August 4, 2023

Sojitz Corporation
Central Research Institute of Electric Power Industry
Green Earth Institute Co., Ltd.
DIC Corporation
Toray Industries, Inc.
Daicel Corporation

Development of Innovative Biomanufacturing Technologies Using CO_2 and H_2 as Feedstocks for Hydrogen-oxidizing Bacteria -Accelerating Technological Development and Open Innovation under NEDO's Green Innovation Fund Project-

Sojitz Corporation, Central Research Institute of Electric Power Industry, Green Earth Institute Co., Ltd., DIC Corporation, Toray Industries, Inc., and Daicel Corporation, have concluded an agreement with Japan's New Energy and Industrial Technology Development Organization (NEDO) for a joint project focused on the development of revolutionary biomanufacturing technology to engineer hydrogen oxidizing bacteria that utilize CO_2. This project was selected for sponsorship under NEDO's Green Innovation Fund Project category, "Promotion of Carbon Recycling Using CO_2 from Biomanufacturing Technology as a Direct Raw Material."

[Project Overview]

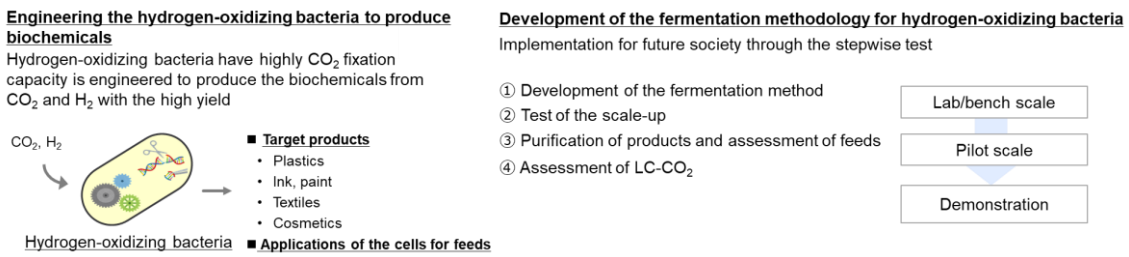
This project entails R&D for manufacturing a variety of chemical products and feed raw materials from CO_2 and H_2. This new biomanufacturing technology will be the world's first example of a commercialized bioprocess directly using CO_2 and H_2 for productions of chemicals and presents a promising option for realizing a carbon neutral society.

The hydrogen-oxidizing bacterium*1 to be engineered is one of microorganisms that have fastest CO_2 fixation rate. Leveraging this high fixation capacity through genetic engineering, it is possible to engineer bacterial strains that can produce useful chemical products with high efficiency. The resulting compounds are then used as raw materials in a wide variety of daily applications including plastics, ink, paint, textiles, and cosmetics. Additionally, the bacterial residues produced in the biomanufacturing process from the biomanufacturing process can be utilized as an

alternative protein source for feed which presents a solution to the recent rise in demand for alternative protein sources. This biomanufacturing technology will therefore simultaneously raise the decarbonization value of businesses and provide a solution to food problems.

Alongside the development of bacterial strains, scale-up demonstrations will be conducted to establish a safe and highly efficient gas fermentation method and to accurately measure CO_2 reduction effects to add environmental benefits to products.

All six organizations will combine their acquired expertise, technologies, and functions to realize social implementation of this next generation biomanufacturing technology in order to advance the structural transformation of chemical products and materials industries which address growing decarbonization needs.



[Project Duration]

Consignment contract period: FY2023 – FY2025
Total project duration (planned): FY2023 – FY2030

[Total Project Costs]

Approximately JPY 6.8 billion
(FY2023 – FY2030)

[Role and Responsibilities of Each Organization]

Sojitz Corporation

Sojitz Corporation is a general trading company developing a wide range of businesses in countries and regions around the world. Sojitz will leverage its business expertise across diverse fields to strengthen material businesses adapted for a decarbonized and recycling-based society.

For this project, Sojitz will serve as project manager, conduct product marketing,

and carry out demonstrations. Additionally, Sojitz will build a supply chain and realize commercialization through the development of derivative products and high-added-value products as well as pursue essential infrastructure development for hydrogen, a raw material required for this biomanufacturing technology, to realize social implementation.

