



R&D and Demonstration Base for Carbon Recycling at Osaki-Kamijima

New Energy and Industrial Technology Development Organization

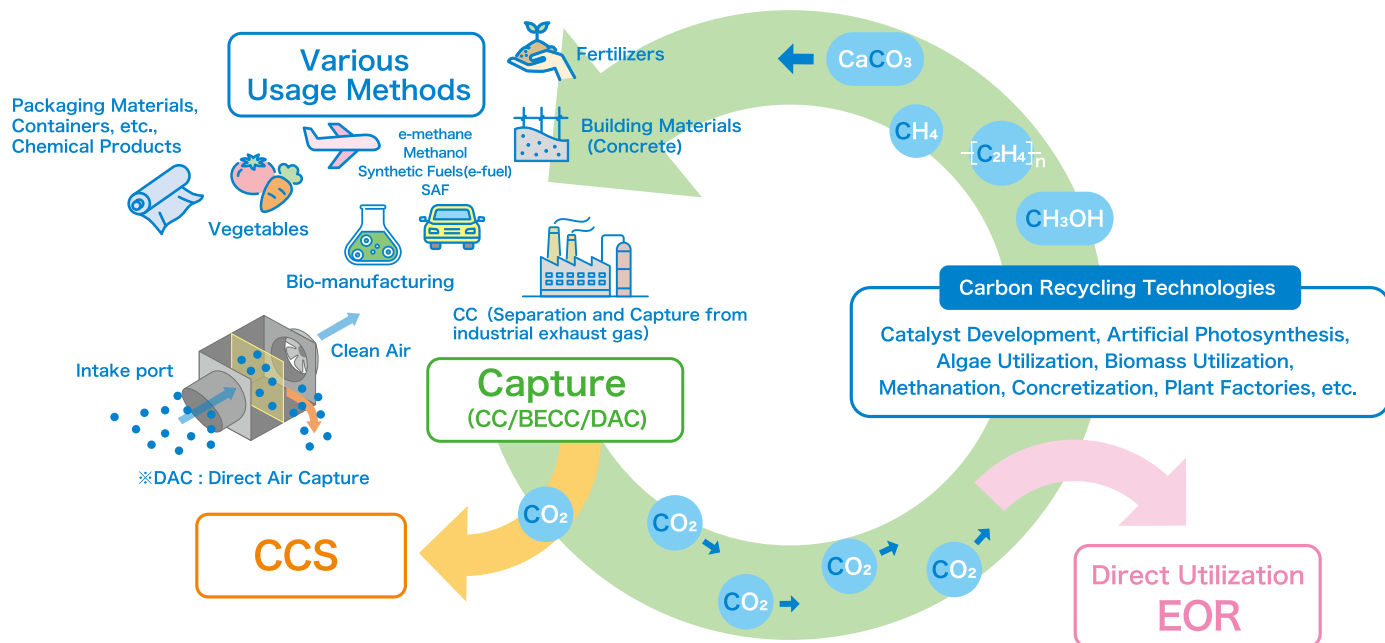
What is Carbon Recycling?

In efforts to curb global warming, reducing CO₂ emissions has become a global challenge. Japan has set a goal of becoming carbon neutral by 2050, aiming to reduce greenhouse gas emissions by 46% from 2013 levels by 2030 and take on the challenge of reaching the 50% mark. Carbon Recycling is currently attracting attention as a way to reduce CO₂ emissions into the atmosphere by reusing CO₂ as a resource for materials, fuel, and other purposes.

So at the Davos meeting in January 2019, Japan referred to the need to recycle CO₂, and in June of the same year, the Ministry of Economy, Trade, and Industry (METI) formulated the Roadmap for Carbon Recycling Technologies, a policy which considers CO₂ as a resource, separates and recovers it, and reuses it in form of various products such as concrete, chemicals, and fuels to curb CO₂ emissions into the atmosphere. The Ministry presented the "3C Initiative for Carbon Recycling" in September of the same year, and the "Innovative Strategy for Environmental Innovation (adopted by the Council for the Promotion of the Integrated Innovation Strategy)" in January 2020. They have announced the development of Osakikamijima city in Hiroshima Prefecture to build a demonstration and research center for carbon recycling technology, as part of a demonstration project for an Integrated Coal Gasification Combined Cycle (IGCC)/ Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC). The center opened in September 2022. In December 2020, the Ministry of Economy, Trade and Industry took the lead in formulating the "Green Growth Strategy Accompanying Carbon Neutrality in 2050" in collaboration with related ministries and agencies. In this strategy, carbon recycling is positioned as a key technology in one of the significant areas to achieve a carbon neutral society. In addition, the Ministry of Economy, Trade and Industry formulated the "Carbon Recycling Roadmap" in June 2023 which outlines goals and issues for social implementation as well as technology.

January, 2019	Japan mentioned the need for CO ₂ recycling (A speech of Prime Minister at the Davos Conference)
June, 2019	"Roadmap for Carbon Recycling Technologies" announced
September, 2019	"Carbon Recycling 3C Initiative" announced
January, 2020	"Progressive Environmental Innovation Strategy" announced
October, 2020	"Achieving Carbon Neutrality in 2050" declared
December, 2020	"Green Growth Strategy Through Achieving Carbon Neutrality in 2050" announced
July, 2021	Carbon Recycling Technology Roadmap Revised
September, 2022	Carbon Recycling Demonstration and Research Center on Osakikamijima city, Hiroshima Prefecture Opened
June, 2023	Carbon Recycling Technology Roadmap Established

