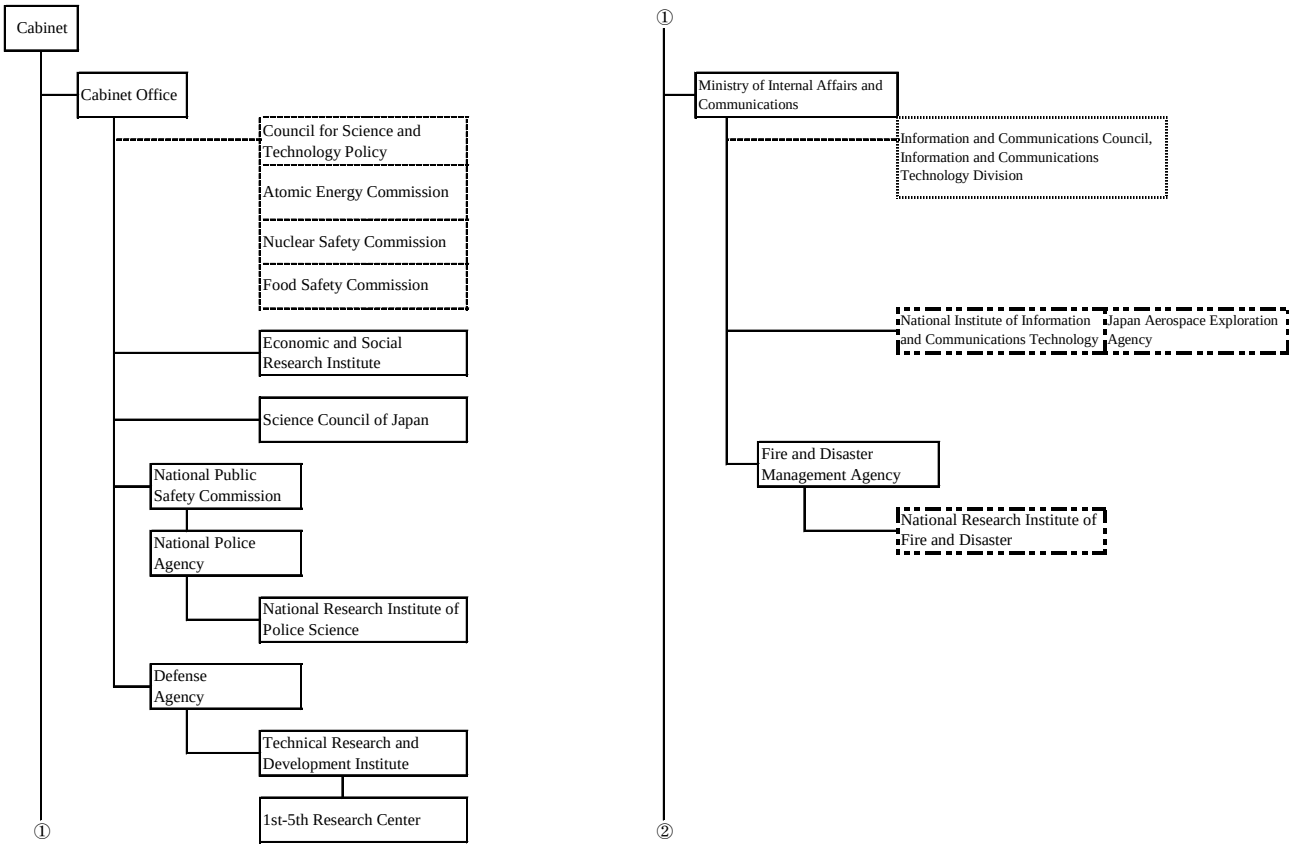
●Formulation of the Third Science and Technology Basic Plan

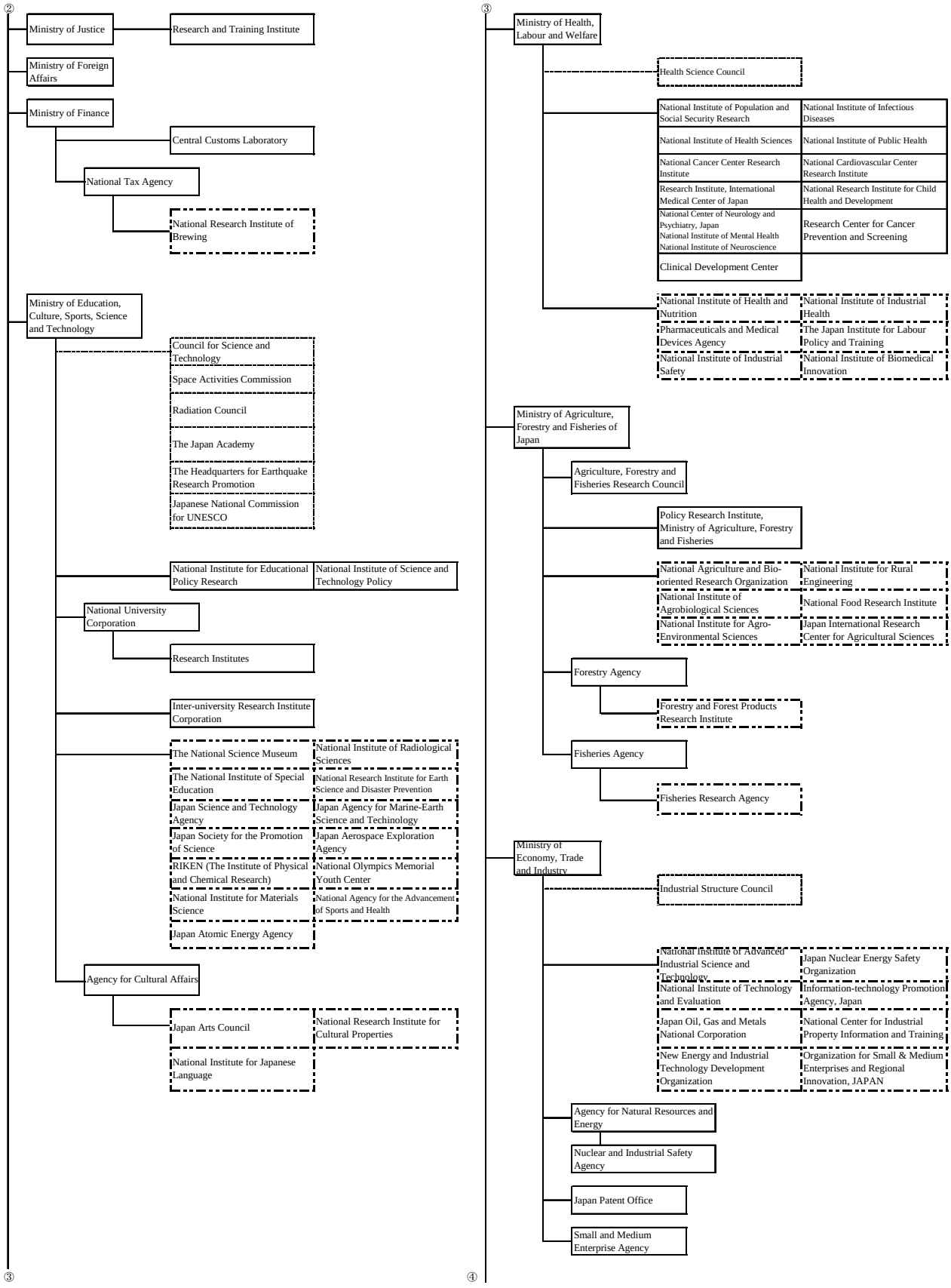
The Council for Science and Technology Policy, which is required to formulate basic policies on science and technology that serve as the basis for the Science and Technology Basic Plan, established the Expert Panel on basic policy in October 2004 to formulate the Third Science and Technology Basic Plan for five years starting in Fiscal 2006. The Expert Panel is composed of experts in various fields, including international politics, national security, economy, fiscal policy, laws, and business management as well as researchers. The task force has been conducting research and study on basic policies concerning science and technology after being instructed by the Prime Minister to study "Japan's Science and Technology Basic Policy Report" in December 2004, and issued a recommendation on December 27, 2005. Upon issuance of the recommendation, the Third Science and Technology Basic Plan was adopted at a Cabinet meeting on March 28, 2006. On the same day, the Council formulated the "Sectoral Promotion Strategy" for the following eight major areas based on the prioritized strategies determined in the Basic Plan: Life sciences; Information and communications; Environmental sciences; Nanotechnoogy/Materials; Energy; MONODZUKURI (manufacturing) technology; Social infrastructure; and Frontier.

3.1.3 Administrative Structure and Budget for Science and Technology

3.1.3.1 Administrative Structure of Science and Technology

Japan's policy concerning science and technology is based on the Science and Technology Basic Law and on the Science and Technology Basic Plan, and is also promoted through programs of the administrative organs based on the various recommendations and advice offered by the former Council for Science and Technology, and now by the CSTP. Research is carried out at national research institutions, public corporations, independent administrative institutions, universities, and university joint research institutions, and various research programs are used to promote research, and carry out preparations for a research and development environment (Figure 3-1-5).

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Ministry of Justice
Research and Training Institute
Ministry of Foreign Affairs
Ministry of Finance
Central Customs Laboratory
National Tax Agency
National Research Institute of Brewing
Ministry of Education, Culture, Sports, Science and Technology
Council for Science and Technology
Space Activities Commission
Radiation Council
The Japan Academy
The Headquarters for Earthquake Research Promotion
Japanese National Commission for UNESCO
National Institute for Educational Policy Research
National Institute of Science and Technology Policy
National University Corporation
Research Institutes
Inter-university Research Institute Corporation
The National Science Museum
National Institute of Radiological Sciences
The National Institute of Special Education
National Research Institute for Earth Science and Disaster Prevention
Japan Science and Technology Agency
Japan Agency for Marine-Earth Science and Techinology
Japan Society for the Promotion of Science
Japan Aerospace Exploration Agency
RIKEN (The Institute of Physical and Chemical Research)
National Olympics Memorial Youth Center
National Institute for Materials Science
National Agency for the Advancement of Sports and Health
Japan Atomic Energy Agency
Agency for Cultural Affairs
Japan Arts Council
National Research Institute for Cultural Properties
National Institute for Japanese Language
③
④
③
Ministry of Health, Labour and Welfare
Health Science Council
National Institute of Population and Social Security Research
National Institute of Infectious Diseases
National Institute of Health Sciences
National Institute of Public Health
National Cancer Center Research Institute
National Cardiovascular Center Research Institute
Research Institute, International Medical Center of Japan
National Research Institute for Child Health and Development
National Center of Neurology and Psychiatry, Japan
National Institute of Mental Health
National Institute of Neuroscience
Research Center for Cancer Prevention and Screening
Clinical Development Center
National Institute of Health and Nutrition
National Institute of Industrial Health
Pharmaceuticals and Medical Devices Agency
The Japan Institute for Labour Policy and Training
National Institute of Industrial Safety
National Institute of Biomedical Innovation
Ministry of Agriculture, Forestry and Fisheries of Japan
Agriculture, Forestry and Fisheries Research Council
Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries
National Agriculture and Bio-oriented Research Organization
National Institute for Rural Engineering
National Institute of Agrobiological Sciences
National Food Research Institute
National Institute for Agro-Environmental Sciences
Japan International Research Center for Agricultural Sciences
Forestry Agency
Forestry and Forest Products Research Institute
Fisheries Agency
Fisheries Research Agency
Ministry of Economy, Trade and Industry
Industrial Structure Council
National Institute of Advanced Industrial Science and Technology
Japan Nuclear Energy Safety Organization
National Institute of Technology and Evaluation
Information-technology Promotion Agency, Japan
Japan Oil, Gas and Metals National Corporation
National Center for Industrial Property Information and Training
New Energy and Industrial Technology Development Organization
Organization for Small & Medium Enterprises and Regional Innovation, JAPAN
Agency for Natural Resources and Energy
Nuclear and Industrial Safety Agency
Japan Patent Office
Small and Medium Enterprise Agency

