Osaka Gas and JFE Engineering to Initiate Demonstration Testing for Simultaneous Generation of Electricity, Hydrogen, and CO_2 via Chemical Looping Combustion

June 27, 2025
Osaka Gas Co., Ltd.

Osaka, Japan (June 27, 2025)—Osaka Gas Co., Ltd. (“Osaka Gas”) and JFE Engineering Corporation (“JFE Engineering”) have announced the launch of demonstration testing for an innovative technology that concurrently produces electricity, hydrogen, and carbon dioxide (“CO_2”) using a process known as chemical looping combustion (“CLC”). This initiative is supported by a grant from the New Energy and Industrial Technology Development Organization (“NEDO”) provided to selected projects.[1]

This project represents the world’s first demonstration test to directly feed solid fuels, specifically biomass, into a reactor to generate electricity, hydrogen, and CO_2 simultaneously through CLC. This demonstration testing aims at scaling up the technology to establish a commercial plant, leveraging outcomes from the tests utilizing biomass and liquid organic waste. The generated electricity, hydrogen, and CO_2 will be supplied to customers pursuing carbon-neutral and circular economy[2] initiatives.

To execute these tests, a 300 kW-class demonstration testing plant will be constructed at Osaka Gas's R&D facility in the Torishima District located in Konohana-ku, Osaka City, with completion expected by the end of FY 2027. Osaka Gas will manage construction and operational testing, while JFE Engineering will oversee design and quality control.

This initiative builds on a collaboration between the Japan Carbon Frontier Organization and Osaka Gas, which took place from FYs 2020 to 2024 as part of a NEDO-commissioned project.[3] This partnership aimed to refine essential technologies by identifying optimal metal oxides as reactants and verifying their fluidity through a cold model facility.[4] As a result, a basic design for the 300 kW[5] class testing facility has been achieved.

At the core of this project is CLC, an innovative approach for generating CO_2, hydrogen, and high-temperature heat for steam generation in power plants. CLC allows for the efficient capture of high-purity CO_2, which is easily separated from exhaust gases free from nitrogen and nitrogen oxides, due to the combustion using oxygen from metal oxides, such as iron oxides, instead of air. High-temperature heat is generated through

the reaction of reduced metal oxides with air while hydrogen is produced through its reaction with water, all while recycling the metal oxides among these processes.

Utilizing carbon-neutral biomass as fuel, the CLC-based technology generates green electricity, hydrogen, and biomass-derived CO_2 simultaneously. In contrast, using organic waste liquids as fuel enables the effective repurposing of waste materials through the concurrent generation of electricity, hydrogen, and CO_2.

■About the Daigas Group[6]

Through the Energy Transition 2050 initiative announced this February, the Daigas Group reaffirms its commitment to developing innovative technologies and services that support the transition to a carbon-neutral society, addressing pressing challenges such as climate change while enhancing customers' lives and businesses.

Notes:

1: NEDO-sponsored projects focused on the “Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/Development of Fundamental Technologies for Next-generation Thermal Power/ Development of technology for a poly-generation system with CO_2 separation/capture capabilities” https://www.nedo.go.jp/koubo/EV3_100297.html

2: An economic system aimed at reducing environmental impact by using resources efficiently and minimizing waste production.

3: NEDO-sponsored projects focused on the “Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/Development of Fundamental Technologies for Next-generation Thermal Power/ Development of technology for a poly-generation system with CO_2 separation/capture capabilities” https://www.nedo.go.jp/koubo/EV3_100219.html

4: This facility was built (already removed) at Osaka Gas's research facility located in Konohana-ku, Osaka City, to confirm the correlation between operating conditions and the circulation fluidity of iron oxide particles

5: Calorific value of supplied fuel per unit time (higher heating value)

