Section 2. Promotion of Green Innovation

It is necessary for Japan to strongly promote green innovation in order to address the following two issues - securement of stable energy supply and response to climate change - faced by Japan as well as the international community. Therefore, with the aim of building of the stable energy supply-demand structure from a long-term view and the world's most advanced low-carbon society through further enhanced environmental and energy technology innovation in which Japan has a decided advantage, Japan is to positively promote to expand and spread such technologies or systems at home and abroad to realize sustainable growth in Japan. In order to accomplish the objective as shown above, Japan sets up the following three important issues - 1) realizing of stable energy supply and a low-carbon society, 2) increasing and smartening of energy utilization efficiency and 3) greening of social infrastructures - and is promoting R&D to resolve these issues.

1 Promotion of Measures to Accomplish Important Issues

(1) Realizing of stable energy supply and a low-carbon society

In order to realize stable energy supply and a low-carbon society, the R&D for innovative technology aiming at accelerating of spread of renewable energy and for innovation of the dispersion energy system is being promoted in a manner consistent with stability, economy and sustainability of energy supply all over Japan. In addition, measures for promotion of biomass utilization have been taken according to the "Basic Plan for the Promotion of Biomass Utilization" (decided by the Cabinet in December 2010) prescribing the basic policies and objectives of Japan.

1) R&D for renewable energy technology

MEXT is promoting R&D towards drastic improvement of conventional technology for renewable energy such as solar power generation or biomass utilization. In particular in the field of plant science and advanced environmental materials, the ministry is promoting R&D aiming at construction of "Green Network of Excellence" which comprehensively supports studies at the highest global standards and human resource development (HRD) in the relevant field with research target, facilities and personnel shared among the leading universities in Japan under strategic cooperation between them.

Following a program for the "Development of Environmental Technology Using Nanotechnology," the Ministry has also established a research center for fundamental R&D to develop the technical seeds of solar power generation and others, to support HRD for advanced environment technology.

JST has set up the fields of solar cell and solar energy utilization system, biotechnology and others to promote R&D for innovative technology (game changing technology) with enormous potential for greenhouse gas reduction from a mid- and long-term standpoint and based on such new scientific and technological knowledge as is not an extension of conventional technology under a competitive environment.

The National Institute for Materials Science (NIMS) is creating new materials useful to boost the efficiency of next-generation solar cells essential to the diffusion of renewable energy utilization.

MAFF has assisted the efforts to integrate raw material supply, fabrication and distribution towards domestic full-scale production of biofuels, to establish the technology for biofuel production and utilization

based on collection and transport of soft cellulosic resources such as rice straw compatible with food or feed supply, and to spread biofuels on a full-scale.

The Ministry is also focusing on the development of the energy crop cultivation at low-cost towards increasing the use of domestic biofuels, development of the high-efficiency biofuel production technology, and construction of a biomass utilization model to coordinate fuel and material utilization of biomass.

METI is implementing R&D for cost reduction and efficiency increasing of the renewable energy-related technology including solar power generation, wind power generation, biomass utilization and power generation utilizing ocean energy.

For solar power generation, for example, the Ministry is conducting R&D of innovative technology such as quantum dot solar cell.

For wind power generation, the ministry is conducting R&D for establishment of wind turbine design technology applicable to the external condition in Japan, and the survey and demonstration project for establishment of bottom-mounted offshore wind turbine technology.

For biomass energy, the ministry is conducting R&D for efficiency increasing and cost reduction of cellulosic ethanol production, for introduction and spread of next-generation biofuel compatible with food production, such as algal biomass.

MOE is implementing R&D and empirical study on renewable energy technology which is necessary and possible to be put into practical use early. For geothermal power generation, for example, the ministry is conducting the development and demonstration of hot spring power generation system using hot spring water, the empirical study on a geothermal reservoir management system for coexistence between hot springs and geothermal power, and the technology development for reducing the cost of slant drilling. For biomass utilization, the Ministry is conducting R&D for cost reduction and efficiency increasing of ethanol production from cellulosic biomass. For wind power generation, the ministry is conducting the development of small- and medium-size wind turbine system with wind-lens technology, and promoting the demonstration project for setting and running Japan's first full-scale floating offshore wind turbine.

The Public Works Research Institute (PWRI) is implementing the technology development contributing to realization of a low-carbon society with environmental impact reduction, which utilizes renewable energy such as biomass energy and recycled resources.

The National Institute for Land and Infrastructure Management (NILIM) is implementing the study on infrastructures including sewage treatment facilities and low carbon houses. The institute is also conducting the survey and examination of enhancement method of water power generation utilizing existing dams in East Japan, in order to contribute to the stable power supply in the future in light of experience obtained from the power shortage caused by the GEJE.

2) R&D of a dispersion energy system

MEXT and independent administrative institutions concerned are promoting R&D for realizing the energy conversion and storage system using fuel cells and batteries with the aim of innovation of a dispersion energy system.

JST has set the research fields of superconducting system, battery device and others to promote R&D for innovative technology (game changing technology) with enormous potential for greenhouse gas reduction and based on such new scientific and technological knowledge as is not an extension of

conventional technology under a competitive environment, in order to continuously and steadily advance the greenhouse gas reduction from a mid- and long-term standpoint.

The National Institute for Materials Science (NIMS) is implementing R&D for creation of new materials for superconducting power transmission or high-performance power generation and storage which contribute to realization of a microgrid[1] society with a combination of small-scale dispersion power generation and networking.

METI is implementing the technology development and demonstration of batteries and fuel cells. For the batteries, in particular, the Ministry is conducting the technology development for performance enhancement and cost reduction of a large-size battery for the system necessary to introduce and expand renewable energy or the lithium-ion battery for next-generation vehicles such as electric cars, plug-in hybrid cars. For the fuel cells, the ministry is conducting the technology development for cost reduction and durability-reliability enhancement, and the technology development and demonstration for a hydrogen station for introduction of fuel cell cars.

On the other hand, the four areas - Yokohama City, Toyota City, Kansai Science City (Keihanna) and Kitakyushu City - started in full swing the large-scale demonstration aiming at construction of a smart community with participation of local residents, local governments and private companies in FY 2011 (refer to Part 1, Chapter 2, Section 2, 1, (2)). For the purpose of utilizing versatile technology or regional energy complementing that demonstration, the seven areas throughout the country started technology demonstration towards construction of a smart community utilizing regional resources and rooted in regional communities to conduct the development of smart grid-related technology. Coordinating with the smart community demonstration on a local level as the above, MEXT is promoting R&D for enhancement of energy management technology.

As for the smart grid, MIC is promoting the empirical experiments of ICT for Building and Energy Management System (BEMS) and Home and Energy Management System (HEMS) and the introduction supporting of communication interface standards necessary to realize the efficiency of energy use on a local level (refer to Part 2, Chapter 3, Section 1, 2, (2)).

MOE is conducting the development of an energy interchange system on direct current among areas for the purpose of construction of a self-sustained dispersion energy system and the development and demonstration of a grid system which adjusts supply-demand balance with a combination of a small-size water power generator and a heat pump for demand load regulation.

