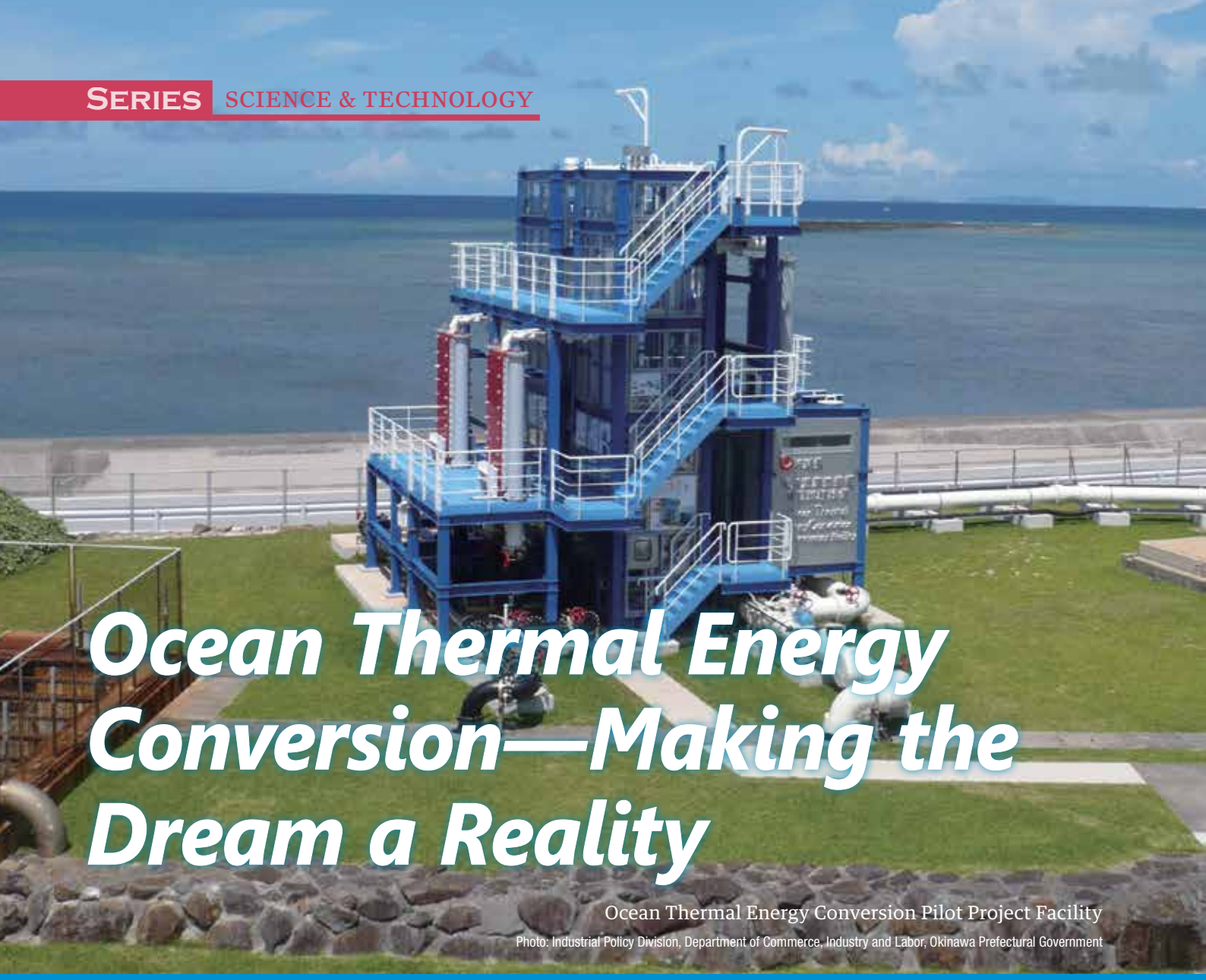


Ocean Thermal Energy Conversion—Making the Dream a Reality

Ocean Thermal Energy Conversion Pilot Project Facility

Photo: Industrial Policy Division, Department of Commerce, Industry and Labor, Okinawa Prefectural Government

Ocean Thermal Energy Conversion (OTEC) is a way to stably supply power without negatively impacting the environment or having to rely on certain weather or climate conditions. With attention around the world focused on this new form of "futuristic power generation," steady progress is being made on pilot projects to prepare for practical use, through cooperation amongst the Japanese companies, universities, and municipalities.