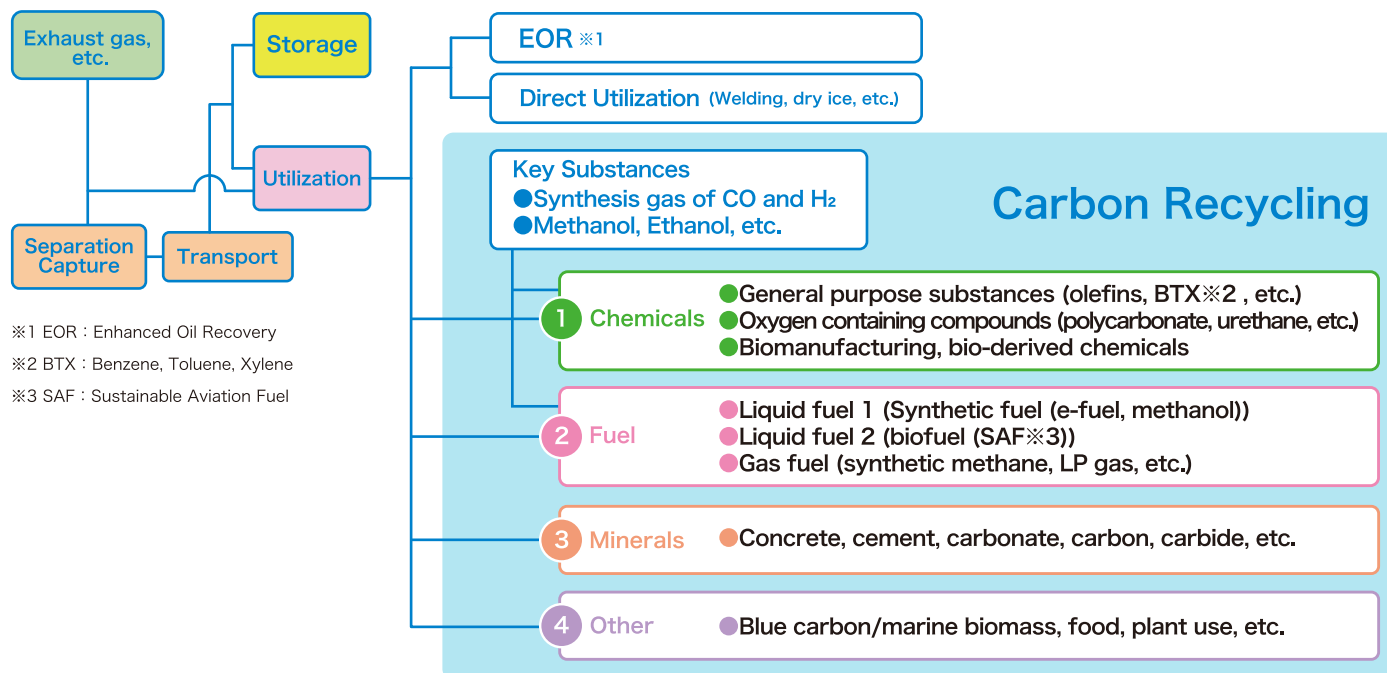
Carbon Recycling, which effectively utilizes CO₂ as a resource, can be used in various fields such as chemicals, concrete/cement, machinery, engineering, fuels for transportation and biotechnology, giving Japan a competitive edge. As Carbon Recycling technology is established, its use is expanded, and costs are lowered, it is expected to develop into a new Japanese industry that will be a major key to reducing the use of fossil fuels and thus helping to prevent global warming in the future.



What is the Use of Carbon Recycling?

At present, the use of Carbon Recycling is mainly assumed in the following categories :

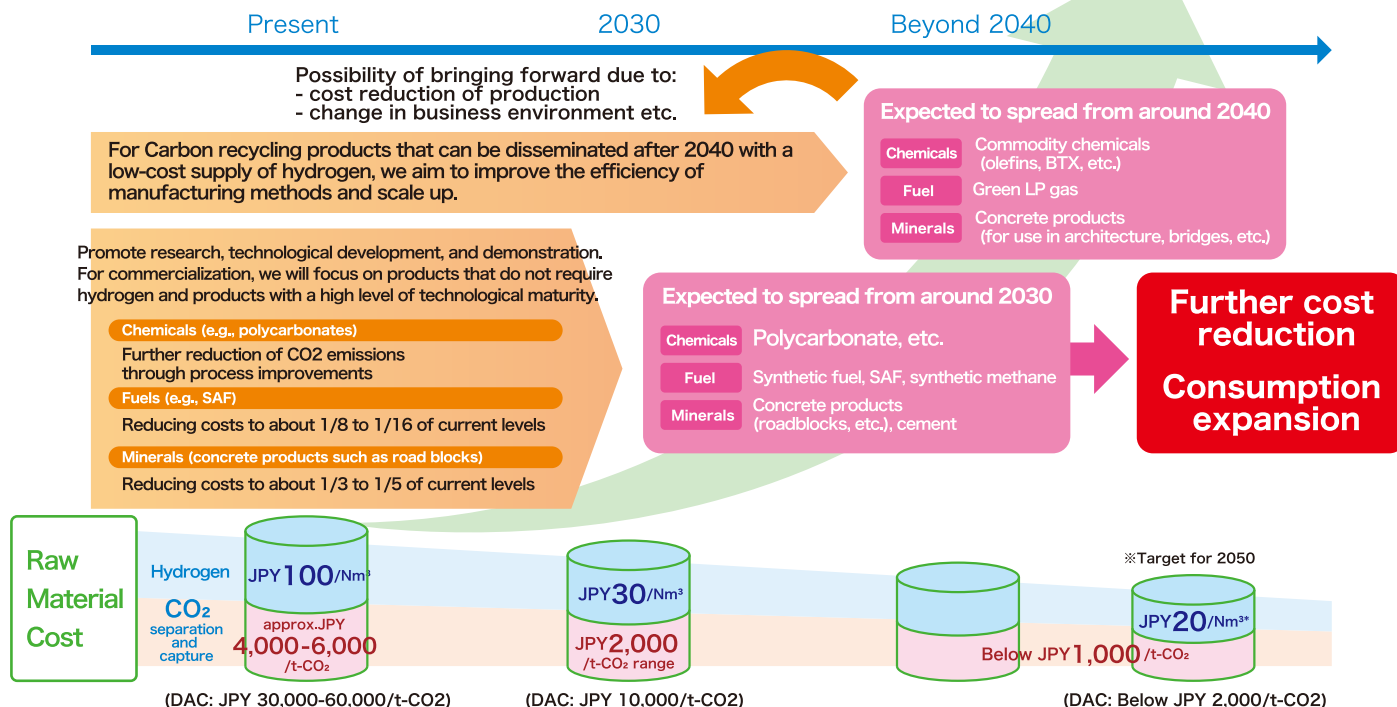
【① chemicals】 , 【② fuels】 , 【③ minerals】 , and 【④ others】 .



Source: Prepared by NEDO based on "Carbon Recycling Roadmap" (Ministry of Economy, Trade and Industry)

Carbon Recycling Roadmap

The "Carbon Recycling Technology Roadmap" was originally formulated in June 2019 and revised in July 2021. It was further developed into "Carbon Recycling Roadmap" mainly by experts for promoting carbon recycling by organizing its significance and issues and formulated in June 23 by the Ministry of Economy, Trade and Industry (METI) in cooperation with the Cabinet Office, Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and Ministry of the Environment (MOE). While taking into account the procurement environment for hydrogen and the maturity of the technologies, the aim is to establish technologies as early as possible in each product field, reduce costs, and promote widespread use. This will be achieved through technological advancement, development and demonstration.