3) Efficiency and low-carbonization of key energy source

(i) Clean Coal Technology

Although it has greater supply stability than petroleum and others, coal as key energy source has more carbon dioxide emissions per unit energy than other fossil fuels in the process of burning, so it is necessary to develop a technology for environmental impact reduction. Taking into account the environmental necessity, METI has developed the Clean Coal Technology based on R&D for realization of the zero-emission thermal power generation with a combination of Integrated Coal Gasification Combined Cycle (IGCC), Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC) which can generate

[1] A system of mutual provision of electricity with a combination of small-scale dispersion power generation, power supply and networking

electricity with high efficiency in restraint of carbon dioxide emissions and Carbon Dioxide Capture and Storage (CCS), and for the high-function steel (offering improved heat resistance , heat life) necessary for such high efficiency.

(ii) Material technology innovation applicable to key energy

The National Institute for Materials Science (NIMS) is promoting R&D for material technology innovation including development of the high-strength and heat-resistant steel applicable to thermal power plants or nuclear power plants, and improvement of the damage evaluation technology for nuclear reactor materials.

(iii) Carbon Dioxide Capture and Storage (CCS)

With the aim of practical use and diffusion of CCS, METI is advancing R&D for demonstration of the integrated system from separation and capture of carbon dioxide from a large carbon dioxide source to a carbon dioxide storage in the ground (1,000 m underground), and for substantial cost reduction and safety improvement of the system.

(iv) Innovative petroleum refinery technology

In response to heavy crude oil trend[1], light petroleum products trend[2] and global warming, METI is advancing development of technology to obtain value-added petrochemical raw material from heavy oil and the innovative petroleum refinery technology to make efficient use of residues remained after petroleum production in oil refineries to promote sophistication of oil refineries.

(v) High-efficiency gas turbine

The Central Research Institute of Electric Power Industry (CRIEPI) has been developing a high-efficiency gas turbine to promptly respond to demand for replacement of aged LNG thermal power plants, carbon dioxide emissions reduction and energy conservation measures in partnership with private companies, and conducted a comprehensive test including operation checks on equipment for practical application of the high-efficiency gas turbine in FY 2011.

4) R&D for nuclear energy power

Regarding nuclear energy power, the government has been discussing revision of the nuclear energy policy as well as the nuclear energy R&D design so as to summarize the result of the discussions approximately in or around the summer of 2012, taking into account the accident at TEPCO Fukushima Daiichi NPS.

In FY 2011, the government addressed R&D and nuclear human resource development (HRD) for atomic energy bases and safety with a particular emphasis on the efforts to recover from the nuclear power disaster. For the fast breeder reactor cycle technologies, the government focused on the further improvement of safety and maintenance of the facilities in anticipation of the discussions about reviewing

[1] A phenomenon where the rate of heavy crude oil is increased
[2] A phenomenon where the rate of light petroleum products such as gasoline, light heating oil becomes higher than that of heavy petroleum products such as heavy heating oil in domestic demand

the nuclear energy policy. For R&D of the nuclear fusion expected as future energy source, the global nuclear cooperation and others, the government has successively made necessary efforts.

In the policy proposing type screening held in November 2011, some participant presented a proposal to review R&D budget related to nuclear energy including "Monju" in light of the accident at TEPCO Fukushima Daiichi NPS to focus on the accident and safety measures, and accordingly the government took measures to reflect that proposal in the government budget in FY 2012.

(i) Securing and developing of nuclear human resources

MEXT and METI are implementing the "Nuclear Human Resource Development Program" supporting the nuclear education in universities or technical colleges to foster superior human resources to serve as a basis of the safety of nuclear power. MEXT is also supporting the inter-organ activities to develop human resources in an effective, efficient and strategic manner in collaboration with relevant bodies of industry, academia and government based on the "Global Nuclear-HRD Initiative (GN-HRD)," and, in FY 2011, focused on the development of human resources who engage in nuclear safety and risk management in light of the accident at TEPCO Fukushima Daiichi NPS.

(ii) Basic and fundamental R&D for nuclear science

The Basic and fundamental R&D for nuclear science aiming at reinforcement of technology bases for utilization of nuclear energy, contribution to safety improvement and creation of new knowledge and technology is important in supporting utilization and development of nuclear energy.

The Japan Atomic Energy Agency (JAEA) is dealing with the basic and fundamental R&D for nuclear data, reactor engineering, irradiation material science, actinide science, radiochemistry, environmental science, radiation protection, computational science, partitioning-transmutation technology, advanced basic research and others. For the purpose of enriching and enhancing the basic and fundamental R&D, MEXT is promoting the research in universities under a competitive environment on the strategic program set to clarify the policy needs according to the "Initiatives for Atomic Energy Basic and Generic Strategic Research," and, in FY 2011, adopted the new issues also in terms of contribution to response to the accident at TEPCO Fukushima Daiichi NPS.

(iii) Fast Breeder Reactor (FBR) cycle technologies

Because FBR can tremendously improve the efficiency in utilizing uranium resources by producing more fuel than consumed in the process of power generation, the FBR cycle technologies holds the possibility of contribution to long-term stable energy supply and to reduction of potential harm of high-level radioactive waste by reusing minor actinide contained in spent fuel as fuel. Although the FBR cycle technologies is placed as key technologies for national security in the 4th Basic Plan, Japan is to decide on the implementation of R&D in anticipation of the direction of energy policy and nuclear energy policy in Japan.

In May 2010, the FBR "Monju" restarted a test run about 14 years and 5 months after the sodium-leak accident, and completed the first phase of the test in July 2010. Thereafter an accident has happened with parts of the In-Vessel Transfer Machine (IVTM) falling down during an operation after fuel handling, in the end, in May 2011, the drawing operation of IVTM was finished. While the original plan was to conduct

the 40% output plant check test within FY 2011, the 40% output plant check test is shelved on the grounds that further safety measures should be taken and efforts to improve safety should be focused on in light of experience obtained from the accident at TEPCO Fukushima Daiichi NPS and Japan is to decide on the implementation of the test in anticipation of the direction of energy policy and nuclear energy policy in Japan.

Regarding R&D for practical application of the FBR cycle technologies, in addition, while R&D on innovative elemental technology and the conceptual design of demonstration facilities were planned to be initiated by JAEA with participation of electric power suppliers and makers as end-users with the aim of presenting in 2015 the practical use image of FBR cycle (conceptual design of demonstration and commercial reactor) achieving performance targets such as safety, economic efficiency which next-generation plants should ensure and R&D plan for practical application, R&D on innovative elemental technology has been frozen, and the curing and storing measures appropriate for maintenance have been taken in light of experience gained through the accident at TEPCO Fukushima Daiichi NPS. Furthermore, the efforts to formulate safety design requirements for the sodium-cooled FBR have been taken within an international framework (Generation-IV International Forum (GIF)).

FBR "Monju" (Tsuruga City, Fukui Pref.)
Photo: JAEA

(iv) Fusion energy

Because of the existence of numerous fuel resources, no emissions of greenhouse gas in the process of power generation and the possibility of large-scale power generation from a small amount of fuel, the fusion energy is expected to serve as one of future energy sources with the possibility to solve both the energy problems and the global environmental problems. Regarding the fusion energy, the advanced R&D with three types of reactors - Tokamak reactor (JAEA, Break-even Plasma Test Facilities: JT-60, shutdown since August 2008 for conversion to superconducting system), Helical reactor (National Institute for Fusion Science (NIFS), Large Helical Device (LHD)) and laser fusion reactor (Institute of Laser Engineering, Osaka University, GEKKO-XII Laser) - have produced world-class results in the fusion field.

