Chapter 2 Strategic Priority Setting in S&T

Section 1 Promotion of Basic Research

Basic research, which spawns human wisdom and serves as a source of knowledge, accumulates as an asset for the whole of humankind and is built upon steady and serious inquiry into the truth based on numerous trials and errors. Additionally, because it is often the unusual discoveries and inventions that result in the greatest leaps in knowledge, it is important to foster innovation. Basic research consists of two types: Type-1 basic research that is conducted based on the free ideas of researchers in S&T; and Type-2 basic research, which aims at future applications based on policies. Both types of basic research should be promoted continuously and extensively with consideration given to the significance of each type.

For the reasons mentioned above, universities are conducting basic research utilizing the Grants-in-Aid for Scientific Research for Type-1, and JST Basic Research Programs and other competitive funds for Type-2, while securing fundamental expenses with government subsidies for national university corporations, financial aid for private educational institutions, and so on.

In addition, in August 2009, a number of experts, serving on the Committee for Enhancing Basic Science Capability [literal translation] under the Ministry of Education, Culture, Sports, Science and Technology (MEXT), arranged "Suggestions for Enhancing Basic Scientific Capability" to promote comprehensive and systematic measures to enhance basic research and other fundamental scientific capabilities.

Section 2 Priority Setting in R&D for Policy-oriented Subjects

Under the Basic Plan, it is necessary to set strategic priority on R&D for policy-oriented subjects while steadily developing basic research in order to maximize the effects of the governmental R&D expenditure, "Investment in Tomorrow." For that purpose, according to the Basic Plan, life sciences, information and telecommunications, environmental sciences, and nanotechnology/materials are labeled as the "four priority fields to be promoted" and are to be the fields prioritized for key investment, while energy, manufacturing technology, infrastructure, and frontiers as "four fields to be promoted" for adequate investment. These are summarized in the Sectoral Promotion Strategy (CSTP decision of March 28, 2006) for the selection and concentration of investments while aiming to achieve the objectives provided. In the strategy, 273 projects were selected as "important R&D issues" to be addressed by the government. The targets of research and objectives to be achieved as the outcomes for each project were clearly defined, and among them, the Council selected 62 types of "strategically prioritized S&T" to be focused on. Currently, based on this strategy, the CSTP is thoroughly implementing the selection and focus of the targets, including the "strategically prioritized S&T" in each of the eight fields of focus, while executing strict scrutiny in their evaluation of the R&D of "key technologies of national importance" as it proceeds with the

implementation of R&D activities.

1 Life Sciences

Life sciences shed light on the complex and delicate mechanisms of the phenomenon of life in living creatures, and, when applied, lead to significant medical development and solutions to food and environmental problems—contributing greatly to the enhancement of people's lives and to a nation's economic prosperity.

In the "Sectoral Promotion Strategy," the following 7 types of strategically prioritized S&T are indicated as the S&T fields to which investment should be focused within the next five years. MEXT and other ministries are primarily implementing R&D activities that are related to the strategically prioritized S&T.

(1) Basic and fundamental research projects supporting the whole of life science studies

1) S&T for the reconstruction of complex systems of life

a) Promotion of research on genome sciences

Based on the completion of a precise decoding of the human genome and the outcomes of genome function analysis, MEXT started an innovative study program to decipher life programs (cell innovation)— focusing primarily on cancer cells—through the utilization of a next-generation sequencer in 2009. In addition, MEXT is making efforts to steadily promote R&D for innovative medical technologies using individual genetic information.

The Ministry of Health, Labour and Welfare (MHLW), on the other hand, is promoting R&D to establish preventive methods, diagnosis, and treatments for diseases, and to develop innovative medicines by locating the genes linked to major diseases in elderly individuals, such as dementia, cancer, diabetes, hypertension, asthma, etc.

The Ministry of Economy, Trade and Industry (METI) is conducting a functional analysis and development of a tool (the technologies of informatics and highly sensitive quantitative analysis) designed to elucidate functional RNA.

b) Promotion of analysis of protein structures and their functions

Proteins are the fundamental molecules that constitute life of all living creatures. The analysis of their structures and functions are indispensable for future industrial applications relating to medicine, pharmaceuticals, food, the environment, and so on.

Although extremely difficult given the limitations of current state-of-the-art technology, MEXT is implementing the "Targeted Proteins Research Program," which makes the most of the existing foundation for protein analysis to analyze the structures and functions of proteins selected for their indispensability to academic study and industrial development.

METI, with the help of the private sector, is conducting R&D to analyze the functions of carbohydrate chains and glycoproteins, to utilize their functions, and to develop technologies to mass synthesize carbohydrate chains.

c) Promotion of brain science

It is hoped that, though accomplishments in the field of brain science, improvements in the quality of social life and medicines will be achieved and new technologies and industries will be created.

MEXT is promoting research activities in RIKEN while utilizing the "Strategic Research Program for Brain Sciences (SRPBS)" and other competitive funds to prioritize research being conducted in the field of brain science. In addition, since it is necessary to strategically promote the studies of brain science and to return the outcome of those studies to society, in June 2009, MEXT organized their first recommendation at the Council for Science and Technology (CST) regarding the fundamental conception and promotion of policy toward brain science research from a long-term perspective.

MHLW is conducting research to clarify the pathogenesis and to develop treatment methods for mental illnesses, including neuromuscular disorders, Parkinson's disease, Alzheimer's disease, high cortical dysfunction, schizophrenia, depression, etc.

d) Promotion of research on allergies and immunology

RIKEN is conducting basic research on diseases related to allergies and immunology. It has concluded a pact for joint research with the Sagamihara National Hospital in an effort to promote effective research through the partnership of basic and clinical research.

(2) R&D projects that contribute to the "To Live a Better Life" field

2) Clinical and translational research

a) Development of research environments and structures to put drugs and medical devices into practical use

In July 2009, the "Medical Research Strategy" was adopted at the Medical Research Council, comprising the Minister of State for Science and Technology Policy, the Minister of Education, Culture, Sports, Science and Technology, the Minister of Health, Labour and Welfare, the Minister of Economy, Trade and Industry, and other experts, to help enhance people's lives and international competitiveness through the utilization of excellent basic research in the field of life sciences and the development of new treatments and drugs. This strategy was adopted to promote medical research (translational research, clinical research) by a united front of several ministers and government offices.

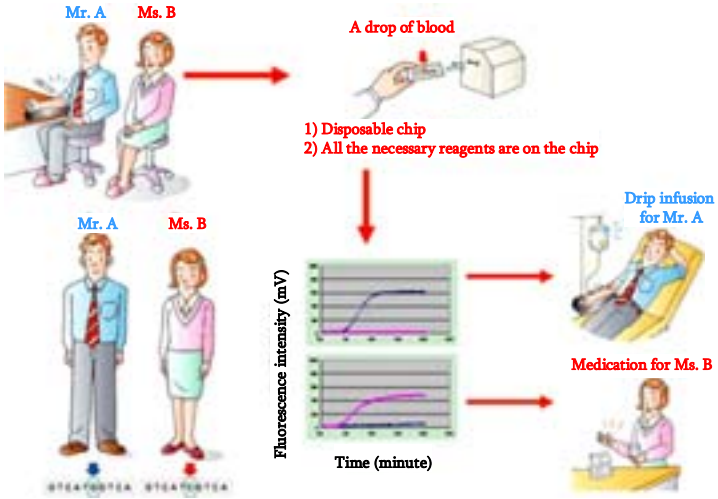
In addition, to overcome the bottlenecks that arise during the development of innovative technologies, "Super Special Consortia for supporting the development of cutting-edge medical care" ("Super Special Consortia" System) have been promoted to test a program to allocate research funds in integrated and efficient ways and to exchange opinions with regulatory authorities from the developmental stages to enhance the development and practical application of advanced regenerative medicine, drugs, and medical devices.

MEXT is also promoting the "Assistance Program to Promote Translational Research" with the Medical Research Council and other organizations to develop assistance centers for universities with excellent translational research achievements that can be put into practical use in partnership

with MHLW, METI, and other government offices.

b) Promotion of research on genetic polymorphism

To provide optimal medical care for individuals, MEXT utilizes biobanks, which manages blood samples taken from patients as well as clinical information to implement a "project for realizing medical care according to individual genetic information (2nd term)" to help clarify the links between genetic information and diseases that may have a significant impact on people's health. In addition, RIKEN is attempting to cooperate with this project by promoting research that will help clarify the causes of diseases.



Flow of using SNPs analyzing system in medical scenarios
With this fully automated SNPs analytical diagnostic system (joint development with Toppan Printing, Co.), it is possible to make a highly accurate SNP determination within 45 minutes from a drop of blood.

Source; RIKEN

c) Promotion of scientific research of development, differentiation, and regeneration

Research in the fields of development, differentiation, and regeneration aims to clarify mechanisms related to cell differentiation in a variety of tissues and internal organs that form and maintain the body. This is the foundation of the regenerative medicine, and in recent years, research on iPS cells and stem cells have been developed rapidly, and the technology to create ES cells has been established.

MEXT is conducting basic research with the Expenses for Basic Research program funded by the Japan Science and Technology Agency (JST) to promote research into applying the results of basic research toward clinical medicine—while striving to achieve the goals set forth in the "iPS cells research road map" (MEXT, June 2009)—and to develop centers in which research on iPS cells and other stem cells will be implemented in the "Project for Realization of Regenerative Medicine (2nd Term)," which is based on the "Revised Comprehensive Strategy for Accelerating the iPS Cells Research" [literal translation] (Decided by Minister of MEXT, Jan 2009). JST is also conducting basic research with JST Basic Research Programs, as well as at RIKEN and other locations.

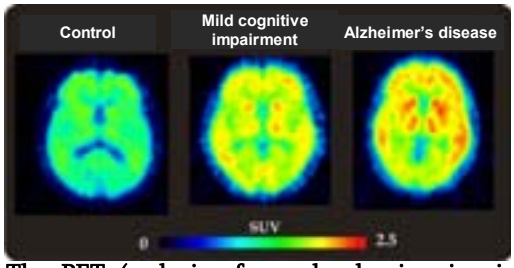
In addition, concerned government offices are working together to develop research structures and to maintain necessary research funding to work on the projects concerned with securing and managing intellectual property.

d) Promotion of research on molecular imaging

Molecular imaging is a technique used to visualize the molecular mass and functions of molecules in living bodies.

MEXT is implementing the "Molecular Imaging Research Program" while conducting innovative

R&D to reform the drug discovery process in an effort to enhance the level of disease diagnosis based on the core center for drug development and molecular imaging Center for PET Diagnosis as the core centers for the molecule imaging research developed domestically.



The PET (a device for molecular imaging in living bodies) can check how much of the substance that causes Alzheimer's disease has accumulated in the brain. The red part contains many causative agents.

Photo: RIKEN

e) R&D that promotes efficiency of the drug discovery process and practical utilization of its accomplishments

METI is conducting R&D of basic technologies to accelerate the discovery of new drugs utilizing genetic information,, including a technology to clarify the mechanisms of diseases at the genetic level utilizing full-length human cDNAs (a strong point of Japanese technology), a technology to create drugs with clarified disease mechanisms, and a technology to make the drug discovery process more efficient by utilizing the structural information of film proteins that play important roles in the living bodies. In addition, METI is also conducting R&D to create new antibodies that will be usable in antibody drugs and to enable antibodies to be refined with higher efficiency. Furthermore, to make the process of evaluating effectiveness and safety of drugs more efficient, METI is conducting R&D of drug discovery tools utilizing stem cells such as iPS cells.

f) Development of new medical technologies and systems in collaboration with the private sector and clinical research institutions

METI is establishing coordinated partnerships with ventures and other companies in the private sector, as well as with clinical institutions, to deliver research achievements in a variety of technological fields while also developing new medical technologies that will reduce the burdens on patients and medical staff. It is also promoting work aimed at hastening the practical application of medical technology and the dissemination of that technology.

3) The targeted therapies and other innovative medical technologies

Based on the "3rd Term Comprehensive 10-Year Strategy for Cancer Control" (Ministers' Decision on July 2003, MEXT and MHLW), the "Cancer-Fighting Basic Act" (enacted in April 2007), and the "Basic Plan to Promote Cancer Control Programs" (Cabinet Decision of June 2007), new preventive methods, diagnosis, and treatments utilizing the research results are under development to shed more light on the nature of cancer.

In their efforts to set forth strategies to promote comprehensive and strategic cancer research, MEXT has established the Working Group for Cancer Research strategies in the CST's Subdivision on R&D Planning and Evaluation to discuss issues related to the research.

In addition, the National Institute of Radiological Sciences is conducting research in heavy-ion cancer therapy, which is expected to provide innovative treatments for types of cancer that are otherwise difficult to treat. Based on the achievement obtained by the research of the Institute and other institutions, a downsized heavy-ion cancer therapy facility was installed in Gunma University

and the university began treatment in March 2010.

MHLW is conducting translational research, which provides widespread application based on the achievements of research conducted to shed light on the nature of cancer. It also engages in joint research on multicenter clinical studies to establish standard therapies for cancer care, research on maintaining or enhancing the quality of care palliative care and recuperation, research on understanding the current state and providing information about the cancer, and research on political issues, such as the development of an organizational framework to promote equalization of regional gaps.

