NEDO's Environmental Technology Activities

New Energy and Industrial Technology Development Organization

About NEDO

- NEDO is a national research and development agency that creates innovation by promoting technological development necessary for realization of a sustainable society.
- NEDO acts as an innovation accelerator to contribute to the resolution of social issues by developing and demonstrating high-risk innovative technologies having practical application.

NEDO's Missions

Addressing energy and global environmental problems

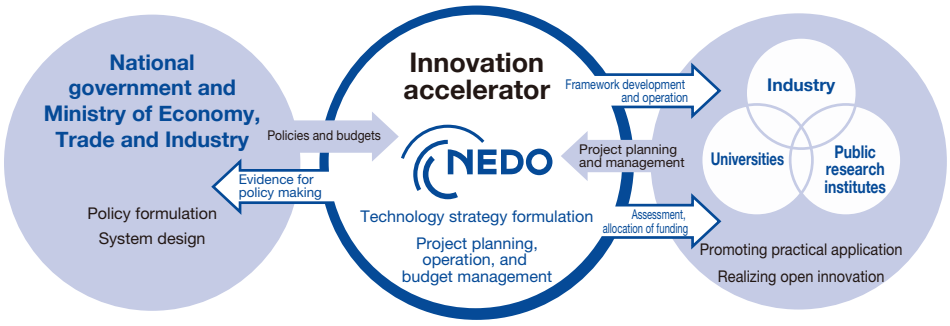
NEDO actively undertakes the development of new energy and energy conservation technologies. It also conducts research to verify technical results. Through these efforts, NEDO promotes greater utilization of new energy and improved energy conservation. NEDO also contributes to a stable energy supply and the resolution of global environmental problems by promoting the demonstration of new energy, energy conservation, and environmental technologies abroad based on the knowledge obtained from domestic projects.

Enhancing industrial technology

With the aim of raising the level of industrial technology, NEDO pursues research and development of advanced new technology. Drawing on its considerable management expertise, NEDO carries out projects to explore future technology seeds as well as mid- to long-term projects that form the basis of industrial development. It also supports research related to practical application.

Positioning of NEDO as an Innovation Accelerator

In order to contribute to the resolution of social issues, NEDO formulates technology strategies and project plans and, as part of its project management, establishes project implementation frameworks by combining the capabilities of industry, academia, and government. NEDO also promotes technology development by carrying out, evaluating, and allocating funding to promising projects to accelerate the practical application of project results.



NEDO's Environmental Technology

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NEDO History

In the 1970s, the world experienced two oil crises. To improve Japan's energy diversification, NEDO was established in 1980 to help usher in energy conservation and new energy technologies. In 1988, NEDO added research and development of industrial technology to its activities. Today, it uses its role as a research and development management organization to boost innovation and promote research and development on energy, environmental technology, and industrial technology.

1974 Long-term Sunshine Project aimed at developing new energy technologies started
1978 Long-term Moonlight Project aimed at developing energy conservation technologies started
1980 New Energy Development Organization established

1988 Research and development on industrial technology added. Name changed to New Energy and Industrial Technology Development Organization (NEDO)

1993 New Sunshine Project started
1996 Integration with Coal Mine Damage Agency. Coal mine damage compensation program added.

2003 Incorporated Administrative Agency New Energy and Industrial Technology Development Organization established under the Act on the New Energy and Industrial Technology Development Organization
2006 Kyoto Mechanisms Credit Acquisition Program added
2007 Transitional operations related to coal mine damage recovery completed

2012 Coal and geothermal operations transferred to Japan Oil, Gas and Metals National Corporation
2014 Technology Strategy Center established
2015 Status changed from incorporated administrative agency to national research and development agency
2016 Kyoto Mechanisms Credit Acquisition Program discontinued
2021 Green Innovation Fund Projects started

1986
Experiments on a large-scale grid-connected photovoltaic power system started for the first time on Rokko Island in Hyogo Prefecture

1998
Development started on underlying optical disc technologies that later led to Blu-ray discs

2012
Commercial model demonstration hydrogen station constructed

FY2023 Budget

1.14 billion US dollars

(FY2023 tentative budget)

NEDO aims to address energy and global environmental problems and raise the level of industrial technology through integrated management of technological development. This ranges from the discovery of technology seeds to the promotion of mid- to long-term projects and support for practical application.

* As only an outline of NEDO's activities is given below, individual budget amounts do not add up to the total.

Individual Operational Activities

Energy Systems (420 million US dollars)

Areas of focus

- System provision technology
- Energy storage technology such as batteries
- Technology related to hydrogen production, storage, transport, and use
- Renewable energy technology

Industrial Technology (283 million US dollars)

Areas of focus

- Robot and AI technology
- IoT, electronics, and information technology
- Manufacturing technology
- Materials and nanotechnology
- Biotechnology

Energy Conservation and Environment (318 million US dollars)

Areas of focus

- Technology to harness unutilized thermal energy
- Environmentally-friendly steel manufacturing technology
- Development of high-efficiency coal-fired power generation technology
- Technology related to sequestration of CO_2
- Fluorocarbon recovery technology
- 3R technology, including resource screening and metal refining technology
- International demonstrations, Joint Crediting Mechanism activities, and others

New Industry Creation and Discovery of Technology Seeds (68 million US dollars)

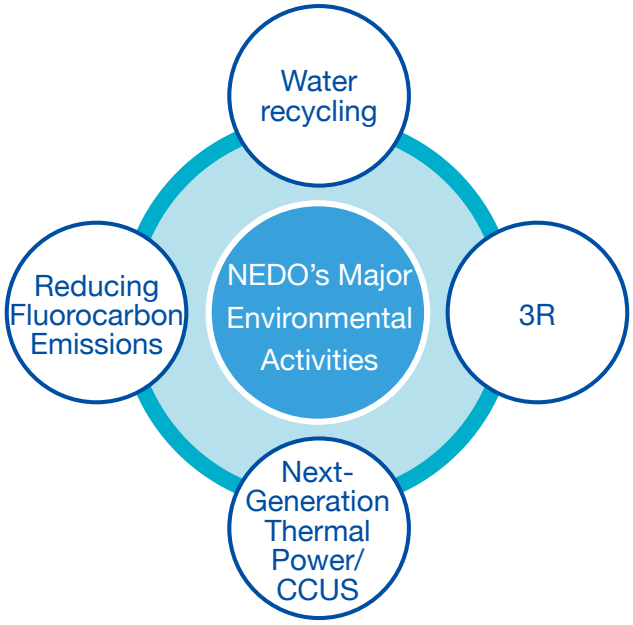
Areas of focus

- Fostering technology-based startups
- Promotion of open innovation

NEDO's Environmental Mission and Activities

Mission

NEDO is aiming to establish a sustainable society by contributing to countermeasures for global environmental issues, such as global warming and plastic waste, in an innovative manner.



I 3R (Reduce, Reuse and Recycle)

A large share of Japan's demand for metal resources is met by imports, which makes the stable procurement of these resources a serious issue. One key solution is the establishment of advanced recycling technologies. Given resource constraints as well as increasing social interest in the concept of a circular economy, there are growing expectations for the appropriate disposal of waste plastic and the establishment of efficient resource recycling technologies for Aluminum materials.

NEDO is striving to build a recycling system for valuable metals using urban mines, develop recycling technologies related to plastic waste, and facilitate the overseas proliferation of technologies developed in Japan.

II Reducing Fluorocarbon Emissions

Following a shift from chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), emissions of hydrofluorocarbons (HFCs) are increasing sharply in the refrigeration and air conditioning sector. NEDO is developing refrigerants and equipment systems while assessing the performance and safety of low global warming potential (GWP) refrigerants to facilitate a shift to low GWP refrigerants in order to more broadly and directly contribute to greenhouse gas (GHG) reduction.

III Water Recycling

Japan's edge in the water recycling industry is being sharpened through the performance of overseas verification of water treatment technologies and systems, such as energy conservation systems for desalinating seawater or recycling various kinds of water at reduced environmental loads.

We are also developing technologies to recover water-soluble organic solvents and water-insoluble organic solvents (oils and fats) from industrial wastewater using innovative separation membranes for energy saving.

IV Next-Generation Thermal Power /CCUS

Thermal power generation-related technologies must be established and their costs must be lowered in order to pursue the maximum use of carbon dioxide capture-based thermal power generation as an option in efforts to achieve net-zero greenhouse gas emissions by 2050.

NEDO has established CO_2 reduction technologies that are in harmony with the global environment. They include integrated coal gasification fuel cell combined cycle (IGFC); carbon dioxide capture, utilization, and storage (CCUS); and carbon recycling. In addition, NEDO is making efforts to disseminate these technologies to various countries around the world while also aiming to reduce CO_2 emissions in the iron and steelmaking process.

Nakoso IGCC power plant

Tomakomai CCS Demonstration Center

3R Initiative

Innovative Plastic Resource Circulation Technology Development

▲ Detail ▲

Business and Project Outline

Tightening waste plastic import restrictions in Asian countries triggered by China's waste plastic import restrictions has caused waste plastic retention in Japan to become a major problem in recent years, and the same is true of marine plastic litter, which leaks waste plastic from land areas. There is an urgent need for recycling and other appropriate treatment of plastic resources, including waste plastic, that has been exported from Japan in the past.

In this project, NEDO will develop basic technologies to realize a highly efficient plastic resource recycling system while reducing the environmental burden by using advanced sorting technology and new material recycling technology for the large amount of waste plastic generated in society. Specifically, in order to dramatically increase the resource value of waste plastics, NEDO will collaborate in the development of (1) advanced sorting technology for waste plastics using complex sensing, AI, and the like, (2) advanced material recycling process technology, (3) petrochemical feedstock conversion technology that achieves a high resource conversion rate, and (4) highly efficient energy recovery and utilization technology. NEDO aims to achieve both advanced resource recycling and reduction of environmental impact by constructing an optimal treatment system according to the quality of waste plastic.

