

Series “Ushering in a New Era of Carbon Neutrality” (5)

Utilization of Biomass, and Expectations Toward the Realization of a Carbon Cycle

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The need for the effective utilization of carbon resources

Reducing greenhouse gas emissions is an important measure in our goal to achieve carbon neutrality by 2050. However, there are sectors and applications for which it is not easy to reduce greenhouse gas emissions to zero.

Firstly, in the materials industry, resources whose constituent elements include carbon (carbon resources), such as petroleum and coal, are used in the production processes, and there are cases where it is difficult to reduce the volume of greenhouse gas generated. The iron and steel industry generates greenhouse gases during the reduction process, which uses coke as a reducing agent. While technological development is ongoing for an alternative reduction technology that uses hydrogen instead of coke, it is difficult to achieve drastic reductions of greenhouse gases in the current situation. Materials that are made from petroleum, such as plastic, are composed of the elements—carbon, hydrogen, and oxygen—and are not easy to decarbonize. In the transportation sector, initiatives that combine the decarbonization of power supply with the promotion of electrification through electric vehicles are highly anticipated. However, it will probably take time to achieve the electrification of means of transportation that require high output and can travel long distances, such as large freight vehicles, ships, and planes.

In these sectors, carbon resources such as fossil fuels and biofuels continue to play a key role. The carbon neutrality that Japan aims to achieve is to strike a balance between the volume of emissions and absorption. In short, in cases that require high-density and high-output energy, and where it is difficult to replace the energy source with other sources such as electricity or hydrogen, there is a need for initiatives that can maintain carbon neutrality by utilizing carbon resources appropriately, while at the same time capturing their greenhouse gas emissions appropriately.

Ongoing development of biofuels in Japan and abroad

Biofuels are expected to fulfill the role of a sustainable carbon resource for achieving this goal. Biomass, which is the raw material for biofuels, refers to animal and plant resources as well as waste matter originating from such resources. It covers a wide range of matter, including agricultural products, timber and seaweed, as well as industrial waste, general urban waste, and sewage sludge.

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The characteristic of biomass is that the use of biomass energy in itself makes it possible to achieve carbon neutrality. For example, while burning wood releases carbon dioxide, that same wood absorbs carbon dioxide through photosynthesis during the process of its growth. For this reason, production and consumption are balanced, and it can be regarded as a state of carbon neutrality. However, as there are also cases in which general urban waste contains fossil fuel-derived waste matter, carbon flow needs to be managed appropriately through the disposal of the gases that are emitted during the combustion of such waste. In other words, in utilizing biomass, it is important to develop a mechanism that enables the circulation of carbon based on striking a balance between production and consumption.

Much of the biofuels that are currently being produced use sugar cane, corn, and palm oil as the raw materials, raising concerns of issues related to competition with food supplies and environmental destruction through deforestation for the development of agricultural land. Technological development is ongoing for new biofuels that can overcome such issues.

A representative example of technological development in Japan is the production of biomass plastic, biodiesel, and bio-jet fuel by Euglena Co., Ltd. using oil extracted from Euglena, which is a micro-algae. J-POWER is engaged in the production of bio-jet fuels using species of micro-algae cultivated in sea water. The Green Earth Institute, in cooperation with Japan Airlines, announced that it has completed the development of a bio-jet fuel with used clothing as the raw material. In February 2021, commercial flights were flown using this fuel. Furthermore, the Ministry of the Environment is reviewing the use of biomass in addition to biofuels. For example, it has unveiled a concept car that gives consideration to resource recycling, and which is more lightweight through the use of biomass-derived materials on the car body.

Overseas, Total S.A., a major player in the energy sector in France, is manufacturing bio-jet fuels by using waste cooking oil as the raw material. The U.S. company LanzaTech, which Mitsui & Co. has invested in, is producing fuels and chemical products, such as ethanol and butadiene, from gases emitted from iron and steel manufacturing plants. All Nippon Airways has announced that LanzaTech will be providing it with bio-jet fuel from 2021. On top of these, efforts are also ongoing to develop technology that contributes to carbon circulation through the production of biofuels with the waste matter as the raw material (Figure).

Importance of utilizing biomass and establishing a carbon cycle

The consumers of fuels and chemical products are also looking forward to the emergence of carbon neutral resources, including biofuels. The International Civil Aviation Organization (ICAO) adopted “CNG2020” at its Assembly in 2010, which aims to prevent the increase of greenhouse gas (carbon dioxide) emissions from 2020. As one of the means for achieving this goal, it prescribes the utilization of sustainable aviation fuels (SAF)

produced from sustainable supply sources, such as biomass. Furthermore, at a press conference held on April 22, Akio Toyoda, President of the Japan Automobile Manufacturers Association, pointed out that efforts will be made to reduce carbon dioxide emissions from all motor vehicles, including used vehicles, by combining the complex technology of high-efficiency engines and motors, with carbon neutral fuels such as biofuels.

In the realization of a decarbonized society, it is important to steadily reduce greenhouse gas emissions, and at the same time, combine that with the appropriate use and capture carbon resources in areas where it is difficult to switch to decarbonized energy sources, as well as technologies that enhance the effectiveness of resources. The utilization of biomass and establishment of a carbon cycle are climate change countermeasures, and at the same time, can be described as initiatives that support a sustainable society through the shift away from fossil fuels.

[Figure] Biofuel production technologies announced in recent years

Raw material	Product	Corporation	Overview
Algae	Jet fuels	Euglena Co., Ltd. (Japan)	Production of bio-jet fuel from the micro-algae, Euglena
	Diesel		Production of next-generation biodiesel from the micro-algae, Euglena
	Bioplastic		Promotion of technological development for biomass plastic
Algae	Jet fuels	J-POWER (Japan)	Production of bio-jet fuel from oceanic micro-algae
Clothing	Jet fuels	Green Earth Institute (Japan)	Production of bio-jet fuel from used clothes collected domestically
Waste cooking oil	Jet fuels	Total S.A. (France)	Production of sustainable aviation fuel (SAF) from waste cooking oil
Alcohol	Jet fuels	LanzaJet, Inc. (U.S.)	Production of jet fuel from alcohol
Waste matter	Ethanol	LanzaTech, Inc. (U.S.)	Production of ethanol from gases emitted in the fermentation process by microorganisms
Waste matter	Diesel, etc.	bio-bean Limited (UK)	Production of biodiesel, using waste coffee grounds as advanced biofuel and biomass pellets
Waste matter	Jet fuels	SkyNRG (Netherlands)	Production of jet fuel from waste oil

Waste matter	Methanol, ethanol	Enerkem (Canada)	Production of renewable methanol and ethanol from urban solid waste
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Source: Prepared by the author based on various reports.

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