METI is conducting development of molecule imaging devices to detect cancer early and a "Next-generation DDS-type Malignant Tumor Therapy System" in order to develop treatments that are able to pinpoint cancer cells. It is also conducting the "Intelligent Surgical Instruments Project" to develop advanced medical devices that will combine diagnosis and treatment to offer patients a reliable treatment with minimal ablation.

4) S&T for overcoming emerging and reemerging infectious diseases

Currently, there are increasing concerns in the international community concerning newly discovered infectious diseases and infections that appear to be under control only to violently re-emerge (emerging/re-emerging infections).

MEXT is promoting the "Program of Founding Research Centers for Emerging and Re-emerging Infectious Diseases" to develop research on emerging and re-emerging infections at research centers established both at home and overseas while integrating fundamental knowledge and providing training for human resources.

MHLW is conducting research activities focusing on emerging and re-emerging infections, animal-derived infectious diseases, diagnostic technology for infectious disease prevention, on-site surveys, and measures against international infections, and, since there is a pressing need for measures to be taken for emerging and re-emerging infections, measures include both domestic and international collaborations. The National Institute of Infectious Diseases (NIID) is also conducting research on a wide range of infectious diseases. In particular, research is being directed toward the new influenza viruses, against which most people do not have immunity. The Ministry is promoting research in preparation for future outbreaks of influenza A/H1N1, which broke out in April 2009, and for other new influenzas that may emerge from the highly pathogenic avian influenza—which still exists as a source of widespread concern.

The Council for Science and Technology Policy (CSTP) has designated "Urgent Research for Measures against New Influenza" as part of the investigation of the program "Promotion of Measures to Address Important Political Issues with Mobility" funded by the Special Coordination Funds for Promoting Science and Technology for 2009 as a measure to address the global spread of the new strain of influenza.

(3) R&D Projects That Contribute to the Fields of "Better Eating" and "Better Lifestyle"

5) S&T to produce and supply safe food that will enhance international competitiveness

a) Research on microbial, animal, and plant genomes in the fields of food and environment

As the science of genomes has developed, the structures and functions of plant genomes have becoming more and more clear. It has been anticipated that these achievements may help improve our eating habits by controlling plant functions.

RIKEN has been conducting research to enhance productivity in terms of quantity and quality through clarification of genome functions of model plants, such as Arabidopsis thaliana.

The Ministry of Agriculture, Forestry and Fisheries (MAFF) is accelerating the process of clarifying genetic functions with focused fixed on the problems of food, environment, and energy. These problems are thought to be of particularly high importance, and the Ministry has already started creating high-yield crops, crops resistant to harsh environments, plants that purify the environment, huge biomass plants, and other plants that can help solve the aforementioned problems. The achievements of studies on genomes are also applied to stock raising and insects, and studies are being conducted for the purpose of creating new demand and innovation for food production technologies. In addition, development of production technologies for seeds that do not respond well to artificial cultivation continue to be promoted, and, in order to achieve our food self-sufficiency ratio goals, domestic agricultural products are under development, including feed with innovative properties in terms of quality and processability. Livestock production technologies are also being developed for high quality meat, etc.

The Cabinet Office, MEXT, MHLW, MAF, and METI are collaborating to promote the Coordination Program of S&T Projects, "Food and Biological Production Research," while focusing on microorganisms, plants, insects, livestock, and fish, to review the current state of research pertaining to food production and materials useful for production, and they are also examining ways in which they can enhance promotion of the projects into the future.

In addition, based on the "Drastic Reform with Effective and Agile Movements for BT innovation in Japan (Dream BT Japan)" (Public-Private Council on Promotion of Biotechnology (BT) Strategy decision in December 2008), they are working on promotion of biotechnology as part of a collaboration between industry, acadamia, and government.

b) R&D in relation to ensuring food safety, securing procurement, and obtaining consumers' trust

People's interest in "food" is very strong and the safety and secure procurement of food is an important issue. MHLW is promoting research on new hazards, survey and research for establishing standards, and R&D for establishing official assays in relation to additives, contaminants, chemicals, pesticide residues, microorganisms, Bovine Spongiform Encephalopathy (BSE), health food, food applying modern biotechnologies, etc., to enhance measures regarding food safety and to improve technologies required to fulfill food hygiene regulations. The achievements from such research are then incorporated in risk management measures. In addition, it conducts research on health crisis management, such as food poisoning and food terrorism.

MAFF is working on developing technologies to elevate the accuracy of the quarantine measures

and to enhance its efficiency to reduce the economical loss of livestock farmers and the potential risk of zoonosis, including avian flu, BSE, etc. to humans. In addition, it is developing technologies to reduce risk in the processes of production, distribution, and processing of farm products in relation to hazardous chemicals, harmful microorganisms, etc.. It is also working on development of technologies to prevent false food labeling and methods to evaluate functionality of unprocessed food by means of nutrigenomics and other methods.

6) Production of materials utilizing biofunctions and S&T for improving the environment

MAFF has developed a technology to reduce the use of chemical fertilizers and pesticides by taking advantage of the biofunctions of. It is also working on development of assessment methods for soil organisms using eDNA (environmental DNA).

METI is working on development of technologies to produce high –value-added materials, such as highly functional proteins, etc., in a closed system using plant functions, technologies to produce useful substances for industrial raw materials, etc., utilizing functions of plants and microorganisms, and technologies of highly efficient bio-treatment for industrial wastewater and other, etc. through microbial group control and other methods.

(4) Issues in relation to development of structures for life science research

7) Arranging a world-class foundation for life sciences

a) Developing bio-resources

Bio-resources are important for the purpose of not only preservation of biological genetic resources but also for opening up new fields for research activities, so it is necessary to work on development, collection, preservation, and supply from a nationally based perspective.

MEXT is conducting the "National BioResource Project" to develop a system to systematically collect, preserve, and supply the important bio-resources that need to be arranged strategically by the national government related to animals and plants for research—the building blocks of life science studies.

MAFF is implementing the agriculture, forestry, and fisheries gene bank project to collect, preserve, evaluate, and supply genetic resources for the industries of agriculture, forestry, and fisheries. It also preserves and offers DNA and other genome resources of rice plants, etc.

Mice (right) born through microinsemination (left) from sperm frozen (-20℃) for 15 years
Photo: RIKEN

As projects of METI, the National Institute of Technology and Evaluation, which is a core institution of Japan with genetic resources including microorganisms, is searching, collecting, and preserving the genetic resources while organizing the related information (systematic positions, sequence information, genetic information, etc.) to provide for R&D and industrialization activities.

In addition, METI is working actively to develop genetic resources in Asia through bilateral agreements with Asian countries in order to conclude biodiversity treaties and arrange a multilateral cooperation structure (Asia consortium), etc., to preserve microbial resources and their

sustainable use.

b) Promotion of bioinformatics

It is important to promote development of a comprehensive database for biological information and of bioinformatics, an integrated field of life science and IT (information technology), as means to utilize DNA base sequence data, protein structure data, and gene expression data, which are created abundantly as a result of life science research.

MEXT has been working on integration of life science databases while starting the "Integrated Database Project" to enhance usability of life science databases in Japan. In view of continuous use and maintenance after completion of the project (FY 2011 or thereafter), the operations will be transferred to the Japan Science and Technology Agency (JST) step by step. The gradual transfer will be run in coordination with JST Bioinformatics Research and Development (BIRD), which is working on enhancement, standardization, and expansion of the database and development of genome analysis tools.

MHLW collects and preserves genes and cell lines cultured from human or animal cells, which are necessary for medical and pharmaceutical research. It also collects, preserves, and supplies medicinal plants and enhances disease animal models.

MAFF implements the "Agriculture, Forestry and Fisheries-related Genomic Information Integrated Database," in which highly usable database is under development integrating the information on genomes and genes of agricultural or fishery products, such as rice, silkworms, livestock, etc., to be offered to researchers and breeders in universities or in companies in the private sector.

METI implements the "Integrated Database Project," in which the data from the research on public funding related to METI are integrated for use by various industries.

In addition, the Life Science Project Team for Integrated Database Task Force Meeting [literal translation] at the Council for Science and Technology Policy (CSTP) released a report in April 2009 on how the centers that provide functions expected by users should be permanently arranged; such as inputting new information into the database, and maintenance and management of the data, to prevent data and database collected and created in each project from scattering, , and to promote further effective use of the data.

Efforts to carry out animal experiments in a proper manner

The "Act on Welfare and Management of Animals" was revised in June 2005 as lawmaker-initiated legislation, and the concept of 3Rs (Replacement, Reduction, and Refinement) was indicated in relation to animal experiments.

In addition, the same act defines that the Minister of the Environment shall determine the standards for animals for experiments, while distinguishing the terms "experimental animals," "animal experiments," etc. On April 28, 2006, the "Standards Relating to the Care and Management of Laboratory Animals and Relief of Pain (Care and Management Standards)" were announced. MEXT, MHLW, and MAFF have settled comprehensive basic guidelines for research institutions under their control for the purpose of proper implementation of animal experiments based on the

guidelines.

Efforts related to the issues of bioethics

Although its usefulness is recognized, the recent rapid development of life science may bring about new bioethical problems involving human dignity and human rights. Thus, concerned ministries have been imposing necessary regulations.

In relation to human ES cell research, in August 2009, the former guidelines were revised to set forth the "Guidelines for Establishing and Distributing Human ES Cells" (MEXT public notice No. 156 of 2009) and the "Guidelines for Use of Human ES Cells" (MEXT public notice No. 157 of 2009). At the same time,further discussions continued to ease procedures and others rules in MEXT, considering the opinions regarding the necessity of revising the guidelines at the CSTP Expert Panel on Bioethics, which was held in November 2008. Currently, about 60 research plans are being carried out. In addition, in February 2009, the Bioethics and Biosafety Commission of the Council for Science and Technology (CST) organized its basic policy to conclude that the creation of germ cells from human ES cells should be approved, and currently, MEXT is examining the matters in view of arranging guidelines.

The creation and use of cloned human embryos were approved with the conditions that the purpose of use is limited to medical research for rare diseases, etc., as stated in the "Basic Policy on the Handling of Human Embryos," which was organized by CSTP. Upon this decision, MEXT also conducted examinations on the matters and, in May 2009, some related guidelines were arranged, including the "Guidelines for Handling Specific Embryos" (MEXT public notice No. 83 of 2009). In relation to the creation and use of human fertilized embryos for the purpose of research on assisted reproduction care, MEXT and MHLW have jointly examined the guidelines based on the opinions of CSTP while organizing a report in March 2009. As of March 2010, they are under the process of arranging the guidelines.

Efforts to secure safety in life science

The technology of genetic modification creates new genetic combinations that do not exist in nature and it is applied not only to basic biological research but also to a wide range of fields, including drug production and crop improvement. Regarding the use of genetically modified plants, etc., necessary regulations have been implemented to prevent negative influence to biodiversity, based on the "Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms" (Act No. 97 of 2003). The clinical research for establishing genetic therapy has been promoted adequately following the "Guidelines for Gene Therapy Clinical Research" (MEXT/MHLW public notice No. 2 of 2004).

The major research projects in life science in 2009 are indicated in Table 2-2-1.

Table 2 2 1 Major subjects in life sciences (FY 2009)

Gov't office	Research institutions, etc.	Research subject
Cabinet Office		-Research on Technology to Evaluate influence of food on health
Ministry of Finance	National Research Institute of Brewing (NRIB)	-R&D operations related to life science
Ministry of Education, Culture, Sports, Science and Technology (MEXT),		-Strategic Research Program for Brain Sciences (SRPBS) -Program to promote assistance to translational research -Project for realizing medical care according to individual genetic information -Project for realization of regenerative medicine -Molecular imaging research program -Initiative for research on innovative protein and cells analysis -Program to establish centers for research concerning emerging and re-emerging infectious diseases -National BioResource Project -Integrated Database Project
	RIKEN	-Comprehensive research project on brain science -Research project on plant science -Comprehensive research project on immunity and allergy sciences -Research project on genome medical science -Comprehensive research project on development and regenerative sciences -Research project on molecular imaging -BioResource project -Project on fundamental research fields for life sciences
	Japan Science and Technology Agency (JST)	-Project on bioinformatics promotion center
	National Institute of Radiological Sciences	-Research in heavy-ion cancer therapy -Research on molecular imaging
Ministry of Health, Labour and Welfare (MHLW)		-Infrastructure promotion research project for new drug creation -Research project for 3rd term comprehensive strategy for cancer control -Research project for emerging and re-emerging infectious diseases, including new flu
Ministry of Agriculture, Forestry and Fisheries (MAFF)		-Development of technologies to provide steady farm products of low cost and good quality for processing and distributors -Development of Japanese-style animal feeding technology by feeding large amounts of roughage -R&D for establishing resource-saving agriculture by recycling local resources -Development of technologies for eel seedling aquaculture -Development of technologies for assessing characteristics of soil organisms by clarifying soil microbial aspects -Comprehensive development of agricultural genome studies -Development of new production systems using IT for training human resources -Building integrated database for agricultural and fishery biological genome information -Development of technologies for highly accurate and efficient risk management for avian flu, BSE, etc. -Development of technologies to clarify characteristics of hazards in the processes of production, distribution, and food processing in a systematic way -Development of basic technologies for securing reliability of displays on food and farm products and for analyzing their functionality -New genome project for agricultural deployment
	National Institute of Agrobiological Sciences	-Operations of gene banks

	National Institute of Advanced Industrial Science and Technology (AIST)	-Analyzing molecular basis for symbiotic evolution of endocellular bacterial symbionts -Development of new genetic resource from unknown microorganisms -Analyzing molecular structures of circadian clock in mammals -Creation of bioluminescent protein and its application to medical use -Development of reliable testing methods for olfactory function

2 Information and Telecommunications

Information and communication technology sparks an enormous revolution in a wide range of socio-economical activities, including realization and diffusion of the use of e-commerce, e-government, teleworking, telemedicine, and distance learning, affecting both industry and lifestyles, and representing an increasingly important infrastructure for safety and security in people's lives. In addition, prioritizing investment in information technologies with international advantages from mid- to long-term perspectives will result in the enhancement of Japanese S&T and academic research efforts as well as the global industrial competitiveness of Japan.

