Progress of Osaki CoolGen Oxygen-blown IGCC with CO_2 Capture Demonstration Test

October 20, 2021

Osaki CoolGen Corporation

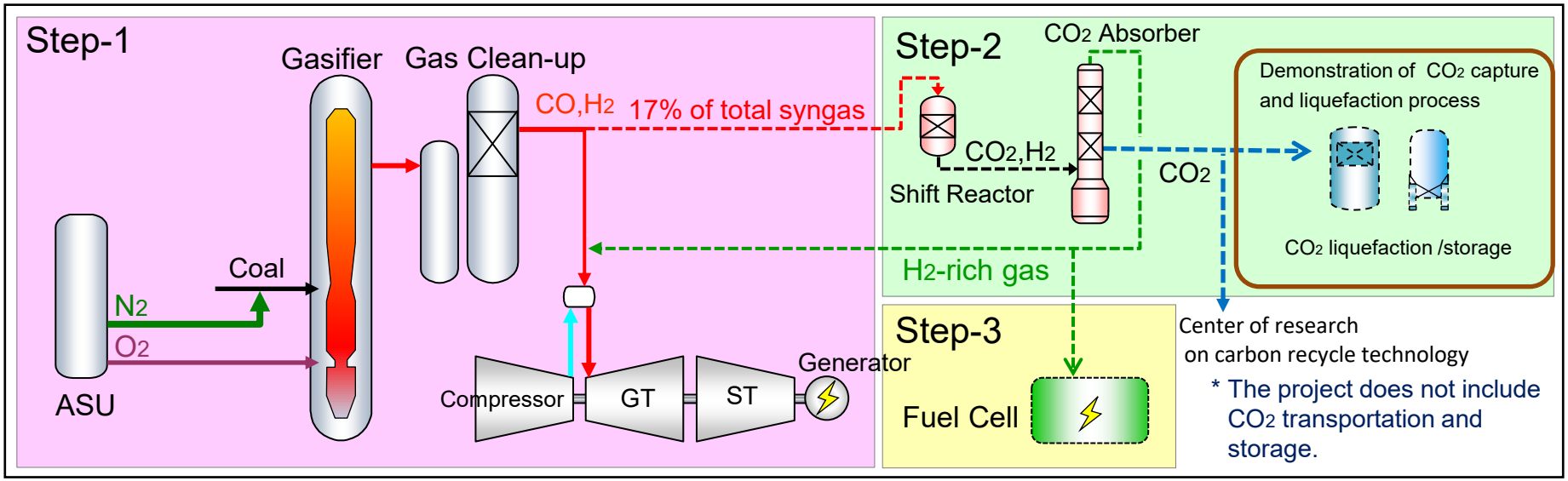
Company Profile

Company name	OSAKI COOLGEN CORPORATION
Founded	July 29, 2009
Location	Hiroshima Prefecture, Japan
Investing enterprises	Chugoku Electric Power Co., Inc. (Energia) Electric Power Development Co., Ltd (J-POWER)
Line of business	Construction of large-scale demonstration plant for oxygen-blown IGCC technology and carbon dioxide capture technology and conducting of tests using such plant