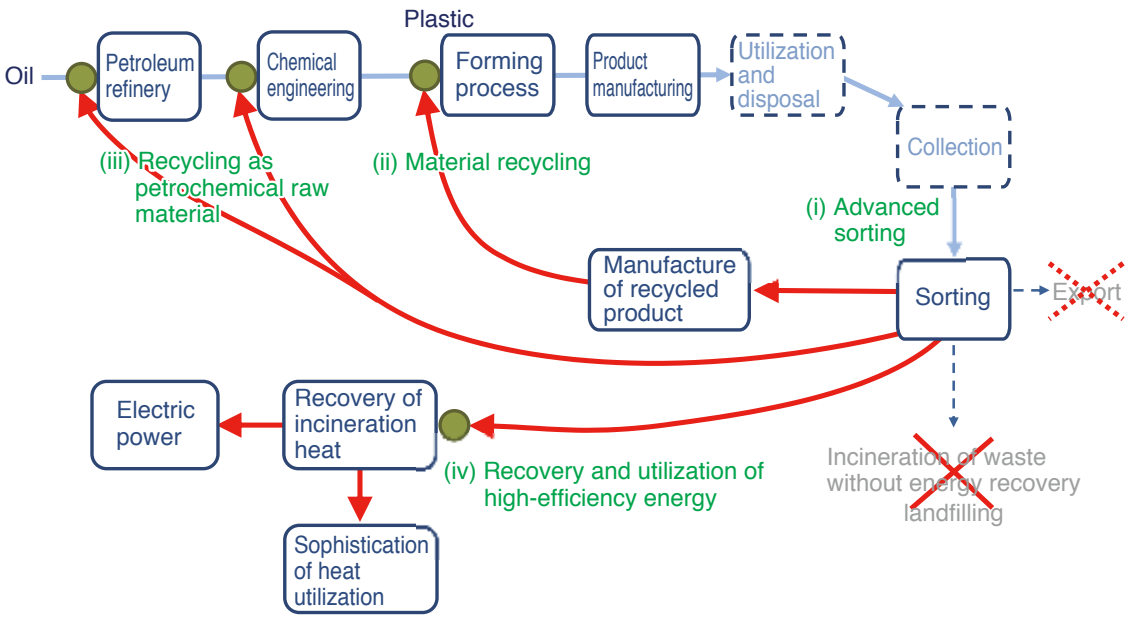


Image of the Business

Details of Research and Development

R&D Item (1) Development of an advanced sorting system

R&D Item (2) Material Regeneration Process Development

R&D Item (3) Petrochemical feedstock process development

R&D Item (4) Development of high-efficiency energy recovery and utilization systems

Project period	FY2020-FY2024	**Budget**	1.03 billion yen (FY2023)
Project participant	National Institute of Advanced Industrial Science and Technology, Fukuoka University, Waseda University, Tohoku University, Tokai National Higher Education and Research System, and 27 other organizations		

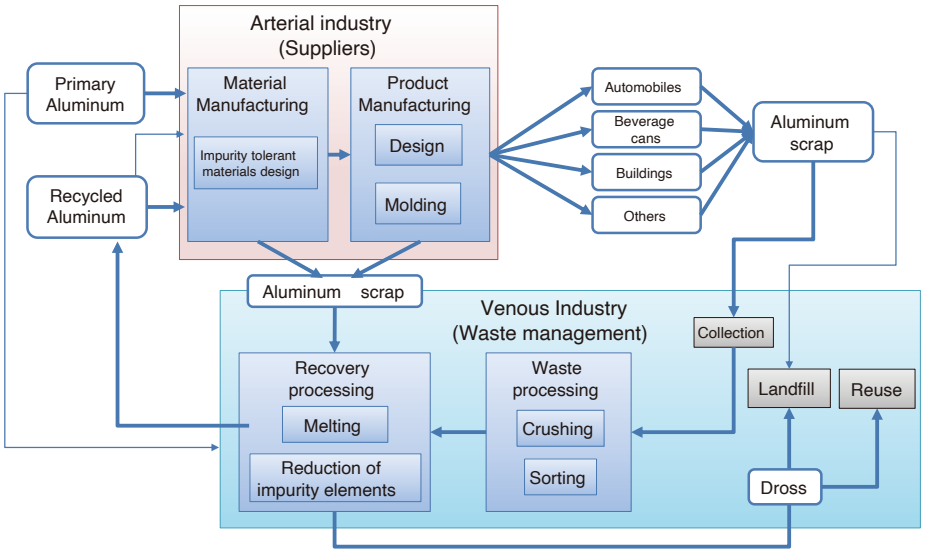
Development of advanced circulation technology for Aluminum materials

▲ Detail ▲

Business and Project Outline

In recent years, a shift to a "Circular Economy (CE)" has been called for in various economic activities. Aluminum is one of the materials for which the improvement of resource recycling is expected, as its demand is expected to grow significantly for the purpose of reducing CO_2 emissions by reducing the weight of transportation equipment. On the other hand, the large CO_2 emission intensity during the production of new ingots has become an issue, and recycled ingot production technology, which requires less energy consumption, is expected to be established and utilized as an Aluminum material with low environmental impact.

In this project, NEDO will develop high-performance recycled expanded products from Aluminum scrap by combining (1) technology to reduce impurity elements through advanced melting processes and (2) technology to render trace impurities harmless through advanced casting, processing, and forming technologies. NEDO will develop technologies to aim at improving the environmental performance of products, overcoming resource constraints, and resolving GHG reduction issues in domestic companies.



Aluminum Recycling System[1]

[1]TSC Foresight Vol.35.

Details of Research and Development

R&D Item (1) Development of technology to reduce impurity elements
NEDO will develop technology to reduce impurity elements by utilizing the phenomenon that pure solids appear first when molten Aluminum solidifies. By utilizing non-contact agitation technology using electromagnetic agitation and mechanical vibration, NEDO will improve the recovery efficiency of high-purity Aluminum.

R&D Item (2) Development of advanced processing technology to render trace impurities harmless.
To improve material properties (high ductility, high strength) in the presence of trace impurities, NEDO will develop casting and rolling technologies as well as processing and heat treatment technologies that enable the detoxification of trace impurities.

Project period	FY2021-FY2025	**Budget**	260 million yen (FY2023)
Project participant	Hoei Metal Co., Ltd., UACJ Corporation, Daiki Aluminum Industry Co., Ltd., Toyota Motor Corporation, Honda Motor Co., Ltd., Denso Corporation, Toyo Seikan Group Holdings, Ltd., Toyo Seikan Co., Ltd., Nippon Light Metal Co., Ltd., Kobe Steel, Ltd., AIZOTH Inc., and the Japan Aluminum Association		

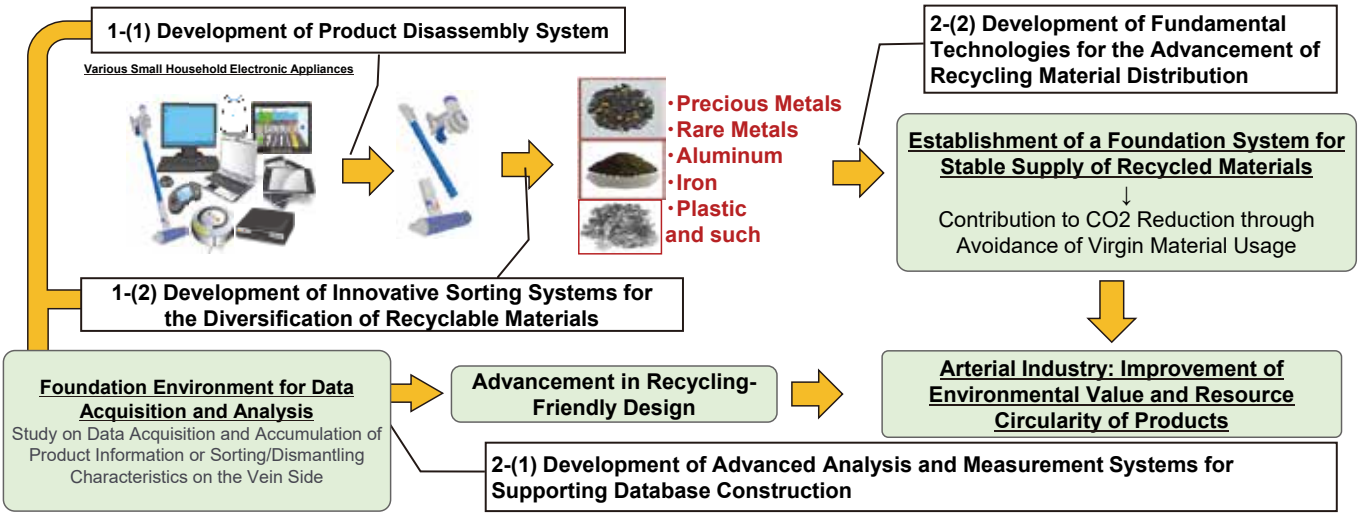
Development of Basic Technology to Process E-Waste for an Advanced Resource Circulation System

▲ Detail ▲

Business and Project Outline

The growing international demand for resources associated with the growth of the global economy and the worsening of environmental problems, such as global warming, requires a shift from a linear economy to a circular economy. Japan is dependent on foreign countries for resources, and in order to establish a resource-autonomous economy, it is essential to shift to a circular economy based on the reliable reuse of waste products.

This project aims to promote the creation and growth of industries related to the circular economy that combine economic activities with the reduction of environmental impact. This will be realized by establishing fundamental technologies that enable to recycle and utilize a wide variety of waste home appliances, including precious metals, copper, rare metals, base metals, plastics, and other resources without surplus.