As part of the government's efforts in relation to general information and communication, the Strategic Headquarters for the Promotion of an Advanced Information and Communication Network Society (IT Strategic Headquarters) set forth the "New IT Reform Strategy" (January 2006) and the "Priority Policy Program 2008" (August 2008) to "realize a ubiquitous and universal network society where everyone can enjoy the benefits of IT." In addition, the National Information Security Policy Council established the "The Second National Strategy on Information Security" (February 2009) to "arrange an environment with reliable IT."

The Ministry of Internal Affairs and Communications (MIC), in increasing coordination with the government's S&T policy, is utilizing the information and communication technology (ICT) to promote R&D in particular for green innovation and life innovation, strengthening international competitiveness.

MEXT is promoting R&D utilizing seeds of technology in universities and similar institutions to address issues such as efficient use of computational resources and large-scale data, reduction of electricity consumption, and enhanced reliability of the information system, in order to realize a society in which cutting-edge information S&T will be fully exploited.

METI implements programs such as the "Green IT Project" to promote "green IT" as a means of realizing a society in which the environment and the economy can coexist. In addition, it is also promoting efforts such as software engineering to yield highly reliable information system software.

The following sections are the summary of seven areas of "important R&D issues" from the "sectoral promotion strategy" reflecting major projects implemented by the respective ministries.

(1) Network

MIC is conducting R&D on basic technology required to build all-packet type high-spec networks for next-generation network technologies, which can instantly transfer vast amounts of information and can be easily and conveniently used by anyone. It is also engaged in R&D for technologies to strengthen the information communication infrastructure compatible with the dramatic increase of internet traffic, network technologies enabling anyone to use highly reliable cloud services, technologies facilitating common use all-optic networks, in which high speed and energy

conservation are mutually compatible, technologies in which multiple wireless systems can be used at the same frequency, technologies enabling easy use of wireless systems at unused spectra, and other R&D related to new network architecture for next-generation networks.

METI is conducting R&D on technology to produce highly efficient network devices using electronic/ optical technology.

(2) Ubiquitous network

MIC is implementing the "R&D on Ubiquitous Platform Technology" to develop a common basis for network technologies and other advanced technologies realizing information and communication services systems (ubiquitous services systems) enabled with the linked information provided by the electronic tag sensors, to provide early resolution of social problems such as child safety, promotion of a healthy senior population, and revitalization of the rural economy, and to maintain Japan's international competitiveness with respect to the United States, Europe, and the Republic of Korea, which have heightened R&D advances in recent years. In addition, it is promoting R&D and standardization of technologies supporting sophisticated services reducing the environmental load of IT home appliances that should show increased use as digitalization and development of broadband networks are enhanced.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) released the basic rules for consistency in free mobility support as the "Technical Specifications for the Free Mobility System (Draft)" based on discussions and outcomes from the feasibility experiments conducted in the "Free Mobility Project."

(3) Device and display

The National Institute of Information and Communications Technology (NICT) is conducting R&D for photonic devices, which are necessary for development of high speed/high spec telecommunications optical networks with reduced power consumption.

MEXT is developing innovative spin devices[1] and technologies for high capacity and high speed storage infrastructure to realize high-function and ultra low-power consumption computing.

With respect to semiconductor technologies, METI is conducting R&D in areas such as miniaturization technologies with technology nodes of 45 nm or less that realize next-generation high-function semiconductors with reduced power consumption (process/material, exposure system, design, masking and other technologies), next-generation non-volatile memory technology, application chip technology enabling reduced power consumption for information household appliances, and 3D integration technology for semiconductor devices. It also invites public participation from universities, joint venture organizations, and other companies in the private sector to conduct test manufacturing and evaluation of semiconductor chips with their excellent circuit designs. In addition, METI is pursuing green cloud computing technology and developing next-generation power devices as part of the "Green IT Project," while conducting R&D for individual devices and equipment yielding energy-saving technologies for the data centers that

1 Spin device utilizes the electon's properties which are due to the electric charge and the magnetic spin.

serve as focal points in the cloud computing age.

(4) Security and software

In terms of security technologies, MIC is working on R&D for "data leak prevention technologies," "technologies to detect, recover, and prevent route hijacking," and "technologies to detect illegal or harmful information on the Internet." In addition, MIC and METI are implementing development and test operation of the BOT collection and analyzing system, along with infection control. METI is also developing technologies to prevent damage from new threats on information security and to minimize any potentially occurring damage, and is conducting research on management methods in relation to information security, which is interrelated with lifestyles and socio-economic activities, and on creation of an environment in which people can access reliable IT.

Concerning software development, MEXT is implementing R&D for "visualization techniques for software construction status" and "system integration and collaboration software for e-science." METI is developing software engineering for widespread incorporation of engineering methods into software development, which traditionally has been entrusted to experienced technicians. It has selected the automobile industry as the first field in which to apply the project and is developing basic software for vehicle control. Furthermore, METI has begun to improve and disseminate technical guidelines (technical reference model) for using the standardized software, which anyone can use, and to determine a system for evaluating software improvement and interoperability to promote the use of the software.

(5) Human interface and content

MIC is developing the technology for coding systems necessary for the high-definition image broadcast system, which is anticipated to be the next-generation broadcasting system, and also the elemental technology for three-dimensional imaging technology, similarly anticipated to be the imaging technique of the future, based on high-definition image broadcast technology. In addition, for the "realization of voice communication technology that overcomes language barriers," a project intended to accelerate the return of research achievements to society, MIC conducts R&D for technologies such as network speech translation. In FY 2009, while accelerating commercialization of automatic speech translation technology, MIC implemented projects involving feasibility experiments on automatic speech translation technology in five tourist areas in Japan to help promote tourism and the local economy by attracting foreign tourists. Furthermore, it is implementing R&D of information analysis technology to offer reliable and verifiably credible information on the network ("R&D of information believability validation technologies in telecommunications services").

MEXT is developing basic software for super high-performance databases, which handle and manage enormous amounts of data, in preparation for the Info-plosion Era. It is also developing software to facilitate seamless use of computers scattered throughout the country. In FY 2009, MEXT began development of a basic technology enabling efficient collection and analysis of movie and image information on the Web to be utilized for research and other purposes.

METI is pursuing next-generation technology to enable accurate search and analysis of desired information from the vast amount available, and is building and demonstrating the foundations of futuristic businesses which can offer appropriate information and services to users according to their needs and preferences ("Information Grand Voyage Project").

The Cabinet Office is promoting the "Very Large Information Integration and Application Platform" in cooperation with MIC, MEXT, and METI, while conducting R&D for utilization of sensor information as a supplementary project ("development of technologies for content and knowledge processing in the next-generation information environment").

(6) Robot

MIC is promoting R&D for network robots enabling protective oversight, health care, and life assistance, especially for the elderly and those with special needs (the challenged), utilizing the networks and robots positioned in various places in teamwork situations.

In the fields of personal care and transport assistance, METI collects and analyzes safety test data required for development and international standardization of personal safety technology, which is essential to utilizing robots that assist people in their daily living. It also develops mechanical element technologies for next-generation robots, indispensable in high-demand areas such as next-generation industrial robots, service robots, and robots for special environments. In addition, METI performs feasibility experiments of intelligent robots, which undertake a variety of jobs in myriad situations subject to frequent change, such as production, daily living, etc., while conducting R&D of reusable "componentization (modulization)" through standardization of connection and control systems of robot components such as sensors, motors, etc.

RIKEN is conducting R&D of human life assistance robots at a collaboration center established in conjunction with Tokai Rubber Industries, Ltd.

The Cabinet Office is promoting collaboration among government offices with the "Next Generation Robot Promotion Council," targeting the above-mentioned projects.

(7) R&D platform

In FY 2009, MEXT committed to construction of the "Innovative High-performance Computing Infrastructure" to connect next-generation supercomputers and existing supercomputers throughout Japan to the network for cooperative use to expand the existing supercomputer project and further enhance the foundations of R&D activities. In addition, selecting five strategic fields (July 2009) in which significant social and academic breakthroughs are expected with next-generation supercomputers, MEXT launched the feasibility study of the "Next-generation Supercomputer Strategic Program [literal translation]" (January 2010), which intends to organize R&D in those fields and the computational S&T system of Japan. [Refer to Part 2, Chapter 2 "Key Technologies of National Importance" (4)]

(8) Others

Targeting graduate schools, MEXT is promoting the "Leading IT Specialist Training Promotion Program" and similar projects aimed at establishing a base for training future leaders of corporations

and other organizations that can deal flexibly with social changes as insightful, world-class IT resources.

Main research topics in the field of information and communications in FY 2009 are shown in Table 2-2-2.

Table 2 2 2 Major Research Projects in Information and Communications (FY 2009)

Ministry	Research organization	Subject
Ministry of Internal Affairs and Communications		- Research and development concerning next-generation backbones - Research and development concerning secure cloud networking technology - Research and development on elemental technology toward high-level uses of frequencies in mobile communication systems - Research and development on basic technologies toward promoting a transition of wireless systems to unused frequency bands - R&D of the integrated satellite-terrestrial mobile communication systems [literal translation] - R&D of the ubiquitous platform technologies [literal translation] - R&D of home network technology with reduced energy consumption - A trial to stop cyber Attacks, such as spam, phishing - Research and development on detection, recovery, and prevention of path hijacking - Research and development of technologies for preventing information leaks - R&D of ubiquitous network robot technology for elderly and challenged people [literal translation]
	National Institute of Information and Communications Technology	- Research and development on basic technologies for next-generation networks - Research and development on photonic network technologies - R&D of the infrastructure technologies for next-generation networks [literal translation] - Research and development concerning information reliability validation technology in telecommunication services - R&D on technology to detect illegal/harmful information on the Internet - R&D on super-high realistic communication technology using the innovative 3D imaging technology - R&D on universal audio/linguistic communication [literal translation]
Ministry of Education, Culture, Sports, Science and Technology		- Development and Use of an Advanced, High-Performance, General-Purpose Supercomputer - Next-Generation Supercomputer Strategic Program - Program for strategic use of information infrastructure (Development of ultra high-performance database core software based on the innovative execution principle, R&D on the system-integrated and collaborative software for realizing e-science, R&D on Web social analysis core software) - Research and development of device/system core technology for high-function and ultra low-power consumption computing - Development and dissemination of visualization technology of software development status - R&D on technologies for highly reliable software - Promotion of R&D for realizing a digital museum - Leading IT Specialist Training Promotion Program
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Food Research Organization	- Development of technologies for robot-harvesting fruits and vegetables
Ministry of Economy, Trade and Industry		- Next-Generation Circuit Architecture Technical Development Program - Project for the actualization of industry-academia collaborative software engineering projects [literal translation] - Secure platform project - Information grand voyage project (Development of next-generation information research/analysis technologies [literal translation] - Infrastructure project for a computer security early-warning system[literal translation] - Project for corporate and personal information security measures[literal translation]

	New Energy and Industrial Technology Development Organization (NEDO)	- GREEN-IT Project - Development of Functionality Innovative Three-dimensional Integrated Circuit (Dream Chip) Technology - MIRAI project - Developing technologies for next-generation process-friendly designing - - Semiconductor application chip project - Spintronics nonvolatile function technology project - Development of core technology for the next-generation, large-size, low-power consumption display - Development of the next-generation high-efficiency network device technology - Project for development of the next-generation robot intelligence technology - Project for Open Innovation Promotion by Utilizing Basic Robotic Technology - Project for Strategic Development of Advanced Robotics Elemental Technologies - Project for industrialization of life assistance robots [literal translation]
	Information Technology Promotion Agency	- Task of creating an early warning system for computer security - Taking security measures for corporate and private information - (2) central location for industry-academia collaborative software engineering, listed under the coordination of industry-academia collaborative software engineering center - Utilization promotion project for open software [literal translation]
Ministry of Land, Infrastructure, Transport and Tourism		- Study on unmanned work, inspection, and diagnosis by using subsea robots

3 Environmental Sciences

The environment sciences, considered a prioritized area by the Science and Technology Basic Plan, is an essential area of science for preserving the natural environment, including ecological systems with diverse forms of life, for maintaining human health and preserving individuals' living environment, and for maintaining the platforms for the future survival of human beings. In particular, addressing climate change, one of the most important issues facing the international community, the 4th Assessment Report prepared by the Intergovernmental Panel on Climate Change (IPCC) in 2007 pointed out serious influences on the global environment. In addition, Former Prime Minister Hatoyama set forth a goal to reduce greenhouse gases by 25% by 2020, compared to the 1990 level, with a precondition that all major countries are willing to construct a fair and practical international framework and accept the goal. It is important to promote the green innovation that contributes to the significant reduction of greenhouse gasses and the shift to a low carbon society. Japan divides the environmental field into six research areas, and is working on the following measures:

(1) Climate change

Promotion of earth observation

To find appropriate solutions to global environmental problems, it is necessary to obtain basic data in order to gain a comprehensive understanding of the situation with which the earth is currently faced and make predictions about its future. Japan has been promoting global environment observation using a variety of means, such as from satellites, land, and ocean, to contribute to the "Global Earth Observation System of Systems 10-Year Implementation Plan," which was agreed upon at the Earth Observation Summit.