Source: Prepared by NEDO based on "Carbon Recycling Roadmap" (Ministry of Economy, Trade and Industry)

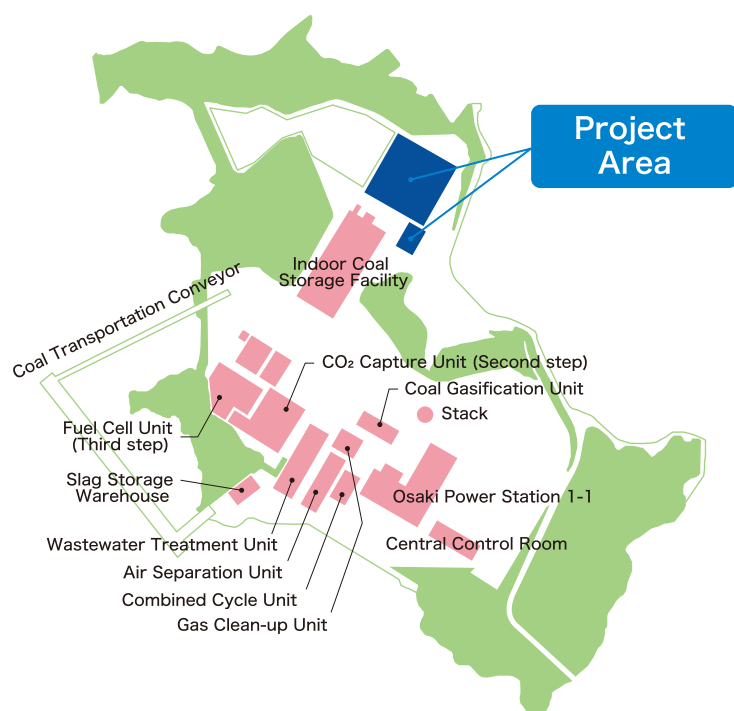


R&D and Demonstration Base for Carbon Recycling -- Our Activities at Osaki-Kamijima --

At Osaki-Kamijima Island, Hiroshima, located in the middle of the scenic Seto Inland Sea, a center of activity was established based on “Carbon Recycling 3C Initiative” announced by METI in 2019. This center offers companies and universities, aiming to realize a carbon-neutral and decarbonized society, hub of activity to promote their R&D activities. Our aim is to accelerate innovation and practical application of Carbon Recycling by conducting underlying technology development and demonstration in a concentrated and extensive manner. Furthermore, through showcasing the details and results of their activities we will share Japan’s cutting-edge technologies to the world.

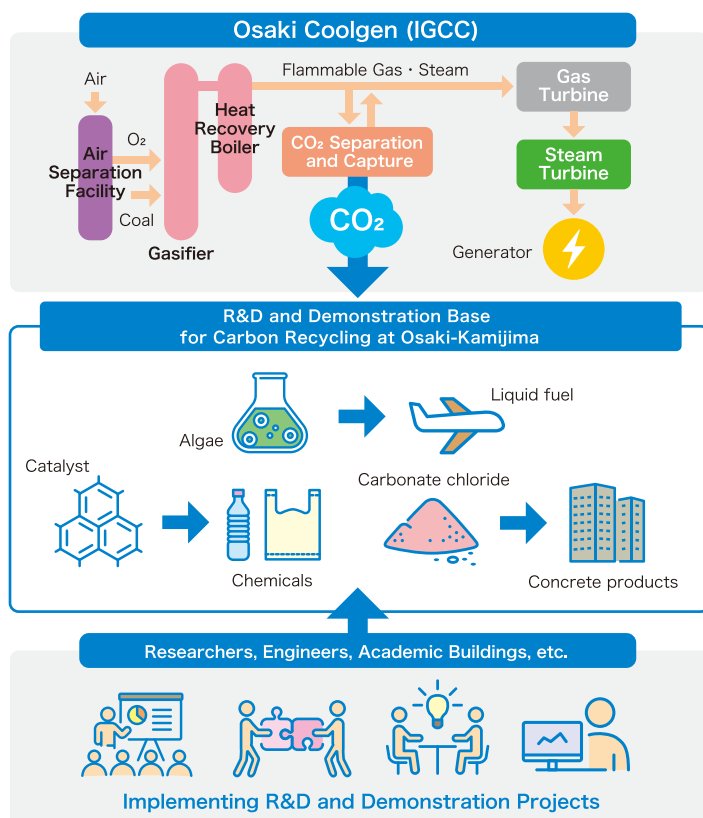
Layout

At the Osaki Power Station (operated by Osaki CoolGen), where demonstration tests of coal-fired thermal power generation combined with IGFC cycle and CO₂ separation and capture technologies are being conducted, an environment will be created to enable centralized research and development of technologies that are world-leading and expected to be soon commercialized.



Diagram

Researchers in algae biotechnology, catalysts, carbon dioxide chloride, etc. will be brought together to conduct underlying technology development and demonstration research in a concentrated and extensive manner.



About the Facilities

The center consists of three areas: the Demonstration Research Area, Algae Research Area, and the Basic Research Area. The CO₂ separated and collected at Osaki CoolGen is transported by pipeline, with the underlying technology development and demonstration research on Carbon Recycling using said CO₂ conducted at each facility.

Demonstration Research Area



Development of Gas-to-Lipids Bioprocess

Develop biorefinery technology using a two-step fermentation process to produce acetic acid from CO₂ and synthesize high-value-added lipids and chemical raw materials.



Carbon recycling technology demonstration and R&D with co-production of multiple valuable commodities by using seawater

Demonstrate CO₂ fixation technology to Magnesium Carbonate by using 20 ton/day of seawater.



CO₂ supply equipment

CO₂ derived from IGCC and backup CO₂ necessary for demonstration research will be supplied.

Basic Research Area



Research Building

Consists of 6 laboratories that are convenient for multiple companies and universities to conduct basic and advanced research efficiently and safely.



Common Use Building

Conference rooms, analysis rooms, and other facilities are available. Also we display information of the Facilities for visitors.

