

# Technical and Product Development

## Technical Development Linked to Promotion of Carbon Neutrality

Toho Gas Group contributes to the achievement of carbon neutrality and other characteristics of a sustainable society by developing technologies that address the diverse needs and challenges of our customer's lives, businesses, and communities.

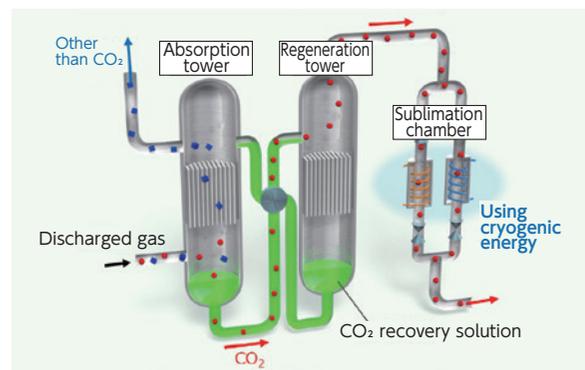
### Development of technology to capture CO<sub>2</sub> from the atmosphere using cryogenic heat

We are working to develop technology that will be widely available by 2050 to enable commercial-scale facilities to separate and capture CO<sub>2</sub> from the atmosphere as part of a project subsidized by the NEDO Moonshot Research and Development Program.

Cryo-DAC<sup>®</sup>\* technology is unique in that it radically reduces the heat load required to regenerate CO<sub>2</sub> by adopting a CO<sub>2</sub> sublimation (dry ice conversion) system that utilizes cryogenic energy from LNG. (\*Direct Air Capture)

### Development of high-efficiency CO<sub>2</sub> capture technology using cryogenic energy

The Japanese government has established a Green



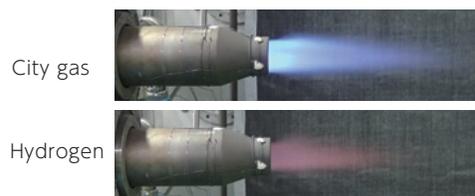
Innovation Fund to subsidize development of technology that will drastically reduce CO<sub>2</sub> capture costs, and Toho Gas is working to meet that goal by developing a CO<sub>2</sub> capture technology called Cryo-Capture<sup>®</sup>, which utilizes unused cryogenic energy from LNG.

Once the pilot phase begins in FY2028, Cryo-Capture<sup>®</sup> technology will be implemented at an LNG terminal, and a series of carbon-recycling tests will be performed, in which the captured CO<sub>2</sub> together with hydrogen produced through water electrolysis will be used in the production of e-methane and its conversion to raw materials for the production of city gas.

### Development of hydrogen burners

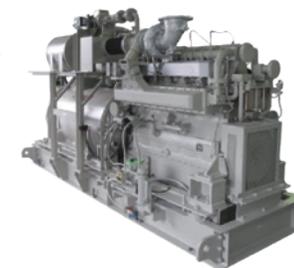
Toho Gas is working to develop new technologies for using hydrogen as a fuel for industrial furnaces, which are indispensable in manufacturing. Solutions to technical issues such as backfiring and other combustion instability, increased emission of NO<sub>x</sub>, and leakage of hydrogen are being developed by making improvements to burners for city gas and evaluating the suitability of solenoid valves, check valves, and other auxiliary devices for use with hydrogen.

We are using both test furnaces and our customers' production furnaces to evaluate temperature rise time and its effect on product quality when using hydrogen.



### Trial operation of a hydrogen cogeneration system

We are working on the development of a city gas/hydrogen co-firing engine technology that can contribute to both low-carbon and decarbonized electric power generation. The results of both co-firing tests of gas engines and model simulations are used to solve problems that arise during hydrogen co-firing, such as suppressing abnormal combustion and reducing emissions of NO<sub>x</sub>. Toho Gas is promoting the future application of this technology to gas-engine cogeneration.



## Developing products that enrich people's lives

### Commercialization of the anti-cold, Trans-Warming<sup>®</sup> L Mat

Toho Gas has commercialized its anti-cold, Trans-Warming<sup>®</sup> L Mat, a thermal mat that alternately stores and releases heat using a material developed by Toho Gas that retains latent heat. Using a solar collector to store heat from sunlight and then dissipating the stored heat by warping the metal strips built into the mat, the Trans-Warming<sup>®</sup> L Mat is perfect for keeping your feet warm. Capable of staying warm all night long, it can be used either as thermal protection during outdoor leisure activities or as a welcome addition to a disaster-preparedness kit.