Earth observation from an artificial satellite is a very effective observation method for collecting a variety of information over an extensive area in a repetitive and continuous fashion. For that reason, satellite-based observation is promoted comprehensively in cooperation with other institutions both in Japan and abroad as a solution for global environmental problems.

Greenhouse Gases Observing Satellite "IBUKI" (GOSAT)
Source: Japan Aerospace Exploration Agency

Greenhouse Gases Observing Satellite "IBUKI" (GOSAT), which was launched in January 2009, is conducting a global observation necessary to obtain more accurate estimations of the absorption and emission of greenhouse gases to help contribute to further promote measures against global warming. The satellite began providing data to the general public on brightness spectrum in October 2009 and on density distribution of carbon dioxide and methane in February 2010. Furthermore, the National Institute for Environmental Studies (NIES) is operating a system to process the observational data of GOSAT (preparation of data processing/provision and validation of data quality).

JAXA continues to measure global observation efforts with the Advanced Land Observing Satellite "DAICHI" (ALOS) and implements demonstration tests concerned with uses for the satellite—such as vegetation comprehension—in cooperation with related institutions. Furthermore, JAXA processes data acquired from Japan's Precipitation Radar (PR) onboard NASA's Tropical Rainfall Measuring Mission (TRMM) satellite and Japan's Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) onboard the Earth Observation Satellite (Aqua) and then provides the data to researchers. In addition, JAXA also promotes global observation using the satellites in space through R&D on earth observation satellites and sensors that collect and provide various data related to the global environment, including precipitation, clouds, aerosols, vegetation, etc., in an effort to further contribute to the improvement of the accuracy of climate change forecasts. {Refer to Part 2, Chapter 2 [Key Technologies of National Importance] (2)}

MEXT promotes observational research and the development of advanced equipment for the observation of carbon dioxide in and on the surface of the ocean or of small elements (nitrogen dioxide, ozone, etc.) and aerosols contained in the troposphere and is building observation networks for unobserved areas.

In addition, MEXT has implemented an environmental observation project under international cooperation in Antarctica where the change of the global environment can be observed clearly. Japanese Antarctic Research Programs are centered at the National Institute of Polar Research, affiliated with the Headquarters for Japanese Antarctic Research Expedition (JARE) (Director: Minister of MEXT), and are operated in cooperation with relevant ministries. In FY 2009, a new icebreaker for the Antarctic expedition "Shirase" was launched and made her first Antarctic expedition. Also, JARE-50 (wintering party) and JARE-51 teams carried out routine observations of weather, ozone, etc. around the Showa Station and performed academic monitoring observations, etc., for the purpose of highlighting the environmental changes that have occurred on a global scale. In particular, they performed research on the global environmental system from the viewpoint of interactions between space-atmosphere-ocean in polar areas.

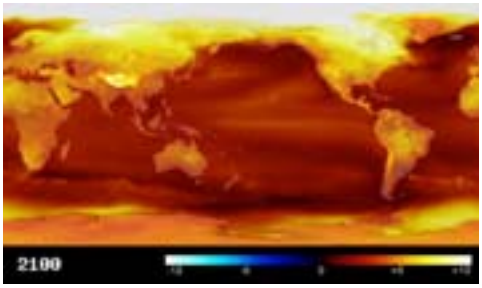
Furthermore, MAFF has been working on the development of a carbon cycling model for forests,

farmland, and marine forests that is conducive to the promotion of countermeasures aimed at global warming.

MIC is developing a differential absorption LIDAR[1] [2], for remote sensing of CO_2 at the National Institute of Information and Communications Technology (NICT). Furthermore, the ministry is implementing R&D on sensing network technology to resolve 3-dimensional structures in urban atmospheres, which will also have a large impact on environmental changes in Asia and the rest of the world, and will be the next generation Doppler radar necessary to measure and project the risk of unexpected localized disasters. In addition, NICT developed a Superconducting Submillimeter-Wave Limb Emission Sounder (SMILES)[3] onboard the exposed facility of the Japanese Experiment Module "Kibo" on the International Space Station and is also researching technology related to the measurement of global environmental changes from space.

MAFF is creating a database of imaging data obtained from the Moderate Resolution Imaging Spectroradiometer (MODIS)—onboard NASA's global observing satellites Terra and Aqua—and making it available on the Internet.

MOE promotes research studies conducive to the preservation of the global environment—including research on the destruction of the ozone layer and global warming—as well as the observation necessary for countermeasures against global warming, from a mid- to long-term perspective.



Global Warming Projection in 2100
Photo: Center for Climate System Research, the University of Tokyo/ National Institute for Environmental Studies /Frontier Research for Global Change, Japan Agency for Marine-Earth Science and Technology

Promotion of climate change projection research

MEXT is executing the "Innovative Program of Climate Change Projection for the 21st Century" for the purpose of providing the scientific foundations necessary to project policies and measures aimed at global warming and its curtailment as part of its contribution to the IPCC Fifth Assessment Report—due for release by around 2013—while promoting R&D on climate models and experiments on high precision and high resolution climate change projection under the Innovative Program of Climate Change Projection for the 21st Century utilizing the Earth Simulator—one of the world's most powerful supercomputers. Furthermore, MEXT is promoting the establishment of a "Data Integration and Analysis System (DIAS)," which aims to integrate and analyze various data and results of climate change projections obtained by satellite, terrestrial, and ocean observations, to provide scientific knowledge related to water resources and agriculture produce/water resource management for policymakers and researchers. {Refer to Part 2, Chapter 2, [Key Technologies of

1 LIDAR (Light Detection and Ranging) is a system to measure the atmospheric status by transmitting laser beams into the atmosphere and observing scattering light from substances floating in the air.
2 Differential Absorption LIDAR (DIAL) measures the concentration of specified atmospheric components by simultaneously transmitting a light beam with a wavelength that is absorbed by specified atmospheric components and a light beam with a wavelength that is not absorbed and then comparing the intensity of the scattered light of the two beams.
3 Superconducting Submillimeter Wave Limb Emission Sounder (SMILES) measures the amount of ozone and other stratospheric trace gases by directing the antenna to the atmospheric limb and receiving submilimeter waves that are radiated by small amount of molecules in the air through the use of a high-sensitivity, low-noise receiver.

National Importance] (2)}

Furthermore, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is performing basic research aimed at providing insight into the mechanisms behind global environmental change and achieving future projections, as well as R&D on technologies to improve the precision and speed of simulations using the Earth Simulator as well as to project global environmental changes.

The Meteorological Research Institute (MRI) of the Japan Meteorological Agency constructed a geographic earth observation system model for the projection of global warming in which analysis of aerosol and ozone was upgraded. For Japan, MRI is developing a local climate model with a high enough precision and resolution to display local cloud imaging specific to Japan and make spatially detailed regional warming projections.

(2) Hydrological cycles and solute transport in watersheds

Research is being carried out in the fields of research related to hydrological cycles and solute transport in watersheds to design scenarios for the realization of a society able to exist in harmony with nature while maintaining a healthy water cycle.

JAMSTEC has established a global earth observation system to observe and collect data and information on water, heat, and material circulation on a regional and global scale and implementing R&D to monitor changes in water circulation on a global scale through onsite and satellite observation of atmosphere, oceans, and land surfaces.

MEXT, in the Japan EOS Promotion Program, established an oceanic research and observation network (including a moored buoy network) and a research and observation network using Doppler radars, with the help international cooperation, collected observation data for atmospheric and oceanic fluctuation phenomena (including the Indian Ocean dipole mode phenomenon), and implemented observational research in order to better understand the mechanisms behind the hydrological cycle and climate change in the Asian monsoon region.

MEXT and MLIT are working to improve the integrated ocean observing system (ARGO Program), which deploys about 3,000 mid-depth floats to observe and report data on water temperatures and salinity by moving through the range of the sea level to as far as 2,000 meters deep at various locations throughout the world as part of a cooperative international effort to monitor the status of oceans around the world in real time.

MLIT is working on the development of technologies, including land infrastructure technologies that can exist in harmony with nature, where development of reproduction and recovery technologies in the basin zone for comprehensive water circulation management that takes the entire basin zone into consideration can take place. The ministry is also promoting research concerning the movement mechanisms of chemical substances in inner-bay deposition and comprehensive monitoring of the environment of inner bays, development of strategic stock management methods for housing and social capital, development of technology to reduce and recycle construction wastes, formation of waste flow systems to facilitate cyclical usage of resources, and research on the collection of biomass energy from sewage sludge and animal manure.

NICT has developed long-range ocean radars able to conduct continuous long-term observation of the flow field of the Kuroshio Current, etc. from shore, installed the radars at Ishigaki and Yonaguni

Islands, and is observing the flow field of the Kuroshio Current south of the East China Sea.

(3) Ecosystem management

In research related to ecosystem management, research is being conducted to achieve an exact understanding of the ecosystem and various organisms that live within it in order to assure their maintenance and reproduction.

MAFF is implementing development of indicators of biodiversity and evaluation techniques for the effective promotion of related measures that are considerate toward biodiversity and environmental conservation agriculture. Moreover, the ministry is developing methods to clarify the relationship between marine resources and large-scale changes, and to manage marine resources continuously through clarification of the influence of climate change on the marine ecosystem.

MOE is promoting research into the projection of—and countermeasures against—the effects of decreases in biodiversity. Furthermore, the ministry is also promoting research in a variety of fields, including those concerned with the preservation of a sound ecological system and human contact with nature, and those concerned with the maintenance and reproduction of a sound ecological system.

(4) Chemical risk and safety management

Chemical substances are used in various products and are increasingly becoming an essential part of people's lives. However, in order to sufficiently utilize the benefits of these substances, it is necessary to scientifically understand the risks and address that risk appropriately while simultaneously working to develop a society with a good sense of balance between risk and benefit. Surveys, R&D, and the formation of an intellectual foundation are all activities currently being conducted—most notably by relevant ministries—for the development of risk evaluation/management methods for chemical substances, the collection and provision of information on safety, and the development of necessary testing/measurement methods.

METI is promoting the development of methods for overall risk evaluation and management throughout the life cycles of chemical substances.

MOE is promoting the R&D of methods for risk assessment tests and measurement methods for chemical substances—including the development of an intellectual foundation—in an effort to contribute to countermeasures aimed at the environmental risks posed by chemical substances. MOE is also conducting surveys and research for related information to determine countermeasures to be taken toward hazardous metal from an international standpoint.

(5) 3R technologies

In the research related to 3R[1] technologies, the achievement of a cycle-based socioeconomic system and solutions to the problems of waste are being promoted.

METI is working on a variety of projects that are able to deal with environmental problems without hurting economic growth in an effort to bring forth a society that is recycling-based and

1 Reduce, Reuse, Recycle

low carbon. More specifically, it is conducting research to develop technology able to recover rare metals from lithium-ion batteries and technologies concerned with the separation of high-grade raw materials in plastic. Furthermore, METI and MOE are conducting joint research on technologies to collect and appropriately dispose of rare metals from used compact consumer appliances.

MOE is promoting research contributing to solutions for problems related to waste and the building of a recycle-based society, including "research for promoting the 3Rs," "research for promoting the use of waste-derived biomass," "social-scientific research for building a recycle-based society," "research on waste control technology for safety and security including solutions for asbestos problems," and "research on solutions for drift waste," while establishing a "special budget for rare metals" to conduct research on technology and techniques concerned with the recovery of rare metals from used products and other disposed goods. Particularly from the point of views of resource productivity and for measures against harmful substances, there is hope that these technologies can be developed rapidly.

(6) Biomass utilization technologies

In the research related to biomass utilization technologies, relevant ministries are promoting the development of biomass utilization technology suited to regions in a way that enables effective energy retrieval.

MAFF is mainly implementing the development of cultivating resource crops for use in domestically produced biofuel and methods for low-cost cultivation of such crops, the development of highly efficient biofuel production technologies, and the building of biomass-use models for the comprehensive use of biomass fuel and materials.

MOE has developed technologies against global warming for practical utilization, such as technologies for efficient production of bioethanol from orange juice residue, technologies to produce methanol from biomass for the production of BDF from used food oil, and so on. Furthermore, the Cabinet Office, the Fire and Disaster Management Agency (FDMA), MAFF, METI, MLIT, and MOE are performing a joint demonstration project, where bio-ethanol is manufactured in Miyakojima, Okinawa, from sugarcane produced on the island where the residents actually use gasoline mixed with 3% ethanol.

(7) Other

MOE is conducting research on material cycling mechanisms and oceanic pollution caused by hazardous chemical substances in order to help preserve the global marine environment.

