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Toshiba Energy Systems & Solutions Corporation

Toyo Engineering Corporation

Toshiba Corporation

Idemitsu Kosan Co.,Ltd.

Japan CCS Co., Ltd.

All Nippon Airways Co., Ltd.

*Adopted for the Ministry of the Environment “FY2021 Project to Promote the Creation of Circular Carbon Society Model through CO<sub>2</sub> Recycling”*

-Regional Revitalization Through CO<sub>2</sub> Recycling Focusing on Production of Sustainable Aviation Fuel (SAF)-

Toshiba Energy Systems & Solutions Corporation, Toyo Engineering Corporation, Toshiba Corporation, Idemitsu Kosan Co.,Ltd., Japan CCS Co., Ltd., and All Nippon Airways Co., Ltd. have proposed a “Regional CO<sub>2</sub> Resource Utilization Study Business Through Electrolysis Utilizing Artificial Photosynthesis Technology” in response to the call for “FY2021 Project to Promote the Creation of Circular Carbon Society Model through CO<sub>2</sub> Recycling” by the Global Environment Bureau, Ministry of the Environment, which proposal was adopted as a commissioned project. The six companies will jointly begin a demonstration project in this September.

The six companies have previously cooperated to combine the CO<sub>2</sub> electrolysis technology\*<sup>1</sup> developed by the Toshiba Corporate Research & Development Center for the conversion of carbon dioxide (CO<sub>2</sub>) into carbon monoxide (CO) with the FT\*<sup>2</sup> synthesis technology used to synthesize liquid fuel from CO and hydrogen to produce Sustainable Aviation Fuel (SAF)\*<sup>3</sup> and to study carbon recycling business models using P2C\*<sup>4</sup>.

This initiative was adopted as a commission project by the Ministry of the Environment and the six companies will study promoting both decarbonization and regional development by utilizing the infrastructure and characteristics of regional areas to achieve carbon recycling within those regions.

Specifically, Toshiba Energy Systems and Solutions Corporation will build a prototype of a full-scale CO<sub>2</sub> electrolysis unit and conduct demonstration operation of the unit at the company’s Hamakawasaki Operations (Kawasaki City, Kanagawa Prefecture). Based on this, the companies will create a basic plan to utilize their knowledge, technology, related plant equipment, and other resources to demonstrate the entire process from the separation and collection of CO<sub>2</sub> to the production and consumption of SAF at potential sites in Japan including Tomakomai City in Hokkaido Prefecture. The data and knowledge that will be obtained from this will be reflected in the regional carbon recycling society model and used to evaluate the viability of establishing a business.

Through this demonstration project the six companies will contribute to the commercialization of a SAF supply chain based on carbon recycling as well as regional revitalization.

**Project Period and Roles of Demonstration Project Participating Companies**

Period: September 2021 to End of March 2025 (planned)

Main roles of demonstration project participating companies:

|  |   |
|--|---|
| Toshiba Energy Systems & Solutions Corporation | Study the carbon recycling society model and business model, build and demonstrate a full-scale CO <sub>2</sub> electrolysis unit prototype, and study and make a general review for a P2C plant. |
| Toyo Engineering Corporation                   | Create the FT synthesis plant basic plan and P2C plant plan.  |
| Toshiba Corporation                            | Demonstrate the CO <sub>2</sub> electrolysis technology.  |
| Idemitsu Kosan Co.,Ltd.                        | Investigate the SAF certification scheme and standards, create the basic plan for the SAF blending facility and quality control.  |
| Japan CCS Co., Ltd.                            | Study the P2C demonstration plant site and regional cooperation plan.   |
| All Nippon Airways Co., Ltd.                   | Conduct a study of the SAF market and fuel supply at airports.  |

**Demonstration Project Background**

Various eco-friendly innovations will be needed to achieve the CO<sub>2</sub> emissions reduction targets indicated in Japan’s Nationally Determined Contribution\*5 for the Paris Agreement. These include separation, storing and recycling CO<sub>2</sub>, making renewable energies into mainstream power sources, expanding the use of hydrogen, and decarbonization of fuels. In the aviation industry, the International Civil Aviation Organization (ICAO) has also defined CO<sub>2</sub> emissions reduction targets in its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), and strongly urges stable production and supply of SAF since using it in aviation is one effective means of meeting these targets.