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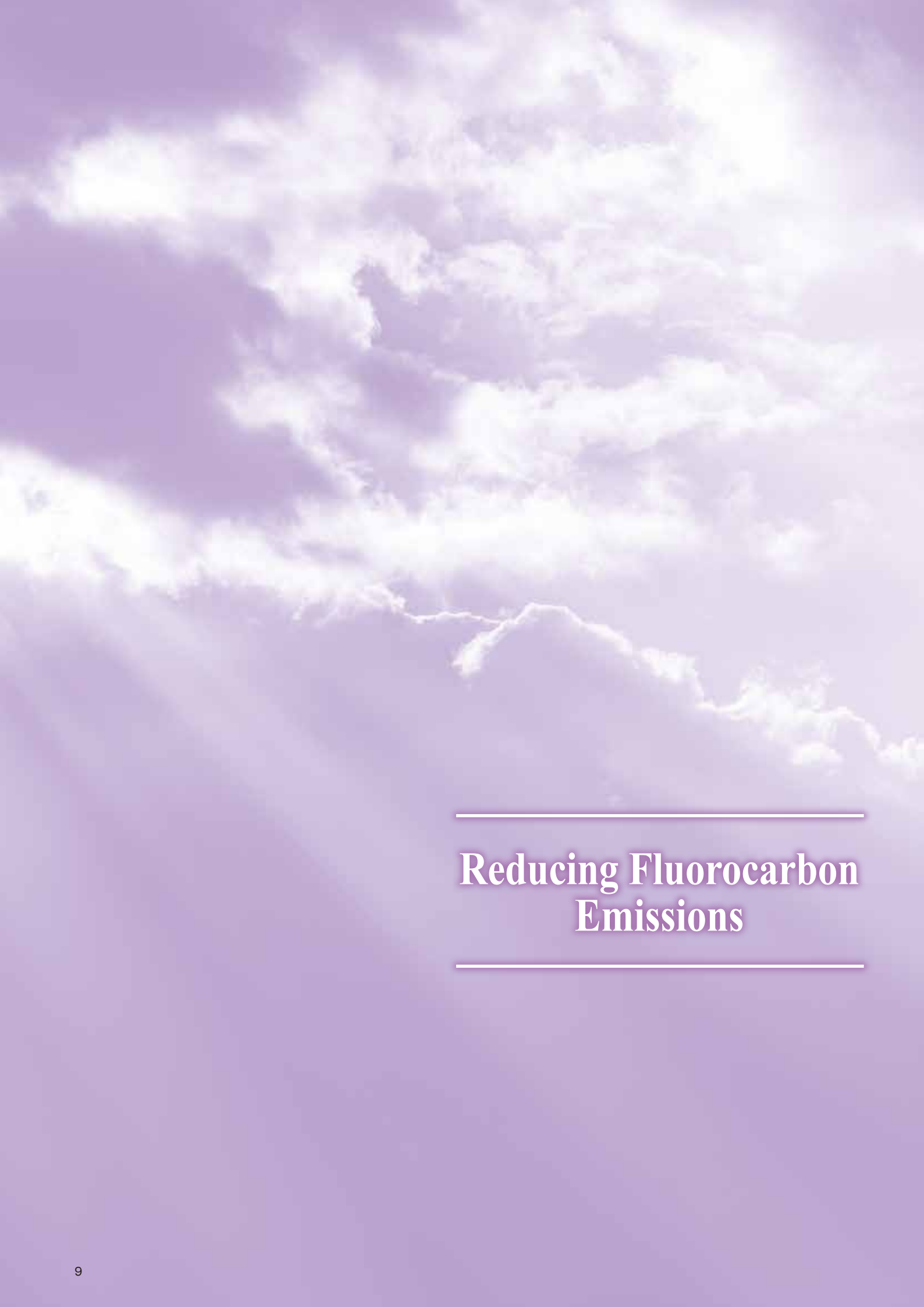
Details of Research and Development

R&D Item (1) Development of Advanced Resource Recycling Process Technology
As technologies that will contribute to the various resource recycling routes for waste home appliances, NEDO will develop (1) product disassembly systems for waste products and (2) innovative sorting systems to diversify recycled materials.

R&D Item (2) Development of Information Linkage Systems
To establish basic technology for the distribution of recycled materials, NEDO will (1) develop an advanced analysis and measurement system to support database construction and (2) develop basic technology to advance the distribution of recycled materials, with the aim of improving recycling through comprehensive information linkage, including the product treatm

Project period	FY2023-FY2027	**Budget**	630 million yen (FY2023)
Project participant	National Institute of Advanced Industrial Science and Technology, SATO TEKKO Co.,LTD, Re-Tem Corporation, Daiei Kankyo Co., Ltd., KANESHIRO SANGYO Co.,LTD, MITSUI MINING & SMELTING Co., Ltd., Tokyo University of Science, Kikuchi Seisakusho Co., Ltd., Panasonic Holdings Corporation, SATO Corporation, Nomura Research Institute, Ltd.		



Reducing Fluorocarbon Emissions

Development of Refrigeration and Air-Conditioning Technologies for Practical Use of Next-Generation Low-GWP Refrigerants

▲ Detail ▲

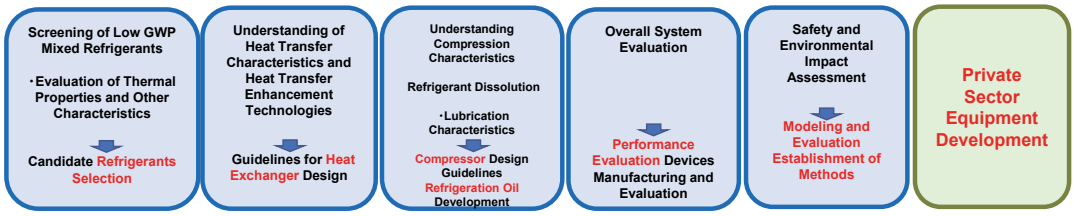
Business and Project Outline

Refrigerants used in refrigeration and air conditioning equipment have been converted from ozone-depleting specified fluorocarbons*1 (CFCs*2 and HCFCs*3) to alternative fluorocarbons *4, such as HFCs*5, but alternative fluorocarbons have a high greenhouse effect. Progress converting to alternative fluorocarbons increases emissions. In light of this, international moves to strengthen regulations on CFC substitutes are currently underway. In particular, the 2016 amendments to the Montreal Protocol*6 set forth a new obligation to phase out the production and consumption of alternative fluorocarbons, and developed countries are required to reduce their production and consumption by 85% from the base year by 2036. In addition, it is necessary to reduce the amount of emissions to practically zero in order to become carbon neutral by 2050. Among greenhouse gases, the emissions from alternative fluorocarbons have been on the rise, and measures to curb their emissions are a pressing issue. In particular, there is an urgent need to accelerate the technological development and social implementation of next-generation refrigerants and equipment that can replace alternative fluorocarbons.

On the other hand, many of the next-generation refrigerant candidates, which have a very low impact on global warming, have high technical hurdles to overcome to achieve the same or better equipment performance as conventional HFC refrigerants. Furthermore, due to safety issues (flammability, chemical instability, and so on), refrigeration and air-conditioning equipment using next-generation refrigerants has not yet been put into practical use worldwide. One of the main reasons for this is the lack of a standardized evaluation methods for the basic characteristics of next-generation refrigerants and for safety and risk assessment in the case of using next-generation refrigerants. Another issue is that although next-generation refrigerants are being applied in some refrigeration and air-conditioning equipment fields, there are areas where they have not been widely adopted due to technical issues.

In this project, NEDO will establish the basic technology for design guidelines of applicable equipment by focusing on residential air conditioners and other equipment for which next-generation refrigerants have not yet been determined to replace CFC substitutes comprehensively: from screening new refrigerant mixtures to developing and evaluating application technologies. NEDO also encourages the early development and marketing of next-generation low-GWP refrigerants and their applicable equipment by the private sector. This will be achieved through the technological development of elemental and peripheral equipment necessary for the widespread use of next-generation low-GWP refrigerants for residential and commercial air conditioning equipment along with commercial refrigeration equipment.

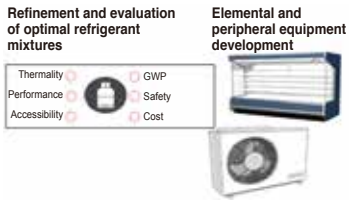
*1 Fluorocarbons: Freon is a trademark for refrigerant. Used as a generic term for refrigerants and industrial gases that are fluorides in turn.
*2 CFC: Abbreviation for chlorofluorocarbon. A man-made compound in which all the hydrogen in low-molecular-weight organic substances is replaced by fluorine and chlorine. A type of fluorocarbon.
*3 HCFC: Abbreviation for hydrochlorofluorocarbon. A man-made compound in which hydrogen in low-molecular-weight organic substances is partially replaced by fluorine and chlorine. A type of fluorocarbon.
*4 Alternative fluorocarbons: Compounds such as HFCs (hydrofluorocarbons) that do not contain chlorine, which is a source of ozone depletion.
*5 HFC: Abbreviation for hydrofluorocarbon. Although not ozone-depleting, it is a potent greenhouse gas and is subject to emission reductions under the Paris Agreement.
*6 Amendments to the Montreal Protocol in 2016: Adopted at the 28th Meeting of the Parties (MOP28) to the Montreal Protocol held in October 2016 in Kigali, the capital of Rwanda. Referred to as the "Kigali Amendment."



Outline of Implementation

Details of Research and Development

R&D Item (1) Development and evaluation of low GWP mixed refrigerants suitable for home air conditioning
Based on the knowledge of refrigerant mixtures obtained in related research and development projects to date, NEDO will quickly narrow down the HFO refrigerant mixture candidates that can be implemented for residential air conditioners. It will also develop basic technologies for the development of heat exchangers, compressors, and other elemental equipment compatible with the HFO mixed refrigerants to be implemented, as well as models and evaluation methods to assess the safety of the refrigerants and the environmental impact of the compatible equipment.



R&D Item (2) Development of equipment compatible with low-GWP refrigerants (residential/commercial air conditioners, refrigerated/freezer showcases, and others)
By applying the results of past related research and development projects and the knowledge of refrigerant and air conditioning element technologies for residential air conditioners in this project, NEDO will develop equipment and peripherals that are compatible with next-generation low-GWP refrigerants and achieve performance equivalent or superior to that of CFC products currently on the market.