Major research subjects conducted in the environmental area in FY 2009 are listed in Table 2-2-3.

Table 2 2 3 Major Research Projects in Environmental Sciences (FY 2009)

Ministry	Research organization	Subject
Ministry of Internal Affairs and Communications	National Institute of Information and Communications Technology (NICT)	- R&D of next generation Doppler Radar technology - R&D on remote sensing [literal translation] - Research on measurement technology for global environmental changes - Research and development of technologies for the measurement of subtropical Earth environments - Research on sensing network technology

	Fire and Disaster Management Agency	- Ensuring security corresponding to the utilization of new technology/materials
Ministry of Education, Culture, Sports, Science and Technology	Japan Agency for Marine-Earth Science and Technology, Japan Aerospace Exploration Agency, National Institute for Environmental Studies, universities, etc.	- Earth Observation and Ocean Exploration System - Research on global environmental changes - The Innovative Program of Climate Change Projection for the 21st Century - Plan for promoting the establishment of a global observation system - Data integration and analysis system (DIAS)
Ministry of Health, Labour and Welfare	Chemicals Risk Research Project [literal translation] (Health and Labour Sciences Research Grants)	- Research on acceleration and sophistication of the evaluation of harmful chemicals [literal translation] - Research on evaluating the impact of chemicals on children [literal translation] - Research on methods to evaluate the impact of nano-materials on human health
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Food Research Organization, National Institute for Agro-Environmental Sciences, Japan International Research Center for Agricultural Sciences, Forestry and Forest Products Research Institute, Fisheries Research Agency, etc.	- Development of biomass utilization technology for local revitalization - Assessment, mitigation and application of technologies toward the effects of global warming on the agriculture, forestry and fishery sectors [literal translation] - Development of technology to predict/control population out break of marine life in relation to environmental change - Development of indicators and assessment technologies of biodiversity applicable in agriculture [literal translation]
Ministry of Economy, Trade and Industry		- Project for the development of alternative rare metal materials - Development of a highly efficient recovery system of rare metals
	National Institute of Advanced Industrial Science and Technology	- Evaluation of CO_2 absorption in forests and oceans [literal translation] - Development of chemical substances and production technology using biomass as a raw material - Preparation of detailed risk evaluation report of typical chemical substances - Development of risk evaluation methods of industrial nano-materials [literal translation] - Development of recycling technology for rare metals, other metals, and chemical products [literal translation]
	New Energy and Industrial Technology Development Organization (NEDO)	- Regional biomass heat usage field test project - Development of methods for assessment of the hazardous properties of oil refinery substances, etc. - Development of evaluation methods for the properties of nanoparticles - Development of risk trade-off analysis method aiming for optimum control of chemical substances - Development of hazard assessment via structure-activity correlation methods
Ministry of Land, Infrastructure, Transport and Tourism	National Institute for Land and Infrastructure Management	- Research on sustainable disposal at landfills in coastal areas - Research on the preservation of marine environments in Japanese waters
	Geographical Survey Institute	- Geodynamics via precise Earth measurement
	Meteorological Research Institute, Meteorological Agency	- Comprehensive projection of climatic change around Japan due to global warming
	Hydrographic and Oceanographic Department, Japan Coast Guard	- As a part of activities by the Hydrographic and Oceanographic Department, 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
	Public Works Research Institute	- Development of recycling construction technology for building a recycling-oriented society - Development of a regional system for the recycling of biomass, centered around joint biogas plant(s) - Development of dam technology to preserve the natural environment - Development of technology to alleviate environmental risks in daily life - Development of technology to preserve/restore water ecosystems - Research on the intensive land use of coastal areas in cold regions - Development of design technology for river basins and channels that coexists with the environment in the field of rivers in cold regions
	National Maritime Research Institute	- Research conducive to the prevention of air pollution due to gas emissions from ships - Research on the development of technologies to reduce volatile organic solvent from painting on ships [literal translation] - Research for the prevention of environmental contamination caused by salvage work [literal translation]
	Port and Airport Research Institute	- Clarification of substance moving mechanisms in the seabed boundary layer [literal translation] - Suggestions on management methods for persistent organic pollutants accumulated in inner bays [literal translation] - Discussion on numeric indicators related to stability and health of coastal natural infrastructure [literal translation] - Permanent consecutive observation and statistical analysis of environments in closed inner bays [literal translation] - Research on geo-environment design technology for tidal mud flat regeneration - Survey and experiment on feeding behaviors of species in higher trophic levels of the coastal ecosystem [literal translation] - Development of simulators of water quality and ecosystem of inner bays for seas filled with living creatures [literal translation] - Survey and experiment on the enhancement of CO_2 absorption in coastal ecosystems [literal translation] - Systemization of technologies to promote effective use of dredged sand for environmental repairs [literal translation]

Ministry of the Environment		- Research on comprehensive evaluation of the impacts of global warming for the examination of dangerous levels of global warming and stable levels of greenhouse gasses [literal translation] - Comprehensive research to clarify the broader air pollution in East Asia and to promote atmospheric environment management with consideration for compatibility with measures against global warming [literal translation] - Research on countermeasures for geomorphic and water resource changes in small island states consisting of atolls [literal translation] - Research on the promotion of a long-term ecosystem monitoring and data network for Asian continental carbon cycle observation [literal translation] - Observation of greenhouse gases over Asia-Pacific region utilizing commercial aircraft - Real-time measurement of nitro compounds in the exhaust of diesel vehicles using PTR-TOFMS [literal translation] - Development of fast and inexpensive analytical systems for inorganic soil pollutants [literal translation] - Research on the development of methods for estimating various types of bear population [literal translation] - Development of systematic methods of evaluating the impacts of ecological risk using microcosms [literal translation] - Examination of categorization and improvement plans of disposal technologies for electrical appliances in Asia [literal translation] - Research on reducing waste generation on the coast of the Japan Sea and promotion of waste collection and preventive measures [literal translation] - Development of technologies for recycling rare metals and the detoxification of arsenic [literal translation] - Development of technology to produce green methanol for carbon-free BDF and advanced utilization of its byproducts. - T&D on practical application of an urban biomass energy system for the use of dry methane fermentation [literal translation] - Development of effective production technologies to produce bioethanol from the residue of orange juice [literal translation] - Production cost of observational research equipment equipped on satellites - Research on comprehensive management methods conducive to unified preservation of ocean and land - Investigative research on the biological effect of environmental nanoparticles - Survey of POP residues in the general environment [literal translation] - Basic research for hazardous heavy metal countermeasure strategy - Provision of information on hazardous property classification, label investigation, and label information on chemical substances
	National Institute for Environmental Studies	- Clarification of the regional characteristics and mechanisms of long-term changes in the concentration of greenhouse gases [literal translation] - Observation of carbon dioxide using satellites and estimation of global carbon balance distribution [literal translation] - Risk assessment of global warming by integrating climate, influence, and land use models [literal translation] - Overall assessment of vision construction and measures for the achievement of an anti-global warming community [literal translation] - Design and evaluation of resource recycling system and policy and management techniques for the near future [literal translation] - Planning and evaluation of measures for the management of the recycling of reusable or toxic substances [literal translation] - Development of Win-Win type resource recycling technologies for biomass waste [literal translation] - Construction of a proper management network and technical system that supports international resource recycling [literal translation] - Exposure level evaluation by integrated analysis of combined factors related to the exposure of chemical substances [literal translation] - Assessment of the impacts of chemical substances on health, focusing on factors of sensitivity [literal translation] - Assessment of the bio-kinetics of environmental nanoparticles and their impact on health [literal translation] - Development of assessment techniques for environmental impact from the viewpoint of biodiversity and ecological function [literal translation] - Development of atmospheric environmental evaluation techniques in Asia [literal translation] - Development of a recycle assessment system for water and substances in East Asia [literal translation] - Development of environmental impact evaluation techniques for valley ecosystems [literal translation]

4 Nanotechnology and Materials

The nanotechnology and materials field contributes to the progress of S&T and to problem solving in fields such as life sciences, information and telecommunications, and environmental sciences. It forms important technology seeds that realize the development of industry, affluent lifestyles for all, and a comfortable society that is safe and secure.

(1) Nanoelectronics

Aiming to bring forth rapid development and overcome the technical and performance limitations of future information and communication technology, NICT is conducting R&D of fundamental technologies, such as advanced quantum control technologies, photo level signal control technologies, technologies for unused spectra, technologies to control and use atomic/molecular structures, and others; utilizing atoms, molecules, and other new materials—such as superconductors.

MEXT is promoting the development of logic devices that will overcome the limitations of silicon devices, information memory with over 100 times the memory density of conventional products, and element technologies for next-generation electron microscopes. Furthermore, the ministry is developing information and communication technology materials utilizing nanotechnology at the National Institute for Materials Science (NIMS).

METI is developing nanoelectronics technology based on the operating principles of near-field optics to realize optical devices that include low-loss and high-function polarization control components.

(2) Bionanotechnology and biomaterial

MEXT is establishing nanobiotechnology research bases that are open to the world. Furthermore, NIMS is developing biomaterials utilizing nanotechnology.

MAFF is working on the development of processing and assessment technologies for developing new food materials utilizing nanotechnologies.

METI is developing molecular imaging equipment to detect functional changes in cells and detect cancer at a significantly early stage as well as devices that will be able to specifically target and treat cancer cells with pinpoint accuracy.

(3) Materials

MEXT is promoting the strategy for rare elements to develop innovative catalysts for structural design and control at the nanoscale and technologies to scientifically elucidating roles of elements that determine the characteristics and functions of substances and materials to help ensure the replacement and reduction of using rare element. In addition, it also promotes fundamental R&D for breakthroughs in environmental technologies as part of the “Project: development of environmental technologies utilizing nanotechnology.”

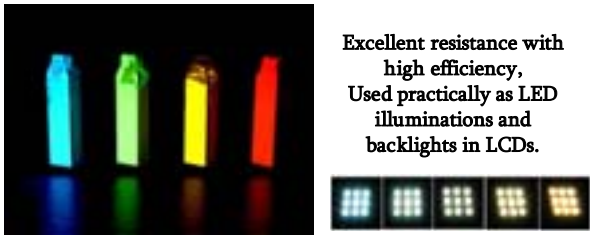
At NIMS, the ministry is also promoting R&D to increase the sophistication of environmental and energy materials as well as R&D of materials that are highly reliable and safe.

METI is developing fundamental processing technologies related to welding and forging

technologies for structural control at the nanoscale to ensure further reliability, higher strength, and lighter weight by taking advantage of the special characteristics inherent to high-class steel products that have been structurally-controlled to that level.

(4) Promotion platform for nanotechnology/material

MEXT is preparing in anticipation of its shared use in FY 2011 of X-ray Free Electron Lasers, which enable instant observation and analysis of ultra-fine structures at the atomic level and the ultra high-speed movements of chemical reactions. {Refer to Part 2, Chapter 2, [Key Technologies of National Importance] (5)} Furthermore, the ministry is promoting the commoditization of state-of-the-art research facilities and equipment owned by research institutions—such as universities and independent administrative institutions—through the "Nanotechnology Network" in an effort to promote research field integration that will produce achievement and spawn innovation. In addition, the ministry started to "develop research base networks to develop a low carbon society" to arrange research foundations to accelerate the industrialization of environmental technologies.



SiAlON Phosphor developed by NIMS (Left) and the applied products (white LED) (Right)
Photo: National Institute for Materials Science (NIMS

METI is promoting the project "Challenges for Nanotechnologies in Interdisciplinary Industries and Fields [literal translation]" to strengthen the vertical collaboration between upstream and downstream industries and cross-industrial and cross-field collaboration in an effort to improve the technical capacity and international competitiveness of Japanese industries. In addition, METI is also implementing the "development of advanced assessment standards for functional semiconductors" to clarify the impact of new materials used in semiconductor manufacturing on the functionality of finished products.

The National Institute of Advanced Industrial Science and Technology (AIST), the National Institute for Materials Science (NIMS), the University of Tsukuba, and industry are working in collaboration to promote the formation of a world-class advanced nanotechnology research center in the City of Tsukuba.

(5) Nanoscience/material science

MEXT is implementing basic/fundamental research at RIKEN regarding the control and creation of nano-level physicality and functions, technological renovation of electronic materials by using cross-correlation of electrons, and basic research on nanoscale structural observation using light. Moreover, the ministry is implementing basic research in a wide range of fields at universities and independent administrative institutions.

Major research subjects conducted in FY 2009 in the nanotechnology/materials field are as shown in Table 2-2-4.

