Development of Technology for High-Efficiency Biomethane Conversion

Waste treatment/Biomethanation/Microbial reactions

Overview and Expected Outcomes

Technology is being developed to convert unused CO_2 in biogas into methane through biomethanation (a microbial reaction) for use as renewable natural gas.

Implementing entity: Swing Engineering Corporation

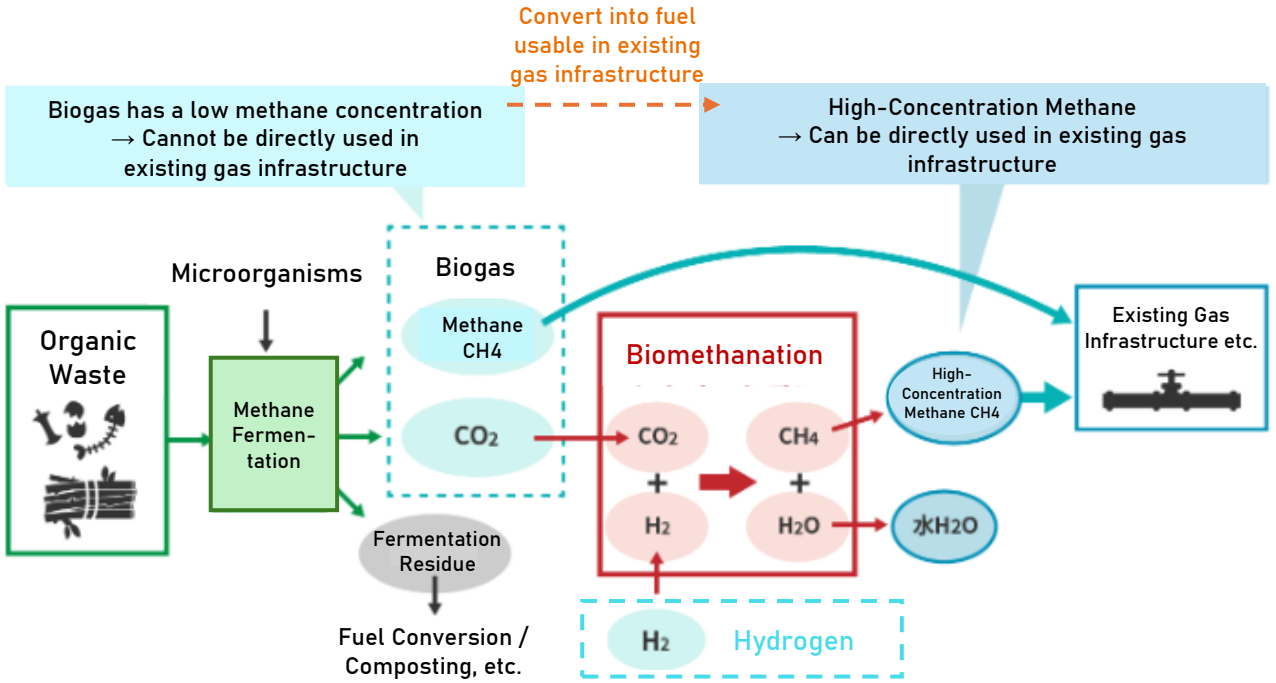
- Biomethane with a methane concentration of 97% or higher
- Methane production rate of 50 NL/Lr-d or higher under low-temperature, low-pressure conditions (up to 0.8 MPa)

Ex-situ method was adopted to enable retrofitting to existing methane fermentation facilities.

Background and Current Status

- To achieve carbon neutrality by 2050, the Green Growth Strategy action plan promotes a transition to a circular economy and aims to reduce overall greenhouse gas emissions to zero.
- Balanced waste treatment systems are needed that combine large-scale, centralized, region-specific processing with decentralized processing optimized for local amounts and types of waste. In areas where large-scale centralization is difficult, the introduction of methane fermentation facilities that target unused regional biomass is expected to increase.
- The main use of biogas at existing methane fermentation facilities is for power generation under the FIT program, but using gas for heating is expected to help reduce carbon emissions associated with thermal energy use.