Project period	FY2023-FY2027	**Budget**	500 million yen (FY2023)
Project participant	Kyushu University and 10 other organizations		

Water Recycling

Full-scale performance demonstration project for energy-saving seawater desalination system in Saudi Arabia

▲ Detail ▲

● Business and Project Outline

This project is being carried out as part of the International Demonstration Project on Japan's Technologies for Decarbonization and Energy Transition. The purpose of the project is to construct and demonstrate an energy-saving seawater desalination system using the technologies (a low-pressure seawater desalination RO membrane, a low-pressure two-stage seawater desalination system) established in the Mega-ton Water System project, which is part of the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program) implemented by the Japanese Cabinet Office. It also aims to verify its energy-saving efficiency, reliability, and economic efficiency, thereby expanding the use of the system in countries and regions where water resources are in short supply.

Part of energy-saving seawater desalination system

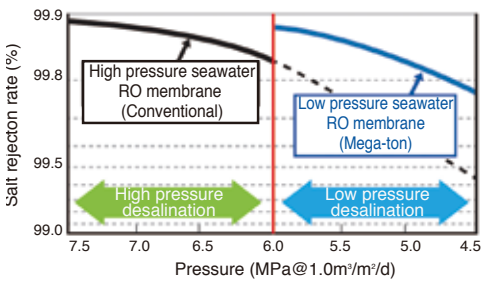
● Details of Research and Development

In collaboration with the Saline Water Conversion Corporation (SWCC), the government agency responsible for the demonstration and dissemination of these technologies in the Kingdom of Saudi Arabia, an energy-saving seawater desalination system with a desalination capacity of 10,000 m^3 per day in a satellite plant facility owned by SWCC in Duba, Kingdom of Saudi Arabia, is constructed and demonstrated. The demonstration operation verifies that the system can stably desalinate water while meeting the required water quality standards, and that the system can save approximately 20% more energy compared to the conventional RO membrane method. This is equivalent to about 800 kl per year as an alternative energy source to crude oil and about 2,000 t-CO_2 per year as a greenhouse gas reduction.

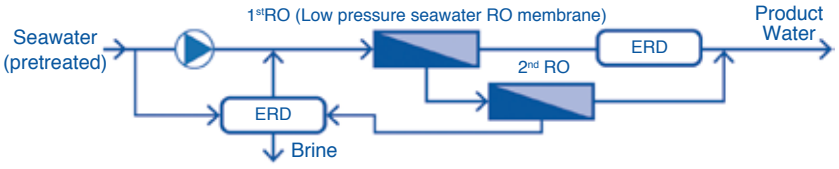
This energy-saving seawater desalination system is a two-stage RO membrane system using a new low-pressure seawater desalination RO membrane that can achieve the specified water quality (salt-rejection rate) at extremely low pressure. Furthermore, combining this system with a high-efficiency energy recovery device (ERD) enables a higher energy saving effect than conventional seawater desalination membrane systems.

System Flow

Salt-rejection Rate and Operation Pressure

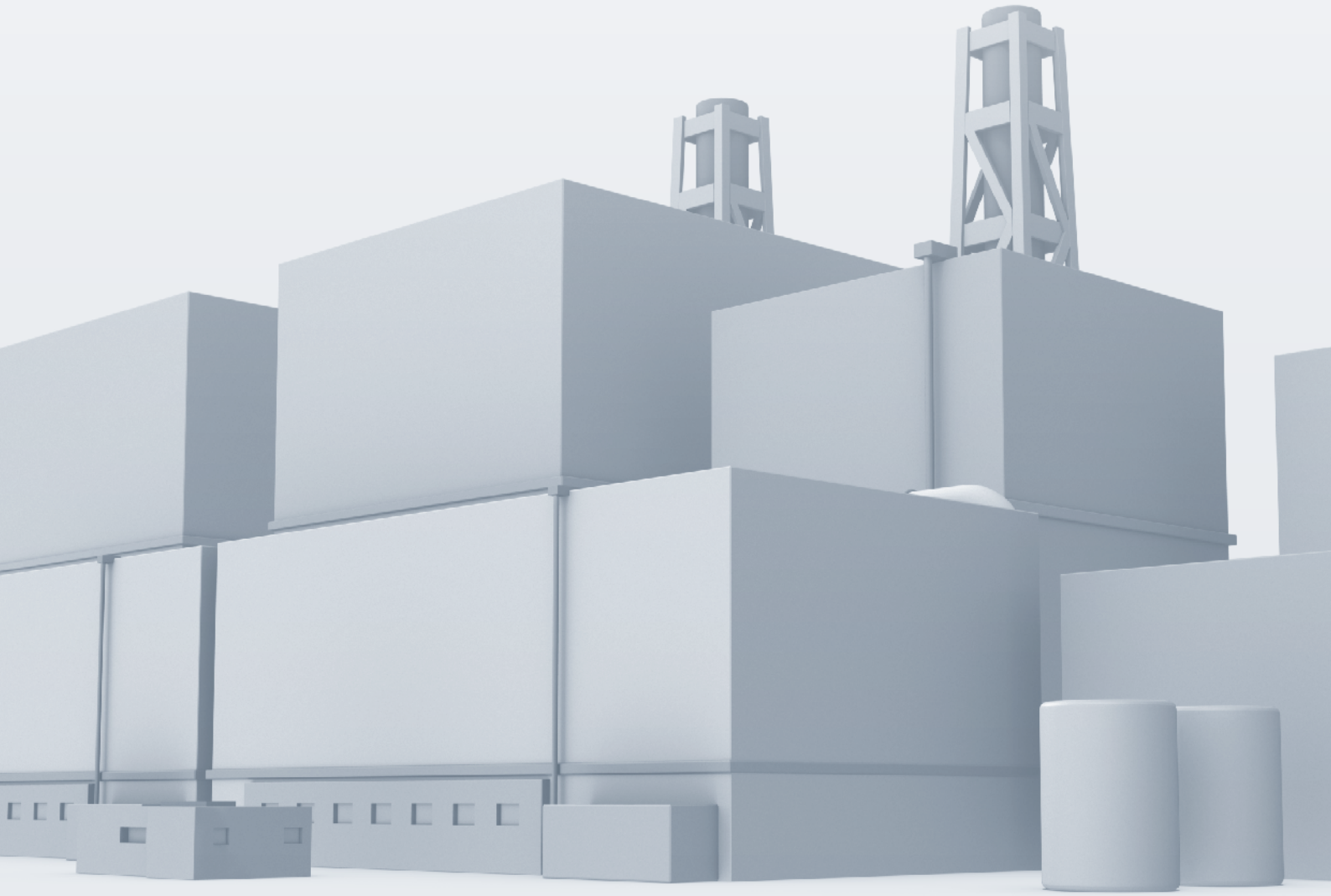


Low Pressure Two-stage RO System (simplified schematic diagram)



ERD : Energy Recovery Device

Project period	FY2014-FY2023	**Budget**	2.94 billion yen borne by NEDO
Project participant	Hitachi Ltd., Toray Industries, Inc.		



Next-Generation Thermal Power Generation/CCUS

Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation

▲ Detail ▲

● Business and Project Outline

The project is working on innovative next-generation thermal power generation technologies, including power generation technologies using CO_2-free fuels (biomass, ammonia, etc.) that will contribute to a significant reduction in CO_2 emissions and load-fluctuation-compatible power generation technologies to stabilize the grid when large amounts of renewable energy. NEDO is also promoting the development of technologies to separate and recover emitted CO_2 at low cost and carbon recycling technologies that use such CO_2 as a resource. Through these technological developments, NEDO aims to realize a carbon-neutral society.

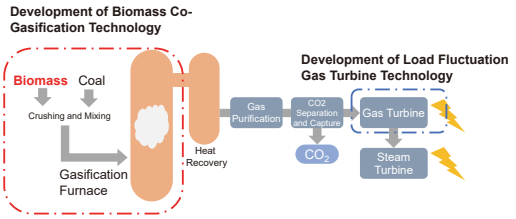
Hekinan Thermal Power Station operated by JERA Co., Inc.

R&D and Demonstration Base for Carbon Recycling

● Details of Research and Development

(1) Demonstration of integrated coal gasification fuel cell combined cycle

In order to significantly reduce CO_2 emissions from coal-fired power generation, NEDO will develop gasification technology for biomass fuel blending and gas turbine element technology to cope with load fluctuations in CO_2 separation and recovery facilities as part of technology development for CO_2 separation and recovery coal gasification fuel cells combined cycle power generation.



(2) R&D and demonstrations on technologies for ammonia co-firing thermal power generation

With the aim of establishing technology to use ammonia as a fuel for thermal power generation, NEDO will carry out various studies for the initial introduction of fuel ammonia into thermal power generation, develop elemental technologies for co-firing ammonia with coal, and conduct demonstration studies of ammonia co-firing technology at commercial coal-fired power generation facilities.

Image of ammonia-mixed burner and boiler
(Courtesy of IHI Corporation)

(3) Development of thermal power generation load fluctuation response technologies

NEDO is developing technologies for gas turbine combined cycle power generation that are highly mobile to support the instantaneous and continuous decline in power generation due to the mass introduction of renewable energy sources and to improve efficiency at low loads. For coal-fired power generation (steam power generation), NEDO is also working on the development of maintenance technologies such as failure prediction and life prediction for excessive load-fluctuation operation, as well as minimum load reduction.

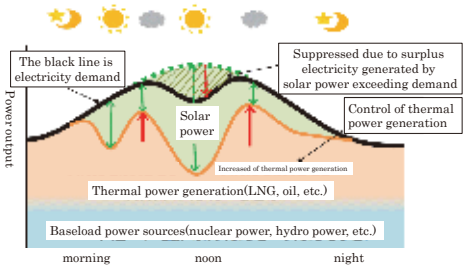
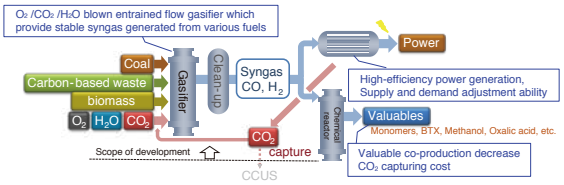


Image of Electricity Supply and Demand
(Source: Ministry of Economy, Trade and Industry, "Toward the Massive Introduction of Renewable Energies: 'Grid Constraint' Issues and Countermeasures")

(4) Development of a polygeneration system for capturing CO_2

NEDO will conduct the development of a polygeneration system for capturing CO_2 using biomass and waste as feedstock, which is characterized by the separation and recovery of CO_2 as well as the co-production of electricity and valuable resources such as chemical substances. This system will reduce CO_2 emissions and the cost of recovered CO_2 through the economic benefits of valuable resources.