Table 2 2 4 Major Research Projects in Nanotechnology/Materials (FY 2009)

Ministry	Research organization	Subject
Ministry of Internal Affairs and Communications	National Institute of Information and Communications Technology (NICT), ect.	- Research and development related to nano-ICT Ministry of Internal Affairs and Communications
Ministry of Education, Culture, Sports, Science and Technology		- Strategy for Rare Elements - Development of processing devices based on non-silicon device materials - Development of memory devices for ultrahigh density information - Founding of biotechnology research centers - Development of environmental functional catalyst based on nanotechnology - Development of microstructure-controlled materials - Development of nano-measurement/processing technologies for practical application (Development of next generation electron microscope element technologies) [literal translation] - Project for the creation of innovations for advanced research facilities (Nanotechnology Network) - Development of environmental technologies utilizing nanotechnology [literal translation]
	National Institute for Material Science	- Development of common fundamental areas in the nanotechnology field - Creation and nano-structural control of new materials on a nano-scale - Development of information and communication materials utilizing nanotechnology - Development of biomaterials utilizing nanotechnology - R&D for improving environmental/energy materials - R&D on materials ensuring high reliability and safety
	RIKEN	- Research for material function creation [literal translation] - Advanced optical science research [literal translation] - Molecule ensemble research - Research on dynamic hydration structures and molecular processes [literal translation] - Material creation research [literal translation] - R&D on an ultimate energy particle observation device [literal translation] - Research on clean chemistry [literal translation]
Ministry of Health, Labour and Welfare	Health and Labour Sciences Research Grants (Nano medicine research)	- Research on the application of nano-level imaging in healthcare - Research on the development of low invasive and non-invasive medical equipment [literal translation]
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Food Research Organization	- Development of technologies for nano-scale processing/evaluation of food materials
Ministry of Economy, Trade and Industry		- Project for development of alternate rare metal materials - Development of technologies for new nano-electronics semiconductor materials/new structures
	National Institute of Advanced Industrial Science and Technology	- Design of soft materials and development of functional materials [literal translation] - Development of energy-saving building materials [literal translation] - Development of nano-simulation technologies [literal translation] - R&D on large-scale synthesis of organic nano-tubes and their improvement [literal translation]
	New Energy and Industrial Technology Development Organization (NEDO)	- Research and development of infrastructure for the innovation of high-strength/high-function ferrous materials - R&D of Next-generation DDS-type Malignant Tumor Therapy System - Project for R&D on Molecule Imaging Equipment - Project on the development of carbon nanotube capacitor - Spintronics nonvolatile function technology project - Challenges to nanotechnologies achieved through fusion of different field and businesses - Development of technologies for new nano-electronics semiconductor materials/new structures – In particular, development of technologies for substrates/epitaxial growth of nitride-based chemical compounds - Development of technologies for new nano-electronics semiconductor materials/new structures – In particular, development of technologies for nano-electronic devices in new materials and structures - Project for creation of photocatalyst industry to help establish a recycle-oriented society - Technology for highly-efficient manufacturing of three-dimensional optical devices - Forged Magnesium Parts Technological Development Project - Development for fundamental technology of materials for textiles featuring new structures with advanced functional expression - Development of sophisticated evaluation base for semiconductor-like functional materials [literal translation]

		- Technology development for ultra-flexible display material - Technology development for low-loss optical materials with new functions - Technology for next-generation electro-optical materials and element synthesis - Development of technologies for components using the innovative micro reaction field - Development of technologies for innovative components using high-function composite metallic glass - Development of sustainable hyper-composite technology
Ministry of the Environment		- Development of simplified all printed water quality test chip via the creation of chemical sensing nanoparticles

5 Energy

Japan stipulated the "Basic Energy Plan" (Cabinet decision: March 2007) based on the "Basic Act on Energy Policy" (Act No. 71 of June 2002) and is promoting measures concerning supply and demand of energy in a comprehensive and systematic manner on a long-term basis.

(1) Diversification of energy sources

Promotion of the use of nuclear energy

Nuclear energy is quasi-domestic energy that contributes to overall measures for preventing global warming as it does not emit CO_2 during the power-generating process, and it boasts excellent supply stability. Today, nuclear power generation accounts for approximately 30% of the total power generation in Japan and continues to be promoted as the core power source for the future.

Research, development, and utilization of atomic energy in Japan have been conducted according to the Atomic Energy Basic Act (enacted in December 1955), solely for peaceful purposes, based on the premise of ensuring safety. The government has been steadily promoting the research, development and utilization of nuclear energy based on the "Framework for Nuclear Energy Policy" (October 2005) and the "Basic Energy Plan."

1) Next-generation light water reactors (LWRs)

At present, LWRs constitute the mainstream of nuclear reactors in Japan. Next-generation LWR development is being promoted with full cooperation of governmental and private sectors as preparation for the large-scale demand for replacement of existing nuclear power plants (NPPs) in Japan, which is expected to begin in approximately 2030, as well as to complete in global markets.

2) Fast Breeder Reactor (FBR) cycle technology

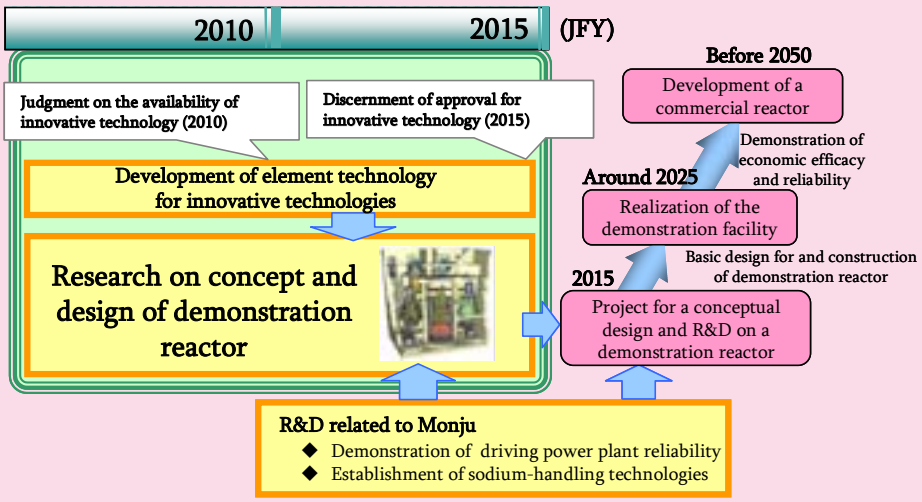
The Fast Breeder Reactor (FBR) remarkably improves the efficiency of uranium resource use because it generates significantly more fuel than that consumed while generating electricity, contributing greatly to a stable energy supply for Japan. In addition, it decreases the yield of high-level radioactive waste by reusing minor actinide contained in the used fuel as fuel, and reduces the burden per generated energy on the environment. Therefore, its development is highly meaningful.

The FBR cycle technology is positioned as "strategically prioritized S&T" and as part of the "Key Technologies of National Importance." In the "Environmental Energy Technology Innovation Plan" (May 2008), it is indicated as "innovative technology for highly effective energy reduction" and related R&D will be promoted strategically. In March 2007, the government stated in the "Basic

Energy Plan" that FBR cycle technology will be "promoted as a "top-priority issue for Japan."

Regarding R&D for FBR cycle technology, the "FBR Cycle Commercialization R&D program" is now underway in which the innovative technology to be adopted for FBR cycle facility will be determined in 2010 and the concept designs of the actual and demonstration plants will be presented in 2015. Thereafter, construction of the demonstration facility will be completed in about 2025, and the commercialization of the reactor will be started before 2050. (Figure 2-2-5)

Figure 2 2 5 Fast Breeder Reactor Cycle R&D Plan



The prototype FBR "Monju" is positioned as the core R&D for FBR cycle technology. The initial goal of establishing its reliability as a power generation plant as well as the development of sodium-handling technologies within about 10 years should be achieved on schedule. In order to meet this schedule, the Japan Atomic Energy Agency (JAEA) completed tests to verify the soundness of the whole plant in August 2009 while placing the ultimate priority on the safety toward resumption of test operations tentatively within 2009.

Prototype Fast Breeder Reactor "Monju" (Tsuruga, Fukui)
Photo: Japan Atomic Energy Agency

In addition, five-way talks including METI, MEXT, electric power utilities companies, manufacturers, and JAEA reached agreement on reinforcement of the management of JAEA projects, rearrangement of the assessment system of electric power utilities companies, and the framework of cost sharing between the public and private sectors, which were set forth in the document, "How to Implement R&D of Demonstration Fast Breeder Reactor Cycle Technology," announced in July 2009.

3) Uranium enrichment and advanced fuel

Since Japan relies on imports for most of its energy resources, the government is steadily promoting efforts to establish the nuclear fuel cycle through effective utilization of recovered

plutonium, etc., from the reprocessing of spent nuclear fuel, in order to secure long-term energy supply stability in view of future energy supply and demand throughout the world, and to reduce the impact on the environment.

The government strives to ensure the transparency of plutonium use, not only through the rigorous management of nuclear materials, but through clear observation of the principle of never holding plutonium that is not required to implement current programs, so as to avoid arousing international concerns regarding the proliferation of nuclear weapons. The Cabinet Office therefore reports and discloses the use and management status of plutonium in Japan to the Nuclear Energy Council every year (reported on September 8, 2009).

From the viewpoint of assuring stable energy supply, Japan promotes the development of domestic uranium enrichment projects to obtain the enriched uranium used as fuel in nuclear power generation, while endeavoring to maintain economic efficiency, in order to secure uranium resources and the respective processes of the nuclear fuel cycle that are required for light-water nuclear reactors in Japan. The new advanced centrifugal machine, featuring higher performance and excellent economic efficiency, has been under development since FY 2002 in close collaboration of public and private sectors. Renewal of the new advanced centrifugal machine has been underway since March 2010 by Japan Nuclear Fuel, Ltd., and plans are in place to start producing enriched uranium in September 2011.

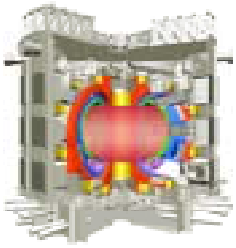
4) Spent fuel reprocessing technology

As a rule, spent fuel should be reprocessed domestically in Japan and construction is underway on Japan's first private-sector reprocessing facility (with an annual reprocessing capacity of 800 tons) in Rokkasho-mura, Aomori Prefecture. Testing using spent fuel is in the final stage (active testing), with aims for the completion of construction in October 2010. In addition to R&D to enhance vitrification technology for high-level radioactive waste, JAEA is providing technical assistance, including human resources, for the Rokkasho reprocessing plant, and construction and operation of the plant aims at the steady establishment of reprocessing technology on a commercial scale, as well as progression toward establishing the nuclear fuel cycle.

Tokai reprocessing facilities
Photo: Japan Atomic Energy Agency

5) Geological disposal of high-level radioactive waste

Geological disposal technology for high-level radioactive waste is essential for Japan in order to continuously implement R&D for greater improvement of reliability, enabling progress with disposal duties and to support the national safety regulations. Such R&D is being conducted by JAEA in close cooperation with the relevant research institutions. In addition, JAEA is promoting two underground research laboratory programs, one in Mizunami, Gifu Prefecture (crystalline rocks) and one in Horonobe, Hokkaido Prefecture (sedimentary rocks).



International Thermonuclear Experiment Reactor (ITER)
Photo: JAEA/ITER Organization

International Fusion Energy Research Center (Rokkasho, Aomori)
Photo: JAEA

6) Technologies for decommissioning nuclear facilities and treatment/disposal of radioactive waste

It is important that decommissioning of nuclear facilities and treatment/disposal of radioactive waste should be conducted under the responsibility of nuclear facility establishers and radioactive waste generators in a planned and efficient manner. JAEA is developing the technologies needed to achieve safe and reasonable treatment, disposal, and reduction of the generated radioactive wastes as well as the recycling of resources. The Decommissioning Engineering Center (reorganized from the Advanced Thermal Reactor "Fugen" in 2008) is executing investigations and research on safety demonstrations; the dismantling of equipment is on schedule and the project will be completed by FY 2028.

7) Fusion energy

Fusion energy is expected to be one of the future solutions for both a plentiful energy supply and global environmental problems for the following reasons: (1) fuel resources are abundant, (2) no greenhouse gases are emitted during the process of electric generation, and (3) it generates large amounts of electric power from small quantities of fuel. Fusion energy R&D has been promoted using three types of reactors in Japan, including a tokamak[1] reactor (critical plasma test equipment JT-60, JAEA; operations have been stopped since August 2008 for replacement to superconductive type); a helical[2] reactor (large helical device LHD, NIFS); and a laser type reactor[3] GEKKO XII, Institute of Laser Engineering at Osaka University). The R&D achievements are leading the world in fusion energy technology.

Furthermore, Japan takes an active role in the ITER (International Thermonuclear Experiment Reactor) Project[4], which aims for demonstrating S&T feasibility of fusion energy. Japan also implements, "broader approach" activities (advanced R&D projects), that complement and support the ITER Project within the country through Japan-Europe cooperation. In these two operations, Japan is promoting the manufacture of equipment they are assigned to procure, and in FY 2010, full-scale advanced R&D and other activities will start when the ITER Rokkasho (International

1 Tokamak type achieves nuclear fusion in the processes to create twisted magnetic fields caused by those generated by coils and plasma current, thus confining heating plasma
2 Helical type achieves nuclear fusion using processes to twist the coils themselves and create twisted magnetic fields, thus confining heating plasma.
3 Laser type achieves nuclear fusion using processes to heat nuclear fusion fuel of ultra high density that is imploded by irradiating laser beams with an ultra high intensity laser.
4 ITER Project is an international joint research and development project which aims to construct and operate a thermonuclear experiment reactor in France, in cooperation with 7 parties; Japan, Europe, the United States, Russian Federation, China, the Republic of Korea, and India.

Fusion Energy Research Center) site, another "broader approach activity, is completed.

