



JAPAN CARBON FRONTIER ORGANIZATION

*JAPAN CARBON FRONTIER ORGANIZATION
WITH INNOVATIVE TECHNOLOGIES (JCOAL)*



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<http://www.jcoal.or.jp/eng>

Our Vision

Coal is one of the most abundant fossil energy resources in the world, and its large amount of reserves has ensured its price has remained low and stable, thereby supporting the very foundations of society across various fields. The Seventh Strategic Energy Plan (target of reducing greenhouse gases by 73% in 2040 compared to 2013) approved by the Cabinet in February 2025 also stipulates that coal is an important energy source that currently has excellent availability and economic efficiency, and that even as the amount of electricity generated (kWh) mainly with inefficient coal-fired thermal power generation decreases, the stable supply of coal remains important, and the independent development ratio of coal will remain at 60% in 2040.

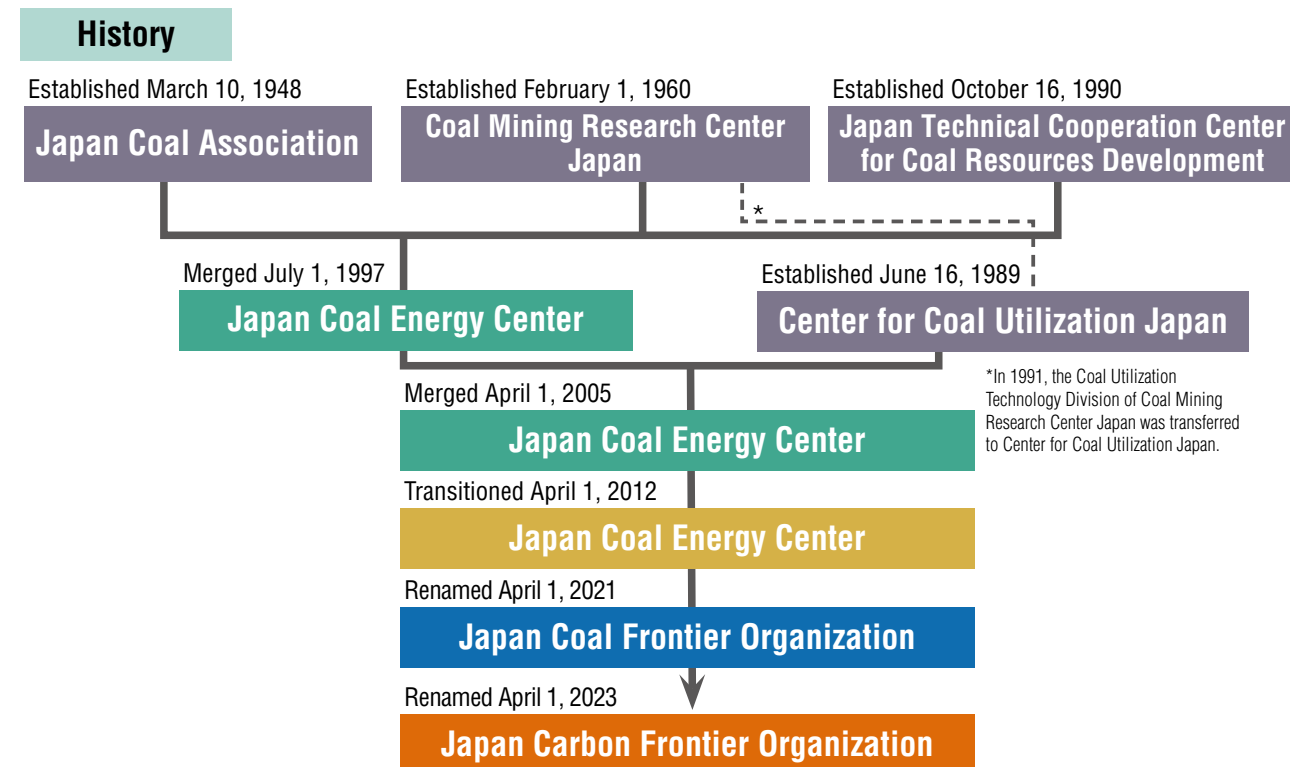
Along with the goal of achieving carbon neutrality by 2050, the GX (Green Transformation) Promotion Act was enacted in May 2023, and the CCS Business Law and the Hydrogen Society Promotion Act were enacted in May 2024. In response to these developments, support has been initiated through Green Transformation Economic Transition Bonds in an effort to promote GX.

Tackling climate change does not call for "getting rid of coal" but for promoting "low/zero CO₂ emissions from the use of coal." Our organization has long been involved in the development of advanced CCT, but has recently focused on projects contributing to carbon neutrality, such as the management and operation of the Carbon Recycling Demonstration Research Center and the research and development of sustainable aviation fuel (SAF) synthesis technology. In FY2025, we will be closely monitoring changes in the global energy situation, and also promoting business together with our member companies while remaining involved in the framework of Green Transformation Economic Transition Bonds in accordance with the basic policy of the GX Promotion Act.