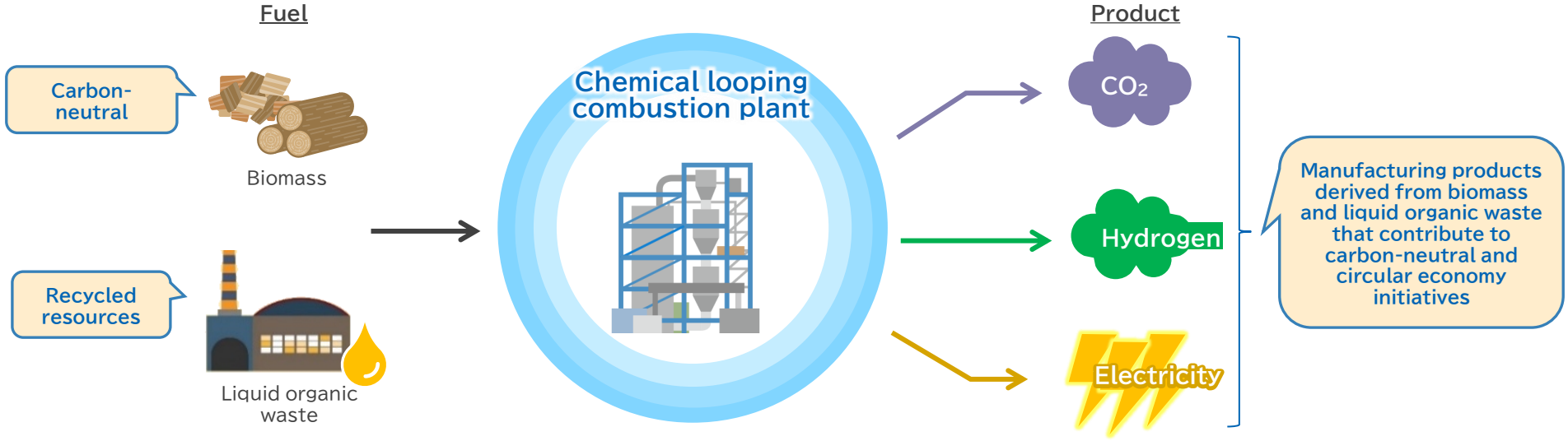
6: Osaka Gas’s corporate group brand name

Chemical Looping Combustion Technology Development Project Selected for a NEDO Grant

- We have been awarded a NEDO[1] grant and partner with JFE Engineering[2] to conduct demonstration tests on a process that simultaneously generates electricity, hydrogen, and CO_2 from hydrocarbon fuels through chemical looping combustion.
- This initiative includes the construction of a 300 kW-class demonstration testing unit by FY 2027. This unit will facilitate operational tests using biomass and liquid organic waste among other fuels. The results of these tests are intended to pave the way for future production of electricity, hydrogen, and CO_2 from biomass and liquid organic waste, catering to customers pursuing carbon-neutral and circular economy initiatives.

1: New Energy and Industrial Technology Development Organization (NEDO)
2: JFE Engineering Corporation

Osaka Gas' Vision



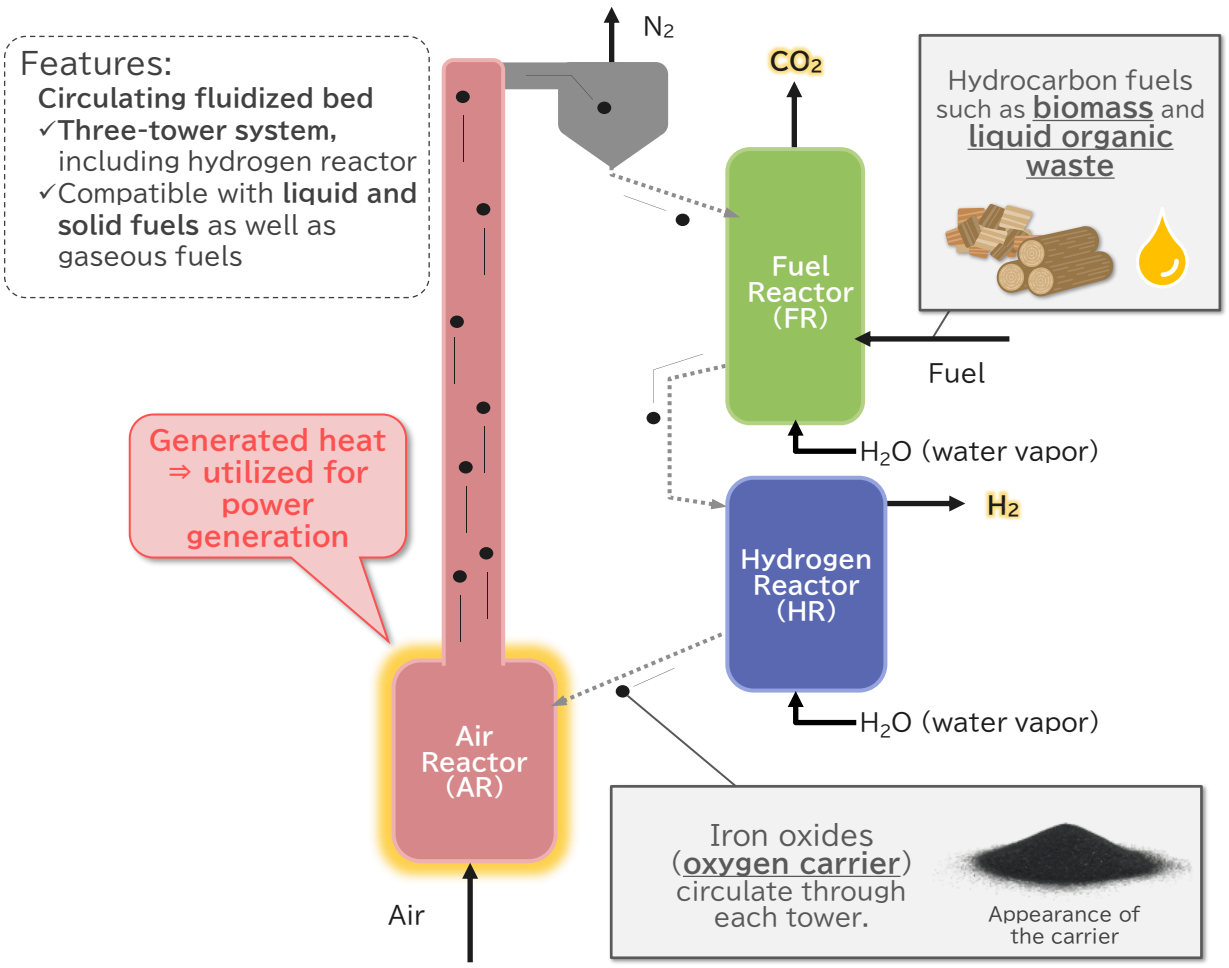
- ✓ Production and supply of green electricity, green hydrogen, and biogenic CO_2 from biomass.
- ✓ Recycling and efficient utilization of liquid organic waste through the generation of electricity, hydrogen, and CO_2