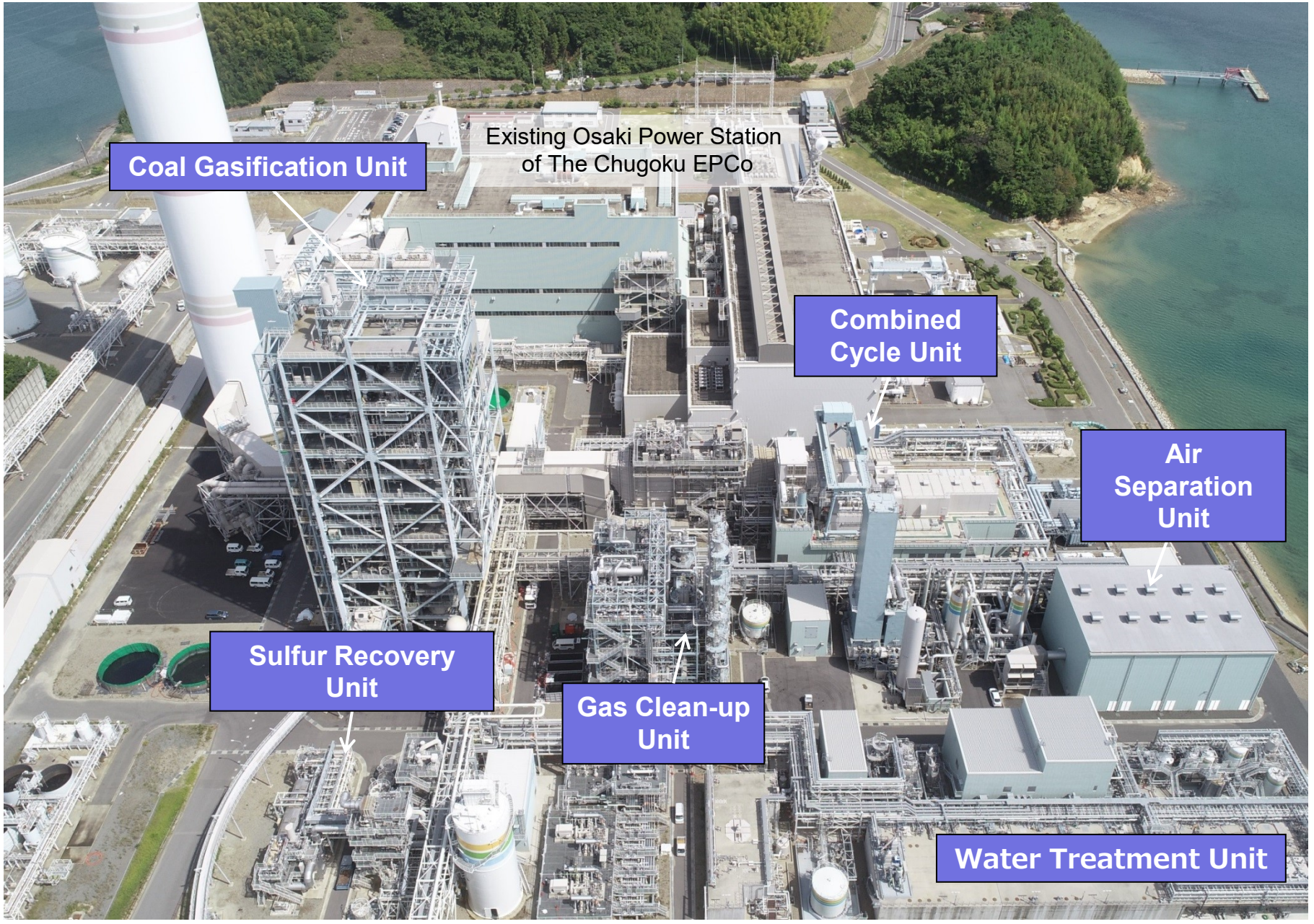
Outline of Osaki CoolGen Project

- For the realization of innovative low carbon coal-fired power generation in which IGFC, an ultimate high-efficiency power generation technology, is combined with CO_2 capture in order to significantly reduce CO_2 emission from coal-fired power generation.
- The project is to be implemented in three steps. Step 1 was implemented from FY2012 as a subsidized project of the Ministry of Economy, Trade and Industry and Step 2 has been implemented since FY2016 as a NEDO subsidized project . Step 3 has been implemented since FY2018 as a NEDO subsidized project.

FY	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Step 1: Demonstration of oxygen-blown IGCC	Design, manufacturing and installation						Demonstration			Construction, Installation	Demonstration
Step 2: Demonstration of IGCC with CO_2 capture (including CO_2 capture and liquefaction process)					Design, manufacturing and installation			Demonstration			Demonstration
Step 3: Demonstration of IGFC with CO_2 capture								Design, manufacturing and installation			