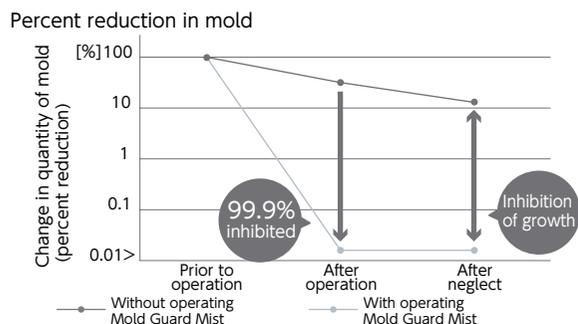


Anti-cold mat

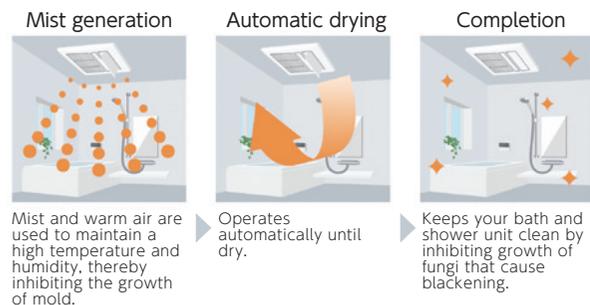
### Development of a bathroom heater-dryer that inhibits the growth of mold

Noting that mold is susceptible to extremely hot water, we verified that the high temperature and high humidity of a mist sauna is capable of inhibiting the growth of mold and correlated the growth of typical molds present in the bathroom against temperature, humidity, and exposure time.

Based on this know-how, we developed jointly with Rinnai Corporation the Mold Guard Mist function, which can inhibit the growth of mold merely by operating the unit once every two weeks, and have incorporated this



\*Based on a survey by Rinnai Corporation. Test conditions as follows. ●Testing organization: NPO Mold Consultation Center ●Test Method: Mold was cultured at 25°C and humidity of 90% for 7 days, after which spores were transferred to a test specimen and placed on a wall near the floor of the bath and shower unit. ●Test subject: Black mold (Cladosporium cladosporioides) ●Before operation: Prior to operation of Mold Guard Mist ●After operation: Under rainy season conditions, 187 minutes of Mold Guard Mist operation (67 minutes of mist + 120 minutes of drying). Without Mold Guard Mist operation, the unit was left standing under rainy season conditions (rainy season conditions: 25°C, humidity 80%). ●After neglect: After neglecting the room for 14 days under rainy season conditions, both with and without Mold Guard Mist operation ●Test No. CFCJ Contract 22-045



function into a commercially available bathroom heater and dryer with a mist sauna unit.

### Gour-meal — a multifunctional, reduced-pressure cooker — goes on sale

Toho Gas has begun sales of Gour-meal—an energy-saving, economical, multi-functional, reduced-pressure cooker, which it developed independently and now sells through the Toho Gas webstore and other sales channels. Reduced-pressure cooking is a great way to prepare meals that are flavorful, take less time to cook, and are less prone to boiling over.



Gour-meal—a multifunctional, reduced-pressure cooker

### Sales of technology and know-how to third parties

#### Chemical analysis technology in support of business

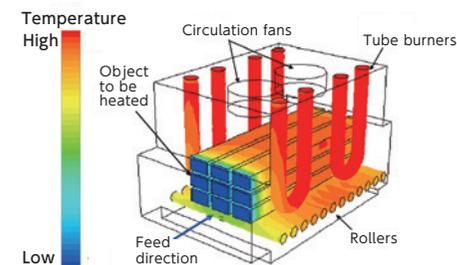
We utilize chemical analysis to ensure a safe and stable supply of city gas and to develop carbon neutrality technologies. We also maintain the capability to perform analysis as necessary to ensure the quality of the hydrogen gas we produce. We also include many of our analytical technologies developed in-house as part of the analytical services we offer our customers.



Chemical analysis

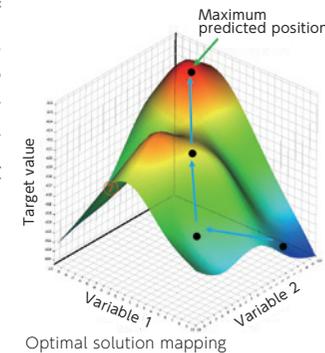
#### Technical support services using simulation technology

Toho Gas uses simulation technology to ensure a safe and stable supply of city gas, to promote new business activities, and to support our customers' efforts to achieve carbon neutrality. We conduct preliminary evaluations of heating performance and propose improvements for fuel conversion in industrial furnaces as well as performance evaluations and improvement proposals for city gas production and supply facilities.



#### Creating new added value using digital technology

In order to provide new services to our customers as well as to promote efficient and sophisticated business operations, Toho Gas is working to utilize cutting-edge data analysis technologies, including big data analysis of energy usage and machine learning in forecasting energy demand. By combining these digital technologies with our accumulated knowledge of energy-related equipment, we are able to create operating schedules for air conditioning and power generation equipment that minimize CO<sub>2</sub> emissions.



Optimal solution mapping