The P2C plant being studied this time will use artificial photosynthesis technology to reduce the CO<sub>2</sub> separated and collected from exhaust resources into CO, which will then be reacted in the FT synthesis process with hydrogen obtained from renewable energy using the existing petroleum refining process in a plant to produce liquid fuels, such as jet fuel, light oil, etc. P2C can efficiently use renewable electric power and hydrogen from renewable energy without extracting new fossil resources and this is expected to significantly reduce the amount of CO<sub>2</sub> emissions and greatly contribute to achieving carbon neutral.

\*1: News release by Toshiba Corporation

[http://www.toshiba.co.jp/rdc/rd/detail\\_e/e1903\\_02.html](http://www.toshiba.co.jp/rdc/rd/detail_e/e1903_02.html)

[https://www.toshiba-energy.com/en/info/info2020\\_1202.htm](https://www.toshiba-energy.com/en/info/info2020_1202.htm)

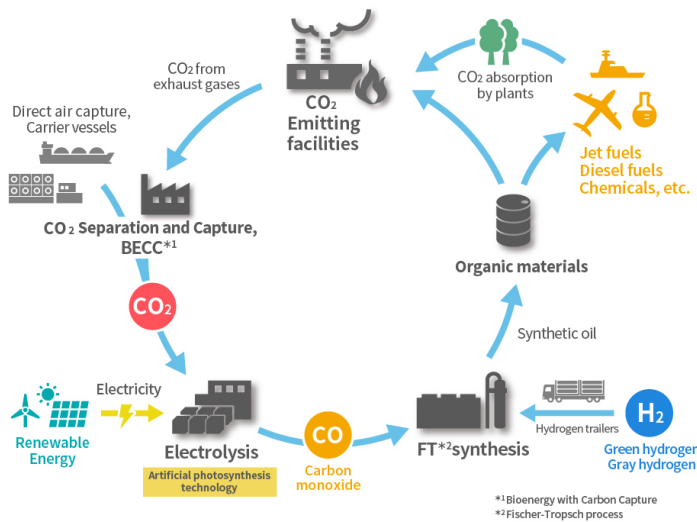
\*2: Fischer-Tropsch (FT) process: A process for synthesizing liquid hydrocarbons from CO and hydrogen by using a catalytic reaction

\*3 SAF: Sustainable Aviation Fuel (jet fuel produced from sustainable supply sources with low-CO<sub>2</sub> emissions in the process from the production and sourcing to the combustion of materials and substances)

\*4: P2C: Power-to-Chemicals is a carbon capture and utilization (CCU) and carbon recycling technology that uses renewable energy and renewable hydrogen energy, etc to recycle CO<sub>2</sub> by converting it into resources with high environmental value. P2C significantly contributes to the spread of renewable energy in addition to reducing CO<sub>2</sub> emissions.

\*5: Nationally Determined Contribution (NDC): Greenhouse gas emissions reduction targets determined by each country, and mitigation efforts to achieve those targets. Japan submitted its NDC to the United Nations Framework Convention on Climate Change (UNFCCC) in March 2020.

**Regional Circular Carbon Society Model (Illustration)**



**Demonstration Project Schedule (Overview)**

|  | FY2021   | FY2022      | FY2023   | FY2024 |
|--|--|-------------|--|--------|
| <b>Regional Circular Carbon Society Business Model</b> | Concept for the regional circular carbon society model and the business model based on it. |             |  |        |
| <b>Feasibility Study of the Proposed Model</b>         | Basic plan for large-scale P2C demonstration plant   |             |  |        |
|  | Actual size large-scale electrolysis cell production                                       |             |  |        |
|  | Stacking of cells  |             |  |        |
|  | Actual size prototype design   | Fabrication | Testing and Demonstration                              |        |
|  | Electrolysis cell and stack durability evaluation  |             |  |        |
| <b>SAF Market, Plan and Commercialization Study</b>    | Study of SAF market trends, certification, and plan  |             |  |        |
|  | Commercial size plant conceptual design, feasibility evaluation                            |             | CO <sub>2</sub> emission reduction amount verification |        |

**TOSHIBA**



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