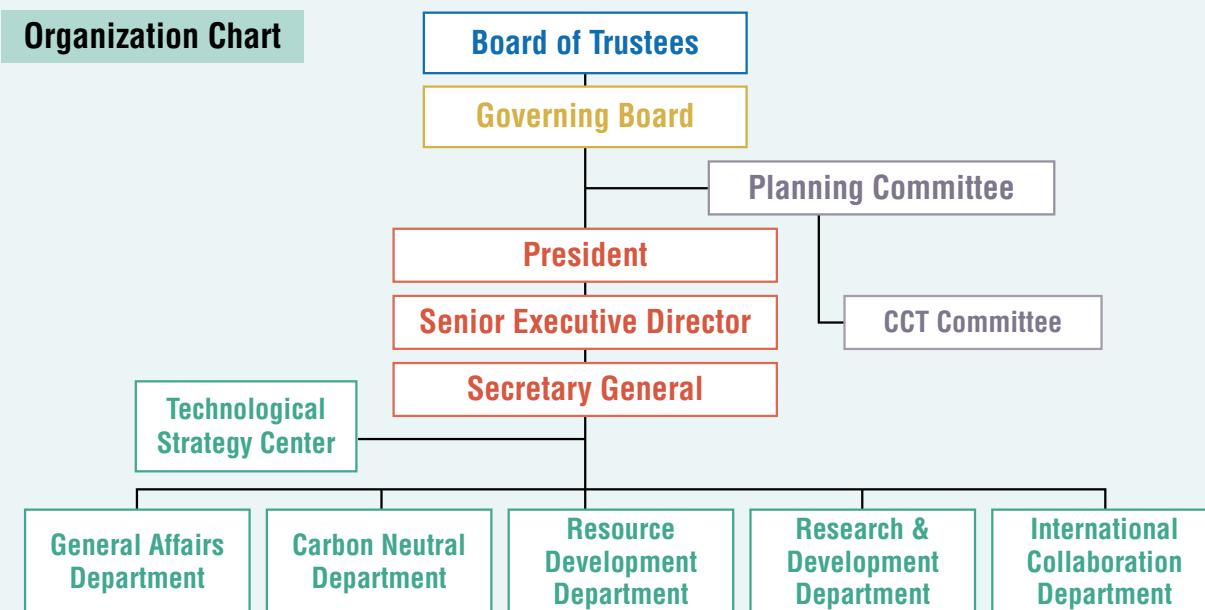
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Organization Outline



Organization Chart



Various committee activities

The Planning Committee is responsible for policy proposals and recommendations, public relations activities, collection of coal-related information, and the establishment, consolidation and management of specialized committees with the aim of ensuring smooth operation of projects and provision of information to member companies. The CCT Committee is formulating and reviewing roadmaps and holding seminars on individual technology topics with the aim of promoting and supporting the development of CCT and carbon recycling technologies.

(Reference: Topics of seminars held most recently)

- Carbon neutrality in general industries (steel, cement, etc.)
- Production and utilization technologies for biomass fuel, ammonia and hydrogen
- Carbon pricing

(carbon credits, emissions trading, etc.)

- Role of coal-fired power generation in response to the mass rollout of renewable energy

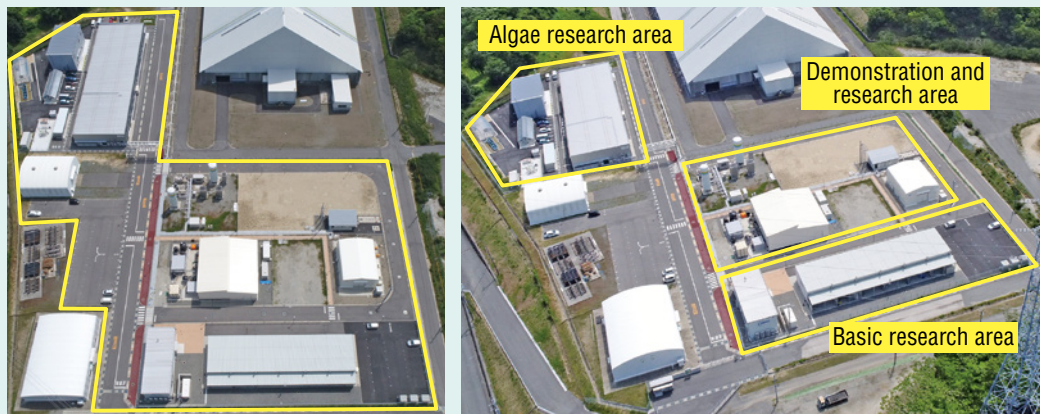
Promotion of Carbon Recycling Activities

Development of a Carbon Recycling (CR) Demonstration Research Center at Osaki-kamijima, Hiroshima **NEDO** **Implementation period: FY 2020-2027**

The Carbon Recycling (CR) Demonstration Research Center that opened in 2022 conducts various R&D activities for producing fuels, chemicals, minerals, etc. from CO₂ (actual gas) that has been separated and recovered at the Osaki CoolGen (an integrated coal gasification fuel cell combined cycle power generation demonstration project) and transported through pipelines.

This Center consists of three areas; a Demonstration Research Area, an Algae Research Area, and a Basic Research Area—each area conducts demonstration tests for the production of fuels, compounds, and chemicals, research and development including culture and extraction tests of microalgae, and elemental research in six laboratories in the research building. The common building also provides support by making available for use centrifuges, gas chromatographs, pure water production equipment, and various analytical equipment. Four meeting rooms are also available as a place for researchers to discuss and perform PR activities.