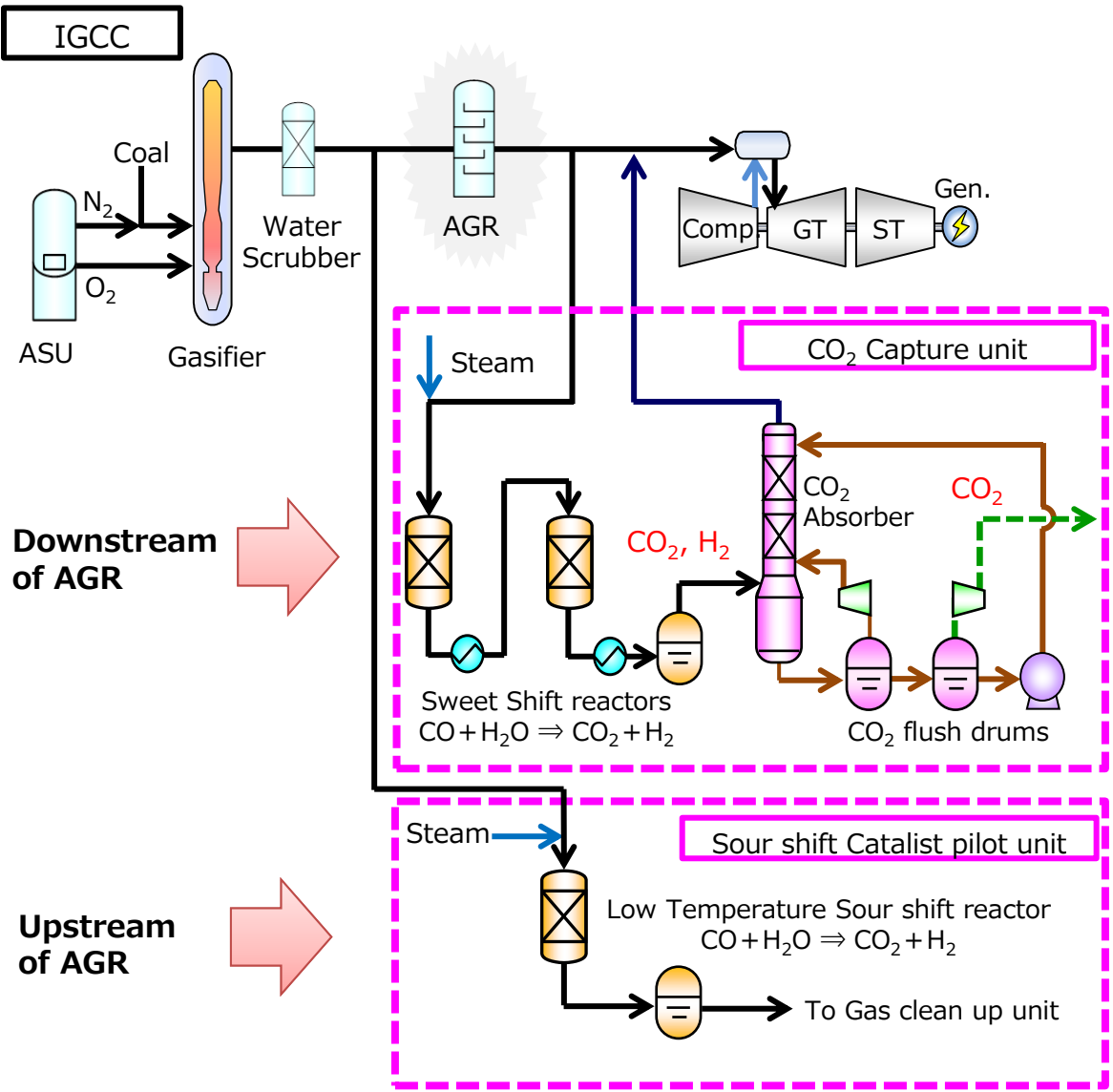
Demonstration Facilities (IGCC)



Demonstration Targets and Results (Step1)

Items	Targets	Results
Plant efficiency	➢ Net efficiency 40.5% (HHV)	➢ Net efficiency 40.8% (HHV) **Achieved**
Emission level	➢ SOx : 8ppm ➢ NOx : 5ppm ➢ Particulate : 3mg/m^{3}N (O_2 equivalent 16 %)	➢ SOx : <8ppm ➢ NOx : <5ppm ➢ Particulate : <3mg/m^{3}N (O_2 equivalent 16 %) **Achieved**
Coal variety compatibility	➢ Applicable to various types of coal	➢ Verified with four kinds of coal (including design coal) **Achieved**
Reliability	➢ Commercial-level annual plant availability of 70% or higher (5,000 hours endurance test)	➢ Endurance test 5,119h (accumulated) ➢ Continuous operation 2,168h **Achieved**
Flexibility	➢ Commercial-level (Load change rate of 1-3%/min)	➢ Load change rate ~16 %/min ➢ Minimum load 0MW(net) **Achieved**
Economy	➢ To obtain a prospect of the equivalent or less generating cost with commercial PCF plant	➢ Obtained a prospect of equivalent generating cost with commercial PCF plant **Achieved**