Central Research Institute of Electric Power Industry

Central Research Institute of Electric Power Industry (CRIEPI), under its vision "to realize sustainable and socially acceptable energy system in 2050", has selected the key research subjects including "the establishment of resource circulation and carbon recycling, and is working to develop essential component technologies.

For this project, CRIEPI aims to develop the foundational technology to culture hydrogen-oxidizing bacteria that enable to utilize CO_2 as a raw material resource. In order to ensure the safe and efficient use of gas, CRIEPI seeks to carry out demonstrations for the culture process up to the pilot scale. Furthermore, CRIEPI will conduct Life Cycle - CO_2 assessments for the chemical production process to estimate the CO_2 reduction effects when biomanufacturing replaces petrochemical production.

Green Earth Institute Co., Ltd.

GEI's mission is "fostering green technology and walking with the earth." As a company specialized in biorefinery business, GEI aims at creating a platform of biomanufacturing.

In this project, GEI will engineer hydrogen-oxidizing bacteria to produce raw materials for manufacturing bioplastics. In addition, GEI will perform the investigation of scaling-up of hydrogen-oxidizing bacteria culture to the pilot scale and operation of the pilot-scale tests.

DIC Corporation

DIC is positioned as a global chemical manufacturing company that considers sustainability as a critical management strategy, aiming to "build a business portfolio that contributes to the sustainable prosperity of society" and "contribute to the realization of environmental and social sustainability."

As a global chemical manufacturer, DIC will leverage its strengths in a variety of

basic technologies and biomaterial design technologies. DIC will utilize the bacteria developed by GEI in order to pursue development and demonstration tests for biochemical production processes. DIC aims to contribute to the realization of a carbon neutral society through commercialization of sustainable biochemicals produced using hydrogen-oxidizing bacteria.

Toray Industries, Inc.

Toray Industries views sustainability as the most important shared global goal for the 21st century. Toray Industries will exert its utmost efforts to address global issues set out by the Paris Agreement and the U.N.'s Sustainable Development Goals (SDGs) in accordance with its corporate philosophy of "Contributing to society through the creation of new value with innovative ideas, technologies and products."

In this project, Toray Industries will leverage its biotechnologies to develop hydrogen-oxidizing bacteria that can produce monomers directly from CO_2. At the same time, Toray Industries will undertake demonstrations for production processes with the aim of building a supply chain for its products manufactured from CO_2.

Daicel Corporation

Since its founding, Daicel has been creating value and contributing to society through manufacturing. Daicel aims to contribute to the realization of a sustainable society by developing and advancing technologies that produce valuable products, providing happiness to people, in a human and environmentally friendly manner.

In this project, Daicel will conduct technology development and production verification to produce cosmetic ingredients from CO_2. By replacing conventional petroleum-based chemical processes with CO_2-derived bio-processes and offering highly refined products, Daicel aims to contribute to a carbon-neutral society.

*1:Hydrogen-oxidizing bacteria: A type of autotrophic bacteria. Autotrophic bacteria have a 50 to 70 times higher carbon fixation capacity compared to algae (cyanobacteria), which makes autotrophic bacteria a promising means of CO_2 absorption. Hydrogen-oxidizing bacteria is a type of autotrophic bacteria characterized by its lack of dependence on photosynthesis with a capacity for CO_2 fixation using the reductive energy of H_2. Hydrogen-oxidizing bacteria also has high potential for industrial use as the bacteria can be cultured quickly at high densities. Benefits include reduced CO_2 emission compared to production processes using fossil fuel resources as well as the additional double benefit of absorbing CO_2 from the atmosphere. Biomanufacturing utilizing hydrogen-oxidizing bacteria therefore has the potential to significantly reduce CO_2 emissions. (Translation of excerpted METI materials, "Promotion of Carbon Recycling Using CO_2 from Biomanufacturing Technology as a Direct Raw Material.")

For further details on selection for the Green Innovation Fund Project, please refer to the following:
https://green-innovation.nedo.go.jp/en/project/bio-manufacturing-technology/

[Related Information]

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