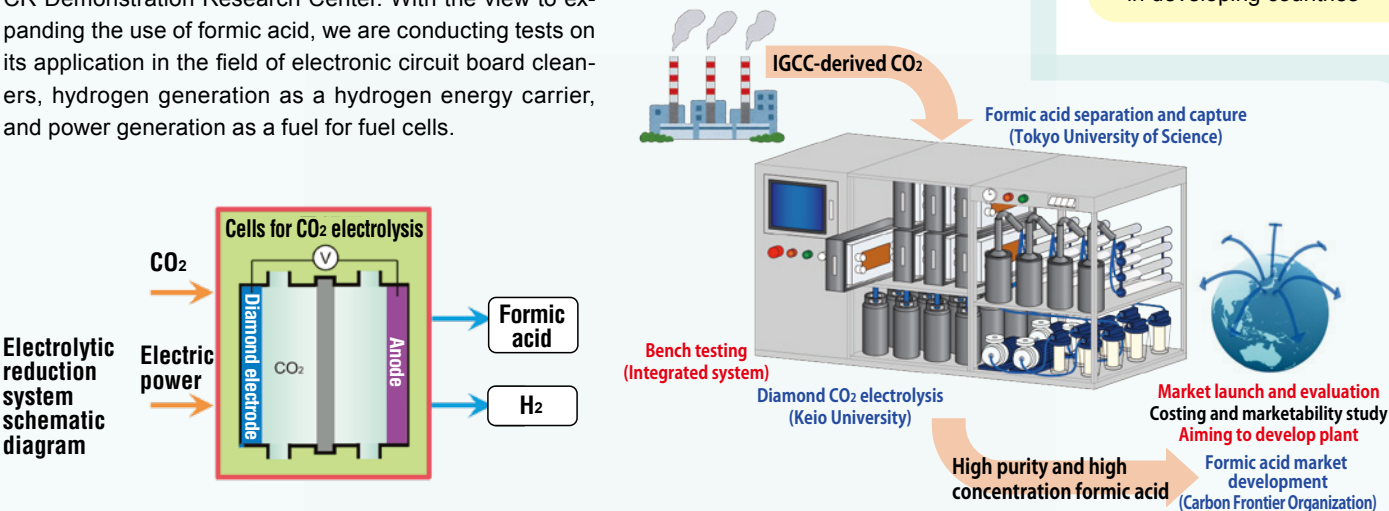
Our organization operates and manages the facility to support all research and development conducted at the Center, as well as contributing to the enhancement and dissemination of CR by sharing the results of research throughout Japan and internationally.



Production of key substances from CO₂ in coal-fired flue gas using diamond electrodes **NEDO** **Implementation period: FY 2020-2025**

Our Organization has been coordinating efforts with Keio University and Tokyo University of Science on the development of formic acid production technology using high-efficiency diamond electrodes—which have a wider reduction area compared to other electrode materials and are superior in durability and stability—to electrochemically reduce CO₂ to produce formic acid, which is then concentrated for use as a chemical raw material or hydrogen energy carrier.

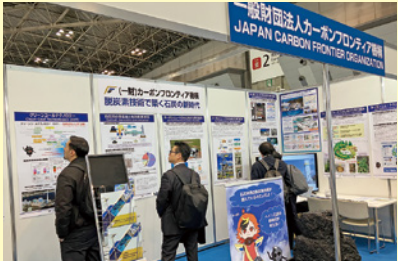
From FY2022, we have been designing, installing and running continuous production of a system integrating the elemental technologies for generation and concentration on a bench-scale at the Osaki-Kamishima CR Demonstration Research Center. With the view to expanding the use of formic acid, we are conducting tests on its application in the field of electronic circuit board cleaners, hydrogen generation as a hydrogen energy carrier, and power generation as a fuel for fuel cells.



Making policy proposals and promoting PR activities



Coal experimentation classes



Zero Emission Thermal Power Generation EXPO

Towards Carbon Neutrality in Coal Use

Promoting optimization of the coal value chain



Coal mine survey in Mozambique

Human resource development

- Training programs for overseas mineral and resource professionals
- Promoting efficient use of natural resources and environmental sustainability in developing countries

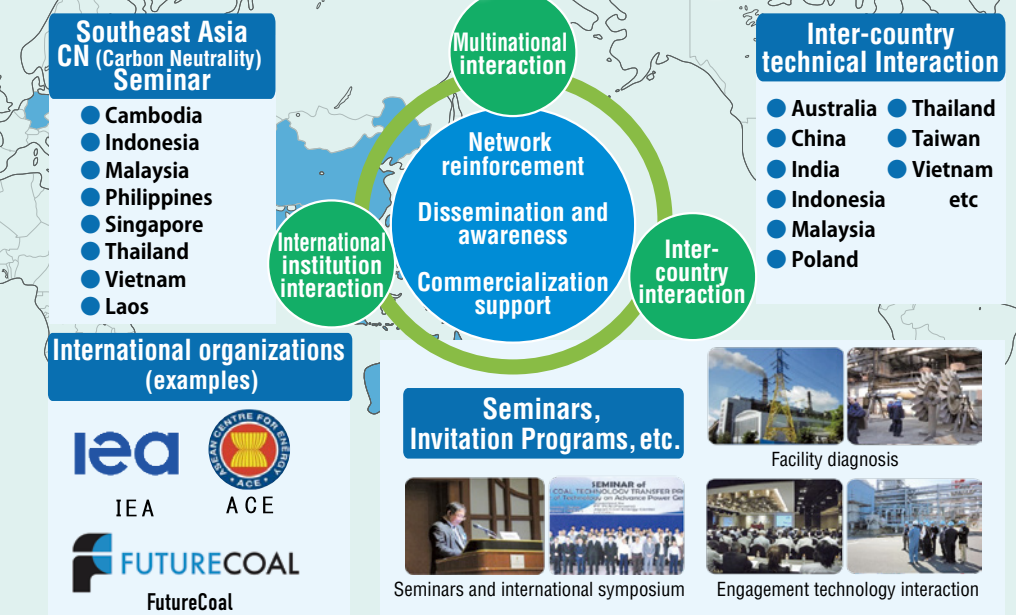


Domestic on-site training (Hokkaido)

Innovative CCT

To achieve carbon neutrality, it is important to establish a cooperative system among industry, government and academia towards the development of technologies such as CCUS/carbon-recycling in the power and non-power sectors that utilize coal. We are working to develop “innovative clean coal technologies” including innovations in fields such as CCUS/carbon recycling, while also working to reduce costs associated with CO₂ emissions.

