Kansai Electric Power
power with heart

Demonstration of hydrogen co-firing power generation at existing thermal power plants

The Kansai Electric Power Co., Inc.

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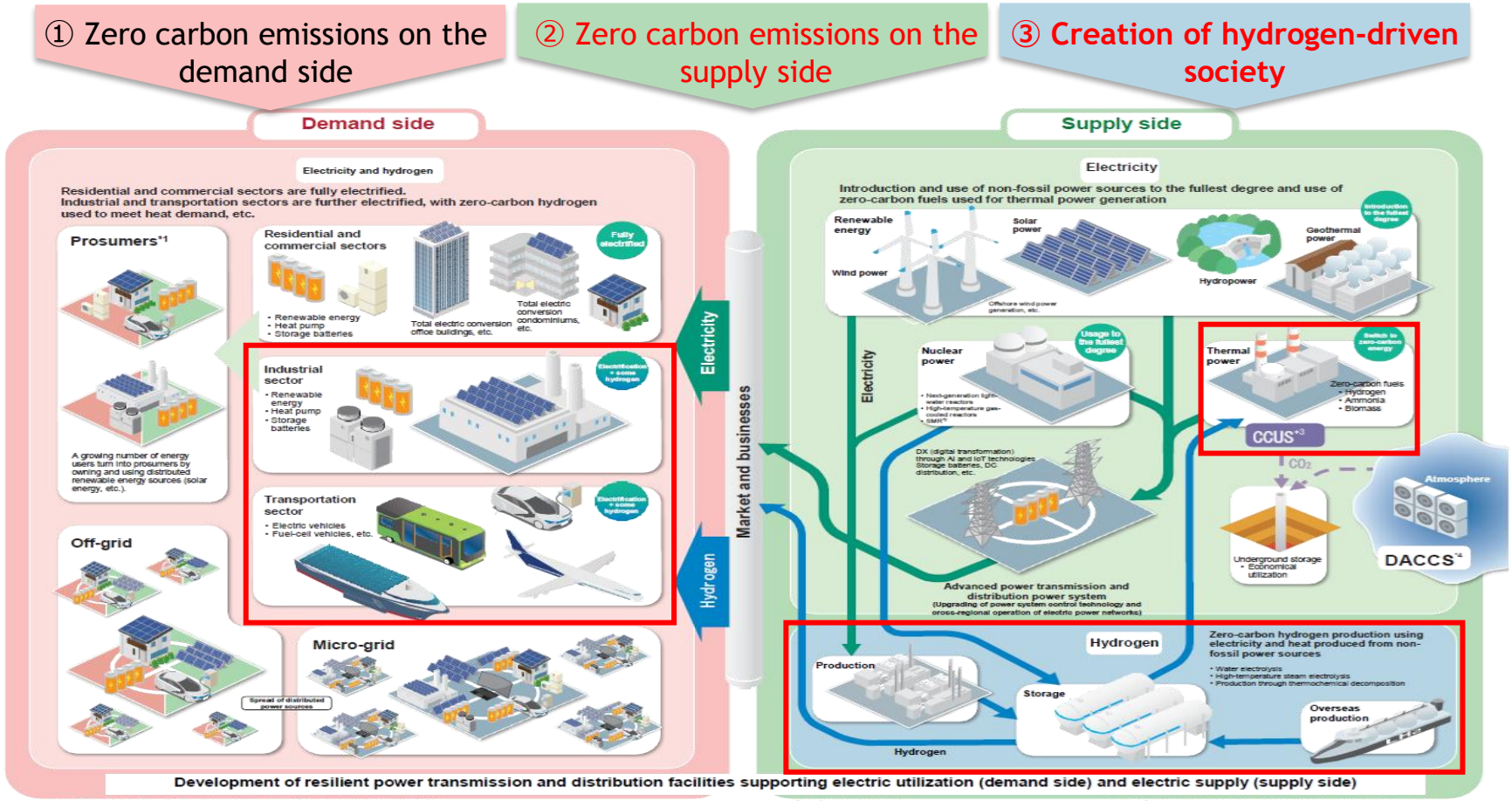
Contents