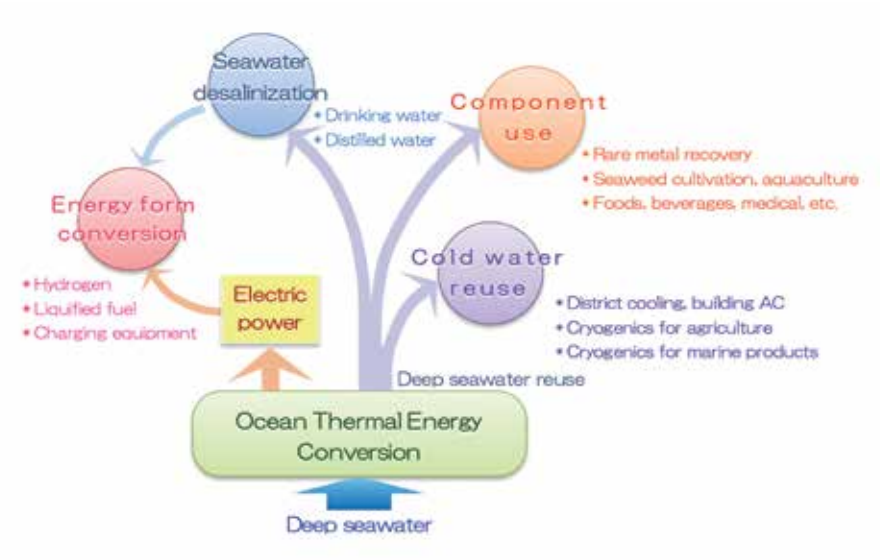
Fukuda Mitsuhiro

OTEC is a power generation system that uses warm 25-30°C ocean water from the sea surface layer as its heating source and cold 5-7°C ocean water from depths of 800-1,000m as its cooling source. Like thermal power and nuclear power, vapor is produced to turn turbines and generate power.

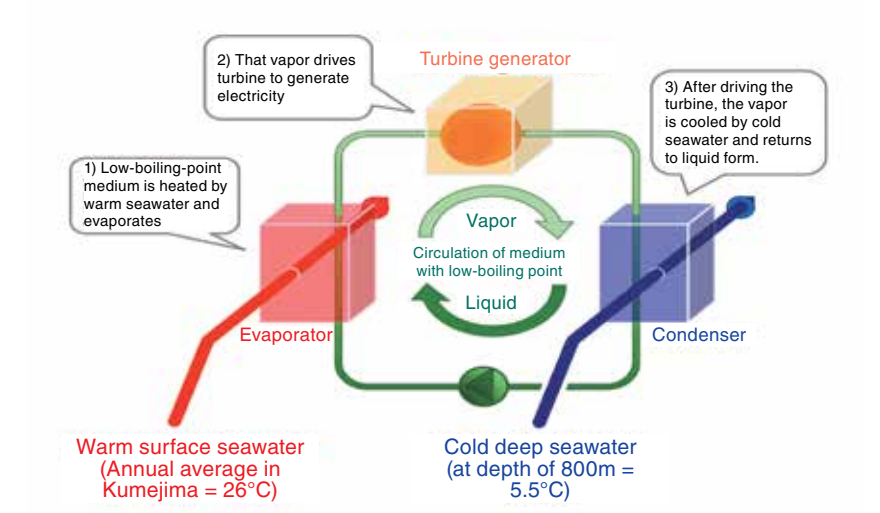
OTEC operates through a facility connecting five pieces of equipment—an evaporator, a condenser, a turbine, a power generator, and a pump. In the facility, electricity is produced by circulating ammonia, a CFC substitute, or other easily vaporized substances with a low boiling point.