On the other hand, Japan takes the initiative in participating in the International Thermonuclear Experimental Reactor (ITER), project aiming at demonstration of scientific and technical feasibility of the fusion energy, and is advancing the Broader Approach as the advanced R&D project complementing and supporting the ITER Project in partnership with Europe in Japan (Rokkasho Village, Aomori Prefecture

and Naka City, Ibaraki Prefecture).

(v) Securing of nuclear safety

It is the major premise for R&D and use of nuclear power to take all possible measures to ensure safety under the strict regulation and control based on the advanced safety research. It is also necessary to prepare the disaster countermeasures to minimize damage to human life and health of residents in the vicinity of the nuclear power facilities in the event of an accident.

While R&D and use of nuclear power in Japan has been controlled at each phase of design, construction and operation of the facilities under the safety regulation set by the government according to the "Nuclear Reactor Regulation Act," the government is to review the regulations and systems for the nuclear safety to restore trust in the nuclear safety administration and to improve the administrative functions in light of the lessons learned from the accident at TEPCO Fukushima Daiichi NPS.

The government is also implementing the safety regulation for radioactive isotopes and radiation generators according to the "Act Concerning the Prevention from Radiation Hazards[1]" to prevent the radiation hazards associated with the use of those. The ministerial ordinance and public notice for the "Act Concerning the Prevention from Radiation Hazards" were revised in May 2012 under a partial revision to the above act in May 2010 for the purpose of introduction of the clearance system[2], addition of activated products to the list of control subjects and enhancement of decommissioning.

Regarding nuclear emergency countermeasures, the efforts to allocate senior specialists for nuclear emergency, to improve and maintain a facility that serves as center for emergency response measures (Off-Site Center) had been made according to "Act on Special Measures Concerning Nuclear Emergency Preparedness," but the local Off-Site Center could not play a given role for initial response at the time of the accident at TEPCO Fukushima Daiichi NPS. Taking into account that fact, it is pointed out in the mid-term report of the Investigation Committee on the Accident at the Fukushima Nuclear Power Stations that it is necessary to promptly and appropriately improve the Off-Site Center so as to maintain the functions in the event of large-scale natural disaster.

It is also shown in the 'Interim Report for Reviewing "Regulatory Guide: Emergency Preparedness for Nuclear Facilities"' summarized by a working group on review of the Emergency Preparedness Guide under the Nuclear Safety Commission of Japan, that the Precautionary Action Zone (PAZ) is to be designated within a radius of about 5 km from the atomic facilities and Urgent Protective Action Planning Zone (UPZ) within a radius of about 30 km from the atomic facilities. In response to this report, the government is to help to add the monitoring posts[3] around the atomic facilities.

Regarding the environmental radiological monitoring, MEXT is holding the initiative in conducting the radiological investigation around the atomic facilities in collaboration with ministries concerned, prefectures and nuclear operators, researching the environmental radioactivity level in Japan and conducting the radiological investigation in case of port call of atomic vessels.

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1 Law Concerning Prevention of Radiation Hazards due to Radioisotopes, etc. (Act No. 167 of 1957)
2 A system to allow to handle as industrial waste or reuse the vanishingly low level radioactive pollutants which require no special treatment in terms of prevention from radiation hazards
3 A facility to continuously measure the environmental radioactivity

(vi) Spread of radiopraxis

Since the radiopraxis has been advanced in wide fields of basic and applied research to medical, industrial and agricultural application, it is important to promote R&D.

In the medical field, the diagnosis and cancer therapy with radiation has been partially put to practical use. Ion-beam cancer therapy has the advantage of reduction the strain on patients because it is not need to surgery with anesthesia or incision. In the agricultural field, irradiation has been applied to pest control or cultivar improvement. Academic researches such as study on water dynamics and toxic metals accumulating process in plants are also in progress. In the industrial field, the radiation has been applied to production of semiconductor devices, radial tires and so on. Irradiation has actively been utilized for modification and production of various industrial materials, and to sterilization of medical instruments. And also, irradiations of semiconductor, creation of new materials and R&D to create new applications by irradiation have been progressed at the Takasaki Ion Accelerators for Advanced Radiation Application (TIARA) in the Takasaki Advanced Radiation Research Institute, JAEA.

(vii) Disposal of waste from research facilities

Although it is still the case that radioactive waste released from research or medical facilities (waste from research facilities) is stored without disposal by each companies concerned, realizing the disposal of such waste is becoming an important issue in advancing R&D and utilization of the atomic energy in the future. In response to this issue, JAEA was designated as body conducting the disposal according to Japan Atomic Energy Agency Act revised in 2008.

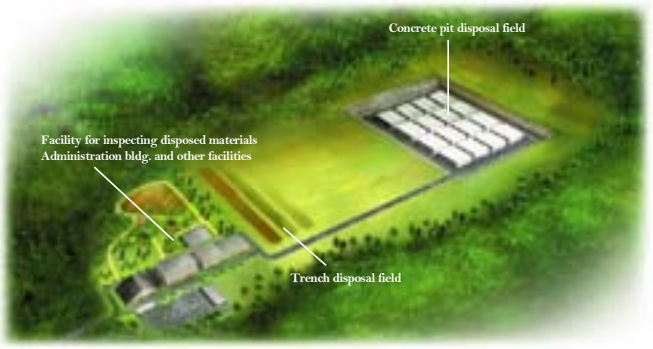


Image of Disposal Facility
Source: JAEA

JAEA is making efforts to establish site criterion and procedures of the disposal facilities according to the "Basic Policy Concerning Implementation of Land Disposal" (decided in December 2008) and the "General Plan for Implementation of Land Disposal" (approved in November 2009) with the aim of realizing the disposal of waste from research facilities.

(viii) Efforts for assuring trust and coexistence with communities

For R&D and utilization of nuclear energy, it is important to obtain public understanding and confidence. MEXT is implementing activities to eliminate anxieties about nuclear energy by providing public hearings for the residents living in the vicinity of the Fast Breeder Reactor (FBR) "Monju" on the subject of what they want to know or questions. The ministry has also provided financial support on education programs related to energy and radiation including nuclear power implemented mainly by prefectural governments, and supported education programs related to radiation at schools including seminars on radiation for the educators and lending service of simple radiation measuring equipment[1].

[1] In FY 2011, MEXT has reviewed the support for the education programs related to energy including nuclear power so as to focus on promoting the public understanding of radiation which is of particular interest to the public, in light of the accident at TEPCO Fukushima Daiichi NPS.

In addition, towards the coexistence of nuclear power research facilities and regions where such facilities are located, the government is supporting the programs which the regions voluntarily execute with governmental subsidies for the Power Source Siting Laws.

(ix) International nuclear power cooperation

MEXT is holding the initiative in promoting peaceful use and non-proliferation of nuclear power through the ministry's contribution to the projects conducted by the International Atomic Energy Agency (IAEA) and other international organizations, and assisting the member countries mainly in Asia in human resource and infrastructural development in the fields of radiation utilization, nuclear power safety and others under a framework of the Forum for Nuclear Cooperation in Asia (FNCA). In addition, the Ministry set up a system for collaboration among industry, academia and government to accept trainees from overseas based on the "Nuclear Human Resource Development Network."