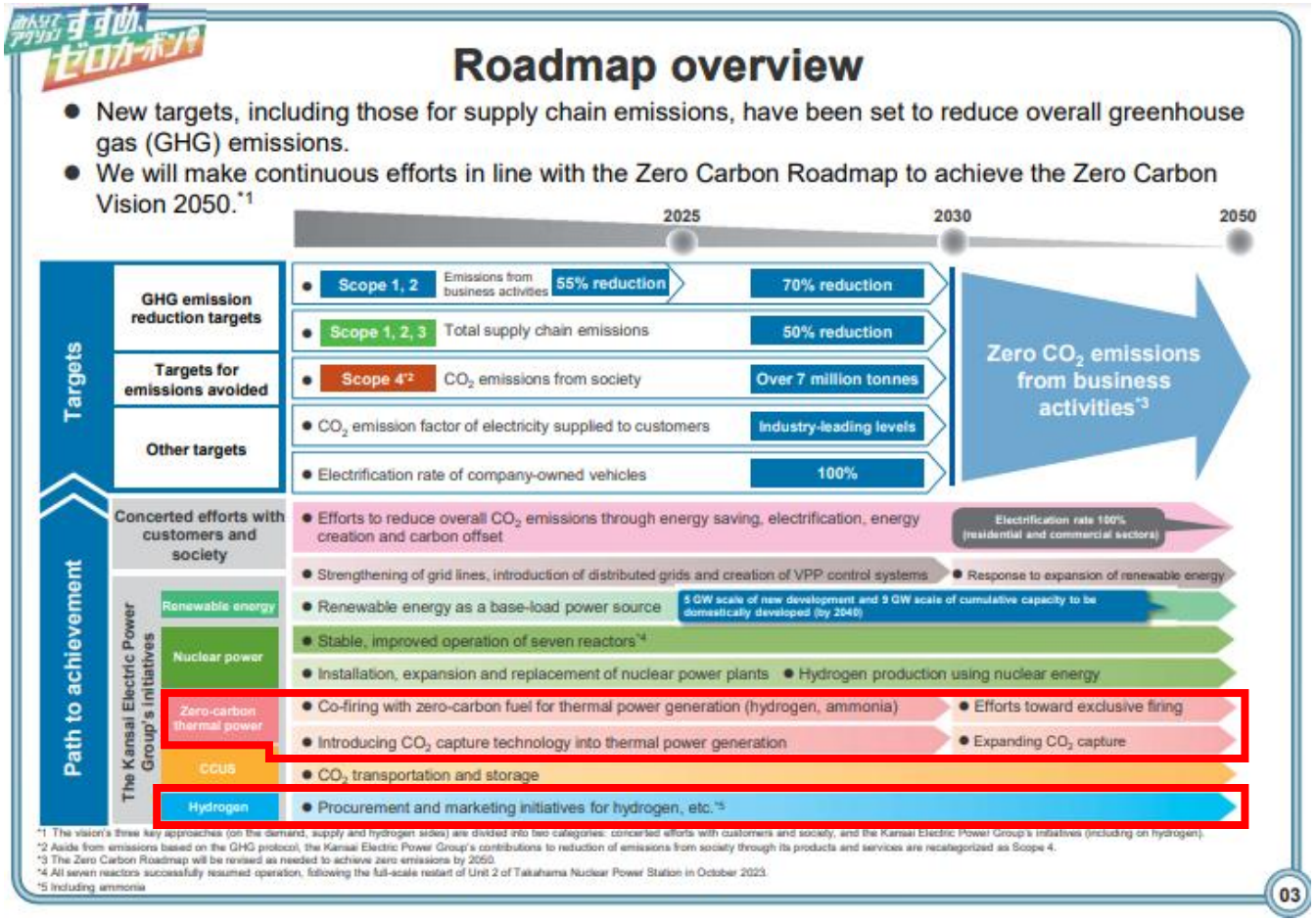
Kansai's Zero Carbon Vision 2050 – Three key approaches

- Under the slogan "Set Net Zero by 2050", Kansai is working to promote electrification on the demand side with decarbonized power generation sources.
- Kansai plans to achieve de-carbonization by replacing our fossil fuels with hydrogen, in addition to renewables, nuclear power, CCS, etc.
- In addition, Kansai is willing to contribute to the de-carbonization of the society as a hydrogen supplier.