8) Basic and fundamental R&D for atomic energy

Basic and generic R&D for atomic energy is important to support utilization and development of atomic energy, such as maintaining a high-level technical basis concerning atomic energy utilization, as well as to create new knowledge and technologies. JAEA conducts basic and generic research projects concerning nuclear and reactor engineering, fuel and material engineering, environmental and radiation engineering, advanced basic research, and other basic and generic research. In addition, MEXT determined strategic program themes that clarify policy needs for the enhancement and strengthening of basic and generic research, following the "Initiatives for Atomic Energy Basic and Generic Strategic Research" [literal translation], aiming at the promotion of research conducted in a competitive environment.

9) Innovative nuclear energy system including a high-temperature gas-cooled reactor

JAEA is promoting performance evaluation of the high temperature gas-cooled reactor the High Temperature Engineering Test Reactor (HTTR) test operation, as well as R&D of the IS process in which hydrogen is produced by pyrolysis of water, in order to establish high temperature gas-cooled reactor technology, which allows for various types of energy supply and heat utilization technologies such as hydrogen production. In FY 2009, JAEA conducted a long-run test (50 days) of HTTR at the output coolant temperature of 950 degrees centigrade.

Ensuring nuclear non-proliferation and peaceful use

As more and more countries are introducing the use of atomic energy, it is necessary to promote efforts to ensure nuclear non-proliferation and peaceful use, which will be a precondition for using atomic energy.

Japan concluded the full-scope safeguards agreements with IAEA in 1977 in response to the ratification of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in 1975 and accepted the "safeguards" of IAEA, which is a measure for preventing nuclear materials from being diverted to nuclear weapons.

After the conclusion of the Agreement, Japan received the determination from IAEA that "there had been no diversion of the declared nuclear materials into nuclear weapons." Furthermore, in 1999, Japan concluded an additional act for strengthen safeguards to proactively deal with the enhancement and promotion of streamlining IAEA safeguards. As a result, IAEA first concluded in its Safeguards Statement in 2004 that, concerning the status of Japan as of 2003, "no undeclared nuclear materials existed and all nuclear materials remained in use in peaceful activities" and the conclusion has been maintained ever since. Based on the conclusion, the Integrated Safeguards have been implemented, streamlining safeguards through a reduction in the number of inspections. In 2008, the world's first Site-Level Integrated Safeguards Approach, including facilities handling plutonium, was introduced in order to promote the Integrated Safeguards that improve both effectiveness and efficiency.

In addition, Japan voluntarily started a project to assess and approve the safeguards in 2009 for

contributing to the realization of effective and efficient international safeguards.

Furthermore, Japan is working on developing an international program to monitor radionuclide, based on the Comprehensive Nuclear-Test-Ban Treaty (CTBT), in addition to activities such as the development of technologies related to nuclear non-proliferation, organization of international training courses for enhancement of technologies to measure and manage nuclear materials, and so on. In the US-Japan Summit of November 2009, the joint statement "World without Nuclear Weapons" was announced, confirming the enhancement of cooperation for technology development in the field of nuclear non-proliferation and nuclear security. Pursuant to this statement, US-Japan cooperation shall be reinforced further in relation to nuclear non-proliferation and nuclear security.

Ensuring nuclear safety

Safety is the indispensable prerequisite for the research, development, and utilization of nuclear energy. Efforts such as stringent regulations and management, as well as execution of safety-related research, are essential to ensuring safety. Moreover, assuming the premise that the accidents cannot be 100% eliminated, countermeasures are needed to ensure that devastation to the lives and health of local residents can be minimized, should an accident occur.

As for research, development and utilization of nuclear energy in Japan, the government imposes stringent safety regulations on nuclear facilities at every stage of design, construction and operation, in accordance with the "Nuclear Reactor Regulation Act," reflecting levels that are not seen in any other industrial sectors in Japan. In addition, regarding radioactive isotopes and radiation generators used in the medical, agricultural, and industrial sectors, among others, the government implements safety regulations based on the "Act Concerning the Prevention from Radiation Hazards" to prevent radiation damage resulting from the use of the above.

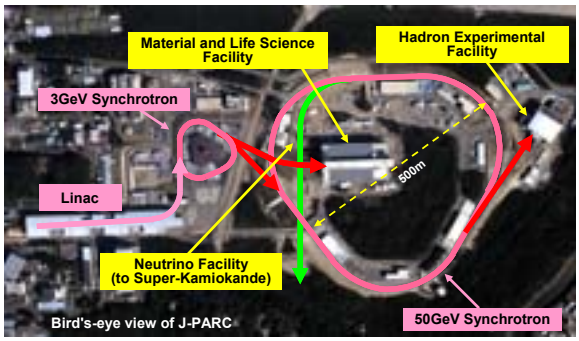
As for nuclear emergency countermeasures, efforts to expand and strengthen nuclear disaster measures are now being promoted based on the "Act on Special Measures concerning Nuclear Emergency Preparedness," including dispatch of specialists in nuclear emergency preparedness, designation and maintenance of Off-site Emergency Centers and implementation of emergency drills.

For assessments of environmental radiation, MEXT and other relevant ministries and agencies, prefectural governments and atomic energy utilities conduct radiation surveys in areas surrounding nuclear facilities, additionally surveying environmental radioactivity levels in Japan and nuclear-powered military vessels upon entry into Japanese ports. In August 2009, the Nuclear Safety Commission of Japan set forth the "Prioritized Nuclear Safety Research Program (2nd term)," in effect for five years from FY 2010, considering the domestic and international trends and issues regarding research into the safety of atomic energy.

Promotion of nuclear S&T, and development of infrastructure for research, development and utilization of nuclear power

1) Promotion of quantum beam technology

Quantum beam technology using an accelerator and high power laser has broad applications in areas ranging from academic research, such as exploration of the fundamental principles of nature, to industrial use. The Japan Proton Accelerator Research Complex (J-PARC Project), a maximum level proton accelerator facility built jointly by JAEA and the High Energy Accelerator Research Organization (KEK), is expected to contribute to R&D spanning a variety of fields including life science, material science, nuclear physics and particle physics through the application of secondary particles, including the neutron, meson, and neutrino, released from the proton accelerator with a global maximum level of beam intensity. All the facilities have been put into operation in FY 2009. In addition, RIKEN is promoting the planned RI Beam Factory (RIBF), an accelerator facility generating beams of all types of radioactive isotopes (RI), from hydrogen to uranium, with the highest intensities in the world.



Japan Proton Accelerator Research Complex (J-PARC) (Tokaimura, Ibaraki)
Photo: J-PARC Center

2) Dissemination of radiation utilization

Since radiation is used in a wide range of fields from basic and applied research to practical areas such as medicine, engineering, and agriculture, it is important to promote radiation usage while conducting research and development.

In terms of broad utilization, radiation is employed to some degree in diagnosis and cancer treatment in the medical arena. For example, treatment using particle beams has the advantage of levying fewer burdens on patients since the anesthesia and incisions that accompany surgery are not required. In the agricultural sector, radiation is used for the extermination of harmful insects and improvement of crop varieties. Academic research has been conducted on the movement of water and the accumulation of harmful metals in plants, for example. In the industrial field, radiation is used for the production of semiconductor devices and radial tires. In addition, radiation is actively used in the reform and manufacture of various types of industrial products, and in the sterilization of medical devices.

3) Fostering and acquiring nuclear technicians

In order to advance R&D and the utilization of nuclear power while securing safety, it is necessary to train outstanding personnel and acquire new personnel who can support these efforts. MEXT and METI have implemented the Nuclear Technician Training Program [literal translation] to support the education of students wishing to become nuclear technicians in universities and colleges of technology. In addition, the training of nuclear technicians has been discussed at the Conference of Nuclear Technician Trainers [literal translation] by individuals representing

collaboration among industry, academia, and government.

4) Disposal of radioactive waste

At present, radioactive waste generated by research institutes and medical facilities is not disposed of, but rather is stored by individual entities; however, disposal of this waste is an important issue for the smooth promotion of research, development and utilization of nuclear energy in the future.

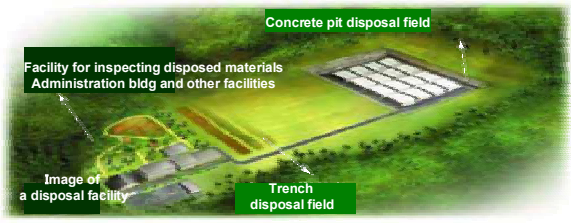


Image of a disposal facility
Photo: Japan Atomic Energy Agency

To this end, the "Act on the Japan Atomic Energy Agency" was partially revised in June 2008 (with enforcement in September 2008) to establish a system for JAEA to discard its own waste together with that released from other businesses. Based on the revision, the national government set forth the "Basic Policy on the Underground Waste Disposal Business [literal translation]" in December 2008, and the "Plan for the Underground Waste Disposal Business [literal translation]" prepared by the JAEA was approved in November 2009.

5) Efforts for assuring trust and coexistence with communities

For smooth promotion of research, development, and utilization of nuclear energy, it is extremely important to obtain public confidence in nuclear power, and nuclear power operators must build up a record of safe operations and strive to win public trust. To this end, activities to enhance the public's understanding of nuclear energy are being implemented via two-way and transparent communication with the community through public hearings and public relations programs, as well as through the support of education programs at schools such as seminars on nuclear energy for educators and the loan of simple radiation measuring equipment.

Furthermore, to promote the coexistence of nuclear power research facilities and regions where such facilities are located, voluntarily-executed programs are being subsidized under the three basic acts related to power-generation facilities and other measures.

6) International nuclear power cooperation

There has been a global trend of countries increasingly trying to introduce nuclear power plants or constructing new nuclear power plants.

MEXT holds the initiative in promotion of non-proliferation and peaceful use of atomic power through the projects conducted by IAEA and other international organizations. At the same time, under the framework of FNCA[1], Japan also assists in human resource training and infrastructural development in the fields of radioactivity and nuclear power safety, targeting the countries that are new to introducing atomic power in Asia and in other regions.

1 Forum for Nuclear Cooperation in Asia: A framework aiming to promote the peaceful and safe utilization of nuclear technologies in Asian countries, thereby promoting their social and economic growth. Ten countries participate in the Forum, including Japan, Australia, Bangladesh, China, Indonesia, Korea, Malaysia, the Philippines, Thailand, and Vietnam.

Regarding the United States, France, and other countries advanced in the use of atomic energy, Japan has been collaborating in a variety of fields, such as R&D of an atomic power system with safer and higher economic efficiency, including FBR, through GIF[1] and other activities. Japan has collaborated with the United States in R&D and human resource training based on the agreement on reinforcement of collaboration regarding nuclear non-proliferation and security declared at the US-Japan leadership summit in November 2009.

Photovoltaic power generation system installation in test site area ("Pal Town Josai-no-Mori," Ota-shi, Gunma)
Photo: New Energy and Industrial Technology Development Organization

Promotion of the use of renewable-energy

Renewable energy, including solar energy, biomass and waste energy, and wind energy, faces issues such as instability of power generation and higher cost. However, since it has advantages, including the potential to address global warming and relatively limited resource constraint, active promotion of technology development is necessary to solve existing problems, thereby facilitating the introduction and dissemination of renewable energy.

1) Photovoltaic power generation

Photovoltaic power generation has been spreading as its cost has fallen. Nevertheless, development of technologies that further lower costs is essential for the early establishment of a truly independent market. For this purpose, METI promotes the development of technologies that achieve lower costs and higher levels of efficiency, as well as the development of recycling and reuse technologies.

2) Biomass energy

Based on the Biomass Nippon Strategy (Cabinet decision): March 2006), the Cabinet Office, MIC, MEXT, MAFF, METI, MLIT and MOE promote R&D into technologies for the efficient conversion of animal wastes, wood residues, organic sewage, food wastes, and other biomass sources into energy resources.

In particular, regarding biofuel, large-scale experimental projects toward full-scale introduction of bioethanol were conducted in Hokkaido (two locations), Niigata, Osaka, and Okinawa. In addition, development of technologies for effective ethanol production from cellulose-based raw materials, such as rice straw and wood, which is consistent with food supply, is being selectively promoted.

Hydrogen energy/Fuel cells

METI promotes R&D of elemental technologies of the main unit of fuel cells, R&D of their utilization technologies in production, transportation and storage of hydrogen fuels, and

1 Generation-IV International Forum: Cooperation that is based on the agreement for further promoting research and development of next-generation nuclear systems (the fourth generation) through international cooperation, with twelve participating countries, including Japan, Argentina, Brazil, Canada, China, France, Korea, Republic of South Africa, Switzerland, England, and the US as well as EURATOM.

demonstration of large-scale fuel cell systems for household use, as well as experimental study on fuel cell-powered vehicles and hydrogen supply system. MLIT supports technology development of an energy conservation system with fuel cells to be equipped in buildings.

Promotion of development and utilization of fossil fuels

1) Petroleum

In response to the requirements for dealing with polymerizatin[1] of crude oil and lightening[2] of the demands of petroleum products, and to promote sophistication of oil refineries, METI promotes projects for the development of innovative oil refining technologies and a technology to produce petrochemical feedstock of high value from heavy-gravity crude oils.

In addition, it is important to develop technologies allowing for promotion of energy conservation and resource saving by means of the advancement and improved efficiency of petroleum refineries as well as cooperation with various industries in petrochemical complexes. For this purpose, METI develops technologies, including promotion of process streamlining in oil refineries, and effective utilization of by-products that are produced in petrochemical complexes.