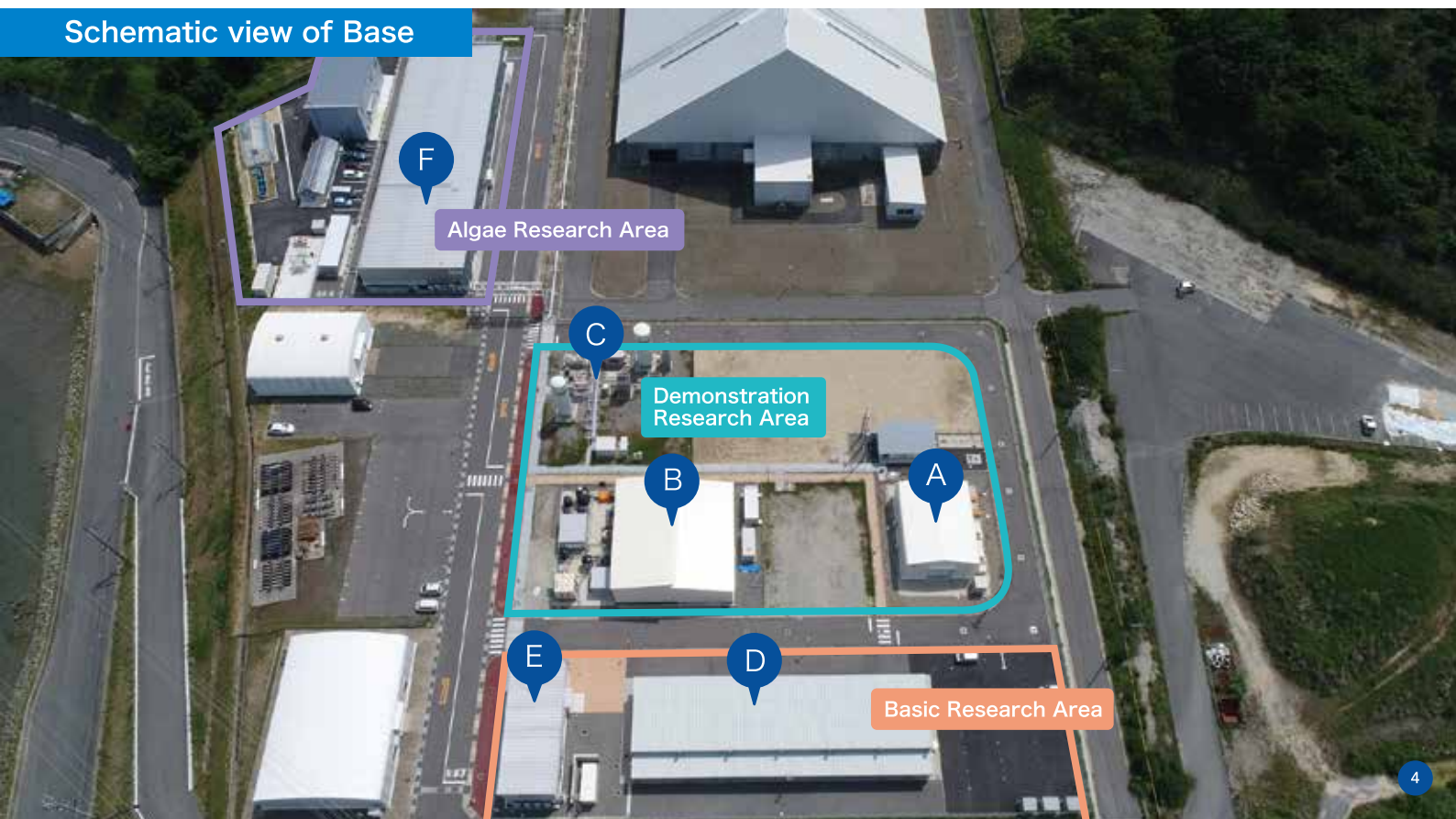
Algae Research Area



Establishing a Research Base and Developing Technologies that Lead to Increased CO₂ Utilization Rate for the Production of Microalgae-Derived SAF

Establish a base where technology verification can be conducted to improve basic technology for microalgae, leading to the industrialization of microalgae-derived SAF production.

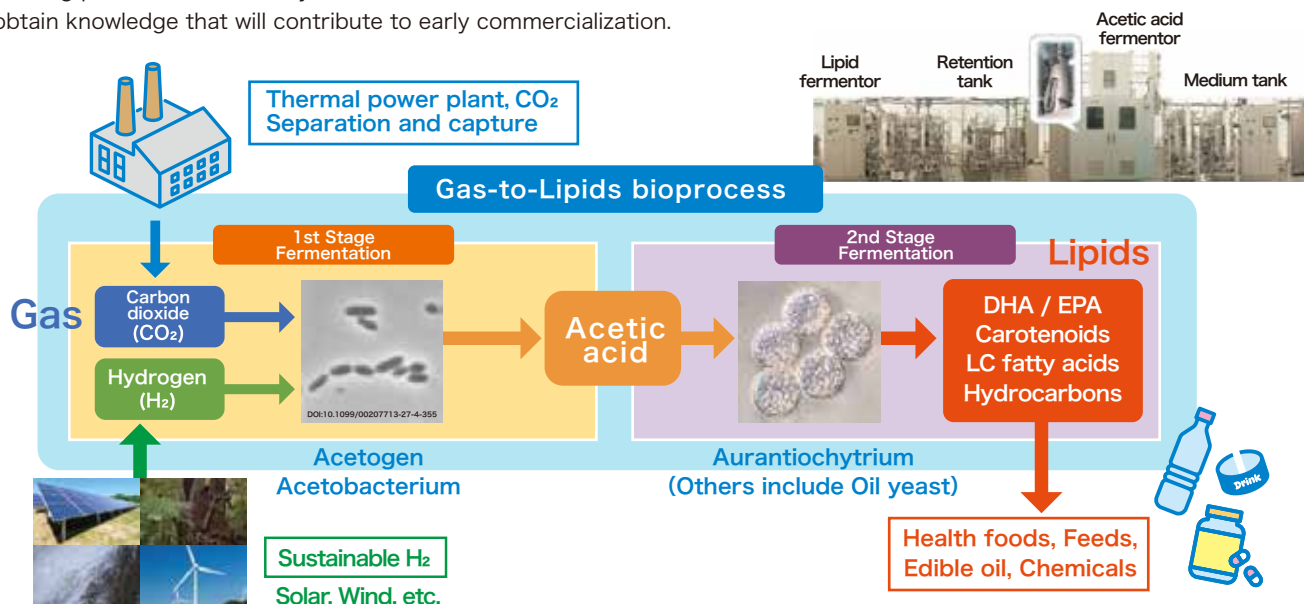
Schematic view of Base



Introduction of R&D and Demonstration Themes

Practical development of Gas-to-Lipids bioprocess

To establish a technology for effective utilization of CO₂ separated and captured from exhaust gases from thermal power plant, We aims to commercialize the "Gas-to-Lipids Bioprocess" a two-stage fermentation consisting of a process for fixing CO₂ to produce acetic acid, and a process for synthesizing high value-added lipids, edible oil raw materials, chemical raw materials, etc. from the acetic acid. The bench-scale testing equipment installed at the R&D and Demonstration Base for Carbon Recycling at Osaki-Kamijima will be improved with the aim of improving economic viability and further increasing production efficiency, and the effectiveness will be verified and the amount of CO₂ reduction will be evaluated to obtain knowledge that will contribute to early commercialization.