Brief diagram of development of basic technology for a polygeneration system utilizing various fuels for capturing CO_2

(5) Promotion of measures to reduce environmental impacts associated with coal utilization

In order to reduce the environmental impact of coal use, NEDO will develop technologies to expand and reduce the use of combustion ash from coal and other materials. In addition, it will develop technologies to clarify the causes of natural heat generation in coal and compile knowledge on guidelines for coal management.

Short fibers for reinforcing concrete made from coal ash and magnified image of its long fibers (Courtesy of Nippon Fiber Corporation KK)

(6) R&D of CO_2 separation/capture technologies

For CO_2 separation and recovery technologies, it is important to select the appropriate thechnologies according to the CO_2 emission source and the CO_2 user. NEDO will conduct research and development on the practical application of solid absorption and membrane separation methods, which are expected to save energy and reduce costs, including separation material development, process studies, and demonstration tests.

CO_2 solid absorber plant (Courtesy of Kawasaki Heavy Industries, Ltd.)

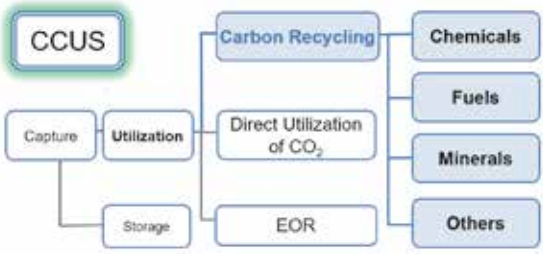
(7) Development of technologies for CO_2 Utilization at the R&D and demonstration base

In order to realize early commercialization of carbon recycling technology that effectively utilizes CO_2 as a resource, the R&D and Demonstration Base for Carbon Recycling will be established in the Osaki Power Plant of Chugoku Electric Power Co. Inc. on Osaki Kamijima, where various carbon recycling technologies will be researched and developed.

Common Use Building (Right) and Research Building (Left) (Courtesy of JAPAN CARBON FRONTIER ORGANIZATION)

(8) Development of Technologies for CO2 Reduction and Utilization

Based on the Carbon Recycling Roadmap, NEDO will conduct research and development related to technologies for synthesizing chemicals, liquid fuels, and gaseous fuels from CO_2 and for immobilizing CO_2 into concrete, cement, carbonate, carbon, and carbides in order to reduce CO_2 emissions into the atmosphere. In addition, NEDO will conduct research on the economic efficiency and CO_2 reduction effects of next-generation thermal power plants that will reduce the environmental burden.



Carbon Recycling (Source: Compiled by NEDO based on the Ministry of Economy, Trade and Industry's "Carbon Recycling Technology Roadmap")

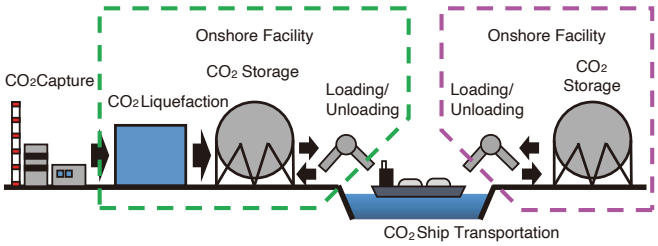
Project period	FY2016-FY2026	Budget	19.1 billion yen (FY2023)

Research, Development, and Demonstration of CCUS Technology

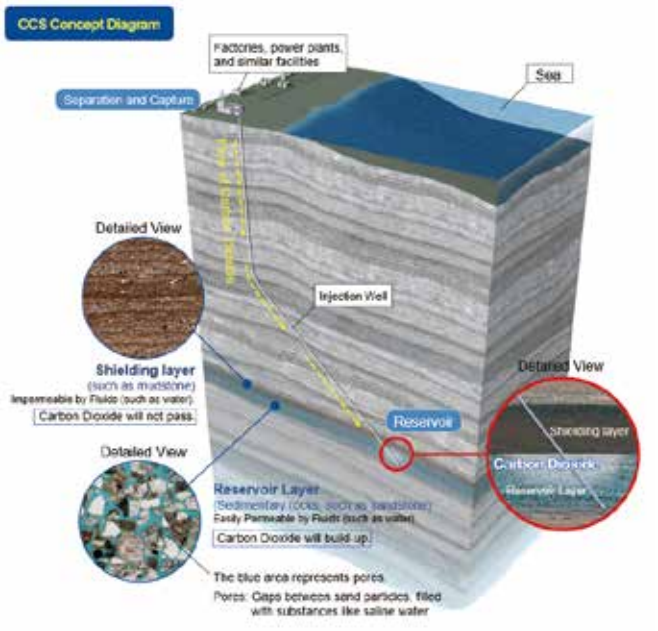
▲ Detail ▲

● Business and Project Outline

In this project, NEDO aims to achieve carbon neutrality by 2050 under the "6th Strategic Energy Plan," approved by the Cabinet in October 2021, and will conduct research and development on CO_2 storage technologies as well as investigation of technologies related to effective CO_2 utilization and others for the early introduction of CCS as soon as possible. In light of the "Long-term Strategy under the Paris Agreement," NEDO aims to establish and commercialize CCUS technology at an early stage by working on the transportation of separated and captured CO_2 to storage and effective utilization sites, thereby promoting integrated technological development from CO_2 separation and capture to transportation, storage, and effective utilization.



Demonstration Test on CO_2 Transportation Conceptual Diagram



CCS Conceptual Diagram

● Details of Research and Development

(1) Large-scale CCUS demonstration testing at Tomakomai

1. Large-scale CCUS demonstration testing at Tomakomai

NEDO conducts CCS demonstration tests to separate and capture CO_2 and store it in geological formations at depths of approximately 1,000 m or more below the seafloor. The target of 300,000 tons of CO_2 injection was achieved in 2019, and NEDO is currently monitoring the behavior of the stored CO_2 as well as conducting marine environmental surveys and other monitoring activities.

2. Demonstration Test on CO_2 Transportation

NEDO researches, develops, and demonstrates the technology necessary to construct an integrated marine transportation system that liquefies, stores, loads, and transports CO_2 at optimal temperature and pressure conditions, which is one of the means to safely transport large volumes of CO_2 separated and captured from exhaust gas at factories and other facilities at the low cost which would accelerate social implementation of CCUS.

(2) R&D of CO_2 storage technologies to safely carry out CCS operations

NEDO implements research on the practical application of technologies necessary for the safe practice of CO_2 retained on a large-scale level. NEDO will proceed with efforts toward the early introduction of CCS, including (1) the development of technologies for safety management related to large-scale CO_2 injection and storage, (2) the development of technologies for effective injection and utilization of large-scale reservoirs, and (3) the development of conditions and standards for CCS dissemination.

(3) Research related to CCUS Technologies

NEDO will conduct research on domestic and international technological development trends and introduction scenarios related to CCUS.

Project period	FY2018-FY2026	**Budget**	8 billion yen (FY2023)
Project participant	Japan CCS Co., Ltd., Engineering Advancement Association of Japan, Itochu Corporation, Nippon Steel Corporation, Geological Carbon Dioxide Storage Technology Research Association, and Nippon Gas Line Co., Ltd.		

International Cooperation Project for Carbon Recycling and Decarbonization Technologies for Thermal Power Generation

▲ Detail ▲

● Business and Project Outline

In order to solve the climate change problem, Japan and other countries have declared themselves carbon neutral, announced targets for a low-carbon society, and have begun to take concrete actions. Under these circumstances, this project will conduct technical exchanges, invitations, trend surveys, and feasibility studies for the introduction of specific technologies in order to disseminate Japan's superior technological capabilities through international cooperation. This will lead to the overseas deployment of carbon recycling technology and the decarbonization of thermal power generation, thereby contributing to the reduction of global CO_2 emissions and environmental impact.

Group photograph at 5th International Conference on Carbon Recycling 2023

International Seminar (Bilateral)

Scene of the panel discussion at 5th International Conference on Carbon Recycling 2023

● Details of Research and Development

R&D Item (1) Project for Promotion of Carbon Recycling and Decarbonization Technologies for Thermal Power Generation
In order to promote the introduction of carbon recycling and decarbonization technologies, an environment will be created for the diffusion and development of carbon recycling as well as the introduction of advanced technologies that will contribute to decarbonization through invitations to partner governments and electric utility companies, seminars, human resource development, and international conferences.

(2) Research on carbon recycling and decarbonization technologies for thermal power generation
Research will be conducted on the creation and feasibility of projects related to the diffusion of carbon recycling and decarbonization technologies in Japan, as well as on trends in the carbon recycling and thermal power generation sectors in the world.

Project period	FY2022-FY2026	**Budget**	380 million yen (FY2023)
Project participant	Mizuho Research & Technologies, Ltd., HighChem Company Ltd., Toyo Engineering Corporation, Japan Carbon Frontier Organization, and other organizations		

Projects Conducted with the Green Innovation Fund

Green Innovation

The Green Innovation Fund Projects, carried out on the basis of ambitious goals shared by the public and private sectors, aims to provide continuous support to companies and other organizations committed to addressing such goals as part of their business activities. Such support, available for up to a maximum of ten years, ranges from research and development (R&D) activities and demonstrations to social implementation of project outcomes.

Basic Policies for Green Innovation Fund (Summary)

01 Purpose and Outline

To achieve carbon neutrality by 2050, METI established a 2 trillion-yen fund as part of NEDO and provide continuous support for R&D projects, demonstrations, and social implementation projects for up to 10 years to companies that commit to ambitious goals.

02 Program Target

(Per project)
Ambitious 2030 targets, etc.
(Performance, Cost, etc.)