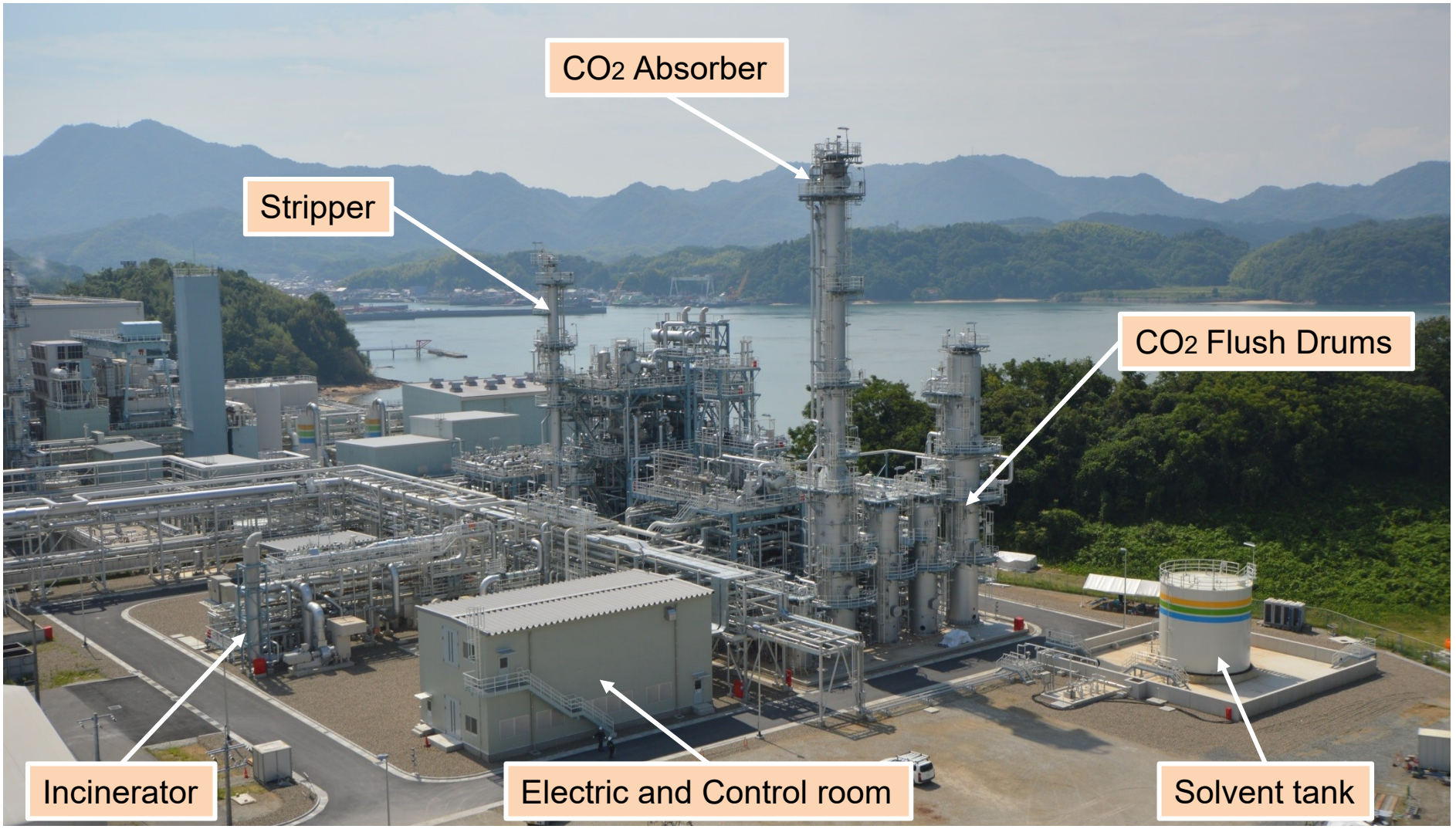
IGCC with CO_2 Capture Flow (Step2)



CO_2 Capture Test	
Feed Gas	17% slipstream syngas
Capacity	Approx. 400t-CO_2/d
CO shift section	Sweet Shift (Downstream of AGR)
CO_2 Capture method	Physical solvent (Selexol™ Max)

Sour Shift Catalyst Pilot Test	
CO shift section	Sour Shift (Upstream of AGR)

CO_2 Capture Facilities



- We have started CO_2 Capture test in December 2019.