International collaboration projects such as technology transfer and business development for the global environment



Clean Coal Day (CCD) International Symposium

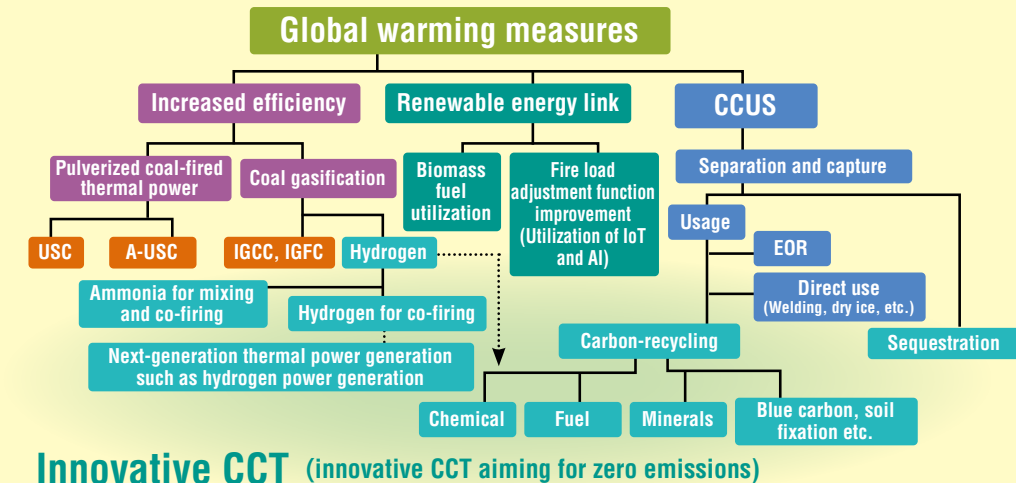


We co-host the CCD International Symposium with METI (Ministry of Economy, Trade and Industry), NEDO (New Energy and Industrial Technology Development Organization), and JOGMEC (Japan Oil, Gas and Metals National Corporation). This international symposium featured presentations and panel discussions on topics such as decarbonization technologies, with participants including government agencies, corporate representatives, academia, and international organizations from Japan, India, Indonesia, Australia, and other countries. The outcomes of the symposium are disseminated domestically and internationally as JCOAL's STATEMENT.

Energy Security with Decarbonization Symposium



Since FY2023, JCOAL holds the "Energy Security with Decarbonization Symposium" in collaboration with JOGMEC, focusing on upstream decarbonization and the stable supply of coal—this symposium took place the day after the CCD International Symposium. Presentations were given by government agency representatives, corporate representatives, academia, and international organizations from countries such as Australia, China, and India, etc.



Innovative CCT (innovative CCT aiming for zero emissions)

Introduction of Initiatives

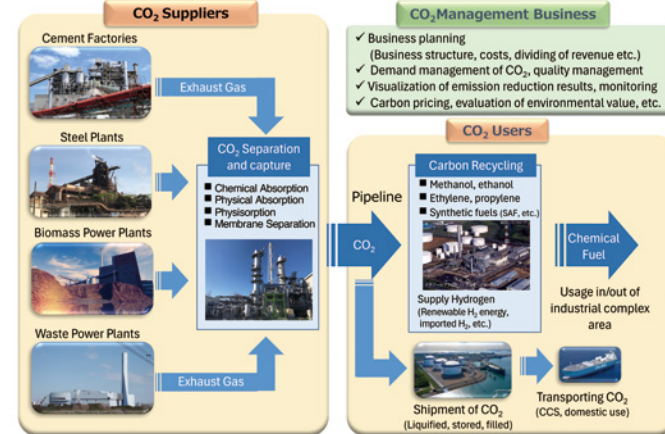
Technological development for the realization of carbon neutrality

1 Promoting Carbon Recycling Technology Implementation Through Inter-Industry Cooperation **NEDO**

Implementation period:
FY 2024-2025

Promotion of Carbon Recycling Business Via Inter-Industry Collaboration

In the domestic petrochemical industrial complex area, there are multiple industries producing a variety of products. In this study subjected to specific industrial complex with a large industrial concentration and in cooperation with multiple industries located in the area, we will investigate the feasibility of a carbon recycling business that can lead to a significant reduction in CO₂ emissions and lower costs through the flexible use of existing infrastructure, unused energy, CO₂ and hydrogen (H₂), etc. Furthermore, the roles required of CO₂ management businesses, assuming there is cooperation between multiple CO₂ suppliers and users, will be examined and the implementation of such projects will be promoted. (Implement together with the Research Association of Refinery Integration for Group-Operation and companies located in the subjected complexes)