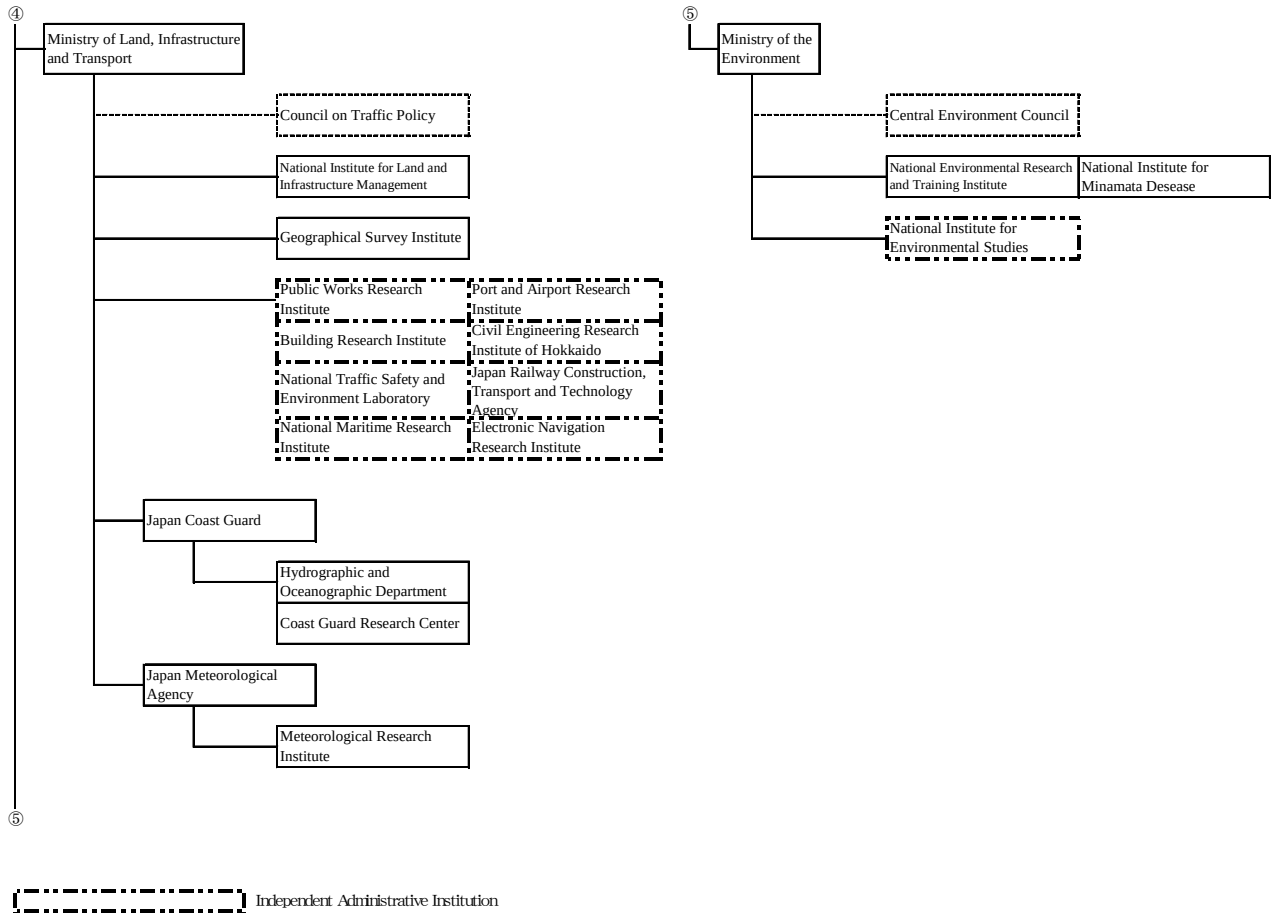

Figure 3-1-5 Japan's Science and Technology Administrative Structure (as of March 2006)

The Council for Science and Technology Policy coordinates the science- and technology-related measures of relevant ministries and agencies as the headquarters under the leadership of the Prime Minister by examining and discussing the basic policies on science and technology, and policies on allocation of the budget, human and other resources related to science and technology. On December 27, 2005, the Council issued a recommendation to the Prime Minister with respect to the inquiry, "Japan's Science and Technology Basic Policy Report," in order to formulate the Science and Technology Basic Plan. The Ministry of Education, Culture, Sports, Science and Technology acts in line with those strategies to prepare specific research and development plans for individual sectors, coordinates policies for estimating costs planned by test and research institutions, etc., and administers allocations of the Special Coordination Fund for Promoting Science and Technology (SCF), in order to coordinate the management of science and technology with relevant administrative institutions. The Ministry comprehensively promotes the implementation of research and development in advanced and important science and technology fields, and the administration of science and technology that advances and strengthens creative and basic research.

In recent years, cooperation between ministries and agencies has been strengthened with the establishment of roundtable groups and inter-ministerial liaison committees concerning various research sectors and related measures, including programs for the promotion of research in brain sciences, and for basic research conducted by public corporations through public canvassing methods. Depending on the character of the respective fields or policies, these programs are promoting lateral, long-term thinking between ministries and agencies and the

adoption of priority guidelines on how to promote research and development, and also promoting co-operation through the promotion of information exchanges concerning the progress of research, etc., and researcher exchanges.

The Science Council conducts surveys and discussions on important issues regarding the comprehensive promotion of science and technology in response to inquiries posed by the Minister of Education, Culture, Sports, Science and Technology, and presents opinions on these issues to the minister.

The Science Council's recommendations are shown in Table 3-1-6.

Table 3-1-6 Recommendations of the Council for Science and Technology (FY2005)

1. Proposals
(i) Revision of Guideline for Evaluation of Research and Development in MEXT (Proposals on September 8, 2005)
2. Principal Reports

Date (m/d/y)	Principal Reports
	Subdivision on Science
6/28/05	Summary of discussions on the transmission of science information in Japan (Working Group for Science Information Foundation, Research and Environment Foundations Section)
6/28/05	Ideal form of future improvement of university libraries or others as science in formation foundations (interim report by Working Group for Science Information Foundation, Research and Environment Foundations Section)
6/29/05 6/30/05	Ideal form of future improvement of computers/networks as science information foundations (interim report by Working Group for Science Information Foundation, Research and Environment Foundations Section) Ideal form of Grants-in-Aid for Scientific Research (interim report by Research Funds Section)
10/13/05	Equipment for science research in national/public/private universities and inter-university research institute corporations – Ideal form of new improvement of the equipments in the future - (report by Working Group for Research Facilities, Research and Environment Foundations Section)
3/6/06	Science policies supporting diversity of research – Ideal form of development of promotion strategies for science research and support by government – (report)
3/23/06	Future plan of a “project for promotion of regional research in response to world’s needs (report by Working Group for Human/Social Science) Ideal form of future science information foundations (report by Working Group for Science Information Foundations)
	Committee on Human Resources
7/20/05	Diverse career paths of young human resources in Science and Technology fields (Points of investigation)
	Special Committee on Science and Technology Basic Plan
4/8/05	Important Policies in the Third Science and Technology Basic Plan-Science and Technology Strategies leading to the era of large-scale intellectual competition - (interim report)

3.1.3.2 Budget for Science and Technology

The Second Basic Plan aims to expand the funding required for the promotion of the measures raised in the Basic Plan based on prioritized and efficient allocation of funding, taking into account future socioeconomic trends, as well as the need for the promotion of science and technology.

In Fiscal 2005, Japan’s budget for science and technology totaled 3.5779 trillion yen. Of this total, the general account budget was 2.9515 trillion yen, while the special account budget was 626.4 billion yen. In the general account budget, the amount sin-

gled out for the promotion of science and technology was 1.317 trillion yen (Table 3-1-7).

Trends in the budget for science and technology by ministry or agency are shown in Table 3-1-8.

Since the administration of science and technology in Japan is spread among a large number of ministries and agencies, there is a need for the coordination of science and technology measures between the relevant ministries and agencies that can eliminate unnecessary duplication and promote stronger cooperation, so as to ensure consistency among ministries as a whole, and to efficiently and effectively promote science and technology.

For this reason, the Council for Science and Technology Policy conducts overall coordination to ensure that important measures stipulated in the Science and Technology Basic Plan are properly and firmly realized throughout Japan, by formulating policies on allocation of the budget, human and other resources related to science and technology and prioritizing science- and technology-related measures of relevant ministries and agencies after budget requests are made. In addition, the Ministry of Education, Culture, Sports, Science and Technology contacts the relevant ministries and agencies each fiscal year, before budget requests for science and technology related expenditures are made, to hear the reasoning behind their budget requests. The ministry then coordinates with the ministries and agencies to eliminate any duplication and to promote inter-ministerial cooperation, as part of government-wide efforts.