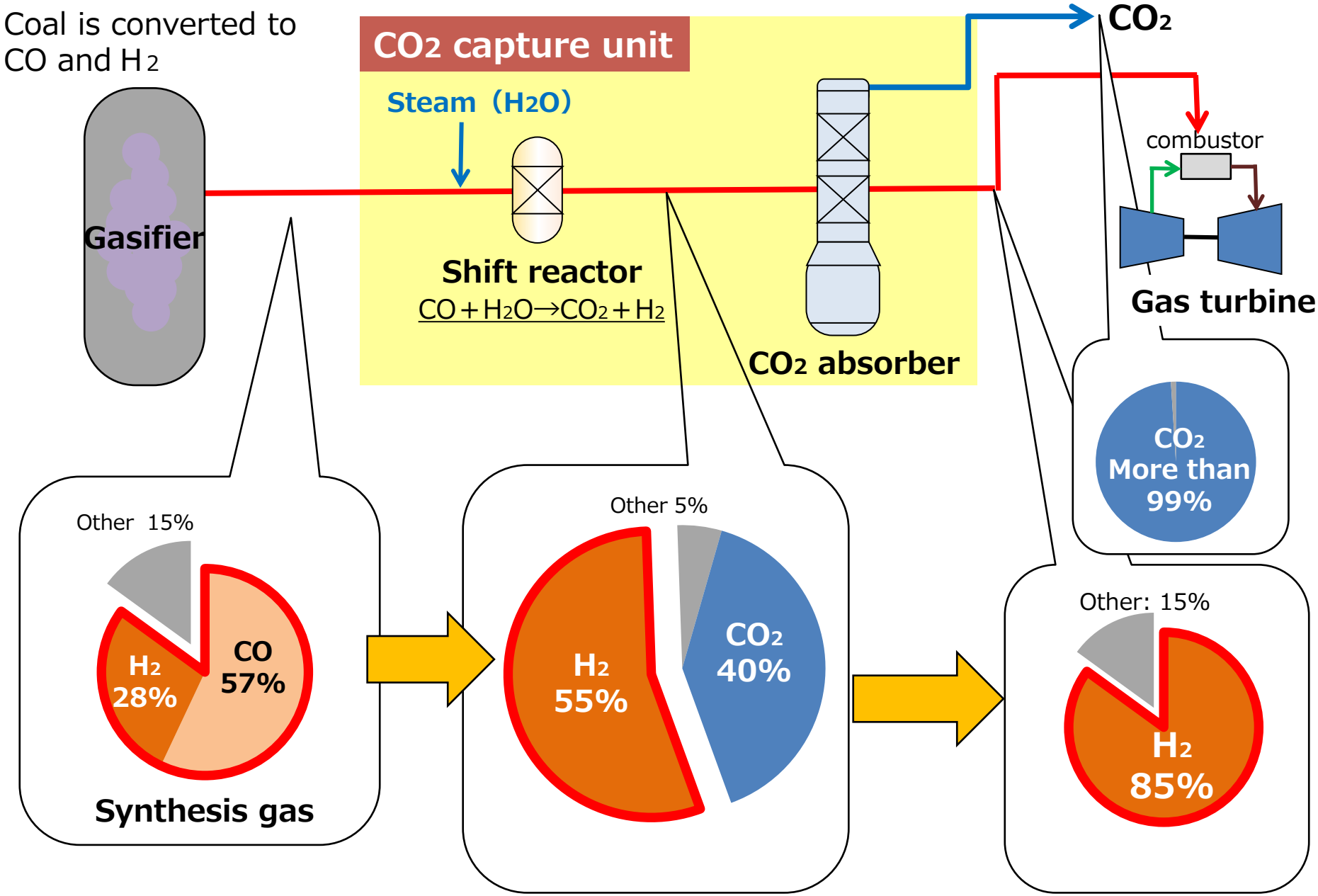
Demonstration Targets and Progress (Step2)

Practical realization of a commercial scale plant through the demonstration of the system using the large-scale demonstration facilities with oxygen-blown IGCC combined with CO_2 capture facilities

Items	Targets	Results
Basic performance	➢ CO_2 recovery rate : 90% or more ➢ Purity of recovered CO_2: 99% or more	➢ CO_2 recovery rate : 90% or more ➢ Purity of recovered CO_2: 99% or more **Achieved**
	The prospect of net efficiency 40% with capturing 90% of CO_2 in a commercial-scale plant (1500℃ class IGCC)	Conduct the additional demonstration test on various operating conditions to optimize process **Under verification**
operability and reliability	Establishment of the operation method of IGCC with CO_2 capture and verification the reliability	➢ Established the method of start-up and stop of IGCC with CO_2 capture ➢ Verified with two different coals **Under verification**
economic efficiency	Evaluation of the cost per amount of recovered CO_2 in the commercial-scale IGCC plant using cost target data shown in the technology roadmap*2 as a benchmark.	Evaluate after the demonstration test **Under verification**

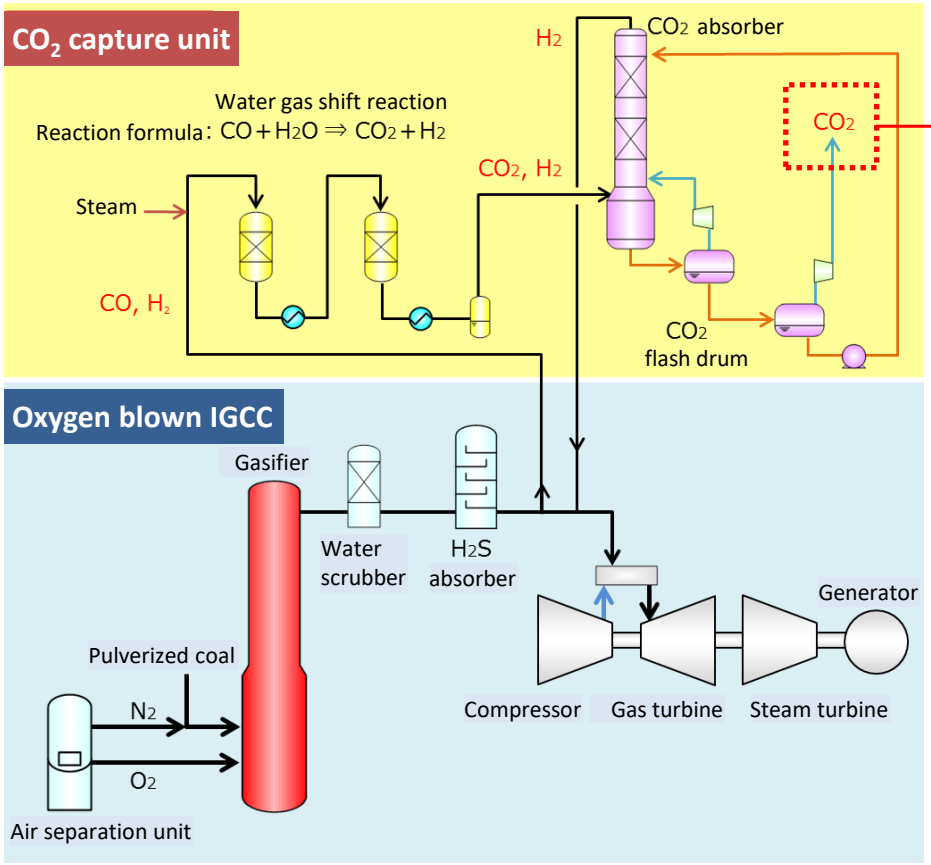
*1 The power generation efficiency includes CO_2 capture process (except power for CO_2 storage)
*2 Technology roadmap for next-generation thermal power generation (METI, June 2015)