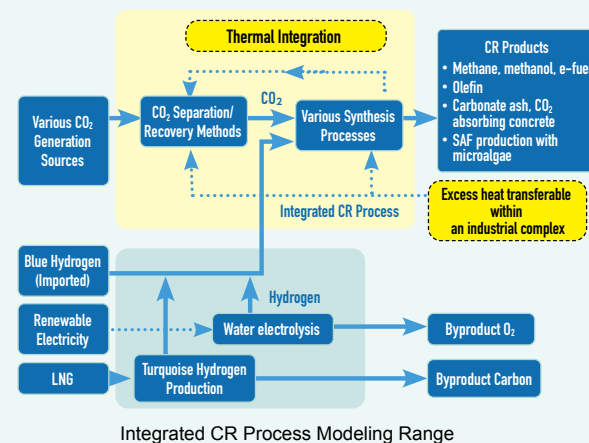


2 Optimization Study of CO₂ Separation and Recovery Technologies for Carbon Recycling **NEDO**

Investigation of Optimal Systems through Process Simulation and Identification of Challenges for Social Implementation

Implementation period:
FY 2024-2025

The "Carbon Recycling Roadmap" revised by the Ministry of Economy, Trade and Industry in 2023 outlined the goal by 2030 of the "development of a societal system that considers the combinations of CO₂ sources, separation and recovery technologies, and CO₂ purity suitable for various applications." This project aims to decarbonize petrochemical complexes that have a concentration of diverse CO₂ emission sources by constructing and simulating an integrated carbon recycling (CR) process comprising "CO₂ emission sources," "CO₂ separation and recovery technologies suitable for these sources," and "synthetic processes utilizing CO₂." We will conduct optimization studies for CO₂ reduction effects and to achieve energy efficiency and cost reductions, while exploring the challenges for social implementation. "CO₂ separation and recovery technologies" suitable for various CO₂ concentrations, gas compositions and emissions in particular will involve studies of five CO₂ separation and recovery technologies: "chemical absorption method," "solid absorption method," "physical absorption method," "physical adsorption method," and "membrane separation method."



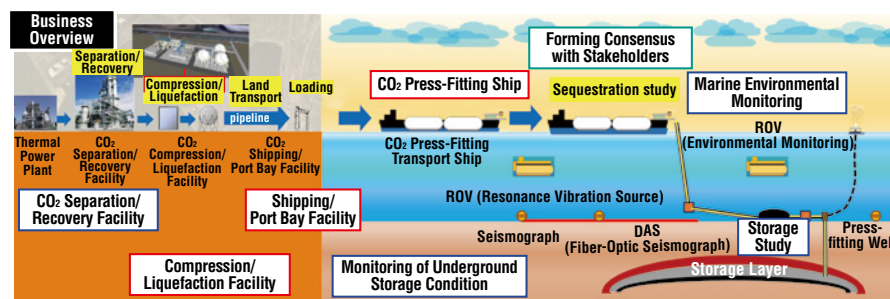
3 Environmentally-conscious CCUS - Integrated demonstration facility and supply chain construction project **Ministry of the Environment**

Implementation period:
FY 2021- 2025

Study to Demonstrate CCS from Offshore

In Japan, CO₂ sources are not always located near sequestration sites. Therefore, it is necessary to transport the CO₂ to the sequestration site. This project involves study of an integrated demonstration to monitor the behavior of sequestered CO₂ which has been separated and captured at the power plant, then compressed liquefied and loaded onto a CO₂ carrier using ship-ping equipment for transport to a seques-tration site.

This project examine methods of transporting liquefied CO₂, injecting it from the sea, surveying sequestration sites, drilling, and monitoring, with the as well as summarizing the benefits, challenges, and risks from economic and environmental perspectives. (A consortium of 9 organizations, including the Japan Carbon Frontier Organization is being formed for implementation)



4 Highly efficient production system for woody biomass fuel using fast-growing trees **NEDO**

Implementation period:
FY 2021 - 2026

Contributing to regional development through the local production and consumption of biomass

One of the main subjects for domestic biomass power generation are the stable supply of bio-mass and the reduction of procurement costs. In Iwaki City, Fukushima Prefecture, a highly ef-ficient production system is being developed for the stable supply of domestic woody biomass fuel from fast-growing trees (such as "Chinese Fir"). By replacing existing Japanese cedar forests with fast-growing trees, applying GIS (Geographic Information System) and cloning technologies of superior seedlings, we will develop a clear-cutting and renewal system for fast-growing trees grown specially for fuel wood production. The develop-ment will contribute to the revitalization of local economies through locally produced and con-sumed biomass fuel.

(Joint implementation with Tohno Kosan and Fu-rukawa Ringyo)



Modified from figure in the Forestry Agency "FY2015 Annual Report on Forest and Forestry in Japan" (Source: NEDO's illustration of the creation of "Energy Forests")

5 Small-scale Distributed SAF Production Technology using Biomass Gasification and FT Synthesis **NEDO**

Implementation period:
FY 2025 - 2029

Production of SAF (Sustainable Aviation Fuel) from regional biomass using small-scale gasification and FT synthesis reactors

In recent years, there has been international momentum in developing SAF (Sustainable Aviation Fuel) derived from low-carbon sources such as algae and biomass. Considering the current energy landscape, it is crucial to develop technologies for a broad range of SAF sourcing, utilizing both domestic and foreign raw materials.

There are several methods for SAF production, but using synthetic gas from biomass gasification as feedstock and employing FT (Fischer-Tropsch) synthesis are highlighted. Miniaturization of gasification and FT synthesis reactors is pivotal as it can reduce plant costs and potentially establish a stable and cost-effective decentralized fuel supply chain.