Table 3-1-7 Trends in the Science and Technology Expenditures

Item \ Fiscal		2001	2002	2003	2004	2005
Science and Technology Promotion Fund	(A)	11,124	11,832	12,298	12,841	13,170
Percentage increase over the previous year	%	108.6	106.4	103.9	104.4	102.6
Other research appropriations	(B)	7,252	6,697	6,554	16,823	16,345
Percentage increase over the previous year	%	103.5	92.3	97.9	256.7	97.2
Science and technology appropriations from the General Account Budget	(C)=(A)+(B)	18,376	18,529	18,852	29,664	29,515
Percentage increase over the previous year	%	106.5	100.8	101.7	157.4	99.5
Science and technology appropriations from Special Accounts	(D)	16,309	16,915	17,122	6,419	6,264
Percentage increase over the previous year	%	104.5	103.7	101.2	37.5	97.6
Science and Technology Budget	(E)=(C)+(D)	34,685	35,444	35,974	36,084	35,779
Percentage increase over the previous year	%	105.6	102.2	101.5	100.3	99.2
General Account Budget	(F)	826,524	812,300	817,891	821,109	821,829
Percentage increase over the previous year	%	97.3	98.3	100.7	100.4	100.1
General Budget Expenditure	(G)	486,589	475,472	475,922	476,320	472,829
Percentage increase over the previous year	%	101.2	97.7	100.1	100.1	99.3

Notes: 1. Amounts shown for Other research appropriations (B) and Science and technology appropriations from Special Accounts (D) are MEXT's estimates.
2. All amounts represent initial budgets or appropriations for the respective fiscal year.
3. Since amounts have been rounded, the sum of the amounts and percentages for each column and the totals and percentages shown above do not necessarily agree.
4. Of the expenditures related to science and technology in the general accounts budget for FY2004 and FY2005, those for national university corporations, etc. were calculated from the aggregate of subsidies for administrative costs, grants for facility maintenance costs, and self generated income. (The amount corresponds to the science and technology budget in the National Schools Special Account (abolished at the end of FY2003)). The same in Table 3-1-8.
5. Based on policies of the Second Science and Technology Basic Plan, the subjects of calculation were revised starting in FY2001.

Table 3-1-8 Science and Technology Expenditure Breakdown by Ministry and Agency

Ministry or agency	FY2004				FY2005			
	Science and Technology Promotion Fund	Other research appropriations from General Account Budget	Science and technology appropriations from Special Accounts	Total amount of Science and Technology Budget	Science and Technology Promotion Fund	Other research appropriations from General Account Budget	Science and technology appropriations from Special Accounts	Total amount of Science and Technology Budget
Diet	956	77	—	1,033	970	47	—	1,017
Cabinet Secretariat	—	63,169	—	63,169	—	62,457	—	62,457
Cabinet Office	6,416	3,536	—	9,952	8,884	4,776	—	13,660
National Police Agency	2,164	—	—	2,164	2,166	—	—	2,166
Defense Agency	—	185,522	—	185,522	—	144,581	—	144,581
Ministry of Internal Affairs and Communications	51,843	17,902	10,400	80,144	57,831	14,663	10,300	82,793
Ministry of Justice	2,167	—	—	2,167	2,162	—	—	2,162
Ministry of Foreign Affairs	—	10,345	—	10,345	—	10,928	—	10,928
Ministry of Finance	1,196	351	—	1,547	1,193	350	—	1,543
Ministry of Education, Culture, Sports, Science and Technology	810,041	1,318,787	155,164	2,283,991	831,781	1,311,532	162,290	2,305,603
Ministry of Health, Labour and Welfare	107,675	1,660	19,684	129,020	107,835	1,512	19,730	129,076
Ministry of Agriculture, Forestry, and Fisheries	113,436	4,088	1,518	119,042	114,428	3,374	1,300	119,102
Ministry of Economy, Trade and Industry	137,659	44,973	422,697	605,328	142,279	48,998	399,429	590,706
Ministry of Land, Infrastructure and Transport	28,525	25,058	30,116	83,699	26,430	26,615	29,909	82,954
Ministry of the Environment	22,036	6,866	2,334	31,236	21,011	4,709	3,476	29,196
Total	**1,284,115**	**1,682,333**	**641,913**	**3,608,361**	**1,316,971**	**1,634,541**	**626,433**	**3,577,945**

Notes: 1. All amounts represent initial expenditures or appropriations for the respective fiscal year.
2. Since amounts have been rounded off, the sum of the amounts for each column and the totals shown above do not necessarily agree.
3. Overlapping is avoided in total amounts, but some amounts include overlapping expenditures.

3.2 Priority Strategies for Science and Technology

3.2.1 Promotion of Basic Research

Basic research creates human wisdom and is the source of every type of knowledge. It is realized in the steady, serious pursuit of truth and after much trial and error.

Basic research consists of two types: academic research based on the free ideas of researchers in science and technology, including human and social sciences; and basic research that aims at future application based on policies. The former promotes a variety of research activities from the very early stages in the pursuit of universal knowledge from a long-term perspective, aiming to accumulate intellectual achievements to generate new knowledge constantly. Meanwhile, the latter is research activities for policy issues, aiming to create knowledge, a source of discontinuous innovations that can reform the economy and society, toward the achievement of policy goals.

While the results of basic research are not always put into practical use immediately, they are rather accumulated as the common property of all humankind. Therefore, basic research should be widely, steadily, and continuously promoted.

3.2.2 Prioritization of Research and Development in Response to Issues Important to the State and Society

Aggressive and strategic investment in priority sectors and promotion of research and development are essential for ensuring sustained economic development through vitalization of the economy and industry, and for assuring people of safe, secure lives.

The following measures were taken in Fiscal 2005 in line with the Priority Strategies stipulated in the Basic Plan and the "Sectoral Promotion Strategy" (see Figure 3-1-4).

3.2.2.1 Life Sciences

(1) Promotion of Life Sciences

The life sciences aim at elucidating the complex and elaborate mechanisms of biological phenomena produced by living things, and their results contribute greatly to the improvement of people's lives and to development of the national economy, through dramatic advances in medicine, resolutions of food supply and environmental problems, and other areas.

●Efforts toward Industrialization, etc.

To strengthen efforts toward commercialization of the life sciences, the heads of five ministries and agencies (the Director-General of the Science and Technology Agency, Minister of Education, Minister of Health and Welfare, Minister of Agriculture, Forestry and Fisheries, and Minister of International Trade and Industry), based on the "Basic Strategy for the Creation of Bio-technology Industries (July 1999)," implemented the "Millennium Project" from Fiscal 2000 to Fiscal 2004, in order to promote revolutionary advances in personalized medicine for individual characteristics in response to the Aging Society, and to promote environments that offer prosperous and healthy eating habits and secure living. This project was completed with the provision of final evaluations and advice in July 2005.

Furthermore, the Prime Minister's Office established the BT (Biotechnology) Strategy Council in July 2002. This strategy council issued the "Strategies for Development of Biotechnology" in December 2002, detailing three strategies focused on 2010, including: (1) revamping research and development; (2) enhancing the process of industrialization; and (3) ensuring public understanding, and specific action plans for achieving those strategies. At the eighth meeting of the BT Strategy Council in January 2006, follow-ups were implemented for the progress in efforts made after the previous meeting was held in March 2005.

●Strategic life sciences fields

1) Genome-related research

On April 14, 2003, the International Human Genome Sequencing Consortium, a grouping of six countries and 24 institutions from Japan, North America, Europe, and China engaged in sequencing the human genome containing all human genetic information, announced completion of detailed sequencing of the human genome.

Based on the result, the Ministry of Education,

Culture, Sports, Science and Technology started the "Genome Network Project" in Fiscal 2004. This project aims to elucidate basic problems relating to life sciences, elucidate the mechanisms of disease development, and develop new treatment methods by clarifying the network that establishes vital activity mainly through comprehensive analysis of the interactions of biological molecules, etc. In addition, research has been steadily promoted in such fields as the analysis of protein structures and functions related to genome-based drug discoveries, etc., and the development of revolutionary medical tecnologies that make use of individual genome information. In addition, basic research in this sector at universities and colleges has been intensively promoted through the Grants-in-Aid for Scientific Research, and other related programs.

Since Fiscal 2000, the Ministry of Health, Labour, and Welfare has been involved in the Millennium Project, using the elucidation of genes related to dementia, cancer, diabetes, high blood pressure, asthma, and other ailments of the elderly, to promote R&D for the establishment of methods for the prevention and treatment of disease and the development of revolutionary new drugs. Moreover, taking into consideration rapid advances in genomic sciences seen in recent years, research and development has been carried out since Fiscal 2002 into basic technologies (toxicogenomics) that allow rapid and effective prediction of the safety (toxicity, side effects, etc.) of compounds that are candidates for medical products.

The Ministry of Agriculture, Forestry and Fisheries, mainly on the strength of the National Institute of Agrobiological Sciences, had sequenced the full length of the rice genome in the project of the international consortium by the end of Fiscal 2004, while elucidating the functions of various genes through establishment of a method to isolate genes from various organisms. The ministry has also collected many materials and data that are critical for research on elucidation of gene functions. In Fiscal 2005, the ministry commenced a post-genome project entitled "Green Technology Program to Improve Food Supply Capabilities" based on the results achieved in the previous rice genome-related research. In accordance with the program, the ministry is conducting research to improve Japan's food supply capabilities and to create new industries, by putting together a variety of knowledge in genome informatics and developing and demonstrating the efficient breeding scheme (genome breeding technology) that controls the balance of expression of various genes at the genome level.

Furthermore, the Ministry of Economy, Trade and Industry engaged in genome function research and technology development at the National Institute of Advanced Industrial Science and Technology, performed DNA analysis, etc., of industrially useful microorganisms at the National Institute of Technology and Evaluation, and worked through the New Energy and Industrial Technology Development Organization to utilize private-sector vitality to pursue technology development for the analysis of genetic information. In Fiscal 2001, analysis of the complete human cDNA[1] structure led to the identification of about 30,000 new human genes, and these genes are now distributed by the National Institute of Technology and Evaluation, with analysis of those genes now in progress.

At the Ministry of the Environment, the independent National Institute for Environmental Research is researching the utilization of genome technology in research for the preservation of biological diversity, and also into the health effects of toxic chemical substances.

a) Promotion of protein structural and functional analyses

Analysis of protein structure and molecular function is one of the most important fields in post-genome research, because the research results can link directly to applications in medicine or to uses in industry.

Toward the goal of developing genome-based drugs in Japan, the Ministry of Education, Culture, Sports, Science and Technology utilized such facilities as the world's largest NMR (Nuclear Magnetic Resonance) facility and SPring-8 (the Large-Scale Synchrotron Radiation Facility) to bring together researchers from industry, academia, and government into the "Protein 3000 Project," to elucidate the structures and functions of one-third

[1] cDNA: abbreviation for "complementary DNA (or complementary deoxyribonucleic acid)." The term denotes DNA synthesized by using reverse transcriptase in a template for messenger RNA (m-RNA). cDNA consists only of the gene regions of the DNA, so that a complete cDNA encompasses all information about a single gene.

(about 3,000) of the approximately 10,000 basic protein folds known to exist, and to transfer the research results, to include patenting the results to industry in Fiscal 2002. By October 2005, a total of 2,738 structures had been confirmed.

The Ministry of Health, Labour and Welfare is promoting research and development into the elucidation of the functions and interactions of proteins affiliated with disease, in order to improve prevention and treatment performance for cancer and heart attacks, the two main causes of death for employment age

Japanese, as well as for such illnesses as strokes, dementia, and bone fractures that are a major source of demand for nursing care.