Change of gas composition (typical value)

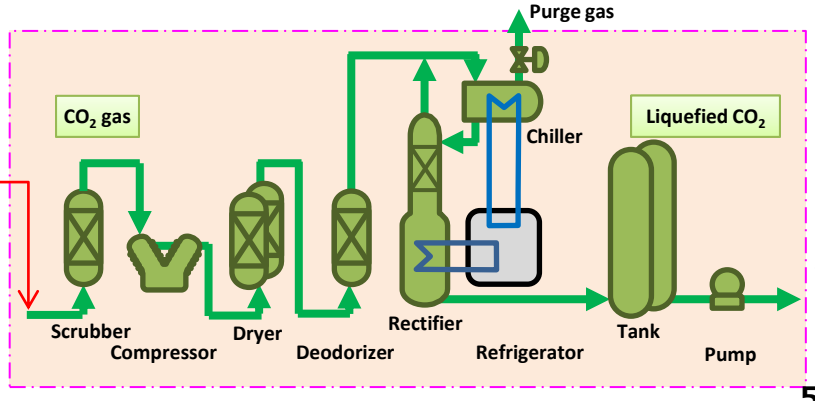


Activity/Contribution to CO_2 Utilization

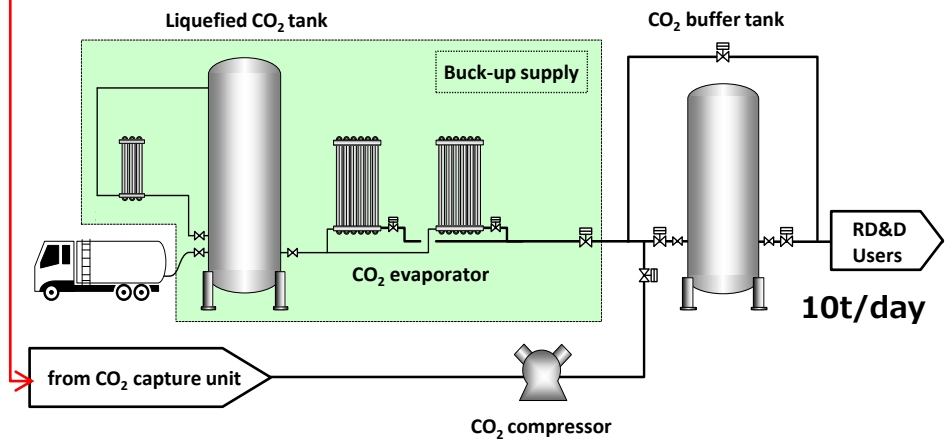
High quality CO_2 will be stably supplied to tomato cultivation demonstration field and carbon recycling RD&D users from the CO_2 capture unit attached to the oxygen blown IGCC demonstration test facility of Osaki Coolgen Project.



Schematic diagram of the Oxygen blown IGCC with CO_2 capture



Schematic diagram of CO_2 liquefaction unit for tomato cultivation, etc.