Converting Waste Into Raw Materials and Fuel Through Methane Fermentation



Source: Prepared by the Green Innovation Project Committee of the Ministry of Economy, Trade and Industry's Industrial Structure Council

Contact Information
NEDO Renewable Energy Department, Biomass Unit

Development of Technology for High-Efficiency Biomethane Conversion

Waste treatment/Biomethanation/Microbial reactions

Social Issues and Market Opportunities

1. **The Need to Cut Greenhouse Gases in the Waste Sector**
   The waste sector accounts for approximately 40 million tons (3.4%) of Japan's greenhouse gas emissions, making it the third largest source after the energy sector and industrial processes including products used (as of 2020).

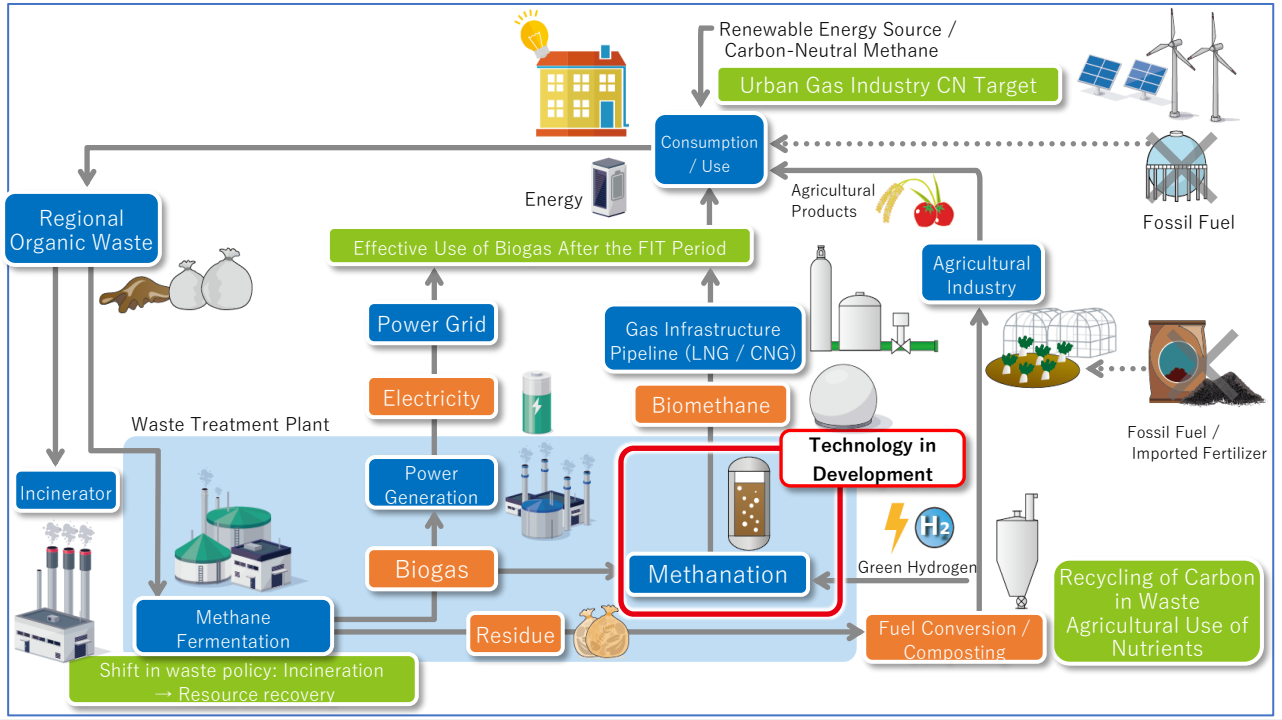
2. **Carbon Neutrality Goals in the City Gas Industry**
   The government's Seventh Basic Energy Plan aims to achieve carbon neutrality in city gas by 2050. Under Gas Vision 2050, the city gas industry set a goal for 50–90% of the gas supply to be synthetic methane or biogas.

3. **Effective Utilization of Biogas After the FIT Period**
   As more methane fermentation facilities reach the end of their FIT period, new options are expected to emerge for utilizing biogas that was previously used for biomass power generation.