Along with the United States, France, and other countries advanced in the use of atomic energy, Japan is collaborating in a variety of fields such as R&D of the atomic power system with high sustainability, including FBR, through the Generation-IV International Forum (GIF).

(2) Increasing and smartening of energy utilization efficiency

Towards increasing the energy utilization efficiency, R&D for more efficient use of fossil resources in manufacturing sectors, for more low-carbon and energy conservation in consumer (domestic use, business use) and transport sectors which account for approximately half of the final energy consumption in Japan. Concerning the information and communication technology necessary to advance the innovation of energy supply and use or social infrastructures, the government is also promoting R&D for further energy conservation.

1) More efficient use of fossil resources in manufacturing sectors

RIKEN is promoting the study and technology development necessary to establish the innovative consistent bioprocess - from production of plant biomass, through efficient decomposition and conditioning of plant biomass by new enzymes, to creation of bioplastic - , making full use of biotechnology in order to utilize carbon dioxide as a resource.

The National Institute for Materials Science (NIMS) is conducting R&D on materials such as photocatalyst which can render hazardous materials in water, air or soil environment harmless.

METI is making efforts in greening the materials, manufacturing process and waste disposal process of petrochemical products or functional chemical products, promoting the green innovations with advanced chemical materials, and improving the common evaluation bases for chemical materials to promote R&D for the Green Sustainable Chemistry contributing to realization of a human- and environment-friendly, sustainable society. In particular, the Ministry is implementing development of the chemical manufacturing technology using biomass or gas as a material, the manufacturing technology which can produce innovatively enhanced energy-saving and highly-efficient electronic devices (electronic paper, large-area sensor) by applying a printing process compared to traditional manufacturing methods, and the evaluation method for chemical materials such as organic EL. For steel manufacture, the Ministry is developing the innovative carbon dioxide reduction technology in steel manufacturing process, including

the technology to partially substitute hydrogen for coke as reductant in steel manufacturing process, to separate and capture carbon dioxide from blast furnace gas towards further improving the utilization efficiency of fossil fuel. In addition, the Ministry is developing technology to ensure good compatibility between energy-saving and response capability to resources based on utilization of low-grade coal or ore which helps to speed-up the reduction reaction and to lower the temperature in blast furnace. On the other hand, the ministry started the development of and the empirical study on basic technology to highly-efficiently produce high value-added products (for example, vaccine, functional food) with genetic modification, in order to promptly put into practical use the production technology of safe and productive substances with plant function.

With the aim of construction of the dispersion energy system using fuel cells, METI is also supporting R&D on innovative hydrogen production technology to produce high-purity hydrogen necessary for fuel cell cars by efficient utilizing hydrogen made through the existing equipment in refineries.

2) Low-carbon and energy-saving in consumer and transport sectors

The National Institute for Materials Science (NIMS) is developing long-lasting, functionally-stabilized and low-cost fuel cell helping to improve the efficiency of energy use in industries and homes which consume a large amount of energy at present, and conducting R&D towards technical breakthrough in magnet for motors, wide-gap semiconductor and LED lighting system which is already used for various purposes. The institute is also conducting R&D of the innovative material technology for lightweight materials for mobile structures which contribute to energy-saving.

In March 2011, METI formulated the "Energy-conservation Technology Strategies 2011" designating important technologies based on the discussion session with experts and summarizing a scenario for the procedure and introduction of technology development. In accordance with the strategies, the ministry set up the important fields and has efficiently conducted R&D to resolve the issues on the energy demand side within a framework of the "R&D Program for Innovative Energy Efficiency Technology" with public offering in a wide range of fields from basic research of energy-saving technology to application and empirical study.

Furthermore, the Ministry has conducted the "R&D of a Next-generation Heat Pump System" aiming at tremendous improvement of efficiency of heat pump, R&D for functional enhancement of steel materials based (improved weldability, good compatibility between high strength and flexible workability) on the latest scientific knowledge towards low-carbon and energy-saving, and R&D for technology of power semiconductor or nanocarbon material.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is supporting various private technology development contributing to the innovative energy conservation for ships, such as development of hull form with high propulsion efficiency, streamlining of ship operation and handling, to reduce carbon dioxide emissions of newly built ships by 30%. The ministry is also integrating the technology development as above with construction of an international framework to regulate carbon dioxide emissions from ships and thus expecting to deploy the developed technology across the world. In addition, the Ministry is promoting technology development contributing to the improvement of environmental performance, such as the control method development for the railway power storage system with which efficient charging or discharging is available.

The National Maritime Research Institute (NMRI) is conducting the study on basic technology contributing to the realization of environmental regulations both for environmental impact reduction by a large extent towards zero emission, and social rationality, in order to reduce carbon dioxide from ships by a large extent.

The Building Research Institute is developing effective evaluation method for energy conservation performance based on the clarified energy consumption structure in housing or construction industry, and conducting R&D for preparing technical data for diffusion of advanced energy-efficient houses.

3) Improvement of the information and communication technology

MIC is advancing R&D for construction of the cloud computing infrastructures with higher reliability and substantially power-saving feature which evacuate important data from a cloud in the disaster area to a safe cloud distant there from to continue information processing in the event of a widespread disaster. NICT is promoting R&D for an all-optical network realizing ultrahigh-speed and low-power consumption of the entire network at the same time to respond to exponential increase in communications traffic and power consumption by utilizing the information and communication technology (ICT). NICT is also promoting R&D on basic technology for realization of a next-generation network following the internet by 2020 with industry-academia-government collaboration.

METI is conducting R&D for evaluation basic technology necessary for a next-generation extreme ultraviolet (EUV) exposure system realizing microfabrication technology of nanoscale semiconductor (at the level of 10nm), ultralow-power technology of semiconductor with new material and structure, normally-off computing key technology consuming power as necessary only during data processing by means of installing involatile elements in the semiconductor, three-dimensional integration technology for semiconductive device, and others. The Ministry is also conducting R&D on different devices or equipment as well as the development of green cloud computing technology and next-generation power devices within a framework of the "Green IT Project" to advance the energy conservation technology development of the data center playing a central role in a cloud computing generation.

(3) Greening of social infrastructure

Japan is promoting R&D for construction of a highly-efficient transport system towards realizing an environmentally-advanced city and efforts to innovate on resource recycling technologies or create substitute materials for rare earth elements[1] and others. In addition, Japan is to greatly improve the technologies related to the information obtained from Earth observation, projection and integration analysis which is an important social and public base, and to promote to utilize such information in various fields.

1) R&D for construction of the highly-efficient transport system

The National Police Agency has been implementing an advanced model project for the traffic control system using probe information[2] in the Tokyo Metropolitan Area and Kanagawa Prefecture for four years

[1] Rare earth elements consisting of a set of seventeen metallic elements in the periodic table
[2] Running history stored in the car-mounted device

since FY 2009 for the purpose of reduction of carbon dioxide emissions and traffic jams. In FY 2011, the agency conducted a renovation necessary for devices of the traffic control system.