In FY2024, we focused on biomass gasification and FT synthesis to study the feasibility of establishing a small-scale SAF produc-tion plant and a supply chains aimed at regional decentralization, and also explore challenges for implementation of these tech-nologies socially. From FY2025, studies will continue with the successor project, "Decentralized Local Production-Local Consumption SAF Production Technology Using Wood Resources and Waste from Akita Prefecture" (United Plan from FY2025, to be implemented jointly with Sumitomo Heavy Industries, Ltd.)

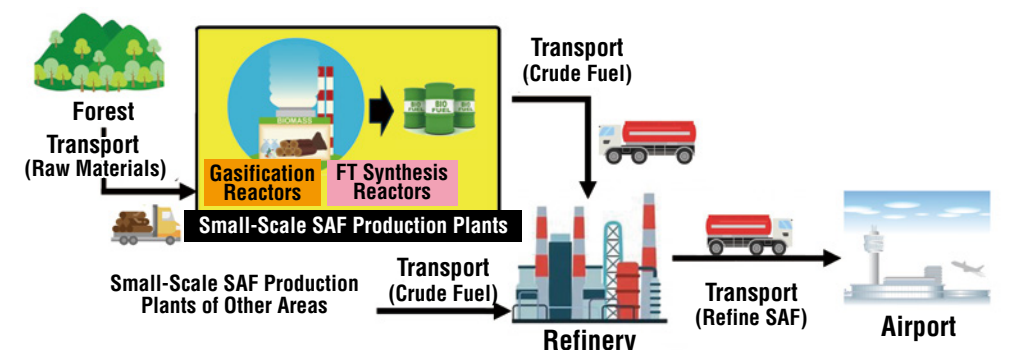


Figure image of domestic SAF supply chain for small scale distributed biomass utilization

6 Chemical looping combustion and poly-generation technology development NEDO

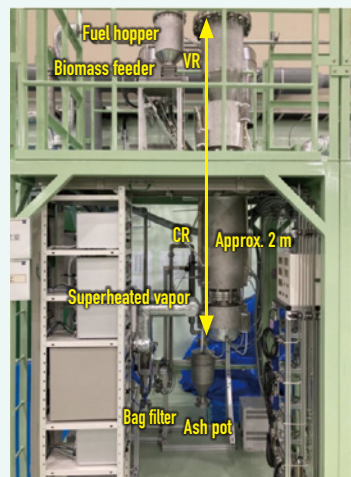
Green power sources and hydrogen production with the application of biomass fuels

With chemical looping combustion technology, biomass and unused organic materials are combusted with the oxygen in the carrier using the redox of carrier particles made of metal oxides to generate power with steam turbines using the heat generated, and hydrogen is generated by adding water vapor to the reduced carrier to produce green electricity and green hydrogen. This technology also incorporates a CO₂ separation and recovery function to generate high-purity CO₂.

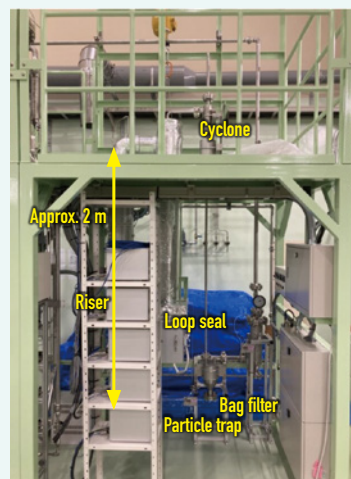
We will be constructing and testing a 300kWth bench for practical use as part of a commissioned project running from FY2020 to FY2024, and a subsidized project from FY2025 to FY2027. Our Organization will conduct complementary bench research, focusing on operational testing of the two-stage fluidized bed reactor and carrier circulation wear assessment system at the Institute of Science Tokyo.

Implementation period: FY 2020 - 2027

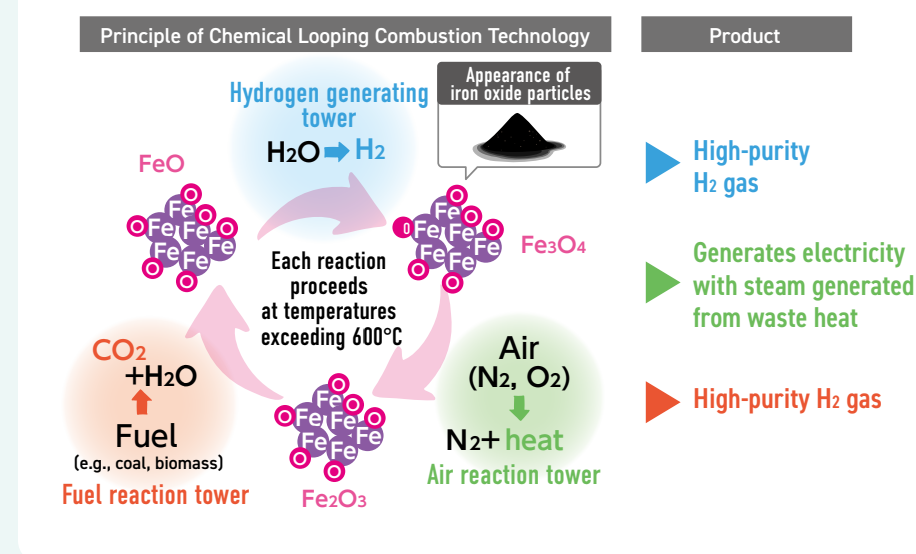
Installation of new test equipment



Two-stage fluidized bed reactor (@Science Tokyo)