Monitor Cross-sectoral monitoring of fund projects based on the following;

- ＊International Competitiveness
- ＊Commercialization (TRL, etc.)
- ＊Potential for attracting private investment

- **CO_2 Reduction Effect**
- **Economic Effect**

03 Support Target

METI's support will focus on priority fields for which implementation plans have been formulated within the Green Growth Strategy, or key fields for which a future roadmap has been presented based on the "Basic Policy for Realization of GX", where policy effects are significant, and long-term continuous support is required to realize public implementation.

- ✔ Average size of conventional R&D projects (20 billion yen) or more.
- ✔ Projects for which short-term government support programs is sufficient are not eligible.
- ✔ Main implementers should be companies or other profit-making businesses capable of carrying out the entire process of public implementation (participation of small and medium-sized venture companies is encouraged; participation of universities and research institutions is also expected).
- ✔ The project must include innovative and fundamental R&D elements that are worthy of being commissioned by the government.

04 Strategy for Maximizing Results

To ensure that research and development results are steadily implemented publicly, METI seeks the commitment of the managers of companies and other organizations to persevere in challenging these goals as long-term business issues.

(Efforts required of company managers)
＊Submission of the vision and the long-term business strategy at the time of application
＊Attendance and report to the WG
＊Submission of a management sheet showing the status of initiatives

(Implementation of a system to enhance commitment)
1)If the status of the project is inadequate, the project will be canceled, and a portion of the consignment fee will be returned.
2)Introduction of a system(an incentive measure)that allows the government to pay more depending on the degree of achievement of targets.

The 14 priority fields in the Green Growth Strategy for which action plans have been compiled

- Upholding ambitious goals, steadily implement action plans corresponding to the phase of technology, and strengthen international competitiveness.
- Trial calculations indicate that the economic effect will be approximately 290 trillion yen and the effect in terms of employment will be approximately 18 million jobs in 2050.

Energy-related Industries

01 Offshore Wind Power, Solar Power, Geothermal Power

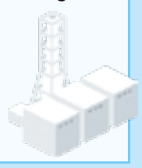
- By 2040, develop projects to generate 30-45GW [Offshore wind power]
- By 2030, aim for a power generation cost of 14 yen/kWh through next-generation solar cells [Solar power]

02 Hydrogen and Fuel Ammonia

- By 2050, introduce approximately 20 million tons [Hydrogen]
- Aim to capture a market of 500 billion yen in Southeast Asia [Fuel ammonia]

03 Next-generation Heat Energy

By 2050, aim to inject synthetic methane by 90% into existing infrastructure.



04 Nuclear Power

By 2030, establish underlying technologies related to carbon-free hydrogen production by high-temperature gas-cooled reactors (HTGR).

05 Automobiles and Storage Batteries

For passenger vehicles, electrified vehicles will account for 100% of new vehicle sales by 2035

06 Semiconductors and Information and Communication

By 2040, aim to achieve carbon neutrality in the semiconductor/information and communication industries.

＊In accordance with Japanese law, NEDO is not authorized to implement or provide funding for research and development activities solely targeting nuclear power.

Fund Projects

Moreover, by leveraging government funding, this program is intended to serve as an impetus encouraging private sector investment in R&D activities and infrastructure development, and also attract global ESG-related funding, estimated to total approximately 35 trillion dollars, to Japan. Through such efforts, Japan aims to realize carbon neutrality by 2050.

05 Scheme

Build a highly transparent and effective governance system that incorporates the knowledge of external experts and close cooperation among related organizations.

Green Innovation Project committee
- ＊Deliberation on the "Basic Policy"
- ＊Preparation of the "Policy for Allocation of Funds for each Field," etc.

Installation Report

Field-specific working groups (WG)
- ＊Deliberation on the content and scale of each project, etc.
- ＊Confirmation of the status of the project, etc.

Presentation and deliberation of the draft basic policy

Presentation and deliberation of proposed R&D and public implementation plan ＊1

Progress reports and Advice

METI
- ＊Project Management office for the committee and WGs
- ＊Preparation of basic policies
- ＊Planning of each project ＊2, etc.

Subsidize and collaboration

NEDO
- ＊Management and administration of funds
- ＊Administrative work related to public solicitation, screening, inspection, payment, etc.
- ＊Technical and business advice by experts, etc.

1 A plan describing the project's goals for 2030, R&D items, maturity level of the target technologies(TRL, etc.), budget scale, etc. (A draft of the plan is discussed by the WG.)
2 Including the division office in charge of the project in the relevant ministry or agency.

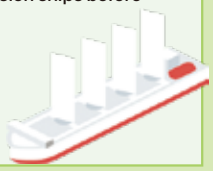
06 Program Schedule

March 2021	From March onward	From April onward	Every year	at any time
Formulate the Basic Policy	**Organize the Projects**	**Implement the projects**	**Evaluate the Projects**	**End of the Projects**
＊Deliberations in the committee	＊Preparation of fund allocation policy for each field ＊Deliberations in WGs	＊Public Offering, Examination, Inspection, Payment, etc.	＊(NEDO → WG → committee) Periodic monitoring	＊Completion or termination ＊Ex-post evaluation

Transportation and manufacturing-related industries

07 Shipping

Realize the commercial operation of zero-emission ships before 2028.



09 Food, Agriculture, Forestry, and Fisheries Industries

By 2050, achieve zero fossil-fuel-derived CO_2 emissions in the agriculture, forestry and fisheries industries.

11 Carbon Recycling and Materials

- By 2050, aim to bring the price of plastic raw materials made by artificial photosynthesis to the same level as existing products [Carbon recycling]
- Realize zero-carbon steel [Materials]

08 Logistics, People Flows, and Civil Engineering Infrastructure

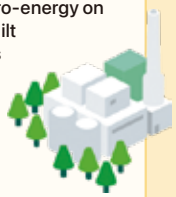
By 2050, realize carbon neutral ports and decarbonization of construction works, etc.

10 Aircraft

Aim for the phased implementation of core technologies for aircraft batteries, etc. from 2030.

12 Housing and Building and Next-generation Power Management

By 2030, realize zero-energy on average in newly built zero-energy homes (ZEH) and zero-energy buildings (ZEB). [Housing and building]



Home and office - related industries

13 Resource Circulation

By 2030, introduce approximately 2 million tons of bioplastics.

14 Lifestyle-related

By 2050, aim to realize carbon-neutral, resilient and comfortable living.

Field of Energy Structure Transformation

Hydrogen Utilization in Iron and Steelmaking Processes

Project Overview

Steel is used in many products, ranging from spacecrafts to more common products such as automobiles, bullet trains, computers, smartphones, and houses, and the steel industry is the foundation for various other industries.

Even in the carbon-neutral society of 2050, demand is expected to remain high for automobiles, electronics, and infrastructure-related products. During the manufacturing process for these products, however, large quantities of CO_2 are emitted.
CO_2 emissions in the iron and steel industry totaled approximately 131 million tons in FY2020, and currently account for roughly 40% of all industrial CO_2 emissions in Japan.

Since ancient times, the primary method for making steel has been to use carbon, in the form of charcoal or coal, as the means for reducing iron ore. However, this method inevitably generates CO_2. Therefore, to reduce CO_2 emissions, it is necessary to radically change the steel-making process by moving away from coal as a raw material/reduction agent. For this reason, research is underway all over the world on steelmaking through the use of hydrogen reduction where hydrogen is used instead of carbon to reduce iron ore, but this method has not yet been put into practical use.

To achieve carbon neutrality in the steelmaking process, this project aims to reduce CO_2 emissions by at least 50% through the application of hydrogen reduction technology to existing blast furnaces (using blast furnace hydrogen reduction technology) and technology for using hydrogen to directly reduce low-grade iron ore (using direct hydrogen reduction technology).

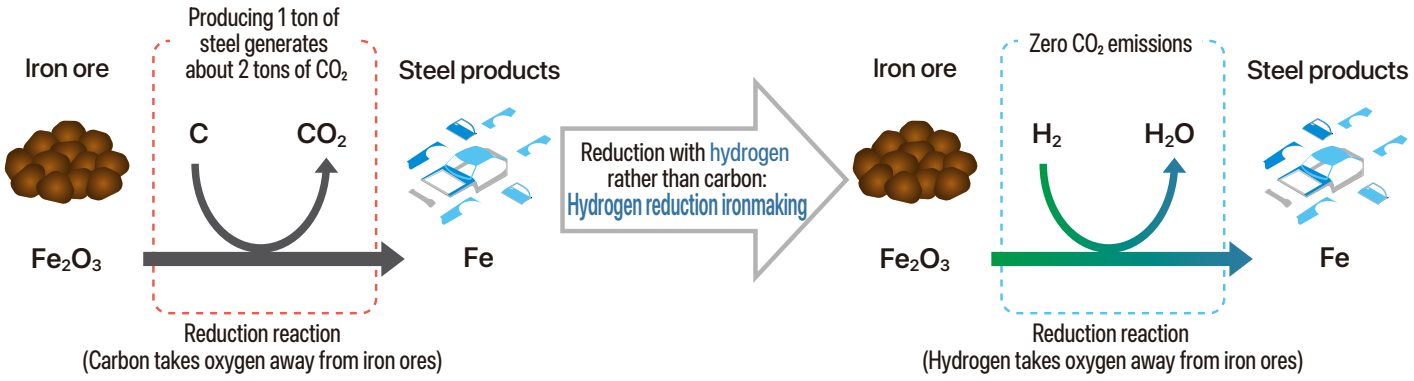
≪Research & Development≫

- Development of hydrogen reduction technology using blast furnaces
- Development of direct hydrogen reduction technology that reduces iron ore with hydrogen only

CO_2 Reduction Effect		Economic Effect (World)	
In2030	(Japan)	In2030	
Approximately 2 million tons/year		Approximately 320 billion yen/year	
In2050	(World)	In2050	
Approximately 1.3 billion tons/year		Approximately 40 trillion yen/year	

Source : METI, R&D and Social Implementation Plan

Image of hydrogen reduction ironmaking



Detailed information https://green-innovation.nedo.go.jp/en/project/utilization-hydrogen-steelmaking/

Project period Maximum of 10 years from FY2021 to FY2030

Department in charge Environment Department

Field of Energy Structure Transformation

Fuel Ammonia Supply Chain Establishment

Project Overview

Similar to hydrogen, ammonia does not emit CO_2 during firing, so it is expected to be used as a zero-emission fuel for power generation and shipping, thereby helping to realize carbon neutrality. For power generation applications in particular, it is important to promote the decarbonization of thermal power generation by replacing fossil fuels with ammonia. Ammonia can also be used as a hydrogen carrier, so by using existing infrastructure, it can be manufactured and transported inexpensively. Because of these characteristics, ammonia fuel is attracting attention all over the world, and demand is expected to increase rapidly in the future, especially in Asia.