2) R&D for advanced water treatment technology

METI is promoting the development of the highly-efficient bioprocessing technology including the microbial community control technology to improve processing efficiency, in order to establish an energy-saving processing process to reduce the power consumption at the time of supplying air necessary for activity of microbial community utilized in drainage treatment.

3) Efforts to create substitute materials for exiting rare resources

In order to overcome the constraint on rare earths or rare metals[1] as materials necessary for next-generation cars or wind power generations, MEXT and METI have been conducting R&D to reduce use of and to create substitute materials for such materials while providing mutual coordination since FY 2007.

MEXT is promoting the "Elements Science and Technology Project" to scientifically clarify elemental role identifying the property or function of substances or materials and to implement the technology development for substitute materials for or reduction of use of rare elements.

METI had promoted the resource measures for rare earths and rare metals in an entire supply chain to support reduction of use of, technology development of substitute materials and introduction of recycle facilities in rare earth or rare metal users, through the "Rare Metal Substitute Materials Development Project" and rare earth comprehensive measures as an emergency measure under a framework of the second supplementary budget for FY 2010 for the purpose of maintaining and strengthening international competitiveness. Under a framework of the third supplementary budget for FY 2011, the ministry has assisted the development necessary for the product design development and the recycle commercialization towards using materials containing no rare earths, which are conducted by material makers such as magnet makers using directly rare earths or rare metals and manufactures such as motor makers mounting that magnet, in order to reduce use of rare earths or rare metals and substitute for parts using them.

METI and MOE have held the joint council consisting of Industrial Structure Council and Central Environment Council since November 2011, in which the ministries started to examine the optimal countermeasures related to recycle of rare metals much contained in main products (car, major appliance, carbide tool, personal computer, secondary battery, and etc.)

4) Promotion of efforts responding to climate change or wide-scale disaster

Japan is to enhance tremendously Earth observation, projection and integration analysis to promote to utilize the information obtained from Earth observation in various fields. Furthermore, Japan is promoting the efforts to organize a city and an area that can cope with climate change or wide-scale disaster, to preserve natural environment and biological diversity, to maintain natural circulation in forests, to mitigate damages caused by natural disasters, and to realize sustainable recycling-based food production.

[1] Some metals of which to secure stable supply is important in the national policy as long as there is the industrial demand (or perspective demand) for them, among the metals "of which the amount in existence is a little or which are difficult to extract for technical or economical reasons," according to a definition accepted by the Mining Industry Council (at present, 31 metals to be covered)

(i) Promotion of Earth observation

Japan is promoting Earth observation with different means from the standpoint of satellites, land and ocean to contribute to the "Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan" agreed in Earth Observation Summit.

Earth observation with satellites is a useful mean which can continuously collect the geoenvironmental information about precipitation, clouds, aerosol[1] and vegetation over a wide range. The Japan Aerospace Exploration Agency (JAXA) has been conducting operation of the Advanced Land Observing Satellite "DAICHI" (ALOS, ended in May 2011) or the Greenhouse Gases Observing Satellite "IBUKI" (GOSAT), and R&D of satellites including successor to the "DAICHI" or the Global Change Observation Mission - Water "SHIZUKU" (GCOM-W) to promote the earth observation utilizing such satellites.

MEXT is conducting an observation program through international cooperation in the Antarctic where global environmental change occurs dramatically The Japanese Antarctic Research Programs have been initiated with the cooperation of ministries concerned under the "Headquarters for Japanese Antarctic Research Expedition" (chief of Headquarters: the minister of MEXT) by the National Institute of Polar Research. In FY 2011, the institute has conducted the long-term continued basic observation as well as the prioritized research project "Exploring Global Warming from Antarctica" including the observation with a large atmospheric radar (PANSY) installed at the Showa Station for the purpose of clarifying of the "global warming" based on "the 8th six-year Antarctic Research Program" (FY 2010 to 2015). In addition, the institute has observed phenomena in the polar region in various fields including upper atmosphere, ocean, snow ice and soil, analyzed comprehensively a change mechanism of the phenomena, and promoted the research and observation for understanding of a role of the polar region on a global scale.

The Japan Meteorological Agency (JMA) is conducting the observation of greenhouse gases at the three observation points in Japan and at the Showa Station, as well as in oceanic air and surface seawater in the western North Pacific by JMA research vessels and at high altitude by airplanes. The agency has been publishing the global warming data obtained from such observation with the analysis result. The agency is also conducting the observation of ozone layer and ultraviolet rays at the four observation points in the country and at the Showa Station.

In Addition, the agency is transmitting information on the current state of and prospects for the oceanic fluctuation related to the global environment based on collection and analysis of various observation data obtained from vessels, Argo Floats[2], satellites and others.

The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has established a global Earth observation system to observe and collect data and information on water, thermal and material cycles not only on regional but also on a global scale, and is conducting R&D to understand the global change of water cycle through the on-site or satellite observation on air, ocean and land.

Within an international cooperation framework, MEXT and JMA are improving and operating the advanced ocean observing system (ARGO Program) which collects the data on water temperature and salinity in the marine layer between ocean surface and about 2,000 m under by means of about 3,000 Argo Floats deployed across the world's oceans to monitor and grasp the situation of all the world's oceans on a

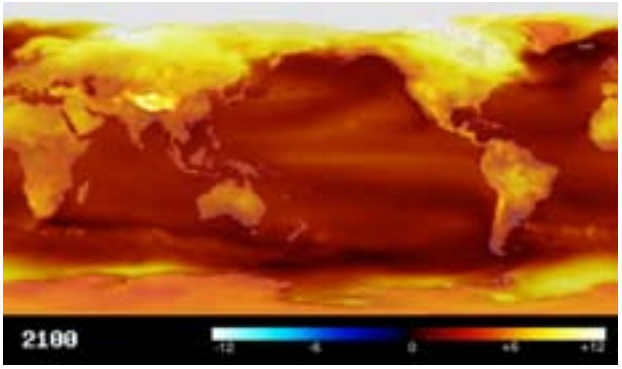
[1] Fine solid particles or liquid droplets suspending in a gas, including floating substances released from ground or sea, smoke discharged from industrial facilities, which have effects on sunlight absorption or scattering and cloud formation

[2] An observation device to measure water temperature, salinity etc. while diving to depths of 2,000 m and floating to the surface to transmit the measured data via satellites

real-time basis.

(ii) Promotion of climate change projection study

MEXT is implementing the "Innovative Program of Climate Change Projection for the 21st Century" aiming at contributing to the 5th assessment report, to be prepared by around 2013, by Intergovernmental Panel on Climate Change (IPCC) and at providing scientific grounds necessary to design policies and measures for reducing of or adapting to global warming, and has promoted the study on a climate change projection with a high degree of accuracy and resolution and the development of a climate model using a supercomputer "Earth Simulator" with the world's most advanced level of climatic simulation capability at JAMSTEC. Besides the above, the ministry is implementing the basic study towards understanding of the mechanism of the environmental change and making a prediction about the future of it using "Earth Simulator" and R&D for technology to increase the speed and accuracy of simulation and for the technology to predict the global environmental change using the former technology.