Schedule Fiscal year 2025-2026

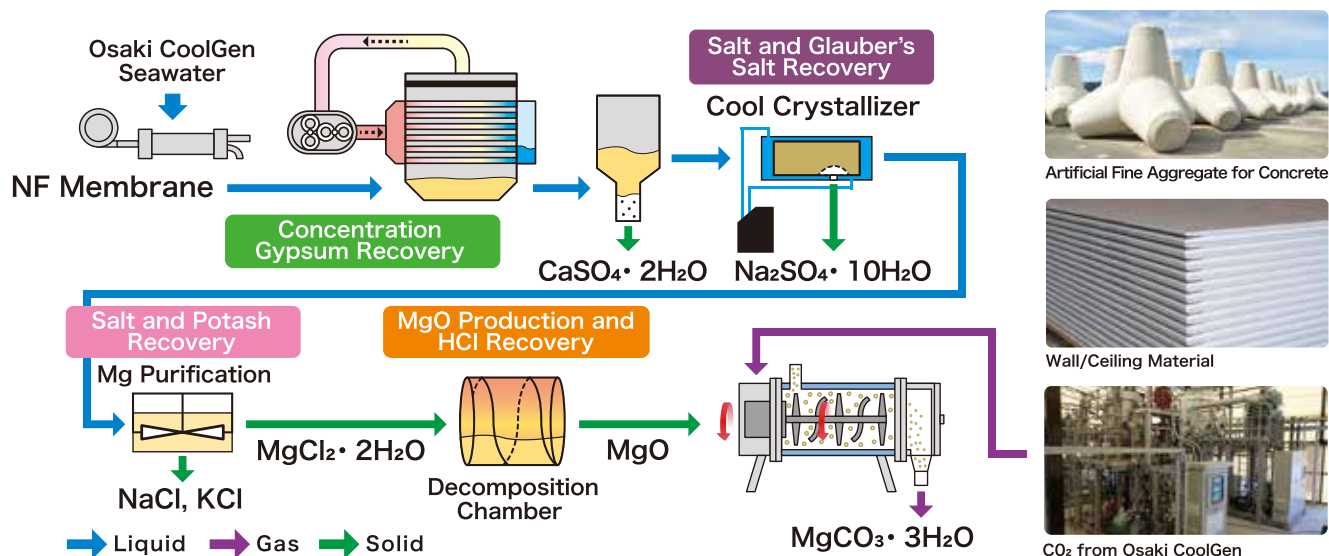
Organization



FUJI OIL CO., LTD.

Carbon recycling technology demonstration and R&D with co-production of multiple valuable commodities by using seawater

In the demonstration research area of Osaki, we will demonstrate CO₂ fixation technology to Magnesium Carbonate by using 20 ton/day of seawater. Magnesium Carbonate will be used for concretes and building materials such as wall materials, and the manufacturing method for these materials will also be developed at the same time. As a summary of this project, feasibility study will be conducted based on the results obtained in the demonstration, and an economic evaluation will be conducted.



Schedule Fiscal year 2022-2025

Organization

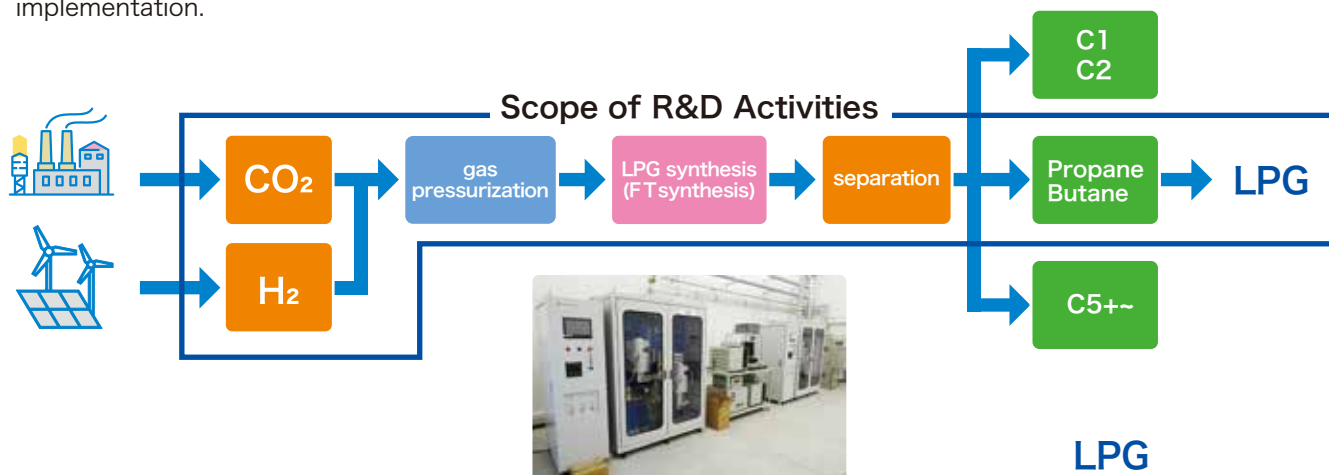


早稲田大学
WASEDA University

SASAKURA
SERVICE CENTER CO., LTD.

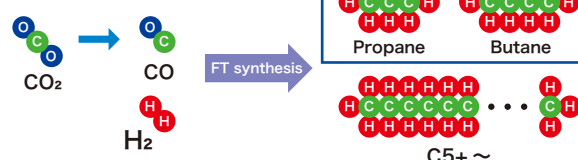
Research and Development for Enhancing Catalyst Practicality and Improving Production Process for Carbon-Recycled LPG

This project will demonstrate carbon-recycled LPG production using CO₂ and H₂. Based on results from a past three-year NEDO project, we will, over two years from FY2025, improve the catalyst, establish mass production methods, design a bench-scale plant, and evaluate technical feasibility for domestic implementation.



The key feature of this LPG synthesis technology is performing two reactions in one reactor.

- A reverse water-gas shift reaction to produce CO from CO₂ and H₂, which serves as a feedstock for Fischer-Tropsch (FT) synthesis.
- FT synthesis to produce carbon-recycled LPG from CO and H₂.



Schedule Fiscal year 2025-2026

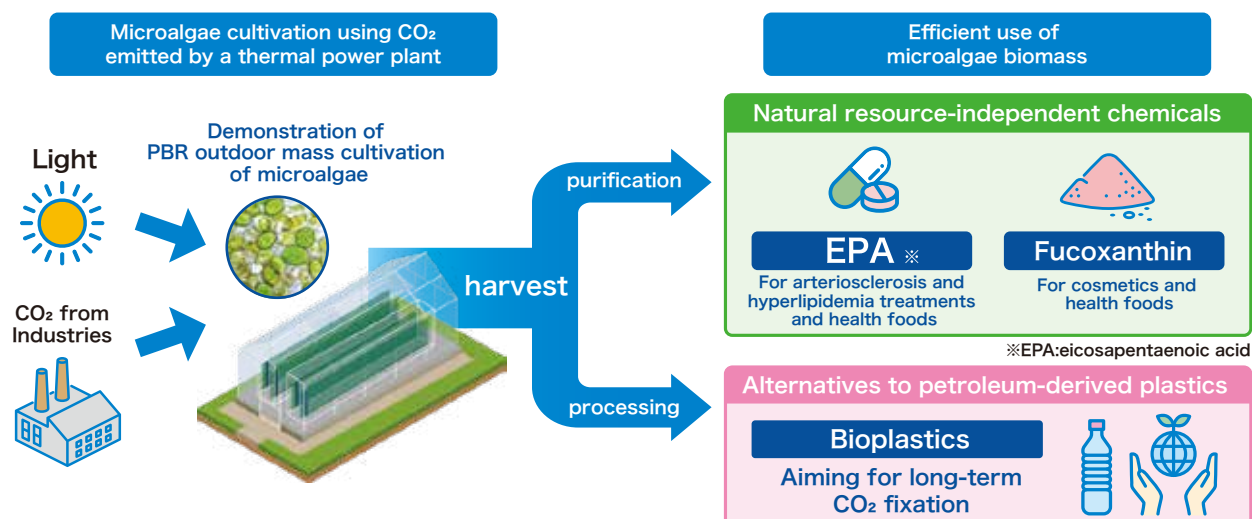
Organization ENEOSグループ株式会社

Research and development on CO₂ fixation technology using microalgae and production of high-value ingredients

In this project, carbon dioxide (CO₂) emissions from coal-fired power plants and industrial facilities will be utilized as a resource. Large-scale cultivation technology for marine diatoms, which can be used as high-value-added functional chemicals with high production efficiency, will be demonstrated. Preliminary findings from the demonstration data set indicate the necessity of revising the integrated system plan as a CCU solution. This revision will facilitate discussions on the introduction of solutions to CO₂ emission sources and the social implementation of carbon recycling technology.