Kansai Electric Power Group "Zero Carbon Road Map”

- The "Zero Carbon Road Map" that defines the roadmap to realize the Zero Carbon Vision 2050 has been formulated and is being implemented.
- As for zero-carbon fuels, we will study the feasibility of co-firing around 2030 and aims to achieve exclusive-firing by 2050.
- As a first step, a hydrogen co-firing power generation demonstration will be conducted at a gas turbine power generation facility at an existing thermal power plant.



Project Overview

- The “Green Innovation Fund (GI Fund)” has been established to support companies that commit to ambitious targets to achieve carbon neutral by 2050, and the "Establishment of Hydrogen Power Generation Technology" project is one of them.
- Aiming to establish operational technologies of hydrogen power generation, supported by the GI Fund, our company is conducting demonstration of hydrogen co-firing power generation using existing gas turbine power generation facilities at our thermal power plants.

Overview

Project organization

Subsidizer

NEDO → 関西電力 power with heart

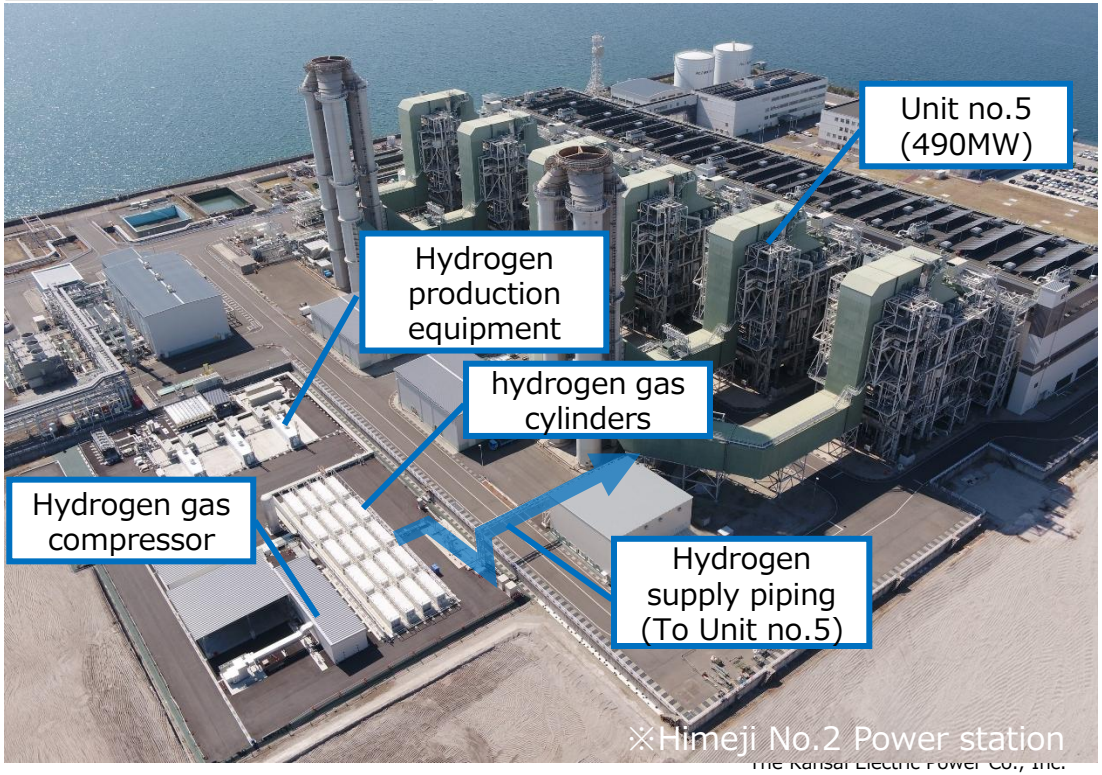
NEDO: New Energy and Industrial Technology Development Organization