Global Warming Projection for 2100
Source: Center for Climate System Research (The University of Tokyo), National Institute for Environmental Studies, and Frontier Research Center for Global Change (JAMSTEC)

The Meteorological Research Institute, JMA has established an Earth system model for the global warming projection, which can display aerosol effect on clouds, ozone change and carbon cycle, to make a near future prediction about the climate changes in the next ten years or a long-term prediction according to an emission scenario prepared by IPCC. Regarding Japanese areas, the institute has also developed a detailed regional cloud resolving model to make a detailed regional warming prediction with enough resolution capability to display local phenomena unique to Japan.

(iii) Promotion of integration and analysis of data

MEXT started a new program to enhance the functions and expand the range of application of the "Data Integration and Analysis System (DIAS)." DIAS is a system to integrate and analyze Earth observation data (such as satellite remote sensing, data of climate change projection etc.) and socioeconomic data to create scientific knowledge. Knowledge will be provided to policy makers and scientists who are concerned with such as water resource, agricultural produce, and fishery resource management. Furthermore, MEXT started the "Green Network of Excellence program (environment information)", GRENE-ei for short, to build a research network of universities and research institutions using DIAS as the core information platform to work on global issues, such as climate change. GRENE-ei

will promote top international level researches and human resource development comprehensively.

In cooperation with the Science Council of Japan among others, NICT is advancing R&D for phenomenon analysis technology, correlation analysis advancing technology and science cloud [1] technology aiming at realizing a world-class science data platform on which analysis of Earth observation data is available.

(iv) Promotion towards a climate change adapted society

MEXT is promoting a R&D program called "Research Program on Climate Change Adaptation" (RECCA, started in FY2010) to provide scientific knowledge for decision makers in local governments so that they can reflect the result of climate change projection in local level to their climate change adaptation policies. RECCA is promoting R&D in the following three fields - advanced data downscaling methods, as global climate change projection data is not useful enough for local scale, adaptation simulation technology to convert data into information which is necessary for planning adaptation measures on local scale, and technology to assimilate observation data into the simulation models to reduce uncertainty of the simulation results. The research results of RECCA will be provided as scientific knowledge to local districts for their consideration on adaptation measures for climate change. In October 2011, RECCA held an "Interactive Symposium on Climate Change" in conjunction with the "Comprehensive Research on Climate Change Impact Assessment and Adaptation Policies (S-8)" which is funded by MOE, in order to foster a better understanding of the climate change adaptation with promotion of broad participation from the public.

MAFF has advanced the development of emission reduction and absorption improvement technology of greenhouse gases, including development of generation and absorption mechanism studies of greenhouse gases, greenhouse gas emission reduction technology, and absorption improvement technology for forest or farm soil (Figure 2-2-7).

As part of the development of a production technology system towards realizing the low-input and recycling-based agriculture, the Ministry has also advanced the establishment of chemical fertilizer and pesticide reduction technology with organic resources recycling or microbial utilization, a fertilization system achieving high nutrient use efficiency, and a management system making an effective use of nutrient accumulated in soil.

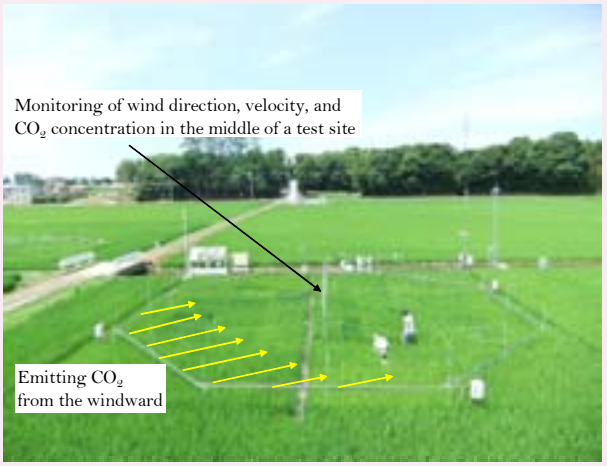
Furthermore, the Ministry has clarified resource reserves and current utilization in tropical forests of Asia with high precision laser metrology and advanced a land-use change projection model, as a part of the development of a support system for measures against deforestation and forest degradation in tropical forests of Asia.

Regarding climate change adaptation technology in agriculture, forestry and fisheries, the ministry has developed a high precision yield and quality prediction model and others to assess the impact of climate change on agricultural and marine products, and promoted the development of the production stabilization technology that can cope with the progress of global warming. In addition, the ministry has promoted the development of breeds resistant to high temperature or dryness, making the most of genome information.

[1] Cloud computing environment or services especially-suitable for data processing of large-capacity data for the purpose of scientific research

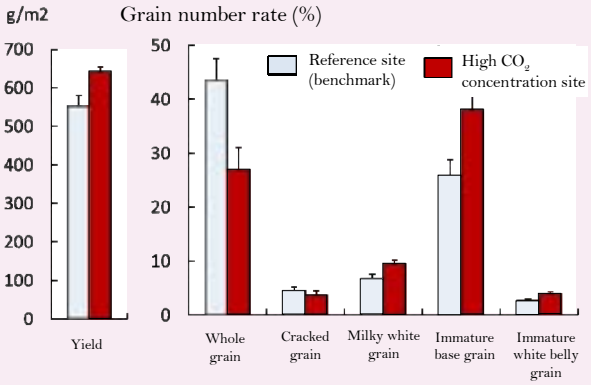
Figure 2-2-7/ Research results of the MAFF-commissioned project research "Technology Development for Establishment of Recycle-based Food Production Coping with Climate Change"

(1) FACE (Free Air CO_2 Enrichment) Experiment Facility in Tsukuba Mirai City, Ibaraki Pref.



Arranging tubes 17 cm in diameter in an octagon shape on a rice paddy to adjust the CO_2 concentration in the site to be higher than ambient air by 200 ppm (584 ppm in a growing period on average)

(2) Impact of high CO_2 concentration on yield of and raw rice quality of Koshihikari



Under such high CO_2 concentration condition as expected in the next 50 years, yield of rice is increased (a fertilization effect), although granulation rate that determines the rice quality is decreased to a large extent.

Source: Created by National Institute for Agro-Environmental Science (NIAES)

(v) Town development in accord with nature

MLIT is implementing the technology development contributing to realization of a sustainable society where humans live in coexistence with nature, including conservation and restoration of nature, maintenance of secure water cycle and establishment of production bases in Hokkaido for improvement of food supply capacity.

The Meteorological Research Institute, JMA is addressing the development of observation and monitoring technology to detect unusual meteorological phenomena such as local heavy rain (the so-called "guerrilla rain") in real time by means of dual polarization radar or GPS. The institute is also advancing the development of a numerical prediction model with enough resolution capability to display local heavy rains with the aim of accuracy improvement of weather information helping to reduce damage due to local

meteorological phenomena.

The Public Works Research Institute (PWRI) is developing low-carbon mixed cement application technology, low-carbon pavement technology, and recycling technology to reuse the heavy-metal containing soil discharged from construction sites as embankment material.

2 System reforms for promotion of green innovation

Japan is advancing system reforms such as regulatory reform or institutional reform to promote green innovation and to promptly and effectively lead the innovation to sustainable growth in Japan and issue resolutions on a global scale.