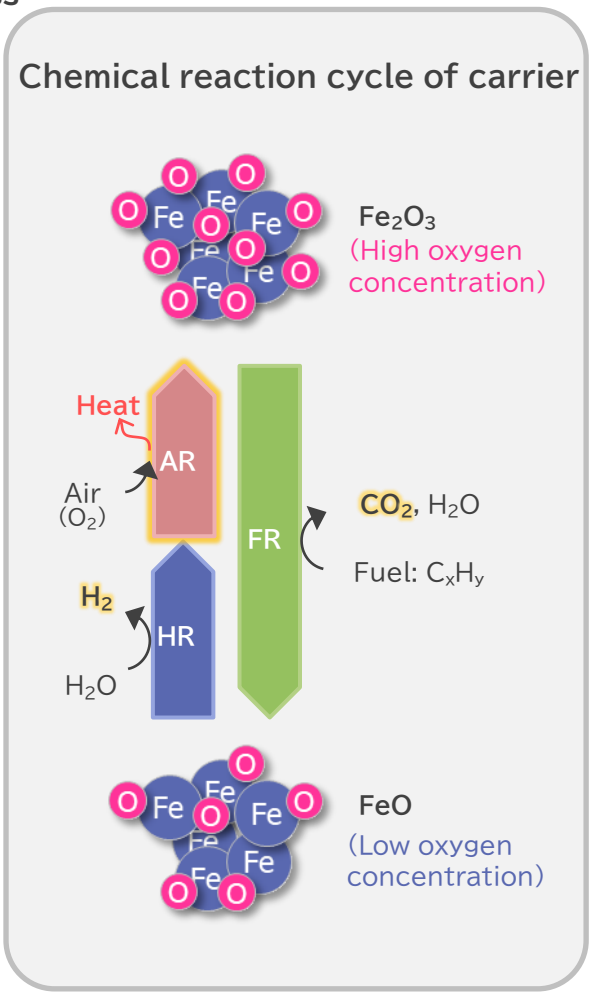
Technical Mechanism and Schematic Diagram of Chemical Looping Combustion

- Our chemical looping combustion technology utilizes a three-tower circulating fluidized bed process, employing iron oxides (oxgen carrier) as a reaction medium.
  This technology is distinguished by its capacity to utilize biomass and liquid organic waste as fuel while simultaneously generating electricity, separating CO_2, and producing hydrogen.

■ Schematic diagram of our three-tower chemical looping combustion process

Features:
Circulating fluidized bed
✓**Three-tower system,** including hydrogen reactor
✓Compatible with **liquid and solid fuels** as well as gaseous fuels





NEDO-Subsidized Project Overview

Name	Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/Development of Fundamental Technologies for Next-generation Thermal Power/ Development of technology for a poly-generation system with CO2 separation/capture capabilities
Description	- Construction of a 300-kW class chemical looping combustion demonstration testing plant - Demonstration tests using biomass and liquid organic waste - Studies for a scale-up unit based on the demonstration test findings
Period	Until FY 2027 (planned)
Participants and roles	- Osaka Gas: Resposible for construction management, testing operations, and plant operations - JFE Engineering: Responbile for design, quality control, and plant operations
Construction Site	Osaka Gas Torishima District located in Konohana-ku, Osaka City (planned)