The Ministry of Economy, Trade and Industry has brought researchers from industry, academia, and government to the Japan Biological Information Research Center at the National Institute of Advanced Industrial Science and Technology to engage in "analysis of the three-dimensional structures in biological molecules," specifically, R&D into the structural analysis of membrane proteins believed to play particularly important roles in the body, and into the "analysis of protein functions" for the analysis of newly discovered human genes using results obtained from analysis of the total human cDNA structure.

b) Promotion of bio-informatics

Recent research into the genome sciences has made available vast volumes of genome-related information, necessitating the appearance of the new field of bio-informatics, an integration of the life sciences and IT (Information Technology) sectors, as a way to utilize this information.

In the Ministry of Education, Culture, Sports, Science and Technology, the Institute for Bio-informatics Research and Development (BIRD) at the Japan Science and Technology Agency is actively engaged in the upgrading, standardization, and expansion of databases, as well as in the development of genome analysis tools with the cooperation of researchers in both the biology and information technology sectors. The ministry is also promoting the development of the DNA Data Bank of Japan (DDBJ), one of the three largest of its kind in the world, under the operation of the National Institute of Genetics, and other genome-related databases. Furthermore, the Special Coordination Fund for Promoting Science and Technology is being utilized to implement programs related to personnel development in the bioinformatics field, with funding targeted at universities and colleges.

In Fiscal 2000, the Ministry of Economy, Trade, and Industry commenced building a H-invitational database (comprehensive database), which includes independently obtained data and advanced search and analysis tools, to enable utilization in research and industrialization of the vast amounts of biotechnology-related data and achievements obtained from the Millennium Project. The database has been made public and further expanded since Fiscal 2004. In addition, the ministry commenced the "Project for Analysis of the Gene Diversity Model" in Fiscal 2000 (based on the supplementary budget) to implement the development of software that will make it possible to conduct efficient searches for genes related to disease, based on micro-satellites, SNPs[2], and other polymorphic gene information.

c) Promotion of gene polymorphic research

Various ministries are engaged in the promotion of research and development for the elucidation of the causes of diseases, with the goal to create more effective medicine suited to specific individuals.

The Ministry of Education, Culture, Sports, Science and Technology, for example, has been conducting the "Project for Realization of Medicine in Response to Individual Genetic Information" since Fiscal 2003. The ministry, with the cooperation of many other medical institutions, performed collection of DNA/serum samples and clinical information from targeted patients for the development of a bio-bank, and, since Fiscal 2005, by using these samples, it has been conducting full-scale research for the elucidation of the relationship between SNPs diseases, drug responsiveness, and side-effects. The RIKEN SNP Research Center made the greatest contribution to the International HapMap Project (Japan, the U.S., the U.K., France, China) among the participating organizations, and released the research results on the JSNP database.

[2] SNPs: abbreviation for Single Nucleotide Polymorphisms. It refers both to the expression of base sequences on the genome that vary according to race or individual (such as the difference between a healthy individual and a sick person), and to the corresponding area on the genome.

Furthermore, the Center has been promoting research on the elucidation of the causes of diseases, in cooperation with the HapMap Project.

In the Ministry of Economy, Trade and Industry, joint examination of the SNPs data by the Institute of Medical Science of the University of Tokyo and the Bio-Industrialization Consortium (JBiC), in the form of analysis of gene polymorph frequencies (allele frequency analysis), was completed in Fiscal 2002. Currently, data about SNP locations is being issued using the JSNP database.

The Ministry of Health, Labour and Welfare is promoting searches for gene polymorphs for disease-related genes and drug-reactive genes related to dementia, cancer, diabetes, high blood pressure, asthma, and other ailments.

In Fiscal 2002, the Ministry of Agriculture, Forestry and Fisheries commenced the development of SNP markers in agricultural crops for the purpose of developing effective crop breeding and nurturing systems that make use of gene polymorphs.

2) Promotion of brain sciences research

Brain science is expected to lead to results that improve the quality of life, as well as to improved medical science and to the creation of new technologies and industries. The resulting efforts have greatly strengthened Japan's brain sciences research, which is divided broadly into the four fields of "understanding the brain," "protecting the brain," "creating the brain," and "strengthening the brain" through research and development that makes maximum use of the many universities and national research institutions that extend beyond the bounds of individual ministries and agencies.

The Ministry of Education, Culture, Sports, Science and Technology is promoting research at the Brain Science Institute at RIKEN, through the utilization of Grants-in-Aid for Scientific Research and competitive research funds by the Japan Science and Technology Agency, for the priority promotion of brain science research at universities and colleges. Since Fiscal 2005, the ministry has been developing information infrastructure including an enormous amount of research results in brain neurochemistry, while promoting neuroinformatics to provide the results for researchers around the world as part of its international cooperation. In order to clarify the impact that a social and living environment has on peoples' minds, bodies and language development, the Japan Science and Technology Agency started to collect and analyze the data for infants gained through questionnaires and action observation by experts, in three prefectures: Osaka, Mie, and Tottori..

Activities at other ministries and agencies include the Ministry of Health, Labour, and Welfare's efforts to promote research on the elucidation of nervous and muscular system disorders such as Parkinson's disease, and mental system disorders such as Alzheimer's disease, higher-brain dysfunction, schizophrenia, and depression and on the development of methods of treatment, while the Ministry of Agriculture, Forestry, and Fisheries is engaged in research on brain and nervous system functions in animals, and the Ministry of Public Management, Home Affairs, Posts and Telecommunications is engaged in research into the elucidation and application of info-communication functions in living organisms.

Furthermore, the "Human Frontier Science Program" (HFSP), which was first proposed by Japan at the Venice Summit of advanced nations in June 1987, operates based on the principles of "internationality," "interdisciplinarity," and "encouragement of young scientists," to provide subsidies within an international framework for research that contributes to the elucidation of brain functions and other complex.mechanisms of living organisms

3) Promotion of research on development, differentiation, and regenerative Science

Research into development, differentiation, and regeneration in biological system aims to elucidate the mechanisms, etc. relating to the process in which one cell differentiates into various tissues or organs to form and maintain an individual. This serves as a basis for regenerative medicine, which is expected to lead to treatment for diseases that are now difficult to cure. The research of this field brings about rapid advances in stem cell research and establishment of technology for producing Embryonic Stem (ES) cells in recent years.

The Ministry of Education, Culture, Sports, Science and Technology is conducting research at the RIKEN Center for Developmental Biology. Moreover, in Fiscal 2003, the ministry launched the "The Project for Realization of Regenerative Medicine" and has been promoting research towards developing a stem cell bank as research infrastructure in

order to provide stem cells for researchers, and applying the results of basic research to clinical areas.

Furthermore, to contribute to the realization of regenerative medicine, the Ministry of Health, Labour, and Welfare is promoting research focusing on clinical aspects in transplant and regenerative medicine.

The Ministry of Economy, Trade and Industry is promoting development of equipment in support of practical applications of regenerative medicine.

4) Promotion of plant science research

Advances in genome science have also led to progress in the analysis of plant genome structures and functions. Control of plant functions based on these results is expected to lead to the development of plants that can contribute to improvements in eating habits, etc.

Rice genome research is important for laying the foundations for research into the major cereals and other crops. The Ministry of Agriculture, Forestry and Fisheries is currently promoting the Second Phase of the "Rice Genome Project," which involves the reading of all DNA base sequences for the rice genome, and the elucidation and patenting of the functions of useful genes, which are efforts that have attracted worldwide acclaim.

The Ministry of Agriculture, Forestry and Fisheries commenced post-genome sequence research even as the base sequence readings were continuing. In Fiscal 2005, the ministry launched the "Green Technology Program to Improve Food Supply Capabilities" in order to elucidate the functions of useful plant genes and gene networks, and has been promoting, based on the achievements of that program, the creation of a leading model system for stable food supply, as well as the establishment of technologies for efficient breeding of useful varieties.

The Ministry of Education, Culture, Sports, Science and Technology is promoting research to improve plant productivity in terms of both quality and quantity, through the genome sequencing of Arabidopsis thaliana etc. at the RIKEN Plant Science Center. Additionally, in plant research, a full-scale foundation for functional analysis, network analysis and metabolome analysis[3] has been developed, enabling Japan to catch up with the United States and Europe in terms of the level of research carried out.

In order to develop basic technologies to produce useful materials such as industrial raw materials using plant functions, the Ministry of Economy, Trade and Industry is implementing the analysis of routes and functions of substance production systems using plants and the development of databases to store the analysis results at the New Energy and Industrial Technology Development Organization.

5) Preparation of bioresources

The field of bioresources is not limited to the mere preservation of genetic resources, but also plays an important role in exploring new areas of research. The national interest is served in the development, collection, storage, and provision of bioresources.

In Fiscal 2002, the Ministry of Education, Culture, Sports, Science and Technology instituted the "National BioResource Project" for the purpose of establishing a system facilitating the systematic collection, storage, and provision of bioresources that are of particular strategic importance to the nation, such as experimental animals and plants (such as mouse clones), various cells, and genetic data from various life forms.

At the Ministry of Health, Labour, and Welfare, the National Institute of Biomedical Innovation joined to establish a Master Bank (in Fiscal 2001, these two institutions began setting up the Pharmaceuticals Basic Technology Research Facility toward an eventual merger) for the collection and preservation of human and animal-derived cultured cells and genes needed for use in research in medical and pharmaceutical fields. The supply of cultured cells and genes is made through the Japan Health Sciences Foundation to researchers and other personnel. The foundation has also commenced distribution of human tissue with careful consideration for bio-ethics issues. It also collects, stores, and supplies medicinal plants, and breeds and supplies kanikui-zaru monkeys and other animals used for medical testing.

[3] Metabolome analysis involves the identification and quantification of all metabolites generated by enzymes in a cell, and correlating these with genome functions.

In the Agriculture, Forestry, and Fisheries Ministry, the Gene Bank Project collects, classifies, and identifies all plants, animals, microorganisms, trees, marine life, and other bioresources utilized in the agricultural, forestry, and fisheries industries. The project also conducts evaluations of characteristics, and propagates and preserves specimens. It provides bioresources and information about those resources to the national research institutes, the independent administrative institutions, the private sector, universities, etc. The ministry also promotes maintenance of genome resources that are the results of rice genome research, as well as storage and provision to the private sector, universities and colleges.

In addition, the Ministry of Economy, Trade and Industry established the NITE Biological Resource Center at the National Institute of Technology and Evaluation as Japan's core bioresource organization for microorganisms, etc. The Center engages in the collection and preservation of biogenetic resources. It also sorts out information related to bioresources (information regarding systematic identification, base sequence, and gene functions, etc.), and project to create a gene resource library for unknown microorganisms, for the purpose of promoting industrial utilization of microorganisms. Furthermore, in order to ensure access to biogenetic resources overseas and thereby promote the industrial utilization of the resources in Japan, the Center has transferred the resources to Japan, in accordance with the Convention on Biological Diversity and based on agreements concluded with other Asian countries concerning the utilization of microorganisms. It is also implementing the development of a system for collecting and utilizing various microorganisms overseas, through promotion of an Asian consortium for preservation and utilization of microbial resources in Asia, as well as enhancement of the system for cooperation with resource-rich countries.