MIC has been engaged in international standardization activities including establishment of best practice models for carbon dioxide reduction with Information and Communication Technology (ICT) and methodology for environmental impact assessment in "Environment and Climate Change" (ITU-T SG5[1]) of International Telecommunication Union in order to help to resolve the environment problems related to ICT utilization. As a part of the results of such engagement, the "L. 1300: Best Practice for Green Data Centers" and the "L. 1410: Methodology for Environmental Impact Assessment of ICT Goods, Networks and Services" were recommended in November 2011 and March 2012 respectively. Besides the above, the Ministry is also conducting verification of effective energy consumption reduction models using ICT in houses or offices.

MEXT is implementing Strategic Funds for the Promotion of Science and Technology "Social System Reformation Program for Adaptation to Climate Change" to advance the social implementation of environmental technologies that can cope with climate change through the development of elemental technologies such as energy management as base of climate change adaptation for system reforms and the demonstration experiment in a social system consisting of such elemental technologies.

METI started the full-scale demonstration towards construction of a smart community with the participation of residents, local governments and private companies in FY 2011 (refer to Part 2, Chapter 2, Section 2, 1, (1)).

Concerning renewable energy facilities such as solar power plants, wind farms and small hydro facilities, the Ministry has made a study on the appointment of chief engineers and the notification of a new plan, of which a high level of public safety is required in terms of the scale of facilities, and reviewed safety regulations under the Electricity Business Act. According to the "Act on the Rational Use of Energy" (Act No. 49 of 1979), the ministry has set the Top Runner Standards for fuel efficiency of vehicles since 1999, from the perspective of encouraging of development efforts in the private sector to a maximum extent. As a result, the fuel efficiency of gasoline cars has been improved by 48.5% in FY 2010 compared to FY 1995. In the joint session of METI and MLIT, the formulation of new fuel efficiency standards for gasoline cars with the aim of accomplishment of them in 2020 was examined based on technical justification and summarized in October 2011 to promote further energy conservation in the future.

[1] International Telecommunication Union Telecommunication Standardization Sector Study Group 5

Table 2-2-8/ Main measures for promotion of Green Innovation (FY 2011)

Ministry	Research organization	Subject
National Police Agency	Kanagawa Prefectural Police, National Police Agency	Enhancement of Traffic Control System Using Probe Information [literal translation]
Ministry of Internal Affairs and Communications (MIC)	MIC	R&D for Building of the Most-advanced Green Cloud Data Centers [literal translation]
		ICT Green Innovation Promotion Project
		Green ICT Project
	National Institute of Information and Communications Technology (NICT)	R&D of Electromagnetic Wave Sensing Infrastructure Technology
		R&D of Network Infrastructure Technology [literal translation]
Ministry of Education, Culture, Sports, Science and Technology (MEXT)	MEXT	Innovative Program of Climate Change Projection for the 21st Century
		Research Program on Climate Change Adaptation (RECCA)
		Data Integration and Analysis System Project 2011-2015 (DIAS-P)
		Green Innovation Creation Program for Start-ups from Universities [literal translation]
		Strategic Funds for the Promotion of Science and Technology "Social System Reformation Program for Adaptation to Climate Change"
		Elements Science and Technology Project
		Development of Environmental Technology Using Nanotechnology
		Improvement of Development Program for Marine Resources Use Promotion Technology (Improvement of preservation and management technology of marine living resources) [literal translation]
		Japanese Antarctic Research Programs
	Japan Aerospace Exploration Agency (JAXA)	Enhancement of Satellite Observation Data for Global Environment Projection, Integration and Analysis [literal translation]
	National Institute for Materials Science (NIMS)	R&D for Advanced Materials Responding to Social Needs
	RIKEN	Biomass Engineering Program
	Japan Science and Technology Agency (JST)	R&D Programs Focused on Technology Transfer (Development of Systems and Technology for Advanced Measurement and Analysis)
		Strategic Basic Research Programs (Advanced Low Carbon Technology R&D Program) [literal translation]
Ministry of Agriculture, Forestry and Fisheries (MAFF)	MAFF	Development of biomass utilization technology for local revitalization
		Technology Development for Establishment of Recycling-based Food Production Dealing with Climate Change [literal translation]
		General Measures for Biomass Utilization [literal translation]
Ministry of Economy, Trade and Industry (METI)	METI	Ultra-low Power Device Project toward Achieving a Low-carbon Society
		Project to demonstrate integration and control system of green sensor.
		Demonstration Test Project of Carbon Dioxide Reduction Technology [literal translation]
		Improvement Project of Carbon Dioxide Capture Technology [literal translation]
		Development Project of Carbon dioxide Capture and Storage (CCS) Safety Evaluation Technology [literal translation]
		Resource Cycle Demonstration Project [literal translation]
		Development of Innovative Steelmaking Process for Strengthening Resource Response Capabilities
		Support Project for Reduction of Rare Earth and Rare Metal Use and Substitute for Parts Containing them [literal translation]
		Demonstration Study Development of Genetically-modified Plants Monodzukuri Using Closed Plant Factory [literal translation]
		Subsidy for the Introduction of Clean-energy Vehicles
		R&D of Environmentally–friendly, Small Aircraft Engine
		Development of Next-generation Aircraft Structural Part Production/ Processing Technology [literal translation]
		Development of Carbon Fiber Composite Material Molding Technology [literal translation]
		R&D on Advanced Aerodynamic Design [literal translation]
		Development of Innovative Carbon Fiber Key Technology
		Elemental Technology Development for Practical Application of Advanced Ultra Super Critical Pressure Power Generation [literal translation]
		Development of Practical Application of High-efficient Gas Turbine Technology [literal translation]
		Development of innovative oil refining technologies
		Development of Next-generation Environment Measures Technology for Petroleum-based Fuel [literal translation]
		Development for Advanced Heavy Oil Processing Technology [literal translation]
		Commission of Improvement Effect Analysis of Next-generation Atmospheric Environment l [literal translation]
		Development for High-efficient Hydrogen Production Technology [literal translation]
		Project for Demonstrating Next-generation Energy and Social System
		Project for Demonstrating Next-generation Energy Technology [literal translation]
Ministry of Economy, Trade and Industry (METI)	National Institute of Advanced Industrial Science and Technology (AIST)	Effective Resources Use and Alternative Technology [literal translation]
		Mass-production Technology and Application of Nanotube, Carbon Materials [literal translation]
		Promotion of low-cost, high-efficiency and low-environmental impact of Fabrication Technology [literal translation]
		Fabrication Technology of Microelectronic Device System with High Energy-saving Rate [literal translation]

