

**Cogeneration is a technology for generating two types of energy, electricity and heat, from energy resources like natural gas and oil. Trigeneration generates one additional product such as carbon dioxide. These technologies contribute to efficient energy use.**

### Generating electricity and heat from one type of energy

How efficiently do we use our limited energy resources? Cogeneration is one widely used solution to help solve this critical global problem.

In Japan, electrical energy, which is so important in our lives, is mostly generated in fossil-fuel power plants using energy resources such as natural gas and oil. Electricity is transmitted to consumers through long power lines, resulting in energy loss. Only about 40 % of the primary energy consumed for power generation can actually be used by us. Energy that is not converted into electricity is mostly lost as heat energy.

Cogeneration is a system for efficiently using heat energy before it is lost. Because it has the advantage of generating and supplying electricity as well as heat at the place where the energy is consumed, cogeneration facilities are often installed in buildings which consume both electricity and heat. Buildings that can benefit from cogeneration require heat throughout the day to meet the demand for heating, air conditioning, and/or hot water. Twenty-four-hour hospitals and hotels are good examples. Diesel engines, gas turbines, and gas engines are used to generate electricity and heat, allowing

the efficiency of primary energy to be raised to 75–80 %.

Cogeneration has a long history. It is said to have begun in the late 19th century when steam was supplied from the Poststrasse power plant to the Hamburg city hall in Germany. Later, it spread widely, especially in Europe and the United States, as the development of the related technologies moved ahead. In Japan, it began to be introduced into the industrial market in factories, etc., because of the 1979 oil crisis. In 1981, cogeneration using city gas was adopted for the National Stadium in Tokyo and also began to be used in the private sector.

Further development of cogeneration is still ongoing. Better power generation efficiency has been accelerated by improved functions and performance of the cogeneration equipment itself. Research on control and energy management is constantly advancing in order to use electrical and heat energy without waste.

In recent years, cogeneration has also received attention as a reliable method of supplying energy. A tight power supply situation caused by the Great East Japan Earthquake in 2011 resulted in a growing need for energy efficiency and for a reliable power supply. Under such circumstances, cogeneration has been increasingly introduced for the disaster preparedness or BCP\*<sup>1</sup> to ensure the supply of power in

case of an emergency as well as for its primary function, generating electricity and heat simultaneously on a daily basis.

What is more, using cogeneration during peak power demand times, such as hot summer afternoons, helps to level the load of the power systems supplying electricity from electric companies to consumers.

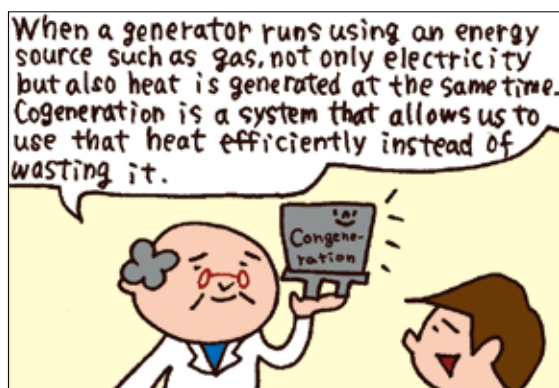
### Efficient use of carbon dioxide from exhaust gas for cultivation of plants

As stated above, cogeneration is a system for efficiently using electricity and heat. Trigeneration is a technology for using one additional type of product, such as the carbon dioxide (CO<sub>2</sub>) in the exhaust gas that is produced during power generation. The prefix “tri” means three, and in this case refers to electricity, heat, and CO<sub>2</sub>.

Currently, CO<sub>2</sub> is used in agricultural and industrial markets. In the agricultural market, it is used in greenhouse cultivation and “plant factories” (closed growing systems for plants) to accelerate photosynthesis. In the industrial market, CO<sub>2</sub> is used in the manufacture of some building materials or methanol, and in the neutralization of industrial wastewater. A variety of ways to use CO<sub>2</sub> will be sought in the future because using CO<sub>2</sub> efficiently contributes to reducing CO<sub>2</sub> emissions.

There are high expectations for cogeneration and trigeneration as technologies that promote preservation of the Earth's environment and energy efficiency, two of the most important themes for our society.

\*1: BCP (Business Continuity Planning) Planning in advance by companies for response in times of emergency, in order to be able to continue with core business or recover rapidly after a natural disaster or other emergency.



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