The Ministry of Environment instituted the "Environmental Sample Time Capsule Project" in Fiscal 2002 for the purpose of preserving the cells of wildlife threatened with extinction. In addition, the independent National Institute for Environmental Research is engaged in the collection, preservation and supply of algae, and in building an algae database.

6) Promotion of R&D in food sciences

Building a stable and sustainable production and distribution system for agricultural, forestry, aro-moting the development of functional foods that can contribute to improving the people's health are essential if Japan is to be able to maintain food security and to guarantee an abundant food supply.
For this purpose, the Ministry of Agriculture, Forestry and Fisheries continues to promote the quality of wheat, soybeans, and vegetables, to improve food self-sufficiency, and as a response to the recent sharp rise in imports of raw vegetables, to develop superior new crops resistant to diseases and pests and rich in nutrition and functional constituents, and new agricultural, distribution methods and processing technologies, as well as to develop cloning and other animal husbandry-related technologies, and technologies for the difficult production of young marine organisms using artificial cultivation. Moreover, to promote food safety and security, the ministry is upgrading technologies for the detection of toxic microorganisms, and developing technologies for DNA identification of species types. For control of Bovine Spongiform Encephalopathy (BSE), the ministry is engaged in the elucidation of the shape and characteristics of prion proteins, and in the development of diagnostic technologies. Moreover, the ministry is engaged in the development of basic technologies useful for the diagnosis and prevention of outbreaks within Japan of diseases shared by humans and animals, both to assuage the people's concerns, and to reduce the effects of such outbreaks on the livestock and poultry industries. Since Fiscal 2005, the ministry has been promoting the development of safe and trusted technologies to produce livestock products for the purpose of reducing the usage of antibiotics, as well as the development of soil conditioning technology for potatoes[4] and seed planters for rice, oats, and soy beans, in order to establish an efficient multiple cropping system. In addition, the ministry is accelerating research into the elucidation of bio-regulatory functions through combinations of foodstuffs capable of contributing to the development of new functional foods, as well as supporting the development of technologies for the use of bio-markers (simple biological indices) in the

[4] Soil conditioning technology for potatoes is a method for cultivating crops, and contributes to developing an appropriate growing environment for potatoes and reducing the amount of work on selecting stones in harvesting by removing the stones from the ground just before planting the potatoes.

scientific evaluation of food efficacy, and the development of production technologies for food that is efficacious at maintaining health.

With the outbreak of various incidents that threaten food safety and the enactment of the Basic Law on Nutritional Education, people are highly concerned with nutrition, and the guarantee of trusted and safe food products has become an important issue to be addressed. In order to expand, improve, and enhance food safety measures, with regard to additives, pollutants, chemical substances, residual pesticides, microorganisms, Bovine Spongiform Encephalopathy (BSE), health products, and food products derived from modern biotechnology, the Ministry of Health, Labour and Welfare has been promoting research on new factors that may cause damage, investigative research to formulate standards, and research and development towards establishing an official method of examination, while reflecting the achievements in risk control measures. Furthermore, the ministry has also conducted research on health risk control including countermeasures against food poisoning and food terrorism.

7) Promotion of cancer-related research

Since cancer accounts for about 30% of total deaths in Japan, the "Third Comprehensive Ten-Year Strategy for Cancer Control" (ratified by the Minister of Education, Culture, Sports, Science and Technology and the Minister of Health, Labour and Welfare in June 1993) was formulated as a new 10-year strategy that started in Fiscal 2004. Based on this strategy, researchers in Japan are promoting the elucidation of the essential elements of cancer, and of new prevention, diagnostic, and treatment methods that utilize these research results.

Under this 10-year strategy, since Fiscal 2004, the Ministry of Education, Culture, Sports, Science and Technology has been promoting the "Cancer Translational Research Program" as bridging research to apply the excellent results of basic research relating to cancer immunotherapy and molecular-targeted therapy clinically. Futhermore, the National Institute of Radiological Sciences is acting under this 10-year strategy to perform clinical trials of a heavy ion medical accelerator that is expected to become a revolutionary new treatment method for particularly difficult-to-treat cancers.

The Ministry of Health, Labour and Welfare, meanwhile, is engaged in the development of a helical CT that will be useful in the early detection of lung cancer, and in the development of safe cancer treatment methods using endoscopes that reduce the burden on the patient.

Since Fiscal 2005, the Ministry of Economy, Trade and Industry has been developing molecular imaging equipment to identify changes in cell functions and enable the very early detection of cancer, as well as equipment to combat cancer cells only.

8) Promotion of research on immunologic and allergic diseases

It is necessary to comprehensively promote research in the area of the immune system, allergies, and infectious diseases with the aim of achieving eradication of hay fever, rheumatoid arthritis, and other immunologic and allergic diseases, which many people desire, and coping with infectious diseases, which are still a national health threat.

The Ministry of Education, Culture, Sports, Science and Technology engages in research for the basic and comprehensive elucidation of immune systems at the RIKEN Research Center for Allergy and Immunology. With respect to infectious diseases, the ministry has been promoting research and development that targets the suppression of Severe Acute Respiratory Syndrome (SARS) and other infectious diseases by utilizing the Special Coordination Funds for Promoting Science and Technology. In Fiscal 2005, the ministry commenced the "Program of Founding Research Centers for Emerging and Reemerging Infectious Diseases" and has been accumulating basic knowledge and fostering personnel to enable the prompt development of countermeasures against emerging and reemerging infectious diseases, through improvement of domestic and overseas research centers and the promotion of joint research conducted mainly at the centers.

The Ministry of Health, Labour and Welfare is promoting research in the sectors of emerging and reemerging infectious diseases, measures against HIV/AIDS, measures against hepatitis, and immunologic and allergic diseases. The ministry is also conducting research on broad-ranging infectious diseases in a leading, unique and comprehensive manner at the National Institute of Infectious Diseases. In addition, the ministry established a clinical research center at the National Hospital Organiza-

tion Sagamihara National Hospital, aiming at the elucidation of immunologic and allergic diseases, and the development of treatment methods. The center's research is currently concentrated on clinical aspects.

Incidentally, the RIKEN Research Center for Allergy and Immunology and the National Hospital Organization Sagamihara National Hospital has made a joint research agreement, and are promoting efficient research through collaboration between the basics and clinical applications.

The Ministry of Agriculture, Forestry and Fisheries is promoting comprehensive research on the control of Bovine Spongiform Encephalopathy (BSE), highly pathogenic avian influenza (Bird Flu) and other infectious diseases shared by humans and animals at the National Agriculture and Bio-oriented Research Organization.

9) Promotion of research and development in interdisciplinary areas

Since Fiscal 2003, the Ministry of Education, Culture, Sports, Science and Technology has been conducting the Cell / Biodynamics Simulation Project, with the aim to simulate the analysis of drug responsiveness and animal tests conducted by using living bodies and cells, based on life information technology and advanced imaging technology.

The ministry commenced the Molecular Imaging Research Program[5] in Fiscal 2005, and has been promoting research to establish the world's most advanced molecular imaging technology that will allow people to visually see the quantity and functions of molecules in a living body. In fact, the technology is expected to serve as a tool for the early detection of cancer and other diseases, identification of drug kinetics, and evaluation of drug effects. The ministry aims to establish an innovative method of diagnosing diseases, shorten drug disco very processes, and reduce costs related to drug disovery, through the establishment of a national-scale R&D system.

10) Promotion of other research and development

Because living things are generally efficient at en ergy conversion, consuming little energy for reactions at normal temperatures and pressures, the Ministry of Economy, Trade and Industry has promoted the "Program for Creation of Recycling-Type Industrial Systems Using Bio-Functions" to develop the basic technologies required for effective utilization of bio-functions based on genome information, and for their expanded use in recycling-oriented industrial systems that are energy-saving and eco-friendly.In regard to research on sugar chains, which are believed to play important roles in a vast array of biological functions, the Ministry of Education, Culture, Sports, Science and Technology is using the Grant-in-Aid for Scientific Research and Basic Research Programs to promote sugar chain research at universities and colleges. The Ministry of Economy, Trade and Industry is promoting research and development into automatic devices for synthesizing sugar chains as well as structure analysis devices, and of the analysis of functions for the general acquisition of genes related to sugar chain synthesis.

With respect to research and development in life science, basic research is being promoted at universities and colleges, with the provision of Grants-in Aid for Scientific Research Program. Utilizing and strengthening the excellent research capabilities of certain regions can be effective for promoting research and development in the life sciences sector. In this regard, the government's Urban Renewal Office decided in August 2001, in "Urban Renewal Project No.2," on the "formation of an international center for life sciences in the Osaka region." This action was followed in July 2002, in "Urban Renewal Project No.4," with the "formation of an international center for genome sciences in the Tokyo region." In line with these decisions, the Ministry of Education, Culture, Sports, Science and Technology has promoted research at universities and colleges, and worked to form life science research sites and to build systems that link the research sites with each other. In addition, the Ministry of Health, Labour and Welfare is promoting the development of core research institutions in the Osaka region for infrastructure technology toward the development of revolutionary new pharmaceutical products, etc.
The major life science research projects implemented in Fiscal 2005 are shown in Table 3-2-1, by ministry or agency.

[5] The Molecular Imaging Research Program aims to search candidate substances for drug discovery and to conduct innovative R&D activities to improve the diagnosis of diseases, through the development of a foundation to promote molecular imaging research and the establishment of a core research center for domestic molecular imaging research.