Ministry of Economy, Trade and Industry (METI)	National Institute of Advanced Industrial Science and Technology (AIST)	Expanding of Biomass Use [literal translation]
		Technologies to Efficiently Manufacture High-quality Substances Using Bioprocesses
		Improvement of Efficiency and Reliability of Solar Power Generation [literal translation]
		Development of Power Conversion Electronics
		Development of Storage Device with High Energy Densities for Next-generation Vehicles [literal translation]
		Safety Evaluation Methods to Support Innovation of Advanced Science Technologies [literal translation]
		Promotion of Green Sustainable Chemistry
		Development of Energy Utilization Technology with High Conversion Efficiency by Fuel Cells [literal translation]
		Measurement Standards to Support Green Innovation
		Energy Conservation technology in IT [literal translation]
		Development of Evaluation Technology for Conservation and Utilization of Geosphere Environment [literal translation]
	New Energy and Industrial Technology Development Organization (NEDO)	Development of Environmentally Friendly Steelmaking Process Technology [literal translation]
		Rare Metal Substitute Materials Development Project
		Project of Equipment Introduction in Rare Earth-using Industries [literal translation]
		Development of Substitute and Reduction Technology for Rare Metal (including Rare Earth) [literal translation]
		Development of Fundamental Technologies for Green and Sustainable Chemical Processes
		Development of Fundamental Technologies for Next-Generation Printed Electronic Materials and Processes
		Development of Solar Thermal Energy-using Houses Technology [literal translation]
		Project to Promote Energy ITS
		Innovative Ultra-light and High-strength Integrated Materials Project toward Achieving a Low-carbon Society (Subsidy for NEDO) [literal translation]
		New Material Power Semiconductor Device Project toward Achieving a Low-carbon Society
		Ultra-low Power Device Project toward Achieving a Low-carbon Society
		Development of Key Technology for Normally-off Computing
		Project to Demonstrate Integration and Control System of Green Sensor
		Green IT Project
		Development of key technology for nitride semiconductor aimed at realization of next-generation illumination
		Development of Clean Coal Technology (Development of Innovative CO_2-collecting Coal Gasification Technology)
		Development of Clean Coal Technology (Including basic research)
		Project of Innovative Energy Conservation Technology Development [literal translation]
		R&D of a Next-generation Heat Pump System
		Project to Create an International Innovative Solar Cell Research Center
		Development of Next-generation High-performance Technologies for Photovoltaic Power Generation
		R&D of Next-generation Wind Power Generation Technology
		R&D of Offshore Wind Power Generation Technology
		R&D of Ocean Energy Technology
		Project to Develop Innovative Cellulosic Ethanol Production System
		Project to Develop Next-generation Technology for Strategic Utilization of Biomass Energy
		Development of Technology for High-efficiency Conversion of Biomass and Other Energy
		Development of High-performance Storage Battery System Technologies for Next-generation Vehicles
		Program for Advanced Basic Research in Innovative Storage Batteries
		Development of Technology for Battery System Compatible with the New Energy System
		Program for New Energy-venture Technology Innovation
		Project to Demonstrate Measuring Technology Using Renewable Energy Heat [literal translation]
		Development of Promotion Technology for Application of Polymer Electrolyte Fuel Cell [literal translation]
		Development of Elemental Technology for Solid Oxide Fuel Cell System [literal translation]
		Development of Technologies for Production, Transportation, Storage, etc. of Hydrogen [literal translation]
		Advanced Fundamental Research Project on Hydrogen Storage Materials
		Advanced Basic Research Project on Hydrogen [literal translation]
		Social Demonstration of Regional Hydrogen Supply Infrastructure Technology
	MLIT	Project to Demonstrate Innovative Sewerage Technologies [literal translation]
		R&D on Safety of Floating Offshore Wind Farms [literal translation]
		R&D of Innovative Energy-saving Ship Technologies [literal translation]

Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	National Institute for Land and Infrastructure Management (NILIM)	Review on Normal Flows Setting Method in Mountain Areas [literal translation]
		Research on an Assessment of Heat Island Measures from an Energy-Saving Viewpoint
		Research on Technical Potential of Sewage Treatment Plant as Resources and Energy Circulation Base in Local Areas [literal translation]
	Japan Meteorological Agency	Improvement of Geostationary Operational Environmental Satellites [literal translation]
	Public Works Research Institute (PWRI)	Promotion of Low-Carbon of Social Infrastructure Improvement and Efficient Resources Utilization [literal translation]
	Building Research Institute	Energy Consumption Reduction by Enhancement of Energy-saving Performance Evaluation Method for Houses and Construction [literal translation]
	National Maritime Research Institute (NMRI)	Study on Energy-saving Technologies Evaluation for Ships [literal translation]
		Study on Development of Maritime Performance and Operation Evaluation Technology [literal translation]
		Study on Development of CO_2 Emission Reduction Technologies [literal translation]
		Research on Development of Conceptual Design and Regulatory Method for Ocean and Air Regulations [literal translation]
		Study on Development of Basic Technology Contributing to Reduction of Air Pollutants such as NO_X, SO_X, PM and Development and Enhancement of Environment Impact Assessment Method Necessary to Spread the Technology [literal translation]
		Study on Building of Assessment Technology for Ecosystem Impact Arising from Ship Operation [literal translation]
		Study on Establishment of Comprehensive Measures against Oil or Harmful Liquid Substances Spill [literal translation]
		Study on Development and Enhancement of Advanced Structural Strength Evaluation Method [literal translation]
		Study on Development of Safety Evaluation Method for New Power System [literal translation]
		Research on Construction of Reasonable Safety Regulation Using Risk-based Safety Evaluation Method [literal translation]
		Study on Development of Inspection and Diagnosis Technologies for Aging and Thickness Effect on Fatigue Strength [literal translation]
		Study on Improvement of Re-enactment and Analysis Technology for Sea Disasters [literal translation]
		Study on Establishment of Reasonable Safety and Operation Rule Systems Based on Accident Cause Analysis and Human Factors Analysis [literal translation]
		Study on Development and Improvement of Policy-based Evaluation Method for Streamlining and Optimizing of Marine Transport [literal translation]
		Study on Development of Operation Support Technology and Transport System Responding to New Needs for Marine Transport [literal translation]
		Study on Development of Basic Technology for Marine Resource Production System Using Floating Technology and Development and Improvement of Safety Evaluation Method [literal translation]
		Study on Environment Impact Reduction as well as Development of Assessment Method for Environment Impact Arising from Marine Utilization or Development [literal translation]
	Port and Airport Research Institute (PARI)	Research and Experiment on Quantification and Increase of Carbon Dioxide Absorption by Coastal Ecosystems [literal translation]
		Research and Experiment on Feeding Behavior of Higher Trophic Level Organisms in Coastal Ecosystems [literal translation]
		Preparing Diagnosis Charts for the Living Environment of Living Creatures by Developing Geotechnical Approaches on the Tidal Flat
		Full-time Continuous Monitoring of the Environment of the Closed Inner Bay and Statistical Analysis of the Results
		Multifunction of Non-static Water Pressure 3-D Coastal Hydraulic Model [literal translation]
		Assessment of Effects of Environmental Restoration Project on Closed Inner Bay by Inner Bay Complex Ecosystem Model [literal translation]
		Proposal on Effect Prediction Method of Environmental Restoration Using Dredged Soil [literal translation]
		Proposal on Management Method for New Chemical Residue Accumulating in Closed Inner Bay [literal translation]
		Study on Behavior Modeling of Saline Mud with a Higher Moisture Content in Closed Inner Bay [literal translation]
		Analysis of Material Exchange Process at Water-Bed Interface [literal translation]
		Arrangement and Analysis of Issues on Application of Ocean Energy Utilization System to Harbors [literal translation]
Ministry of the Environment (MOE)	MOE	Environment Research and Technology Development Fund
		Technology Development Project on Global Warming Countermeasures
		Floating Offshore Wind Turbine Demonstration Project