Source of figure on right: Swing Engineering Corporation
Business Strategy Vision, Development of Biomethanation Technology (June 2025)

Outlook

Industrial Architecture in a Carbon-Neutral Society



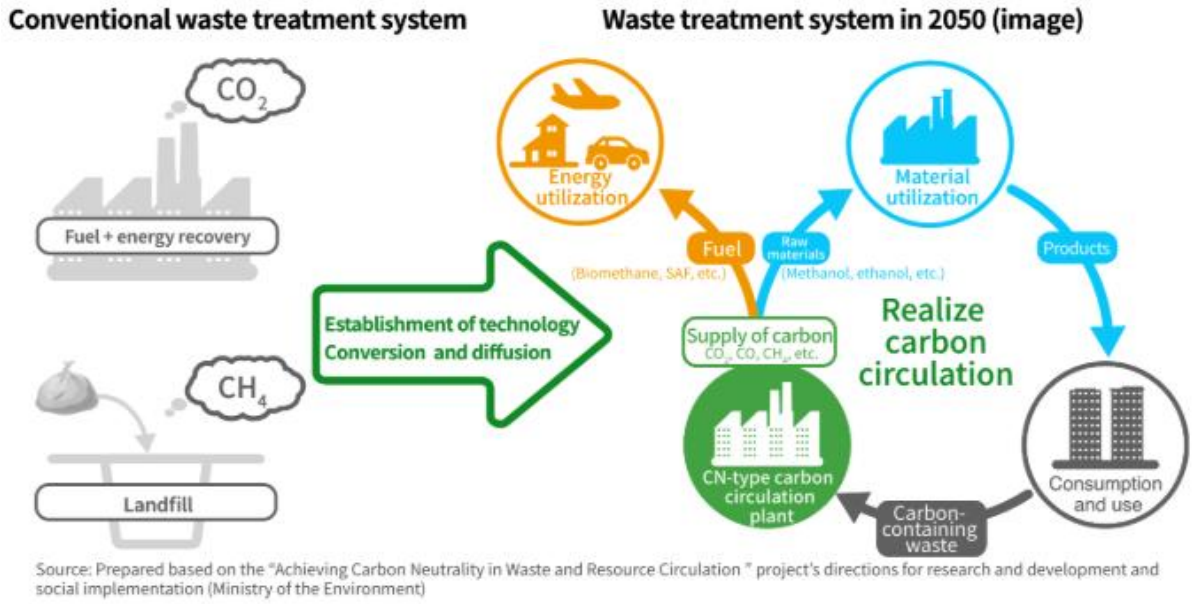
Development of Technology for High-Efficiency Biomethane Conversion

Waste treatment/Biomethanation/Microbial reactions

Green Innovation Fund Projects

NEDO Initiatives

Green Power Promotion and Related Fields
Achieving Carbon Neutrality in Waste and Resource Circulation



Source: Prepared based on the "Achieving Carbon Neutrality in Waste and Resource Circulation " project's directions for research and development and social implementation (Ministry of the Environment)

Budget	Up to 44.5 B¥
CO_2 Reduction Effect	Approx. 1.244 Bt/yr
Economic Effect	Approx. 5.2 T¥/yr

Project Features

1. Development of waste incineration treatment technology based on CO_2 separation and capture
   Large-scale demonstrations will focus on two areas: developing new combustion technologies to increase CO_2 concentration in waste incineration exhaust gas and enhance CO_2 separation and recovery efficiency, and developing integrated technologies for exhaust gas treatment facilities. The goal is to achieve a stable capture rate of at least 90% of the carbon contained in waste.
2. Large-scale demonstration of high-efficiency pyrolysis treatment plant
   To efficiently utilize carbon in waste, large-scale demonstrations will focus on innovative pyrolysis technologies, new furnace designs, and technologies for reusing residual CO_2. The goal is to maximize the effective use of carbon and harness the calorific value of waste.
3. Development of technology for high-efficiency biomethane conversion
   To efficiently convert organic waste into fuels such as biomethane, pilot-scale demonstrations will focus on elemental technologies for optimal reactor and process design. The goal is to achieve a methane concentration of at least 97% and a production rate of at least 50 NL/Lr-d through direct methane fermentation and methanation under low-temperature, low-pressure conditions.
   Information is available at this exhibition.

NEDO Project: Green Innovation Fund Projects/ Achieving Carbon Neutrality in Waste and Resource Circulation

Contact Information: NEDO Renewable Energy Department, Biomass Unit

The University of Tokyo and NEDO Special Courses: Human Resource Development Related to Microalgae

Human Resource Development/Microalgae

Purpose of the Course

This course aims to provide scientific knowledge and perspectives focused on microalgae, which are increasingly used in fields such as bio-manufacturing. We aim to provide insights from a multifaceted perspective that allow participants—working professionals, undergraduates, and graduate students—to envision their aspirations for the future. Through this, we can foster talent and networks capable of creating truly sustainable, *symbiotic new industries* utilizing microalgae.