Table 3-2-1 Major research subjects in life sciences (FY2005)

Ministry or Agency	Research institute or program	Subject
National Police Agency	National Research Institute of Police Science	・Study into a new personal identification system using information obtained from biological samples
Ministry of Internal Affairs and Communications	Program for Promoting Strategic Information and Communications Research and Development National Institute of Information and Communications Technology	・Research into elucidating and applying the info-communications functions of living organisms ・Research into a communication-friendly society
Ministry of Finance	National Research Institute of Brewing	・Research and development in the manufacturing process for alcoholic beverages. ・Research into alcoholic beverages. ・Research into brewing-related microorganisms.
Ministry of Education, Culture, Sports, Science and Technology	RIKEN (The Institute of Physical and Chemical Research)	・Promotion of bioresource projects ・Promotion of comprehensive research into brain science ・Promotion of comprehensive research into genome science ・Promotion of plant science research ・Promotion of comprehensive research into developmental and regenerative science ・Promotion of varied genetic research ・Promotion of immunological and allergy research
	Japan Science and Technology Agency	・Promotion of bio-informatics ・Promotion of research using competitive funding
	National Institute of Radiological Sciences	・Promotion of research and development for upgrading heavy particle therapy of cancer
	Japan Agency for Marine-Earth Science and Technology	・Promotion of Frontier Research System for Extremophiles, etc.
	Japan Aerospace Exploration Agency	・Research into medical science, etc., related to space
	Universities and colleges	・Research into the overall promotion of cancer research ・Basic research into carcinogenesis and the prevention of carcinogenesis ・Research into the biological aspects of cancer ・Diagnosis and treatment of cancer ・Research into human cancers, and epidemiological research into host factors ・Strategic and advanced research into cancer ・Comprehensive genome research toward the elucidation of living systems ・Genomic analysis of hereditary factors, and the elucidation of abnormal molecule conditions in human diseases ・New developments in genomic biology toward the elucidation of cellular systems ・New developments in genome informatics ・Advanced research into brain science ・Molecular foundations for the appearance of infection, and host response
	Special coordination funds for promoting science and technology	・Rapid searching of important traits in full-length complementary DNA of rice plants ・Construction of a comprehensive database of diseases and molecular pathogenesis ・Strategical prevention with mucosal adjuvant biogenic substances ・Chaos analysis and science of “pulse diagnosis” in Chinese Medicine ・Research into alternative medicine, especially multidirectional scientific evaluation methods for Chinese medicine and acupuncture ・Development of evaluation methods for alternative medicine using gene expression analysis ・Master of Clinical Biomedical Science Program Course ・Biomedical Omics Informatics Educational Program ・Genetic counselor and coordinator Unit ・Life Information Science Technologist Training Unit ・Advanced Medical Engineering and Information Science Technologist Reeducation Unit ・Development of novel SQAG radiotherapy sensitizer ・Protein Manipulation ・Development of models for human immune disease in marmosets ・Construction of Asian international network for cell storage of avian species ・Development of pluralism and universal norm of bioethics ・Research and study into database integration of life science ・Organism elucidation and genomic analysis of virus in wild birds
	HFSP (Human Frontier Science Program) (Note)	・International joint research for the elucidation of the complex mechanisms of living organisms

Ministry or Agency	Research institute or program	Subject
Ministry of Health, Labour and Welfare	Health and labour sciences research grants	・Third comprehensive research on strategy against cancer ・Comprehensive research on aging and health ・Research on the human genome, tissue engineering ・Research on psychiatric and neurological diseases and mental health ・Research on emerging and re-emerging infectious diseases ・Research on HIV/AIDS ・Research on sensory and communicative disorders ・Research for the eradication of intractable diseases ・Research into assuring and promoting reliability and safety of food ・General research for development of policy drugs ・Research on allergic disease and immunology ・Research on proteomics ・Research on toxicogenomics ・Research on analysis, support, and alternative medical devices for physical functioning ・Research on promotion of clinical application of translational research results
	National Institute of Infectious Disease	・Research into gene recombinant vaccines, etc. ・Research into the development of vectors related to gene treatment, safety evaluations, etc. ・Research into AIDS, Hansen's disease, etc. ・Research into methods for the diagnosis, prevention, and treatment of SARS and other infectious diseases
	National Institute of Health Sciences	・Research into standard test methods, quality evaluation methods, etc., for pharmaceuticals ・Research into assuring the safety of food, chemical substances, living environment, etc. ・Research into safety information on drugs, food, chemical substances, etc.
	National Institution of Industrial Health	・Study on work environment management for irregular work using organic solvents ・Comprehensive research on occupational stress of elderly workers ・Research on genetic factors that determine sensitivity to adverse factors in the work environment
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Bio-oriented Research Organization, National Institute of Agrobiological Sciences, etc.	・Integrated research for providing fresh and delicious "Brand Nippon" agricultural-products ・Development of technology for reducing the impact on the environment using biofunction ・Development of technologies for the suppression of Bovine Spongiform Encephalopathy (BSE), and diseases shared by humans and animals ・Development of safe and secure manufacturing technologies for animal products ・Development of the techniques for seed production in the Japanese eel and spiny lobster ・Development of a comprehensive management system of hazardous chemicals in agricultural, forestry and fisheries ecosystem ・Genome-wide analysis of spatial and temporal gene expression in rice panicle development ・Development of DNA marker-aided selection technology for plants and animals ・Development of efficient technology for breeding specific kinds by genome breeding ・Accelerate research of the livestock industrial genome ・Insect Technology Research for Utilization of the Greatest Unused Resources of the 21st Century

Ministry or Agency	Research institute or program	Subject
		・Comprehensive research into food safety and functionality ・Development of isolation and utilization technologies for useful genes obtained through animal genome analysis ・Assurance of Safe Use of Genetically Modified Organisms ・Development of stable production technology of cloned animals by somatic cell nuclear transfer ・Technical development for the establishment of a high productivity area rotation-of-crops system ・Elucidation of animal (livestock, insect) behavioral mechanisms, and the development of control technologies ・Surveys and research into local agricultural methods using special resources ・Expenses required for the promotion of research into the prevention of invasive insect pests ・Elucidation of the effects of climate warming on crops and animal husbandry, and the development of technologies to control those effects ・Evaluation of the effects of organic farming on the soil environment, and the certification of environmental conservation effects ・Elucidation of the mechanism for outbreaks of mastitis, and the development of preventive technologies ・Comprehensive research into the creation of new agriculture, forestry, and fisheries products by modifying morphological and physiological functions ・Development of new weed control technologies that utilize plant metabolism genes ・Establishment of useful substance production systems using plants, animals, and insects ・Gene bank project
	Private sector, universities, etc.	・Development of technologies for assuring food safety and security ・Development of technologies for the promotion of "Brand Japan" processed food supplies ・Development of efficient plant breeding and growing systems that utilize genetic information ・Development of new separation and extraction technologies in the food industry ・Development of health-oriented food evaluation and production technologies using the life sciences ・Development of next-generation fermentation technologies in the food industry
Ministry of Economy, Trade and Industry	New Energy and Industrial Technology Development Organization	・Development of basic technologies for production processes using biological functions ・Elucidation of useful protein functions, utilizing human genome information and its analysis tools ・Development of information technology required for DNA analysis, disease prevention, etc. ・Development of technologies for the synthesis and structural analysis of sugar chains ・Construction of a gene resource library for unknown micro-organisms based on genome information ・Development of tools for analysis of biomolecules through the use of nanotechnology ・Development of high-safety technologies for the differentiation and cultivation of a mass volume of artificial cells and tissues enabling regenerative medicine ・Analysis of the three-dimensional structures of physiological macromolecules of membrane proteins ・Development of technologies for the analysis of intracellular network dynamism ・Development of bioinformatics-related databases ・Development of technology for model analysis of gene diversity ・Behavior-based human environment creation technology
	National Institute of Advanced Industrial Science and Technology	・Construction of a neural network and development of new information processing technology based on its functions ・Age-dimension technology program for creating a healthy and productive society ・Identification of stress markers and evaluation of its usefulness
	HFSP (Human Frontier Science Program) (Note)	・International joint research for the elucidation of the complex mechanisms of living organisms
Ministry of the Environment	National Institute for Environmental Studies	・Development and verification of an in vivo model that comprehensively evaluates the effects of environmental pollutants on superior function ・Studies on application of toxicogenomics for risk assessment of environmental pollutants

Note: Funding provided by the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Economy, Trade and Industry.

●Coordination program for science and technology projects

In post-genome research and research on emerging and re-emerging infectious diseases, the Cabinet Office is implementing the "Coordination Program for Science and Technology Projects," with the aim to remove the negative effects of sectionalism such as unnecessary overlan and to enhance collaboration among relevant ministries and agencies. In the program, the Cabinet Office has promoted the following research projects that should be carried out as supplementary measures taken by ministries and agencies in fiscal 2005: the "Research and Studies on the Integration of Life Science Database" (for the post genome research); and the "Research on the Migratory Routes of Wild Birds Involved in Spreading Virus, Research on the Pathogenic Organisms of the Wild Birds, and Relevant Database Construction" (for the research on new or revived infectious diseases.)

(2) Efforts for Bioethical Issues and Safety

●Efforts for bioethical issues

Rapid developments in the life sciences in recent years have given rise to expectations of revolutionary achievements in the fields of medicine and elsewhere.Therefore, to cope with these issues appropriately, the Expert panel on Bioethics , established under the Council for Science and Technology Policy (CSTP), are now engaged in surveys and examinations of specific important issues concerning bioethics, while the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare and other ministries are preparing the relevant laws, regulations, and guidelines and conducting other activities.

Regarding human cloning technology, the Ministry of Education, Culture, Sports, Science and Technology has taken measures prohibiting the production of human clone individuals under the Law Concerning Regulation Relating to Human Cloning

Techniques and Other Similar Techniques (Year 2000, Law No.146) and prohibiting the creation and utilization of human clone embryos for the time being under the guidelines based on the said law.

The Expert Panel on Bioethics under the CSTP has discussed the handling of human fertilized embryos and cloned human embryo since August 2001 according to the provisions of the said law. Consequently, in July 2004, the CSTP compiled a statement of opinions to related office and ministries concerning the "Basic Conceptual Approach Relating to Treatment of Human Embryos." This statement permitted, for research purposes and with limitations, the creation and utilization of human clone embryos and human fertilized embryos, and requested the development of a framework to ensure the proper treatment of embryos. In response to this, the Working Group on the Studies and Utilization of Human Clone Embryos established under the Ministry of Education, Culture, Sports, Science and Technology is examining the treatment of human clone embryos. The Expert Committee on Medical Technology for Reproductive Treatment and the Expert Committee on Research on Human Embryos, established respectively under the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labour and Welfare, is holding discussions on the treatment of human fertilized embryos for the purpose of research into assisted reproduction technologies at joint committee meetings.

In the area of human Embryonic Stem (ES)[6] cell research, the Ministry of Education, Culture, Sports, Science and Technology has conducted examination of research plans under the guidelines formulated in 2001 and has reviewed compliance with the guidelines for one derivation plan and 32 utilization plans so far.
Elsewhere, in the areas of human genome and gene sequencing research, epidemiological research[7] or clinical research, respect of human dignity and suitable management of personal information are required. Therefore, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare and the Ministry of Economy, Trade and Industry are cooperating for the appropriate promotion of research based on the guidelines[8].

[6] Human Embryonic Stem (ES) cells: these primordial cells have attracted high expectations for medical applications because of their capability of differentiating into all parts of the human body. At the same time, however, sacrificing human embryos would raise ethical concerns.
[7] Epidemiological Research: scientific research that clarifies causes of a disease by investigating the frequency and geographical distribution of disease incidence and other factors related to human health
[8] Ethical Guidelines for Human Genome and Gene Analysis, Ethical Guidelines for Epidemiological Research, and Ethical Guidelines for Clinica Research

In August 2005, the Special Committee on Guidelines in the 21st Century for the Life Science and Bioethics, Science Council of Japan announced the results of examining various issues related to bioethics, in the form of the"On the foundation for the respect for 'life' and the respect for 'mental well-being' ~ a social system to develop a new set of bioethical values ~."