However, ammonia is not currently used as a fuel, so to realize a society where ammonia fuel can be used, various issues must be addressed, such as expanding its use, securing stable supply sources, and reducing its cost.

To address these issues, the aim of this project is to realize technology necessary to reduce ammonia supply costs to the high 10 yen range perNm^3 (equivalent to hydrogen bycalorific value) by 2030. Another goal concerns establishing high-ratio co-firing and single-fuel firing technologies for using ammonia power generation to achieve the estimated domestic demand level of 30 million tons/year by 2050.

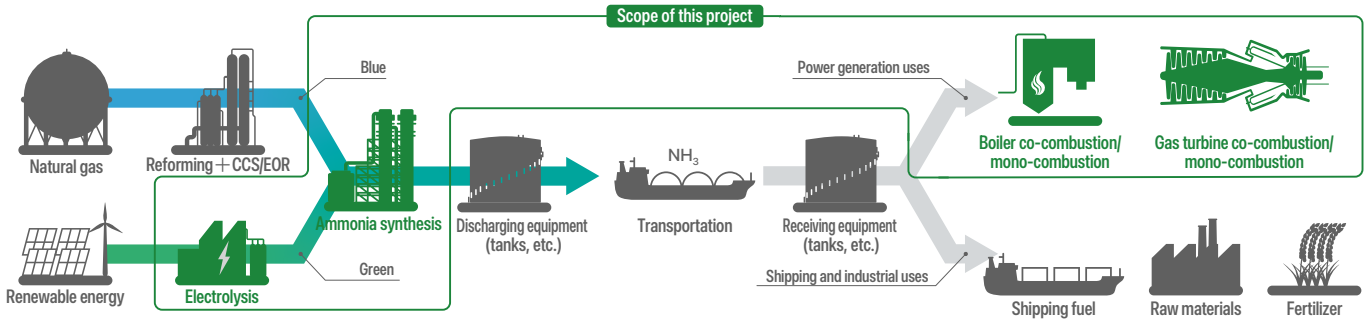
≪Research & Development≫

- Reduction of ammonia supply costs
- Ammonia high-ratio co-firing and single-fuel firing for thermal power generation

CO_2 Reduction Effect	Economic Effect (World)
In2030 (Japan) Approximately 6.15 million tons/year	In2030 Approximately 0.75 trillion yen
In2050 (World) Approximately 1.15 billion tons/year	In2050 Approximately 7.3 trillion yen/year

Source : METI, R&D and Social Implementation Plan

Fuel Ammonia Supply Chain



Source: Created by NEDO based on diagram produced by IHI Corporation

Detailed information https://green-innovation.nedo.go.jp/en/project/building-fuel-ammonia-supply-chain/

Project period Maximum of 10 years from FY2021 to FY2030

Department in charge Reduction of Ammonia Supply Costs : Smart Community and Energy Systems Department

Use of Ammonia for Power Generation : Environment Department

Field of Energy Structure Transformation

Development of Technology for Producing Fuel Using CO_2, etc.

Project Overview

To achieve carbon neutrality by 2050, it is essential to replace fossil fuels with fuels that do not increase CO_2 levels in the atmosphere when burned.

Such fuels have the potential to transform the energy supply and demand structure in Japan—which is dependent on fossil fuels from other countries—making it important from the perspective of energy security. Using existing infrastructure will greatly help reduce initial costs. The goal is to solve issues related to production technology and lower production costs to implement them throughout society.

It is necessary to promote the development of technology for carbon recycling fuels as one of the various options for realizing a decarbonized society. This project will work toward the social implementation of two liquid fuels—(1) synthetic fuels and (2) sustainable aviation fuels (SAF)—and two gaseous fuels—(3) synthetic methane and (4) green LPG.

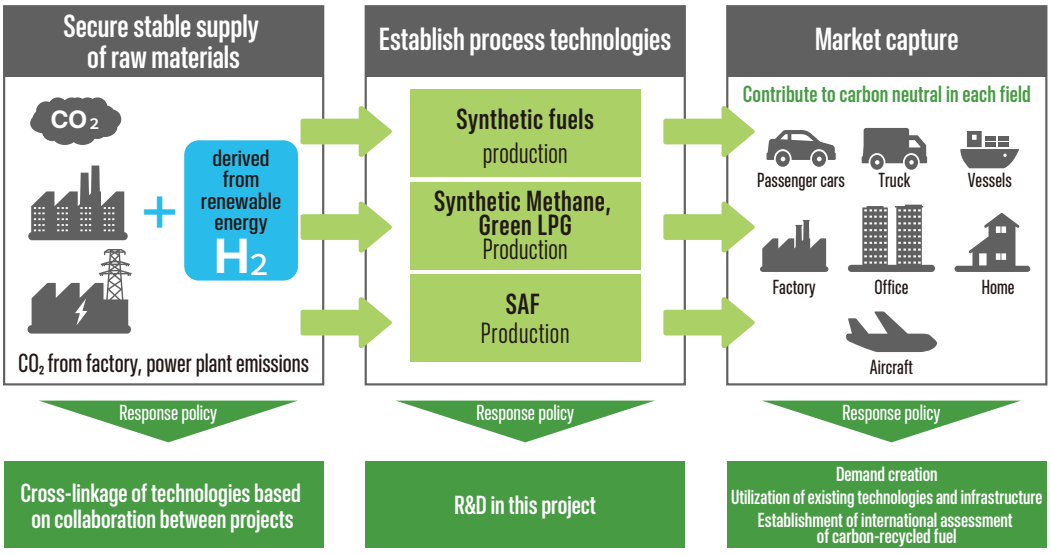
≪Research & Development≫

- Development of technology for improving production yield and utilization technology of synthetic fuels
- Development of technology for producing Sustainable Aviation Fuel (SAF)
- Development of innovative technology for the production of synthetic methane
- Development of technology for synthesizing green LPG without fossil fuels

CO_2 Reduction Effect (World)	Economic Effect (World)
In2030 Approximately 6.008 million to 9.438 million tons/year	In2030 Approximately 270.4 billion to 1.1 trillion yen (Total up to 2030)
In2050 Approximately 320 million tons/year	In2050 Approximately 17.1 trillion yen (Total up to 2050)

Source : METI, R&D and Social Implementation Plan

Image of utilization of CO_2 etc. in major carbon recycle fuels



Source: METI, Development of technology for producing fuel using CO_2, etc, revision

Detailed information https://green-innovation.nedo.go.jp/en/project/development-fuel-manufacturing-technology-co2/

Project period Maximum of 9 years from FY2022 to FY2030

Department in charge

Synthetic Fuels (Improving Production Yield), Synthetic Methane,Green LPG : Environment Department

Synthetic Fuels (Utilization Technology) : Energy Conservation Technology Department

Sustainable Aviation Fuels (SAF) : New Energy Technology Department

Field of Energy Structure Transformation

Development of Technology for Producing Concrete and Cement Using CO_2

Project Overview

Carbon Recycling is a key technology that effectively utilizes CO_2 as a resource for realizing a carbon neutral society. Japan has a competitive edge in the field of CO_2 separation and capture, as well as certain kinds of chemicals relevant to this technology.

Due to the high potential for CO_2 fixation and the stability of products, the use of CO_2 in concrete, cement, and carbonates (hereinafter referred to as "concrete and cement fields") in particular will be implemented in society, which is expected to greatly reduce CO_2 levels. In Japan, the United States, and Europe, R&D and demonstration projects in this area are already underway.

In order to achieve decarbonization in concrete and cement field, however, it is necessary to reduce CO_2 emissions and increase CO_2 fixation of concrete, a product used all around the world, as well as promote its use by reducing costs. Cement, a material used in concrete, also emits CO_2 through the decarbonization reaction of limestone, one of its raw materials, making it another issue that needs to be addressed.

To realize a carbon neutral society, the aim of this project is to address the above issues related to the social implementation of Carbon Recycling technologies, and strategically promote their diffusion in Japan and overseas.

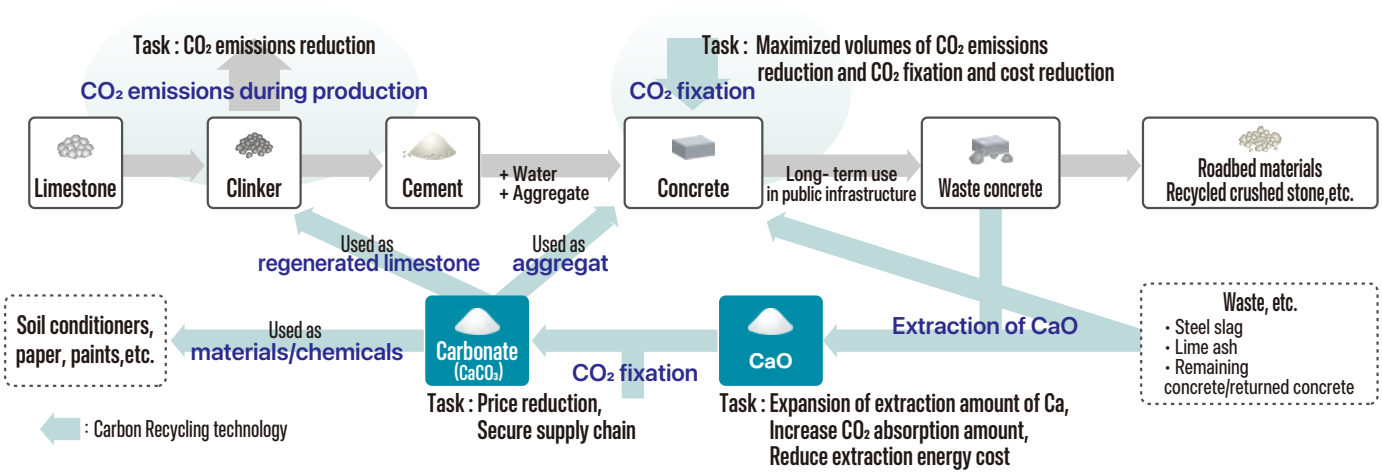
≪Research & Development≫

- Development of concrete produced with maximized volumes of CO_2 emissions reduction and CO_2 fixation
- Development of technology related to quality control/fixation evaluation methods for concrete produced with maximized volumes of CO_2 emissions reduction and CO_2 fixation
- Design and demonstration of CO_2-recovering cement production process
- Establishment of carbonic acid chloride technology using various calcium sources

CO_2 Reduction Effect (World)	Economic Effect (World)
In2030 Approximately 0.6 to 1.4 billion tons/year	In2030 Approximately 380 billion yen
In2050 Approximately 3 billion tons/year	In2050 Approximately 156 trillion yen

Source : METI, R&D and Social Implementation Plan

Producing concrete and cement using CO_2



Detailed information https://green-innovation.nedo.go.jp/en/project/development-manufacturing-concrete-using-co2/

Project period Maximum of 10 years from FY2021 to FY2030

Department in charge Environment Department

Field of Energy Structure Transformation

Development of Technology for CO_2 Separation, Capture, etc.