The power generation flow works as follows. First, the warm water in the ocean surface layer is drawn up and sent to the evaporator. Ammonia or other liquids that evaporate at a low boiling point are also sent to the evaporator where they are warmed by the warm seawater and evaporate. The vapor expands through the turbine, generating power. After expanding through the turbine, the vapor is sent to the condenser, where it is cooled by the cold seawater from the deep layer and returns to liquid form. This cycle is repeated.

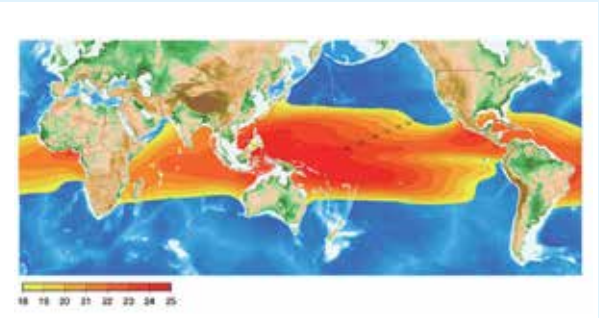
OTEC differs significantly from thermal and nuclear power generation in that it uses renewable resources, seawater of different temperatures as its energy source. With today's technology, OTEC power generation is considered possible in subtropical and tropical regions where the temperature difference between surface



Deep seawater used in Ocean Thermal Energy Conversion can be used for many purposes



Basic Diagram of OTEC



Temperature difference map of surface seawater and deep seawater (depth = 1,000m)

seawater and deep seawater is 20°C or more. In Japan, power generation is possible in the Ogasawara Islands, as well as around Okinawa. About 100 countries worldwide have the potential to build such plants, with power generation potential estimated at 1 trillion kW.

A notable characteristic of OTEC is stability of supply. Unlike wind and solar, which are affected by weather, making continuous operation difficult, OTEC can be used perpetually to supply a fixed amount of power.

Furthermore, OTEC has extremely low CO_2 emissions compared to other power generation methods, and it also promotes the growth of seaweed and the absorption of CO°C by discharging the deep seawater used to generate electricity to the surface.

Secondary reuse of the deep seawater used for power generation is a major benefit. Deep seawater has immeasurable potential for mariculture, agriculture, district cooling, manufacturing of mineral salts as well as mineral water, and extraction of rare minerals. All these benefits are expected.

Xenesys Inc. and several other private enterprises are working together with Saga University to practically implement OTEC. With the desire to do business that contributes to the global environment, Xenesys approached the Institute of Ocean Energy, Saga University in 1997. They poured their efforts into designing the systems needed for OTEC and developing the heat exchanger, which is the most important element of the system.

In 2013, pilot projects at the 100kW level[1] operated by Okinawa Prefecture began in Kumejima Town. Secondary use of deep seawater for mariculture, etc., was also performed in partnership with local municipalities. Power generating capacity will be increased going forward, with targets of 1MW[2] by 2026, and 100MW by 2030.

OTEC is getting attention overseas. In 2018, a project supporting practical application was launched in Malaysia. Mauritius, Indonesia, and Hawaii have also been mentioned as candidate locations for the establishment of power generation facilities.

It could be said that the futuristic power generation method of OTEC, which has low CO°C emissions and is environmentally friendly, and provides a stable supply, is now making steady steps toward practical use.

1. Roughly equivalent to the average power consumption of 200 Japanese households
2. Roughly equivalent to 15% of the entire electricity demand of Kumejima Town, Okinawa Prefecture