●Efforts to ensure safety in the life sciences

Recombinant DNA technology is applied to a broad range of fields, from basic biological research to the production of pharmaceuticals and improvement of agricultural crops, however, one of its characteristics is its application of new properties to living organisms. For this reason, the ensuring of appropriate use of living modified organisms, etc. has been aimed at based on the Law Concerning the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms (Year 2003, Law No. 97), which stipulate the measures necessary to prevent adverse effects on biodiversity due to the utilization of living modified organisms. As some organizations illegally utilized living modified organisms after the Law was enforced, written warnings were issued to the organizations, and briefing sessions were held, aimed at thorough compliance with laws and ordinances.

For clinical research aimed at the establishment of gene therapy[9], the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labour and Welfare are making efforts for the appropriate promotion of research based on the Guidelines for Gene Therapy Clinical Research.

3.2.2.2 Information and Commnications

Promotion of research and development in the information and communications sector not only brings about innovative results in many other areas of research and development but also contributes to the creation of new industries and development of existing industries. In addition, as can be seen from the dissemination of mobile phones and computers, information and communications technology has become essential for a wide variety of activities in our daily life, and is an important foundation that enables people to live safely, comfortably and with confidence.

●A society served by ubiquitous networks, and building a High-Speed, Highly Reliable Information Communication System for the creation of a world market

Society demands that Japan swiftly return research results to society and to the economy by constructing a "high-speed, highly reliable information communication system" with unified hardware and software and strong cooperation among industry, academia, and government ahead of the rest of the world, centered around superior technologies (information appliances, mobile, optical, device technologies, etc.).

For specific research and development topics, the Ministry of Internal Affairs and Communications is engaged in "R&D on ubiquitous network technologies," involving research and development into technologies for real-time verification from extremely large numbers of terminals, and into technologies for the control of network channels.

The Ministry of Education, Culture, Sports, Science and Technology is promoting the "R&D project for Basic Technology Supporting Safe Ubiquitous Society," established to conduct research and development on the following basic technologies supporting an ubiquitous environment that allows people to exchange information safely and with peace of mind: electronic tags equipped with security functions of higher performance and larger capacity; and built-in basic software that ensures safety.

The Ministry of Economy, Trade and Industry is engaged in the "business grid computing project," which aims for the development of infrastructure software allowing multiple network-linked computers or memory devices to function as if they were a single computer, toward the realization of the goal of a highly reliable, safe-to-use social IT infrastructure.

[9] Gene therapy: a treatment method that involves the insertion of genes, or cells containing genes, into the bodies of patients for the purpose of treatment of disease. It is not an established method of treatment at present, but is practiced as one aspect of clinical research

●Information and communication technologies that lead to next-generation breakthroughs and the seeds of new industries

Society demands the promotion of research and development into advanced information and communication technologies carried out in cooperation with interdisciplinary sectors, like next-generation human interface technologies, next-generation information and communication technologies that make use of quantum engineering and other new principles and technologies, such as space development (communications),nanotechnology, and bioinformatics.

In order to exceed the limit of existing supercomputing technologies, the Ministry of Education, Culture, Sports, Science and Technology is promoting the "R&D Project for Elemental Technologies for Future Supercomputing" to conduct research and development on basic technologies that relate to hardware with large spillover effects and that require future breakthroughs.

The Ministry of Economy, Trade and Industry is promoting a variety of projects such as: the "Project for the Practical Application of Next-Generation Robots" to conduct demonstration tests, at the 2005 World Expo Aichi, on nine types of robots (project for promoting the development of practical systems) and 65 types of prototype robots (project for promoting the development of prototypes) in areas of living and welfare; the "Project for Practical Application of Human Support Robots" to implement the development and demonstration testing of technologies for the practical application of robots, which are designed to serve a specific person and are required to have high-level safety and operative flexibility; and the "Project for the Development of a Common Basis for Next-generation Robots" to develop a common interface connecting parts and systems with the aim to expand the robotics industry through the modularity of basic parts that is essential to develop robots efficiently.

The Ministry of Internal Affairs and Communications, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure and Transport plan to work together, in cooperation with the private sector, to conduct research and development on a quasi-zenith satellite system that will be able to provide highly accurate positioning services to virtually 100% of the country without being affected by narrow mountain valleys or tall buildings.

●Infrastructure technologies for research and development

Society demands the development of science and technology databases, an area in which Japan lags behind Europe and North America, the development and equipment of technologies for supercomputer net-works, and virtual research institutes that allow joint research over long distances by linking research institutions with universities via high-speed net-works.

In the Ministry of Education, Culture, Sports, Science and Technology, specific research and development topics being carried out include the "R&D Project for Innovative Simulation Software," which involves the research and development of world-class multiscale multiphysics simulation software that enables the development of drugs tailored to individual differences with the use of the Earth Simulator[10] and other ultra-high speed computers.

The main research topics in the information and communications sector during Fiscal 2005 are as shown in Table 3-2-2.

[10] The Earth Simulator, a supercomputer owned by the JAMSTEC's Earth Simulator Center, is able to simulate global climate and the mechanism of crustal movements.

Table3-2-2 Major research subjects in the information and communications sector (FY2005)

Ministry or agency	Research institute or program	Subject
Ministry of Internal Affairs and Communications	National Institute of Information and Communications Technology	・Research and development on ubiquitous network technologies ・Research and development for Sophisticated Use of RFID ・Research and development on ubiquitous sensor network technologies ・Research and development on the next generation of image contents production and distribution support technology ・Promotion of transition to Internet IPv6 ・Research and development into Asian broadband satellite infrastructure technologies ・Comprehensive research and development into network human interface technologies ・R&D on time-stamping platform technologies ・Promotion of research and development into information security measures ・Comprehensive support for the development of electrical communication systems that form the foundation for the merger of communication and broadcasting services ・Research and development into quantum information communication technologies ・Research and development of photonic network technologies ・Comprehensive research and development of IPv6 for (digital) Information consumer electronics, etc.
Ministry of Education, Culture, Sports, Science and Technology	Universities, Japan Science and Technology Agency, National Institute for Materials Science, RIKEN (the Institute of Physical and Chemical Research), Japan Atomic Energy Research Institute, Japan Aerospace Exploration Agency (Japan Atomic Energy Agency), National Research Institute for Earth Science and Disaster Prevention, Japan Agency for Marine-Earth Science and Technology, National Institute of Informatics, etc.	・Research and development project of elemental technology for super computing of the future ・Research and development project for innovative simulation software ・Research and development project of fundamental technology for supporting a safe ubiquitous society ・Establishment of software technology infrastructure to support electronic storage and utilization of intellectual assets ・National Research Grid Initiative (NAREGI) ・Comprehensive software development for e-Society infrastructure ・Priority research and development project for realization of the world's most advanced IT nation ・e-Science realization project
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Bio-oriented Research Organization, etc.	・Construction of an agricultural, forestry, and fisheries research information digital community, etc.
Ministry of Economy, Trade and Industry	New Energy and Industrial Technology Development Organization, Information Technology Promotion Agency, etc.	・Next generation of semiconducting material and process base (MIRAI) project ・Semiconductor application chip project ・Business grid computing project ・Development of an Extreme Ultraviolet (EUV) exposure system ・Digital information device interoperability infrastructure project ・Development of efficient organic device technology ・Development of photonic network technology, etc.
Ministry of Land, Infrastructure and Transport	Engineering Affairs Division, Minister's Secretariat National Institute for Land and Infrastructure Management	・Development of robotic and other IT implementation systems, etc. ・Development of circulation analysis technology for urban space utilizing four dimensional GIS data
Ministry of Internal Affairs and Communications Ministry of Education, Culture, Sports, Science and Technology Ministry of Economy, Trade and Industry Ministry of Land, Infrastructure and Transport	National Institute of Information and Communications Technology Japan Aerospace Exploration Agency New Energy and Industrial Development Organization	・Quasi-zenithal satellite communications system program

3.2.2.3 Environment

The field of the environment is an essential area of science for the preservation of the natural environment, including ecological systems with their diverse forms of life, for the maintenance of human health and the preservation of the living environment, and for maintaining the foundations for the future survival of mankind. At present, there is an increasing need for efforts in science and technology to resolve global environmental problems, and Japan is actively moving ahead in this area, through the research and development projects detailed below.

(1) Research into Earth Observation and Change Forecasts, and Other Solutions for Global Environmental Problems

In recent years, global warming and other globalscale environmental issues have become imminent, and these issues urgently require international cooperation in their resolution.

In response to the "science and technology for sustainable development" action plan agreement reached in June 2003 at the G8 Evian Summit in France, the First Earth Observation Summit was held in the United States in July 2003. Following that, the Second Earth Observation Summit was held in Tokyo in April 2004, and a framework for a 10-year implementation plan for the establishment of Global Earth Observation System of Systems (GEOSS) was adopted with the participation of 43 countries. Based on those results, the 10-year implementation plan was adopted at the Third Earth Observation Summit in Belgium in February 2005.

In regards to global warming issues, the Kyoto Protocol, which incorporated commitments to reduce the amount of greenhouse gas emissions in advanced nations and other countries, went into effect in February 2005. In December 2004, the Tenth Conference of Parties to the Framework Convention on Climate Change (COP 10) was held in Argentina to give consideration to the steady introduction of the Implementation Plan for the Global Climate Observing System (GCOS).

●R&D and related measures for under standing phenomena on a global scale

Since phenomena relating to global environment problems go beyond national borders, global cooperation is crucial in promoting research and development. Therefore, Japanese researchers are participants in the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), and other international research programs, continuing to advance joint research.

Promoting the international sharing of global observation information is important for the elucidation of various global-scale phenomena. Japan hosted the Second Earth Observation Summit in April 2004, and is an active participant in and contributor to the Committee on Earth Observation Satellites (CEOS) and the Integrated Global Observing Strategy Partnership (IGOS-P).

The Ministry of Education, Culture, Sports, Science and Technology is promoting research and development into the highly trustworthy projection of global change using the "Earth Simulator" system, one of the world's fastest supercomputers. The "Earth Simulator" won the "Global 100 Eco-Tech Award" at the 2005 World Expo Aichi, as a "technology for new development" which greatly contributes to resolving global environment problems and benefits the 21st century. As research and development using the "Earth Simulator," the ministry implemented the Intergovernmental Panel on Climate Change (IPCC), which provides scientific information regarding climate change and the "Project for Sustainable Coexistence of Humans, Nature and the Earth," which aims to achieve high-precision predictions of global warming that will contribute to the Fourth Assessment Report (AR4) and the forecast of water resources and water-based disasters in the future. In addition to contributing to the 10-year implementation plan prepared by the Earth Observation Summit, the ministry established the Earth Observation Promotion Committee under the Council for Science and Technology, in accordance with the Basic Strategy for Efforts Regarding Future Earth Observation (December 2004).

The Japan Agency for Marine-Earth Science and Technology is promoting research on global environment prediction, including climate variation research, hydrological cycle research, global warming research, atmospheric composition research, ecosystem change research, and integrated modeling. In addition, regarding research on global environ-

ment observation, the agency is promoting observation of climate change, observation of the hydrological cycle, observation of global warming and observation of ocean general circulation. Moreover, research cooperation with the United States is carried out at the International Pacific Research Center (IPRC) located at the University of Hawaii, and the International Arctic Research Center (IARC) at the University of Alaska.