Carrier circulation wear assessment system (@Science Tokyo)



Principle of Chemical Looping Combustion (CLC) Technology
(Osaka Gas Co., Ltd. website: https://www.daigasgroup.com/rd/topic/1310192_53539.html)

7 Promotion of coal ash use in shallow water areas NEDO

Global warming measures utilizing the marine ecosystem

Japan, a country surrounded by the sea, is a nation with the world's sixth largest ocean area. By making use of our rich sea area and installing blocks, substrates, and artificial stones made from coal ash in shallow waters, various installments can be developed, such as restoring seaweed beds, improving fishing grounds for clams, and preventing scouring of structures such as offshore wind turbines. Furthermore, we can expect that the installed blocks and artificial stones will improve the growth environment of marine organisms as well as preserve the marine environment. In the future, it can contribute to enhancing the ability to incorporate atmospheric CO₂ into ecosystems. We will conduct an economic and business feasibility evaluation through an actual marine trial, as well as an evaluation of the potential of CO₂ absorption and fixation for future implementation.

(Jointly conducted by the Central Research Institute of the Electric Power Industry, Tokyo Power Technology and Toyo Construction)



Seaweed (Sargassum confusum) thriving on a block installed at Iwade Fishing Port, Akita Prefecture, Japan

Implementation period: FY 2021 - 2025

8 Project Supporting the Establishment of a Sustainable Aviation Fuel (SAF) Production and Supply System Ministry of Environment, Trade and Industry

Achieving a system that enables a stable supply of SAF at internationally competitive prices as a subsidy recipient (implementing organization)

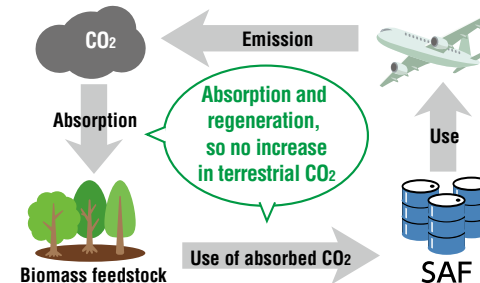
Implementation period:
FY 2024 - 2028

Green Transformation (GX) is required to achieve carbon neutrality by 2050. With demand for SAF expected to increase on a global scale, SAF production and supply capacity in Japan needs to be increased. By subsidizing the cost of investment in large-scale SAF production facilities to increase the production and supply of SAF, the project aims to establish a system that will enable a stable supply of SAF at internationally competitive prices and achieve a certain level of emission reductions. As the implementing organization, we select secondary implementing organizations that construct facilities through public solicitation, determine grants, and provide support services during implementation.

* Project Requirements:

- (1) Manufacturing technology is HEFA or AtJ
- (2) Production capacity of 100,000kL/year or more
- (3) Greenhouse gas emission reduction rate is 1. At least 10% as neat SAF, and 2. At least 5% as mixed SAF for jet fuel oil.

SAF is a fuel that does not increase atmospheric CO₂ when used because it is derived from plant-derived energy produced from atmospheric CO₂.



21 raw materials are registered with ICAO*.

69 different combinations of raw materials, origins, and production methods.

* A specialized agency of the UN responsible for establishing international standards and legal frameworks for international civil aviation
E.g.: Municipal waste, used cooking oil, tallow, sugar cane, corn oil, etc.



(Source: Excerpt from SAF, Ministry of Land, Infrastructure, Transport and Tourism)

Introduction of Initiatives

A Project Our Organization Supports

Expanding from Coal Ash Utilization and Supply of Disaster

Reconstruction Materials Ministry of Economy, Trade and Industry, and others

Contributing to Civil Engineering and Environmental Fields with Locally Produced and Consumed Coal Ash Products

In Minamisoma City, Fukushima Prefecture, we operate a manufacturing and sales business of civil engineering materials using coal ash (fly ash) through Fukushima EcoCrete Co., Ltd., a joint venture established (commencing production in 2018). Aimed at recycling coal ash in Fukushima Prefecture, we produce approximately 90,000 tons annually of roadbed materials alternative OR Crete (Odaka Revive (Recycle) Crete). As part of our business expansion efforts, we also utilize combustion ashes from biomass power plants.

Following the publication of technical guidelines by the Japan Society of Civil Engineers on the use of coal ash blended materials (March 2021), we promote the widespread adoption of effective coal ash utilization products in the civil engineering and environmental fields. We actively implement initiatives such as applying carbonation technology to achieve CO₂ reduction.

(Joint project with Japan Land Development and Shinwa Trading Co., Ltd.)