Schematic diagram of CO_2 supply unit for carbon recycling RD&D

Supported by NEDO

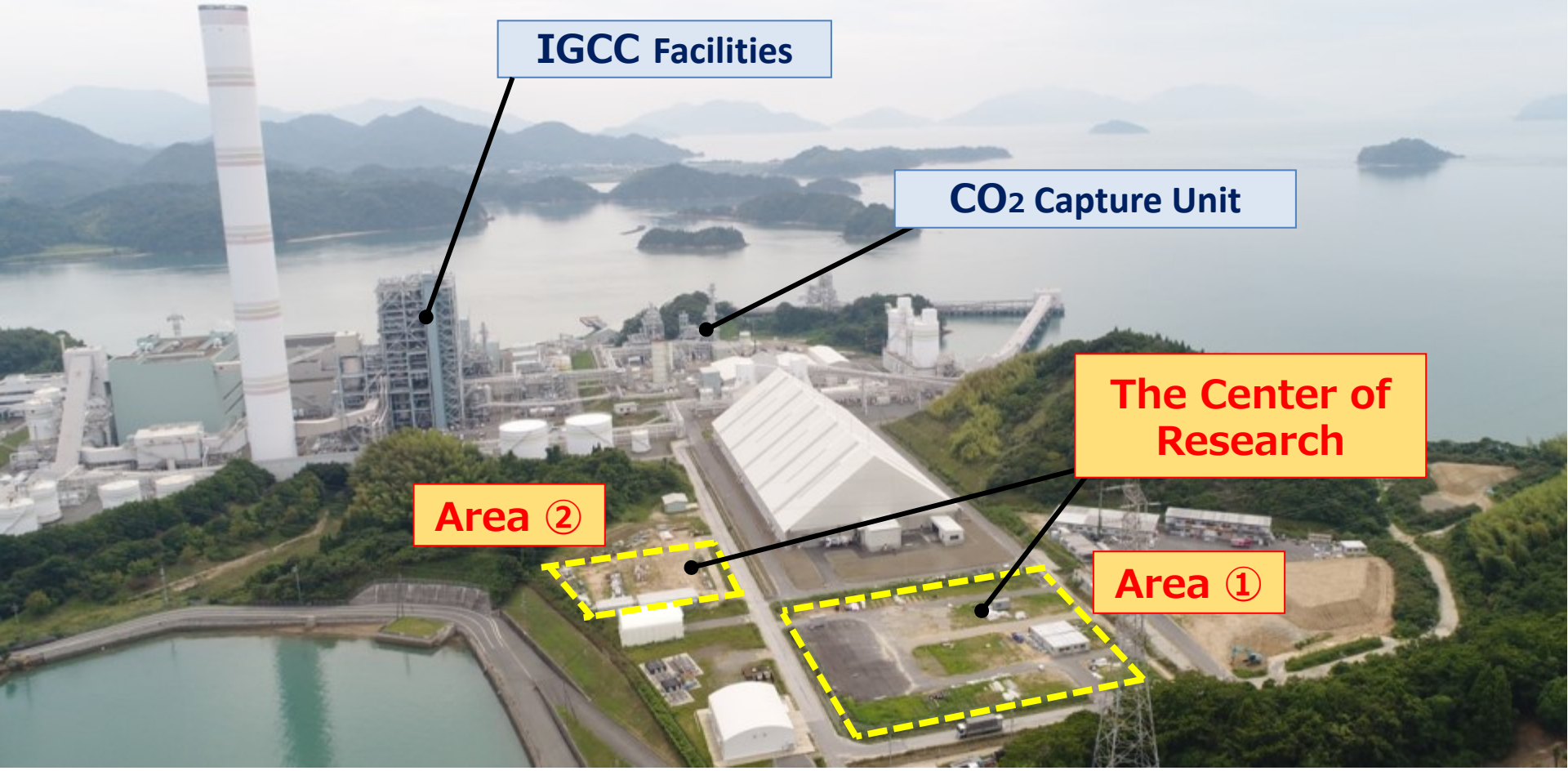
Carbon Recycling Demonstration

As a Carbon Recycling demonstration, CO_2 captured in OCG project will be liquefied and transported to tomato cultivation farm by tank truck.

Tomato cultivation: HIBIKINADA FARM

Promotion project on establishment of the Center

- OCG will promote to establish the center of research while adjusting with other contractors, as a NEDO commissioned project.