R&D 1 Demonstration of large-scale outdoor cultivation of microalgae in PBRs

R&D 2 Development of an integrated system plan for a microalgae CCU model



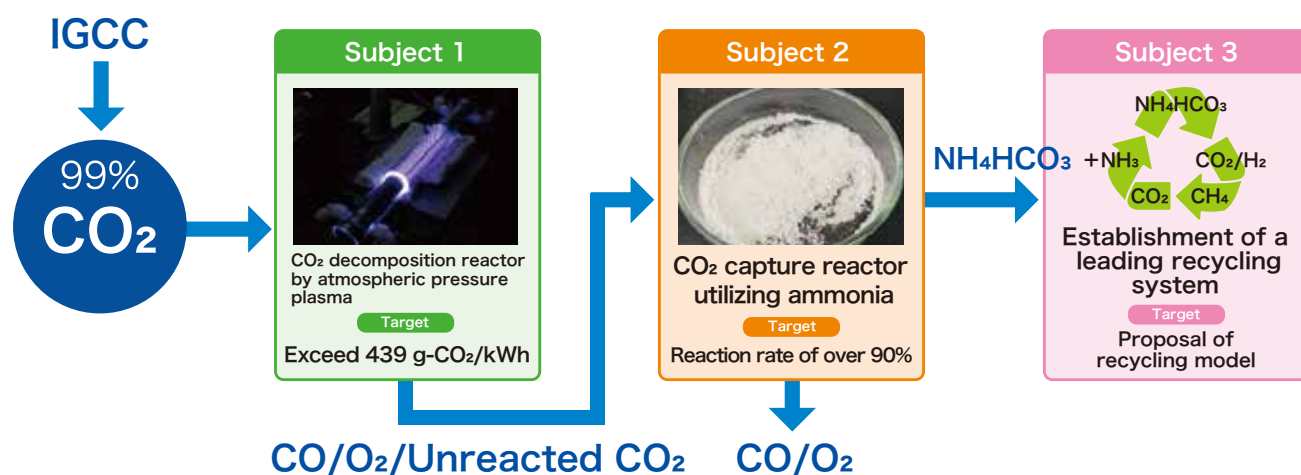
Schedule Fiscal year 2025-2026

Organization algal bio

Research & Development of a leading carbon recycling system using ammonia and atmospheric pressure plasma

CO₂ is directly decomposed with high efficiency using electronic energy from atmospheric pressure plasma, and CO is produced that is useful in the manufacture of synthetic fuels and chemical products. Unreacted CO₂ is recovered as ammonium hydrogen carbonate with blue/green ammonia as a reactant. We will establish a leading carbon recycling system that aims to reuse raw materials for methanation represented by methane synthesis.

- Subject 1** Scale-up and improvement of energy efficiency for a CO₂ decomposition reactor by atmospheric pressure plasma.
- Subject 2** Development of a CO₂ capture reactor utilizing ammonia.
- Subject 3** Establishment and economic evaluation of a leading recycling system for ammonium hydrogen carbonate.



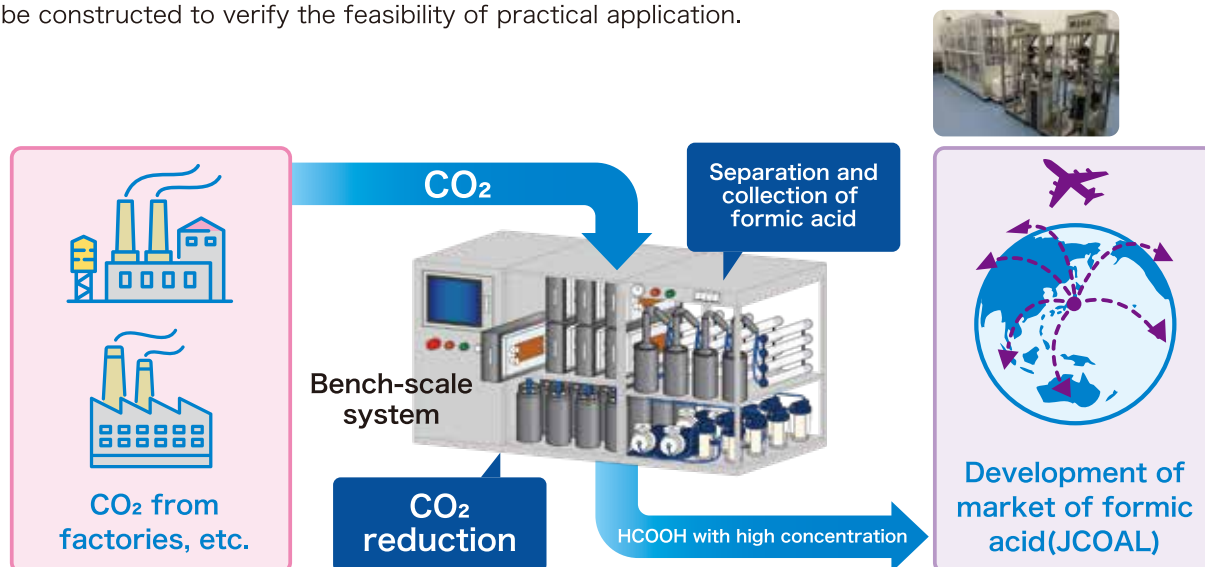
Schedule Fiscal year 2025-2027

Organization



Production of Value-added Chemicals from CO₂ Using Boron-doped Diamond Electrodes

Diamond electrode, a next-generation electrode material, has excellent durability and unique electrochemical properties, and can selectively and efficiently produce formic acid by electrolytic reduction of CO₂. In this project, we will integrate the elemental technologies for formic acid production by electrolytic reduction of CO₂ using diamond electrodes as well as its separation and recovery, and construct a laboratory-scale integrated system that can continuously produce formic acid. In addition, a bench-scale integrated system will be constructed to verify the feasibility of practical application.