Guest lecturers from industry and academia (partial list)

Course Overview

Special Lectures by the University of Tokyo and NEDO

Period: October 2024 – March 2026

Time: Thursdays, 5th period (16:50–18:35)

Location: The University of Tokyo, Yayoi Campus

Target Audience: Working professionals, undergraduate students, graduate students

Highlights:

1. Lectures by a diverse range of experts from industry and academia
2. Hands-on training in microalgae cultivation
3. Fieldwork during visits to domestic and international microalgae utilization hubs
4. Workshops for generating ideas for new industries
5. Mentoring by business leaders
6. Student proposals for symbiotic new industries

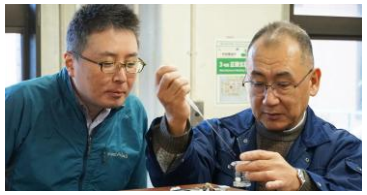
NEDO Project: Course for Human Resource Development Toward Creating New Industries in Harmony with the Environment — Centered on Microalgae

Contact Information: NEDO Renewable Energy Dept. Biomass Unit
https://www.nedo.go.jp/activities/AN_00011.html (Japanese only)

The University of Tokyo and NEDO Special Courses: Human Resource Development Related to Microalgae

Human Resource Development/Microalgae

Microalgae



Hands-on training

Hands-on training

Collaboration

Visiting cultivation facilities

Visiting Chitose Laboratory Corp. in Malaysia

Visiting Universiti Brunei Darussalam

Future Plans

Results Presentation – Public Symposium Schedule

Date & Time: Tuesday, February 17, 2026, 15:00–18:00 (tentative)

Venue: The University of Tokyo, Yayoi Campus, Faculty of Agriculture, Lecture Room 8

Contact: The University of Tokyo, Graduate School of Agricultural and Life Sciences/Faculty of Agriculture, One Earth Guardians Development Program Office

Second Term Announced!

Period: Autumn 2026 – March 2028

Location: The University of Tokyo, Yayoi Campus

Target Audience: Enrollment planned for working professionals, undergraduate students, and graduate students

NEDO Project: Course for Human Resource Development Toward Creating New Industries in Harmony with the Environment — Centered on Microalgae

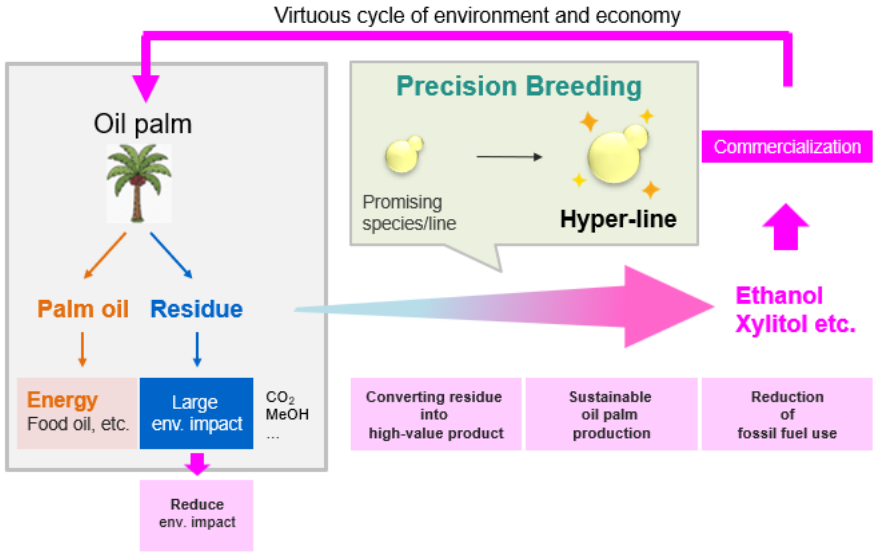
Contact Information: NEDO Renewable Energy Dept. Biomass Unit
https://www.nedo.go.jp/activities/AN_00011.html (Japanese only)

International Collaborative Research and Development of Microorganisms for High Ethanol Production Using Palm Oil Residue

Unused residue/Microorganisms/International collaboration

Overview

This research aims to contribute to the Green Growth Strategy for Carbon Neutrality by 2050 by using microorganisms to convert palm oil residue into high-value products and energy. This will promote the effective utilization of previously wasted palm oil residues.