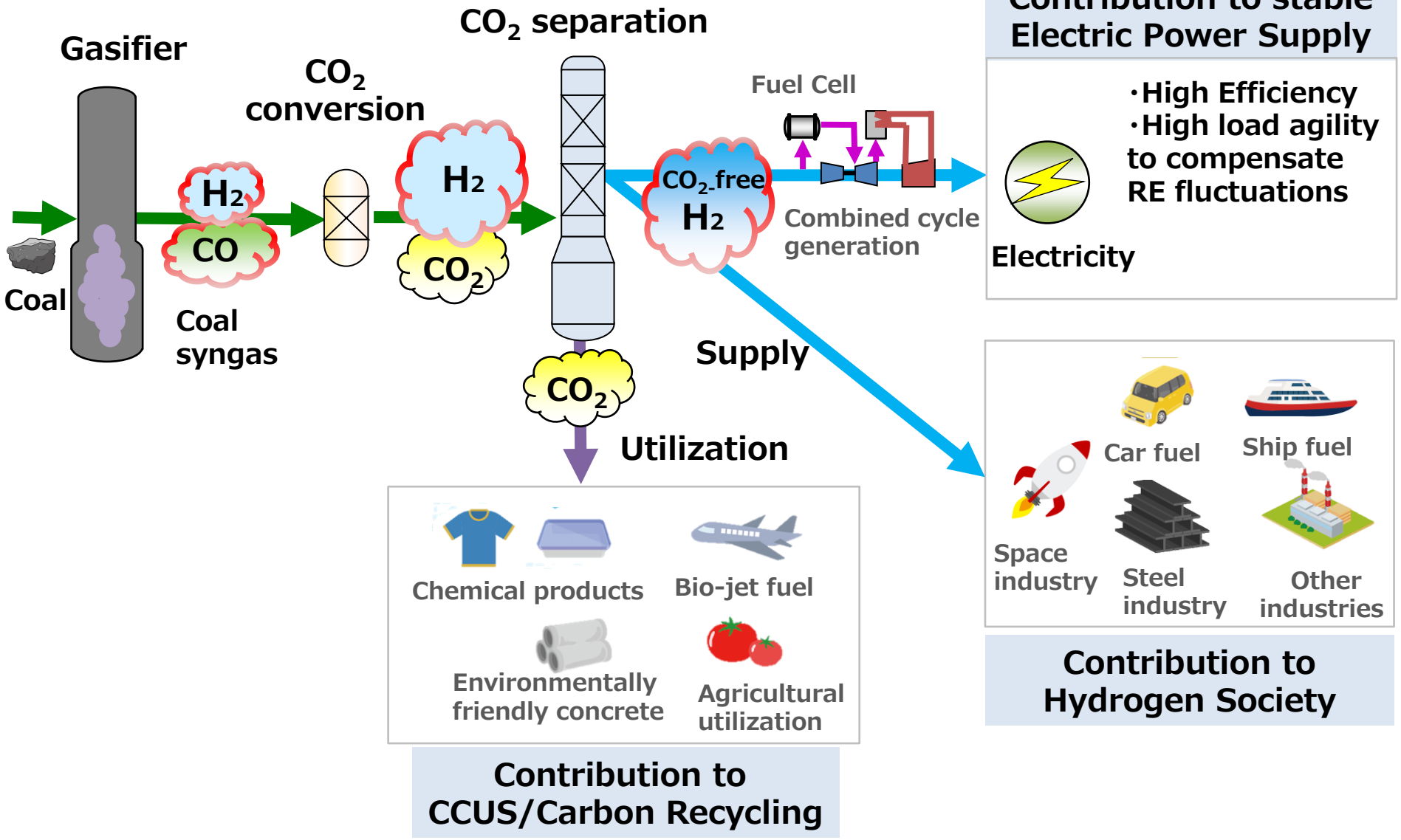


Carbon Recycling RD&D (NEDO commissioned project)

■ Carbon Recycling 3C initiative, as a Japan policy, is decided to establish the Center of Research at Osakikamijima town, Hiroshima prefecture where CO_2 can be captured now.

	Theme	Contractor
Ⅰ. Promotion project on establishment of the Center for CO_2 utilization	Promotion project on establishment of the Center	**Osaki Coolgen Corp.**
	Optimization study and implementation for the basic research base establishment	JAPAN COAL FRONTIER ORGANIZATION
Area ① Ⅱ. Development of Technologies at the Center of research on CO_2 utilization	Development of Efficient CO_2-Use Concrete	The Chugoku Electric Power co.,inc., KAJIMA CORP. MITSUBISHI Corp.
	Development of selective synthesis technology of chemical product for carbon recycling	Kawasaki Heavy Industries, Ltd., Osaka Univ.
	Development of gas-to-lipids bio process	Hiroshima Univ. The Chugoku Electric Power co.,inc.
Area ② Development of basic technology at the Microalgae Research Center	Establishment of a Research & Technology Center for Industrialization of Bio-Jet Fuel and Improvement of CO_2 Utilization Efficiency Utilizing Microalgae	Institute of Microalgal Technology

Contribution of OCG technology to De-carbonized Society
"New possibility of Coal toward Carbon Neutral"



Thank you for your kind attention

We would like to express our gratitude to the Ministry of Economy, Trade and Industry (METI), and the New Energy and Industrial Technology Development Organization (NEDO) for continuous support to the Osaki CoolGen Project.

We will carry on design, construction and demonstration steadily and safely, and make our best effort to achieve successful completion of the Osaki CoolGen Project.

OSAKI COOLGEN

http://www.osaki-coolgen.jp