Project Overview

The power sector is moving toward decarbonization by introducing renewable energy to the greatest extent possible. However, in order to meet domestic demand for electricity, it is necessary to maintain a certain amount of thermal power generation and capture the resulting CO_2 emissions.

At the same time, while efforts to realize decarbonization in the industrial sector are moving forward, by such means as electrification and fuel conversion to hydrogen, demand for fossil fuels is expected to continue to some degree due to cost-related factors. In addition, it is difficult to avoid CO_2 emissions emanating from raw materials used in industrial sectors such as cement, steel, and chemicals.

There is consequently an increasing need for CO_2 separation and capture technologies in both the power generation and industrial sectors. However, challenges include the large amount of energy inputs needed for separation and capture and high costs for the equipment and materials used for capture.

The aims of this project are to establish technology for the first time for low-pressure, low-concentration CO_2 separation and capture at a concentration of 10% or less, to expand the business for CO_2 separation and capture equipment and materials, and to strengthen Japan's international competitiveness in the carbon recycling market while linking these results to the development of negative emission technologies such as Direct Air Capture (DAC).

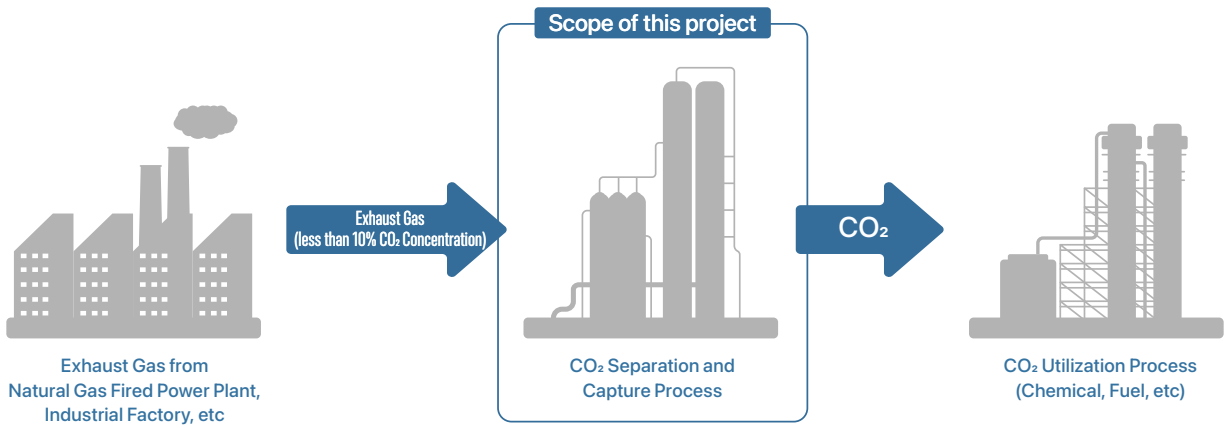
≪Research & Development≫

- Technology development and demonstration of large-scale CO_2 separation and capture from natural gas-fired power generation exhaust gas
- Technology development and demonstration of small- and medium-scale CO_2 separation and capture from factory exhaust gas, etc.
- Establish a common base for evaluating the standards of CO_2 separation materials

CO_2 Reduction Effect (World)	Economic Effect (World)
In2030 Approximately 1.6 billion tons/year	In2030 Approximately 6 trillion yen/year
In2050 Approximately 8 billion tons/year	In2050 Approximately 10 trillion yen/year

Source : METI, R&D and Social Implementation Plan

CO_2 (Low Pressure/Low Concentration) Separation and Capture Process



Detailed information https://green-innovation.nedo.go.jp/en/project/development-co2-separation-recovery/

Project period Maximum of 9 years from FY2022 to FY2030

Department in charge Environment Department

Background Information

Designation
National Research and Development Agency
New Energy and Industrial Technology Development Organization (NEDO)
Business name: New Energy and Industrial Technology Development Organization (NEDO)

Foundation
Originally established on October 1, 1980; reorganized as an incorporated administrative agency on October 1, 2003

Foundation Purpose
The purpose of NEDO is to enhance industrial technology and promote commercialization by comprehensively performing functions such as: promoting research and development carried out using skills from the private sector; promoting research and development carried out by the private sector with regard to technology for non-fossil energies, combustible natural gas, and coal; promoting the technology required for the rational use of energy and technology in mining and industry; and promoting the utilization of such technology in cooperation with the international community; to thereby contribute to ensuring a stable and efficient energy supply in accordance with the changes in the domestic and foreign economic and social environments and to the development of the economy and industry.

Details of Major Operations
Operations relating to research and development management (national projects and practical application promotion activities)

Minister in Charge
Minister of Economy, Trade and Industry

Governing Laws
Act on General Rules for Incorporated Administrative Agencies Act on the New Energy and Industrial Technology Development Organization

Personnel
1,464 (as of April 1, 2023)

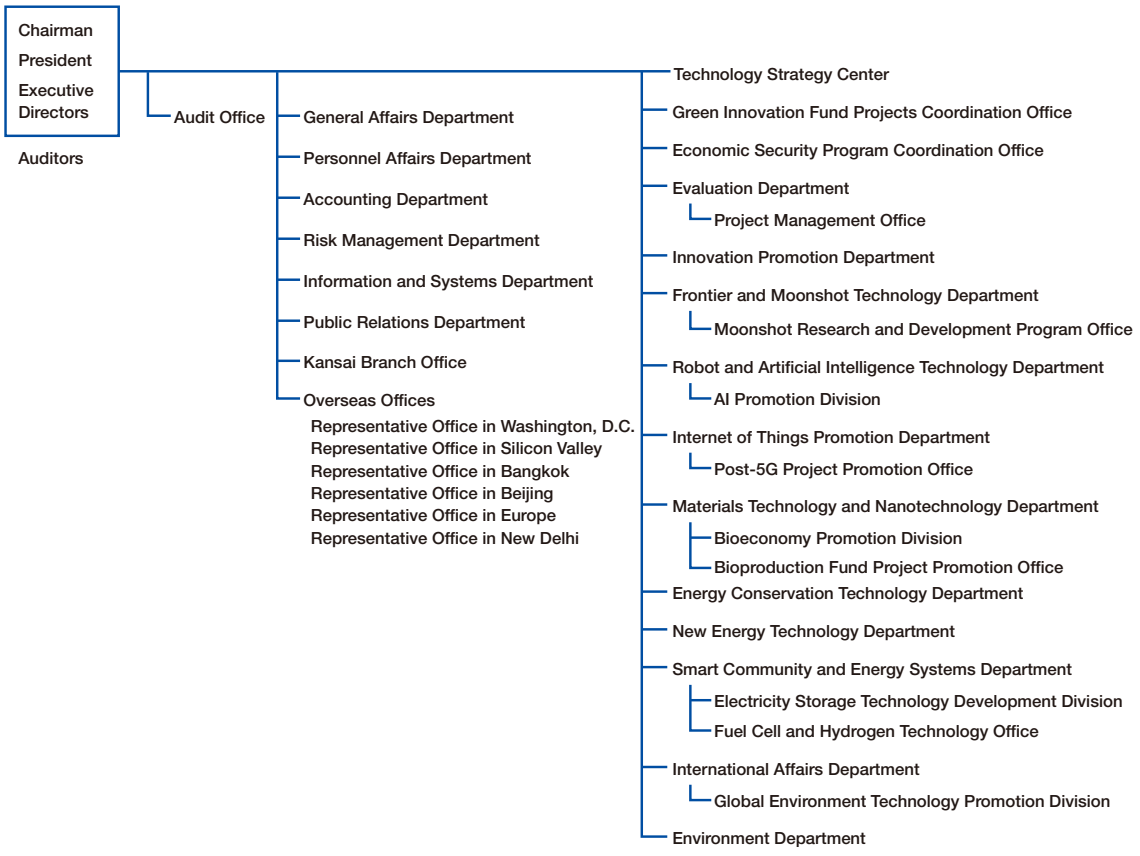
Budget
Approximately 1.14 billion US dollars (initial budget for FY 2023)
*Converted at the exchange rate of 1 US dollar = 133.04 yen
Additional funding programs are also being implemented.

Executives

Chairman	Mr. SAITO Tamotsu
President	Mr. YOKOSHIMA Naohiko
Executive Directors	Mr. YOSHIOKA Masatsugu, Mr. YUMITORI Shuji, Mr. HAYASHI Shigekazu, Mr. NISHIMURA Tomoyasu, Ms. IIMURA Akiko
Auditors	Mr. YABUTA Keisuke, Ms. FUKUSHIMA Michi

(as of October 1, 2023)

Organization



(as of July 1, 2023)

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URL: https://www.nedo.go.jp/english/index.html

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