2) Coal

Coal offers excellent supply stability compared to petroleum and other sources. But since coal emits the highest carbon dioxide of all fossil fuels, R&D is needed to reduce its burden on the environment. For this purpose, METI promotes the development of clean coal technologies for the Integrated coal Gasification Combined Cycle (IGCC) and the Integrated coal Gasification Fuel cell Combined Cycle (IGFC) which are highly efficient power generation systems capable of reducing carbon dioxide emissions.

In addition, R&D of Carbon dioxide Capture and Storage (CCS) technologies is being promoted with mid- and long-term frames of reference.

3) Natural gas, etc.

Because natural gas has lower carbon dioxide emission and less environmental burden than other fossil fuels, promotion of R&D into its utilization is therefore of importance. Consequently, METI promotes research into technologies for the manufacture and utilization of liquid fuels (GTL, or Gas-to-Liquid) and dimethyl ethyl (DME), obtained by converting natural gas into liquid fuel, which should lead to the expansion of natural gas use. The ministry also promotes the R&D of new technologies for the utilization of methane hydrates as an energy source, as they are believed to be available in relatively large quantities from the seas around Japan.

(2) Promotion of countermeasures for energy conservation

From the viewpoint of global warming prevention and effective utilization of limited energy resources, it is important to carry out R&D to improve efficiency in specific individual devices and

1 Increase of the ratio of heavy crude oil with heavy gravity.
2 Increase of a relative percent of the light petroleum products such as gasoline and kerosene compared with heavy gravity petroleum products such as heavy fuel oil in domestic demand.

element technologies and to promote R&D for improving energy supply and utilization efficiency of energy systems throughout social systems by applying unused energy. It is also necessary to promote R&D from the viewpoint of reducing all energy (life cycle energy) that is directly or indirectly consumed during the production, use, re-use, and disposal of various products.

For this purpose, METI established a strategy for the development of energy conservation technologies from discovery through commercialization of a new technology, thereby enhancing the effectiveness of energy conservation technology development. The ministry promotes strategic research and development.

(3) Other

Issues concerning energy and environment require research in both natural science and social science. Table 2-2-6 shows major research topics in the energy sector (excluding nuclear power) implemented during FY 2009.

Table 2 2 6 Major Research Projects in Non-nuclear Energy (FY 2009)

Ministry	Research organization	Subject
Ministry of Internal Affairs and Communications	Fire and Disaster Management Agency	- Assurance of safety measures that respond to new technologies and new materials
Ministry of Education, Culture, Sports, Science and Technology	National universities and other institutions	- R&D in new energy and energy conservation - Design of Sustainable Management and Recycling System for Biomass and General and Industrial Wastes - Development of fuel cells featuring higher performance and lower cost than conventional types
	National Institute for Materials Science	- Development of new heat-resistant materials that resist ultra high temperatures for long durations - Development of ultra-light and highly intense structural materials featuring excellent workability that contributes to efficient use of energy
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Food Research Organization	- Development of biomass utilization technology for local revitalization
Ministry of Economy, Trade and Industry		- Development of innovative technologies including those for petroleum refining responsive to heavier crude oil - Development of technologies that fuses advanced functions of petroleum refining within industrial complexes - Development of hydrogen energy technologies - Development of methane hydrate technologies - Research and development into clean coal technologies - Development of energy conservation technologies/energy-saving technologies - Research and development for CO_2 heat pump water heater with higher efficiency and reduced size - Development of element technologies for practical use of high-efficiency gas turbine - Development of high-efficiency lighting equipment using organic electro-luminescence (organic EL) - Development of electric double-layer condenser using carbon nano-tube - Study on carbon-fiber reinforced composite materials for weight save of automotives - Development of core technology related to next-generation low power consumption semiconductors - Development of core technologies for inverters by using high-performance power devices (power elements) - Development of technology for distributed energy network systems - Development of technologies for sequestration and effective use of carbon dioxide

	New Energy and Industrial Technology Development Organization (NEDO)	- Demonstration of a fuel cell (solid oxide fuel cell) system using ceramics as electrolytes [literal translation] - Development of technologies for practical use of fuel cells (polymer electrolyte fuel cells) that use ion-exchange membranes as electrolytes - Maintenance project for building common infrastructure for a hydrogen society - Basic research into enhancing the reliability and durability of solid oxide fuel cells [literal translation] - Research and development of new energy technologies - Development of technologies for practical use of next-generation battery systems - Development of technologies including the stabilization of electric power systems used in wind-power generation - Large-scale demonstration for dissemination of gas mixed with 3% ethanol - Development of technologies for electric appliances with yttrium superconductor [literal translation] - R&D in energy conservation technology - R&D in fuel cell system - Strategic development of technology for streamlined energy use - Development of technologies for an environmentally friendly steel production process [literal translation]
	Japan Oil, Gas and Metals National Corporation	- Development of liquid fuel from natural gas - Promotion of development and utilization of oil and natural gas - Development of technologies for an energy conservative system that uses fuel cells equipped in buildings [literal translation]
Ministry of Land, Infrastructure, Transport and Tourism	National Institute for Land and Infrastructure Management	- Research on comprehensive evaluation methods and designing methods in relation to energy-saving functions in commercial construction [literal translation]
	National Maritime Research Institute	- Research contributing to the prevention of global warming derived from CO_2 emission from ships [literal translation] - Research for the creation of an estimation technique for CO_2 emission from foreign shipping—an international issue [literal translation]
	Port and Airport Research Institute	- Research on the understanding of coastal and offshore wind condition characteristics as well as utilization of wind energy - Demonstrative research of an offshore wind profile observation system [literal translation]

6 Manufacturing Technology

The manufacturing industry is one of the fields with the highest international competitiveness among all industries, and is a lifeline for Japan. It also has a large ripple effect on other industries and serves as a driving force for economic growth.

Under the Science and Technology Basic Plan, manufaturing technology is being promoted in order to clearly show the viewpoint that it strengthens the ability of value-creating manufacturing, which aims for the development of S&T that raises the value of “things” by stepping out of the conventional development framework of manufacturing technology.

(1) Promotion of manufacturing technology with a shared foundation

MEXT promotes the development of the “only one, number one” advanced measurement analysis technology and devices that are able to respond to the needs of cutting-edge researchers and on-site manufacturing. Moreover, MEXT has developed close industry-academia collaboration systems, and promotes R&D on high-performance, state-of-the-art, advanced, complex, and large-scale simulation software in the area of manufacturing technology.

METI implements the development of manufacturing technologies from the different fields cooperating in the Bio Electro-mechanical Autonomous Nano Systems (BEANS) that integrate MEMS technology, biotechnology, and nanotechnology, leading to the generic technologies to realize next-generation micro devices which are high-performance and energy-saving (innovative biological devices that could not be manufactured before), such as medical instruments and

environmental sensors. Further, METI promotes the development of robot technologies that are utilized in the manufacturing sector. With these projects, the ministry supports creation of innovation in manufacturing technology .

Support for the advancement of core manufacturing **technology at SMEs**

In pursuant to the "Act on Technology Advancement of SMEs" (enacted in June 2006), future directions and visions (guidelines) of technological development are indicated in relation to core manufacturing technology (casting, forging, cutting work, plating, etc.), and at the same time, assistance is provided to improve the core manufacturing technology through legal and budgetary measures.

1) Support for R&D by manufacturing SMEs

Based on the "Act on Technology Advancement of SMEs," the national government approved and supported plans for specific R&D prepared by SMEs according to guidelines. More specifically, financial assistance was provided for R&D for improvement of specific core manufacturing technologies implemented by SMEs, while supporting R&D to realize innovation in production processes, mitigating expenses for patent application of achievements obtained through the plans of specific R&D by SMEs, and implementing low-interest financing by Japan Finance Corporation.

2) Enhancement of the environment for the advancement of core manufacturing technology

Support was provided for activities to create "opportunities to meet" for SMEs and downstream companies, including allocation of personnel who coordinate and fine-tune cooperation between SMEs which play key roles in core technologies and industries, with establishment of opportunities for information exchange between them.

Serving as "intellectual shelters" for SMEs with problems involving intellectual property, societies of commerce and industry and chambers of commerce and industry across the country served as one-stop access points for advice and consultation. Seminars on prevailing corporate activities focusing on intellectual property were also staged in various places nationwide.

(2) Promotion of manufacturing technology with groundbreaking, dramatic development expected

METI implements the Project for Strategic Development of Advanced Robotics Elemental Technologies, which executes development of state-of-the-art technologies (for industrial, service and special environment use) toward realization of mission-oriented, competitive and advanced robots within the scope of the Strategic Technology Roadmap. In addition, the "Green Sustainable Chemical Process Core Technology Development" has been implemented to enhance simplicity, cleanliness, lower energy consumption, and resource productivity in the manufacturing process of petrochemical products and functional chemicals, as well as to pursue waste reduction and easy recycling.

Such projects are expected to lead to innovative and dramatic development of manufacturing processes, thus contributing to industrial and international competitiveness. METI implements the

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(3) Development and fostering of personnel, ensuring thorough skill legacy

The manufacturing technology field can be referred to as the lifeline of our country, but a shortage in the quality and quantity of competent persons who support manufacturing technology is reaching serious proportions.

To solve this problem, MEXT is establishing systems to nurture individuals and is pursuing other versatile creative measures in elementary, lower secondary, and upper secondary education, and even in subsequent lifelong learning stages.

In elementary and lower secondary levels, manufacturing technology is taught within related academic subjects, based on National Curriculum Standards. In particular, at specialized upper secondary schools, the "Project to Foster Competent Persons for Local Industries" [literal translation], which aims to develop technical specialists reflecting specific regional characteristics, is underway in cooperation with local industries.

At the upper secondary level, under the Project to Foster Practical Competent Persons by Industry-Academia Collaboration: Towards fostering engineers, the engineers with advanced skills and education who are capable of innovating manufacturing are being nurtured at universities, through development and implementation of educational programs organically combined with experiments, practical training and lectures in cooperation with regional communities and industries. In particular, technical colleges demonstrate the appeal of manufacturing technology through approaches such as the Idea Showdown: Technical College Robot Contest, while sharing manufacturing technology with the community through extension lectures and other efforts.

In the area of lifelong learning, opportunities for career improvement are being amplified through the acceptance of working people at universities and other schools, and through practical training programs. Children are being given opportunities to experience and study manufacturing technology at the local level, through utilization of community centers, museums, and classrooms, ensuring ongoing nurturing of human resources in manufacturing. Furthermore, the retired population's knowledge and resources are also being tapped in order to ensure a continuation of skilled individuals in the field of manufacturing technology . The major research topics in FY 2009 in manufacturing technology are as shown in Table 2-2-7

Table 2 2 7 Major Research Projects in Manufacturing Technology (FY 2009)

Ministry	Research organization	Subject
Ministry of Education, Culture, Sports, Science and Technology		- R&D on simulation software that becomes the base of innovation creation [literal translation]
	Japan Science and Technology Agency	- Project on acceleration of industry-academia collaboration [literal translation]
	RIKEN	- Research on the establishment of technology information integration system in advanced IT
Ministry of Economy, Trade and Industry	New Energy and Industrial Technology Development Organization (NEDO)	- Development of technologies for ultra-flexible display component [literal translation] - Development of technologies for super hybrid materials [literal translation] - Development of basic technologies for green sustainable chemical process [literal translation] - Technology for next-generation optical-wave control materials and elements [literal translation] - Technology for highly efficient manufacturing of three-dimensional optical device - Project to develop element technologies for strategic, cutting-edge robots - Project to develop manufacturing technology for next-generation devices combining different fields [literal translation]
Ministry of Land, Infrastructure, Transport and Tourism	National Institute for Land and Infrastructure Management	- Research on comprehensive evaluation methods and designing methods in relation to energy-saving functions in commercial construction [literal translation]

7 Social Infrastructure

Social infrastructure is a basic field that supports people's lives. In order to achieve a prosperous, secure, and safe society, R&D is being promoted to contribute to reducing the risks inherent in society and to improving public conveniences.

Disaster prevention

Natural disasters responsible for horrific damage occurred in Japan and abroad in 2009, including heavy rains in Chugoku and northern Kyushu in July 2009, the Haiti earthquake in January 2010, the Central Chile earthquake in February of the same year, and so on. These disasters make it extremely important to promote the earthquake-volcano forecasting research and disaster-prevention technologies aimed at reducing the damage caused by them.

Earthquake research in Japan is being promoted with the collaboration and cooperation of related administrative agencies under the Headquarters for Earthquake Research Promotion (Director: Minister of MEXT; hereinafter referred to as the "Earthquake Headquarters") established under the Act on Special Measures concerning the Earthquake Disaster Prevention (Act No. 111 of 1995). The Earthquake Headquarters compiled a new 10-year plan starting from FY 2009 with the "New Earthquake Research Promotion" [literal translation] in April 2009. This new plan suggests that research on ocean-trench earthquake and the active fault be promoted integrally and strategically within at least the first 10 years—with consideration to also be given to a 30-year timeframe—and their results be applied effectively to disaster-prevention and disaster-reduction countermeasures that aim to establish a society capable of minimizing seismic damage.

In regards to research on seismic/volcanic eruption forecasting, a new 10-year plan set forth by the Earthquake Headquarters also emphasized the importance of basic research based on the