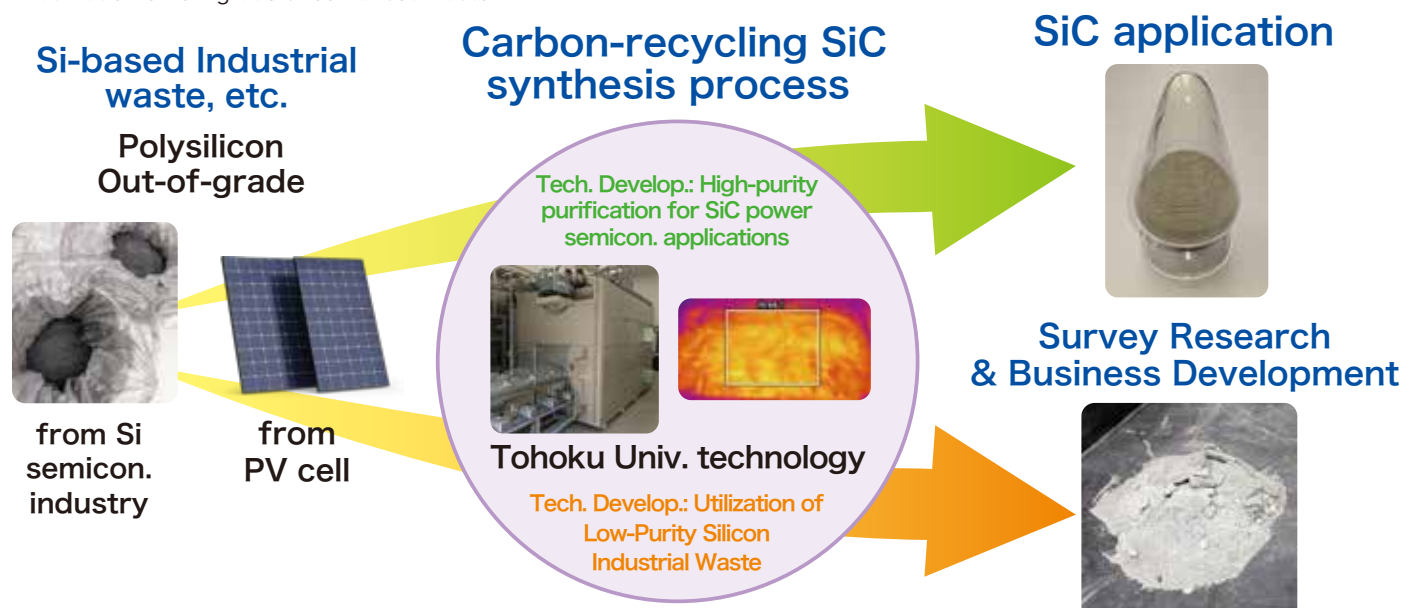
Schedule Fiscal year 2022-2025

Organization



Research and development of carbon-recycling SiC synthesis via advanced resource utilization technology for silicon-based waste

With the goal of contributing to a carbon-neutral society and a circular economy, we are conducting research and development on carbon-recycling silicon carbide (CR-SiC) synthesis using advanced resource recovery technologies for silicon-based waste. Building upon our previously established CO₂ utilization technologies, this initiative aims to address two key technical challenges: the development of purification methods for producing high-purity CR-SiC powder, and the utilization of low-grade silicon-based waste.



Schedule Fiscal year 2025-2027

Organization



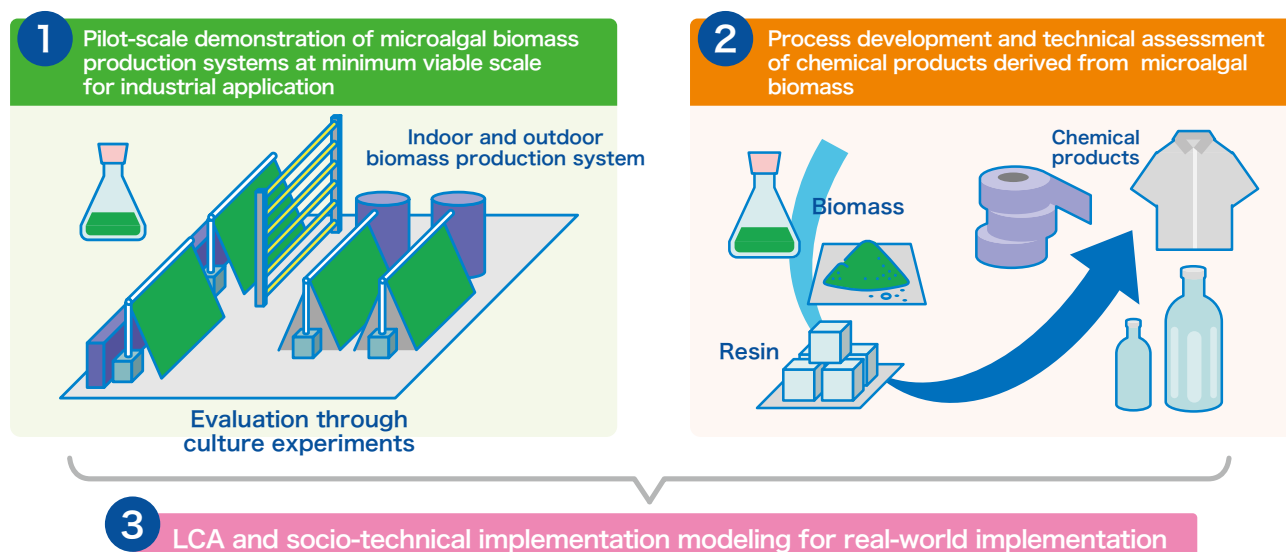
TOHOKU UNIVERSITY

Sumitomo Corporation

Enriching lives and the world

Development of Microalgal Biofilm Culture and Bioproducts Toward Carbon Recycling

This project aims to establish a carbon recycling platform utilizing microalgal biotechnology. The platform will focus on microalgal biofilm culture (substrate-based cultivation) as a high-efficiency method for converting CO₂ into biomass. A minimal operational scale biomass production system will be developed and its performance evaluated through controlled indoor experiments, as well as field-scale outdoor trials. In parallel, a series of downstream processing technologies will be developed and validated for the manufacturing of target chemical products using microalgal biomass. Finally, the entire process -from cultivation to utilization- will be comprehensively assessed using LCA and socio-technical implementation modeling to evaluate its overall feasibility and potential for real-world implementation.