Product Image (OR Crete)



Entire view of Fukushima EcoCrete Plant

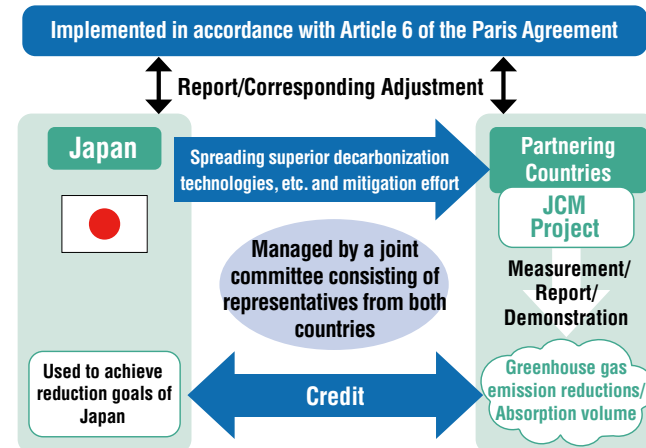
Introduction of Initiatives

Contributing to Global Carbon Neutrality with Japanese Technology

1 Promoting Innovative CCT Globally

Japan's Initiative to Obtain Carbon Credits (Environmental Economy Office Activated)

As countries and companies worldwide work towards carbon neutrality by reducing CO₂ emissions, attention is turning to carbon pricing as a cost-effective method. Carbon pricing options include carbon taxes, emissions trading, and carbon credits. Among these, carbon credits through the private-led Joint Crediting Mechanism (JCM) are particularly promising for promoting emission reductions through bilateral credit projects. At JCOAL, we not only support the global promotion of innovative CCT (Clean Coal Technologies) but also collaborate with Japanese government agencies to actively contribute to private sector initiatives for CO₂ reduction abroad. Our aim is to facilitate the issuance of carbon credits through technology dissemination, thereby supporting global efforts towards carbon neutrality.



Source: Materials of Ministry of the Environment

2 Overseas expansion of Innovative CCTs

Countries around the world are promoting diverse initiatives to achieve carbon neutrality, factoring in their national and regional characteristics. JCOAL contributes to promoting carbon neutrality on a global scale through a variety of international exchange activities, including international conferences that countries participate in, bilateral exchanges, and cooperation with international organizations.

Multinational interaction

- Clean Coal Day (CCD) International Symposium
- Southeast Asia CN(Carbon Neutrality) Seminar

Experts and policy makers from relevant organizations (power, steel, cement, chemicals, and other industrial sectors) in eight South-east Asian countries took part (250 participants from 8 countries).

CCUS/CR and other Japan-originated decarbonization technologies that contribute to carbon neutrality were introduced, and business matching was facilitated.

Network reinforcement
Dissemination and awareness
Commercialization support

International Institution Interaction And Cooperation

- International Energy Agency (IEA)
- FutureCoal
- ASEAN Centre for Energy (ACE)
- Economic Research Institute for ASEAN and East Asia(ERIA) and others

The official parallel public-private forum of the ASEAN Ministers on Energy Meeting. JCOAL was also invited to participate in the Fossil Fuel Panel, which was attended by experts from ASEAN and related countries.



ASEAN Energy Business Forum (AEBF) - 24 (September 2024, Vientiane)

Inter-country interaction

- Various seminars and invitational programs (India, Vietnam, China, Indonesia, etc.)

CEA-JCOAL Workshop (India)

Workshop held under a long-term partnership with the Central Electricity Authority of India (CEA) under an MoU. It helped resolve key energy transition policy issues being addressed by the Indian electricity sector.



CEA-JCOAL Workshop (Delhi, December 2023)

Japan-China Joint Committee (China)

This Committee was established in 2008 and has continued to serve as a representative cooperative platform in the energy sector facilitated by the governments of Japan and China. It has recently been sharing information on carbon neutrality.



Japan-China Joint Committee (November 2024, Tokyo)

Introduction of Initiatives

Development of Coal Resources - Towards stable coal supply

1 Building relationships with coal-mining countries

A stable energy supply is essential for coal importing countries

Japan's energy policy is based on "S+3E," placing an emphasis on Safety, and pursuing the goals of increasing self-sufficiency and ensuring a stable supply system (Energy Security), reducing costs (Economic Efficiency) and reducing CO₂ emissions (Environment).

To achieve carbon neutrality, it is necessary to reduce the consumption of fossil fuels. However, fossil fuels, including coal, is still needed to produce thermal power to coordinate with fluctuations in renewable energy. It is important to establish win-win relationships with coal-producing countries to secure a stable supply of coal, and we have implemented the following initiatives so far in this regard.

Bio-coal Briquette Dissemination Program in Mozambique (JOGMEC)



More than 90% of the people of Mozambique use firewood and charcoal as household fuel and it causes serious deforestation.

The use of bio-coal briquettes made from coal and agricultural waste which cannot be exported is being promoted as an alternative fuel to address these household fuels.

Overseas Geological and Geophysical Survey (JOGMEC)

To secure a stable supply of coal, we are conducting coal exploration jointly with coal-producing countries. Up till now, we have conducted drilling exploration in Australia, Mozambique, Indonesia, Vietnam, and other countries.



2024 Exploration for Anthracite Coal in Vietnam

2 Human resource development initiatives

Educating young human resources to lead the future

We provide on-site training at coal mines and coal-related facilities in coal-producing countries for young employees at member companies and college students, and also holds a "Seminar on Coal Basics." We are also committed to building human networks through the implementation of capacity building training and collaboration programs for young and mid-career professionals in Asian and African countries.



Seminar on Coal Basics (Tokyo)



Internships for Japanese students (Open-pit coal mine in NSW, Australia)



X (Twitter)



Web



Instagram



Office: 3F Daiwa Nishi-Shimbashi Bldg.
3-2-1 Nishi-Shimbashi, Minato-ku,
Tokyo 105-0003, Japan
Tel: 03-6402-6100
Fax: 03-6402-6110

Access

JR	Shimbashi Station	Karasumori Exit
Mita Line	Onarimon Station	Exit A5
Ginza Line	Toranomon Station	Exit B1
Hibiya Line	Toranomon Hills Station	Exit A1b