Background/Current Situation

Environmental challenges in palm oil production

Palm oil is widely produced in Southeast Asia, especially Indonesia, for food and as a fossil fuel alternative. However, the process has a negative effect on the environment, particularly with greenhouse gas emissions from residue and wastewater.

Greenhouse gas emissions and the need for solutions

Discarded residue and wastewater release methane and other GHGs, leading some countries to restrict their use as biofuels. Effective utilization of palm oil residue is vital for expanding fossil fuel alternatives and promoting industry in Southeast Asia.

Universitas Brawijaya (Indonesia), Setsuro Tech Inc., and Tokushima University are involved in this research. Ethanol-producing microorganisms from Indonesia will be improved with genome editing and genetic engineering to boost ethanol production from palm oil residue, turning waste into a valuable resource.

NEDO Project

Research and Development Program for Promoting Innovative Energy and Environmental Technologies Through International Collaboration

Contact Information

Regarding the research: NEDO Renewable Energy Dept. Biomass Unit
Regarding project schemes and open calls: NEDO Frontier Dept.

International Collaborative Research and Development of Microorganisms for High Ethanol Production Using Palm Oil Residue

Unused residue/Microorganisms/International collaboration

Technical Challenge

Developing low-cost, practical technology for xylose decomposition in palm oil residue

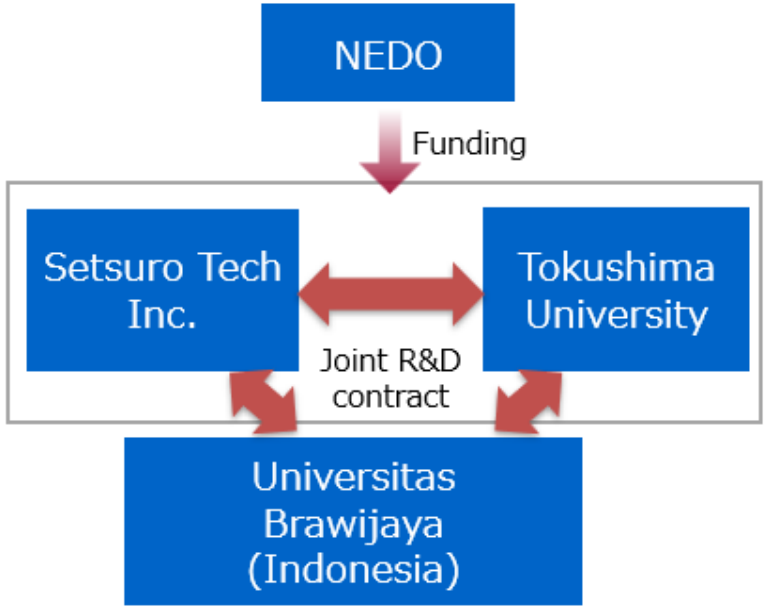
- The cellulose components in palm oil residue are classified into cellulose and hemicellulose. Xylose within hemicellulose inhibits the breakdown of cellulose.
- Currently available xylose-decomposing enzymes are expensive, and existing xylose-decomposing microorganisms show reduced efficiency under real environmental conditions. In addition, byproducts generated during microbial decomposition of residue are known to suppress microbial growth and activity.
- Effective decomposition of xylose would improve the overall breakdown efficiency of palm oil residue and significantly increase bioethanol yield.

Solution

Create microbial strains to effectively decompose palm oil residue and other woody biomass

- Xylose-decomposing microbial strains isolated in Indonesia demonstrate resistance to growth inhibition caused by byproducts during the decomposition process.
- By applying multiple genome editing and genetic modification techniques to these strains, more effective microorganisms can be developed.

Project Scheme



NEDO Project

Research and Development Program for Promoting Innovative Energy and Environmental Technologies Through International Collaboration

Contact Information

Regarding the research: NEDO Renewable Energy Dept. Biomass Unit
Regarding project schemes and open calls: NEDO Frontier Dept.