Schedule Fiscal year 2025-2027

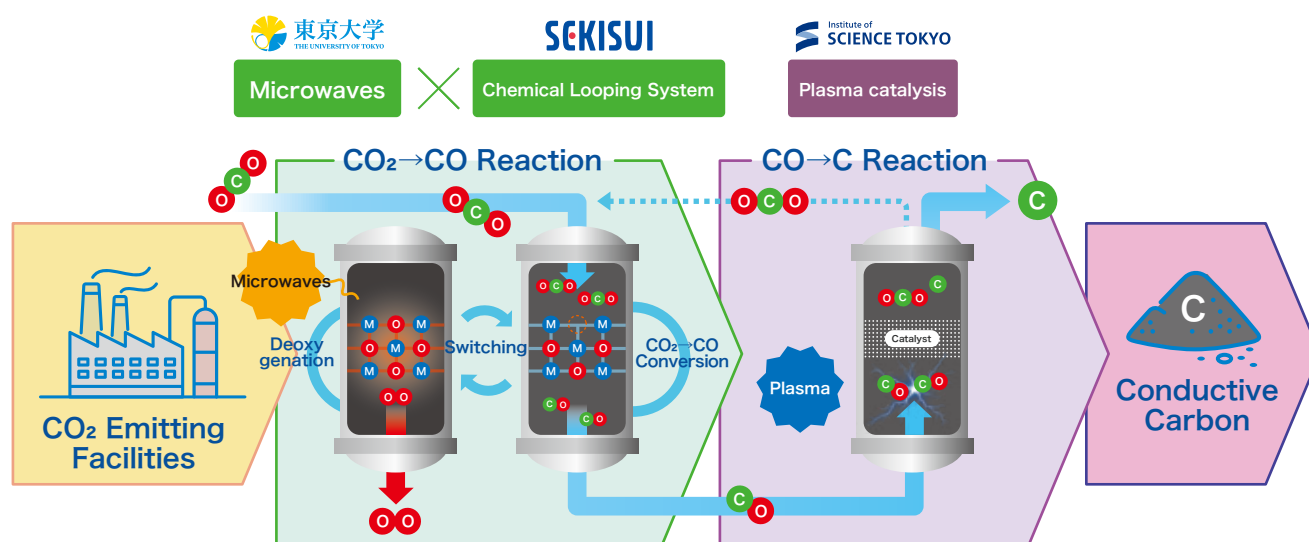
Organization



NIPPON STEEL
日本製鉄株式会社

Innovative Hydrogen-free CO₂ to Conductive Carbon Conversion: Large-scale Manufacturing at High Energy Efficiency

This project aims to develop a novel technology for producing conductive carbon materials from CO₂ without using hydrogen, by employing Microwaves and Plasma catalysis technologies. In the first stage, Microwave technology developed by the University of Tokyo will be integrated into Sekisui Chemical's chemical looping system, enabling highly efficient CO to CO₂ conversion. Subsequently, the CO disproportionation reaction to produce conductive carbon materials will be performed by Plasma catalysis technology developed by Institute of Science Tokyo. The project involves the development of catalytic systems and bench-scale reactors for each step of the process, with the ultimate goal of realizing the scalable production of conductive carbon materials derived from CO₂.



Schedule Fiscal year 2025-2027

Organization

SEKISUI

東京大学
THE UNIVERSITY OF TOKYO

Institute of SCIENCE TOKYO

※This project at R&D and demonstration base for carbon recycling is scheduled to be implemented from fiscal year 2026 onwards.

A platform aimed at enhancing the value of the microalgae industry

IMAT (Institute of Microalgal Technology, Japan) functions as a hub for consolidating the insights and technologies of microalgae-related businesses in Japan. We strive towards advancing the microalgae industry, standardizing methodologies, and promoting environmental impact assessments.



Role as a research testbed

An indoor research platform equipped with advanced infrastructure for the microalgae industry has been established to facilitate open, and collaborative R&D aimed at advancing the microalgal industry.



Business activities

- Collection and analysis of research data related to processes from cultivation to extraction
- Implementation of CO₂ footprint and financial assessment

Setting new standards

Establishment and formulation of standardization methods and specifications for research and development related to microalgal technology. Development of a platform for industrial utilization, and proposals for policy recommendations.



Business activities

- Standardization of testing, analysis, and evaluation methods
- Acquisition of various standard reference values such as biomass productivity
- Proposal of model cases and scenarios

Promoting new business initiatives

Promoting the development of new microalgae-related businesses by providing opportunities for information exchange by organizing events involving businesses from diverse sectors.



Business activities

- R&D between Industry, Government, and Academia
- Providing consulting services such as the evaluation of technologies

Schedule Fiscal year 2020-

Organization

IMAT
日本微細藻類技術協会



Other activities

We contribute to the spread and development of carbon recycling technology through various activities.



activity
1



Site Tour

You can visit each research site and observe cutting-edge research and development. Applications are accepted on our website at any time.



QR code for more information

<https://osakikamijima-carbon-recycling.nedo.go.jp/en/tour/>

activity
3



Technical Exchange Seminar

We hold events to promote exchange among researchers through lectures and presentations on carbon recycling technologies.



QR code for more information

<https://osakikamijima-carbon-recycling.nedo.go.jp/news-all/636/>

activity
2



Experience tours for students

With the aim of developing the next generation of talent, we hold events where students can experience research while observing it.

activity
4



Special lectures for carbon recycling

We are offering special lectures aimed to training personnel and human interaction to take charge of practical carbon recycling technology. The lectures are held at R&D demonstration base for carbon recycling and its surrounding facilities, or at Hiroshima University.



QR code for more information

<https://crss.aesg.hiroshima-u.ac.jp/cr/>

Location

Directions from Tokyo, Osaka, and Hiroshima

Air



JR

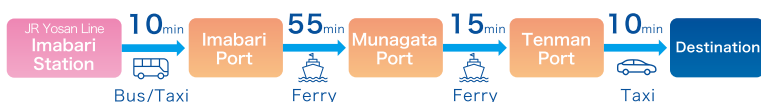


Car



Directions from Shikoku

JR



Address

6208-1 Nakano, Osaki-Kamijima-cho, Toyota-gun, Hiroshima Prefecture 725-0301, Japan



Hiroshima Prefecture

Ferry to Osaki-Kamijima

- Sanyo Shosen (Takehara) : +81-846-22-2133
- Akitsu Ferry (Akitsu) : +81-846-45-0462
- Osaki Kisen (Takehara) : +81-846-22-2390
- Omishima Blue Line (Imabari) : +81-898-32-6713

Taxi In Osaki-Kamijima

- Higashino Taxi : +81-846-65-2091

Contact Us

New Energy and Industrial Technology Development Organization

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MUZA Kawasaki Central Tower, 15F-20F 1310 Omiya-cho, Saiwai-ku Kawasaki City, Kanagawa 212-8554, Japan

Contact Us

+81-44-520-5252

Reception hours: 10:00 ~ 12:00/13:00 ~ 17:00 (on weekdays)

Website

<https://www.nedo.go.jp>

Map of Surrounding Area



Access

- 3 min, from JR Kawasaki Station West Exit.
- 5-10 min, from Keihinkyukou Kawasaki Station West Exit.

Latest information will be updated on the official website.

<https://osakikamijima-carbon-recycling.nedo.go.jp/en/>