The Japan Science and Technology Agency's Basic Research Programs promote research and development related to the "Mechanism of Global Change" and "Hydrological System Modeling and Water Resources System."

The Ministry of Internal Affairs and Communications' National Institute of Information and Communications Technology (NICT) is currently engaged in international joint research with the United States, primarily with the University of Alaska, within the framework of the Japan-U.S. Science and Technology Cooperation Agreement, to promote comprehensive research into technologies for the observation and measurement of the arctic atmosphere.

Japanese Antarctic Research Programs are centered at the National Institute of Polar Research, affiliated to the Headquarters for the Japanese Antarctic Research Expedition (JARE) (Chairman: Minister of the Ministry of Education, Culture, Sports, Science and Technology (MEXT)), and are operated in cooperation with relevant government agencies. In Fiscal 2005, the 46th winter expedition and the 47th expedition carried out routine observations of ocean and atmospheric phenomena around Showa Station, and also performed monitoring observations, etc., for the purpose of bringing to light environmental changes on a global scale. In January 2006, they conducted ice sheet excavation activities at Dome Fuji Station and succeeded in collecting ice cores from a depth of about 3,029 meters.

●Earth Observation Technology Using Satellites

Satellite-based observation of the Earth is an extremely effective method for repeated and continuous acquisition of varied information covering wide areas. Japan is currently engaged in comprehensive promotion of this activity toward the resolution of global environmental problems, in cooperation with related organizations in Japan and abroad.

The National Institute of Information and Communications Technology (NICT) is promoting the development of a Superconducting Submillimeter Wave Limb Emission Sounder (SMILES) mounted on the exposed facility of the Japanese Experiment Module (JEM; also known as "Kibo") on the International Space Station. NICT is also studying technology to enable the measurement of global environmental changes from space.

The Japan Aerospace Exploration Agency (JAXA) processes the data collected from a Precipitation Radar (PR) mounted on the Tropical Rainfall Measuring Mission (TRMM) satellite of the National Aeronautics and Space Administration (NASA), the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) mounted on the NASA Earth Observing System (EOS) Aqua satellite and other satellites to provide the data for researchers and users. JAXA launched the Advanced Land Observation Satellite "DAICHI" (ALOS) in January this year and plans to begin routine operation of the satellite in September. JAXA is also developing, in cooperation with relevant agencies, the Greenhouse Gas Observing Satellite (GOSAT), the Global Precipitation Measurement/Dual-frequency Precipitation Radar (GPM/DPR), and the Global Change Observation Mission (GCOM).

The Ministry of Economy, Trade and Industry is currently engaged in joint operations with the Japan Aerospace Exploration Agency for the operation of the Advanced Spaceborne Thermal Emission and Reflectance (ASTER) radiometer, a resource exploration sensor mounted on the NASA global observation satellite (Terra), and for the development of the next-generation Phased Array Type L-Band Synthetic Aperture Radar (PALSAR), to be mounted on ALOS. It is also engaged in the development of the ground-based processing and analysis technologies required for the observation data obtained from the satellite sensors.

The Japan Meteorological Agency procured the Multi-functional Transport Satellite (MTSAT-1R) and launched it on February 26, 2005, as a follow-on satellite to the Geostationary Meteorological Satellite-5 (GMS-5).

The Ministry of Agriculture, Forestry and Fisheries has created a database of imaging data obtained from the Moderate Resolution Imaging Spectroradiometer (MODIS) mounted on Terra and Aqua NASA global observing satellites, and has

made it available on the Internet.

The Ministry of the Environment is using valuable observation data on the ozone layer and other phenomena obtained from the Improved Limb Atmospheric Spectrometer-II (ILAS-II) mounted on "Midori II" (ADEOS-II) to promote observation, monitoring, and research of the global environment, and is cooperating with JAXA and the National Institute for Environmental Studies for development of the greenhouse gas monitoring sensor mounted on GOSAT.

To promote the use of the data obtained in this way from satellites, JAXA's Earth Observation Research and Application Center is promoting the development and operation of satellite data information systems that promote the use of satellite data in Earth observations, disaster monitoring, resource management, etc., the mutual utilization of data, and research into data analysis and utilization. Furthermore, the agency uses a web page to publish satellite data, etc., to deepen peoples' understanding of the current status of the global environment.

●Ocean observation technology

The oceans occupy about 70% of the Earth's surface, and are strongly related to many global-scale phenomena on earth, so that the elucidation of the roles that they play is an important issue. To advance knowledge in this area, the Japan Agency for Marine-Earth Science and Technology promoted research and development into ocean observation technologies, including the next-generation JAMSTEC-Compact Arctic Drifter (J-CAD) and Argo float for establishing a global ocean intermediate water observation system.

The Ministry of Internal Affairs and Communications developed an extended-range marine radar, which realizes continuous long-term observation of the flow field of the Kuroshio Current, etc. at the shore at the National Institute of Information and Communications Technology, and started observing the flow field of Kuroshio Current in the south of the East China Sea by installing the radars at Ishigaki Island and Yonaguni Island.

To observe the global ocean in real time, the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Land, Infrastructure and Transport have been engaged in the development of an Advanced Ocean Observing System (Japan ARGO[11]). In this project, an array of 3,000 mid-depth floats are being deployed with international cooperation all around the world to measure temperature and salinity to an ocean depth of 2,000m.

In addition, the Ministry of Economy, Trade and Industry is promoting research on the mechanism for CO2 circulation in the Pacific Ocean.

The Ministry of the Environment is promoting research into the utilization of satellite remote sensing technology, a special method for monitoring the ocean environment, as a part of the Northwest Pacific Regional Ocean Action Program (NOWPAP) promoted by the United Nations Environment Program (UNEP) in the Sea of Japan and part of the Yellow Sea.

●Technology development to restrain the emission of carbon dioxide accompanying energy use

Carbon dioxide accompanying energy use accounts for about 90% of the total emission of greenhouse gases that cause global warming. Therefore, it is necessary to develop, practically apply, introduce and disseminate technologies for restraining the emission of carbon dioxide.

In Fiscal 2004 the Ministry of the Environment started promoting development for practical application of basic mitigation techniques and development of mitigation techniques that can be commercialized in a short period of time.

Incidentally, the major research subjects conducted during Fiscal 2005 are as shown in Table 3-2-3.

[11] ARGO is named after the ship of the Greek mythic hero Jason, which is the name of the related earth observation satellites series.

Table 3-2-3 Elucidation of various global-scale phenomena, and major research topics in the earth sciences and technology sector (FY2005)

Ministry or agency	Research institute or program	Subject
Ministry of Internal Affairs and Communications	National Institute of Information and Communications Technology	International joint research on advanced electromagnetic technology for the global environment Research and development of technologies for the measurement of subtropical Earth environments Research on global environment measurement and forecasting technology, using 3-D high-resolution imaging radar Research of prediction techniques Promotion of international information networks for conservation of the Earth's environment
Ministry of Education, Culture, Sports, Science and Technology	Special Coordination Funds for Promoting Science and Technology	Aeolian dust experiment on climate impact International research project on the interaction between the sub-vent biosphere and geo-environment Unzen Volcano: International cooperative research with scientific drilling for understanding eruption mechanisms and magmatic activity
	National Research Institute for Earth Science and Disaster Prevention	Study on extreme weather events and water-related disasters due to Climatic Change Research on earthquake and volcanic eruptions
	National Universities and Other Institutions	International cooperative research project on the arctic environment Academic research into earthquake and volcanic eruption prediction systems
Ministry of Agriculture, Forestry and Fisheries	National Institute for Agro-Environmental Sciences	Assessment and mitigation techniques of global warming effects on the agriculture, forestry and fisheries sector
	National Institute for Rural Engineering, National Institute for Agro-Environmental Sciences, Japan International Research Center for Agricultural Sciences, Forestry and Forest Products Research Institute	Assessment of the impact of global-scale change in water cycles on food production and alternative policy scenarios
Ministry of Economy, Trade and Industry	National Institute of Advanced Industrial Science and Technology	Evaluation of long-term carbon dioxide absorption, based on the analysis of intermediate- and deep-ocean water in the Pacific Ocean
Ministry of Land, Infrastructure and Transport	Hydrographic and Oceanographic Department, Japan Coast Guard	As part of activities of Hydrographic and Oceanographic department, comprehensive ocean research in jurisdictional sea areas, marine geodesy using satellites, geomorphological and geological surveys of sea bottoms for the detection of volcanic eruptions, and observations of water temperatures, ocean currents, waves, and other aspects of the Western Pacific ocean region
	Meteorological Research Institute, Japan Meteorological Agency	Comprehensive projection of climatic change around Japan due to global warming Development and improvement of a materials circulation model and research on assessment of the effect on the global environment Observational study of radiative process in the atmosphere
	Geographical Survey Institute	Study on geodynamics using precise Earth measurement technology Plate motion and deformation in the East-Asia and Pacific region Technical development of precise determination of the geoid and the gravity field variations in the Northwest Pacific from dedicated satellite gravity data
	Port and Airport Research Institute	Use of tide-level observation to monitor rising sea levels Research into the change of characteristics for the occurrence of high water due to global warming
	National Institute for Land and Infrastructure Management	Research into supporting technology for energy conservation with better performance of existing residences

Ministry or agency	Research institute or program	Subject
Ministry of the Environment	Global Environment Research Fund	Development of greenhouse gas sink and source control technologies, through the utilization and preservation of land ecological systems -- mid- and long-term policies toward the stabilization of greenhouse gases in the atmosphere Research into the maintenance of sustainable national territories for island nations formed from coral atolls Elucidation of the dynamics of global-scale ocean pollution caused by toxic substances, and research into their prediction Research into gene migration due to the release of gene recombinant organisms, and evaluation of the impact on biological diversity Integrated study for the terrestrial carbon management of Asia in the 21st century based on scientific advancements Research on the explanation of long-term trends, and prediction of future change ozone layer Comprehensive assessment of climate change impacts to determine the dangerous levels of global warming and the appropriate stabilization target of atmospheric greenhouse gas concentration Study on the process of the transport and transformation of aerosols and their precursors from Asian Continent
	Global Environment Research Coordination System	Research into the mechanisms for the carbon dioxide cycle in ocean surface layers, using radioactive nuclides as multi-tracers Evaluation of the impact of carbon dioxide marine isolation on the ocean material cycling process
	Technology Development Program for Mitigating Global Warming (competitive funding)	Development toward practical application of basic technology to restrain emission of carbon dioxide
	Open-Type Project to Subsidize Development of Technologies Directly Connected to the Marketing of Competitive Global Warming Mitigation Measures	Development of technologies to restrain emission of carbon dioxide, which can be commercialized in a short period of time