Overseas Demonstration Initiatives

Overseas expansion/Carbon credits/Decarbonization

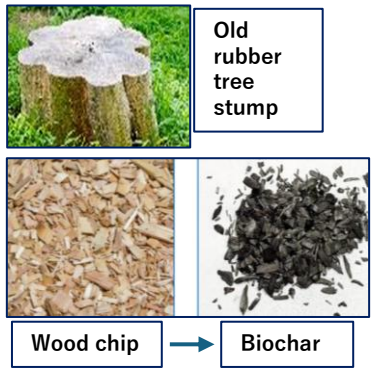
Feasibility study (IDP only) → Open call → FEED project stage → External evaluation → Demonstration

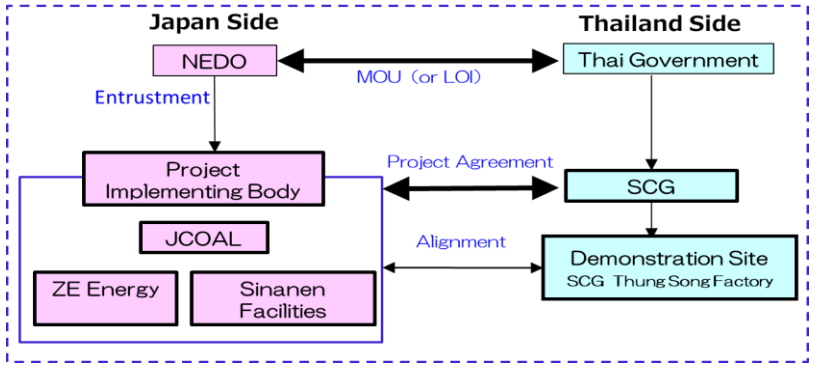
1)Biochar Production and Utilization Demonstration Project for Cement Industry in Thailand

Japan Side Project Entity : JCOAL・Sinanen Facilities・ZE Energy

Overview : Using old rubber tree stumps generated annually in large quantities at rubber plantations in Thailand, biochar is to be manufactured with Japanese corporate technology. This biochar is planned to be supplied to SCG, a Thai cement manufacturer, as a coal substitute fuel in their facilities.

Objective :To reduce CO_2 emissions by substituting coal with biochar and obtain credits under the Joint Crediting Mechanism, thereby contributing to global efforts to mitigate greenhouse gas emissions.



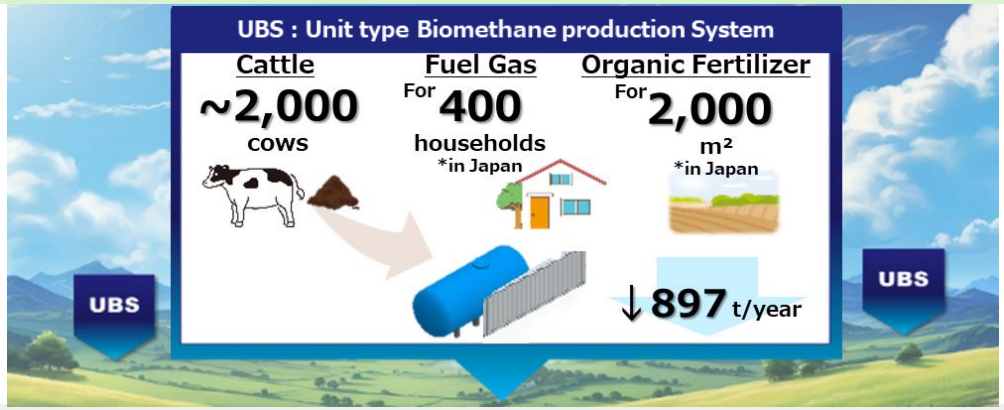


2)Demonstration study of a system for biomethane production from unused resources to realize a local bioenergy supply chain

Japanese project entity: Air Water Inc./Air Water India Private Limited

Overview: FEED is underway at Indian dairy farms and cow shelters with the goal of establishing local supply chains that produce carbon-neutral biomethane and organic fertilizer from manure and agricultural waste.

Objective: The deployment of low-cost, small-scale distributed methane fermentation facilities will contribute to the decarbonization of local energy in India.



NEDO Project

1. Program to Facilitate Overseas Promotion of Low Carbon Technology Through the Joint Crediting Mechanism (JCM)
2. International Demonstration Project on Japan's Technologies for Decarbonization and Energy Transition (IDP)

Contact Information

Regarding these FEED stages: NEDO Renewable Energy Dept. Biomass Unit

Regarding project schemes and open calls: NEDO Project Management Dept.