Project period

FY2021 - FY2025 (5 years)

2021	2022	2023	2024	2025
FS Phase		FEED and Installation Phase		Demonstration phase
・Desk study about technical issues, processes, etc.at Demonstration		・ Detailed design of related equipment ・ Manufacturing, installation, and modification of existing equipment		・Demonstration

Overall view



R&D Targets by Phase (partial)

- Our output target for 2030 is “Establishment of technology to realize hydrogen gas turbine power generation that creates large-scale demand," and we will conduct demonstrations of hydrogen co-firing power generation to establish operational technologies.
- The R&D targets and actual efforts for the establishment of operational technology for hydrogen co-firing power generation were set as follows for the FEED and Installation phase (FY2023~2024) and the demonstration phase (FY2025), respectively.

R&D Targets	FEED and Installation Phase (FY2023, 2024)	Demonstration phase (FY2025)
Determination of the scope of modifications for existing equipment	Determine the scope of modifications when utilizing existing power generation facilities	Realization of hydrogen co-firing power generation (~30 vol.%) in demonstration test
Determination of operation method	Confirmation that combustion conditions with exclusive natural gas firing is the same level as the conventional ones after modification	Conduct the 30% co-firing test safely, ensuring no abnormalities in the operating conditions
Determination of safety measures during hydrogen power generation	Safety measures, clarification of scope	Safe and stable operation of hydrogen through demonstration

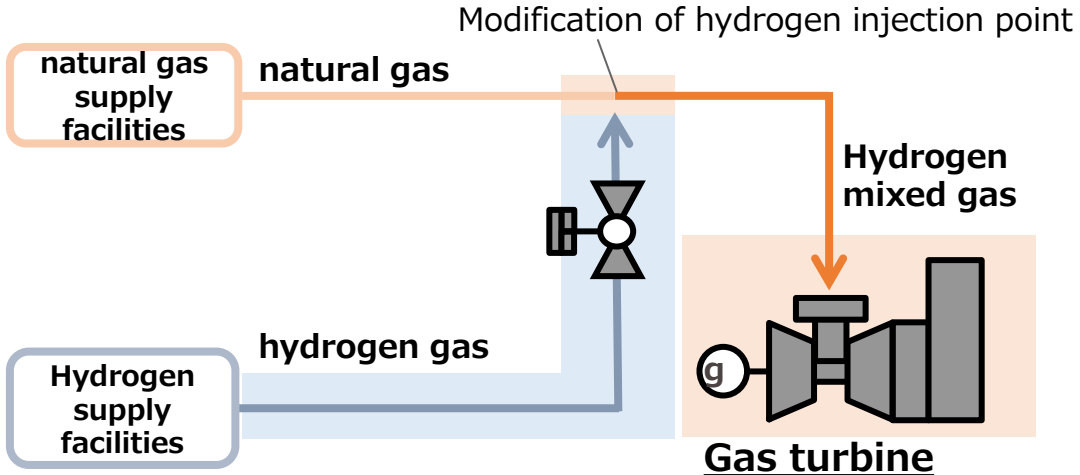
Scope of modifications for existing equipmentand and results of exclusive natural gas firing operation after modification

- As for the power generation facilities, existing equipment is utilized as much as possible
- On the other hand, along with the change from exclusive natural gas firing to hydrogen co-firing, a new hydrogen supply facility have installed in the power plant, and the combustor was modified mainly for hydrogen co-firing operation (up to 30 vol.%).
- After the modification, a test run confirmed that the plant can be operated exclusive natural gas firing.

Modification Scope

New Scope

Modification Scope



Gas turbine
Modification of combustor (nozzle replacement)

Instrumentation equipment
- Addition of hydrogen gas leak detection system
- Change to instrumentation that takes into account hydrogen gas explosion protection

Control unit
- Modification of control unit
- Addition of interlocks

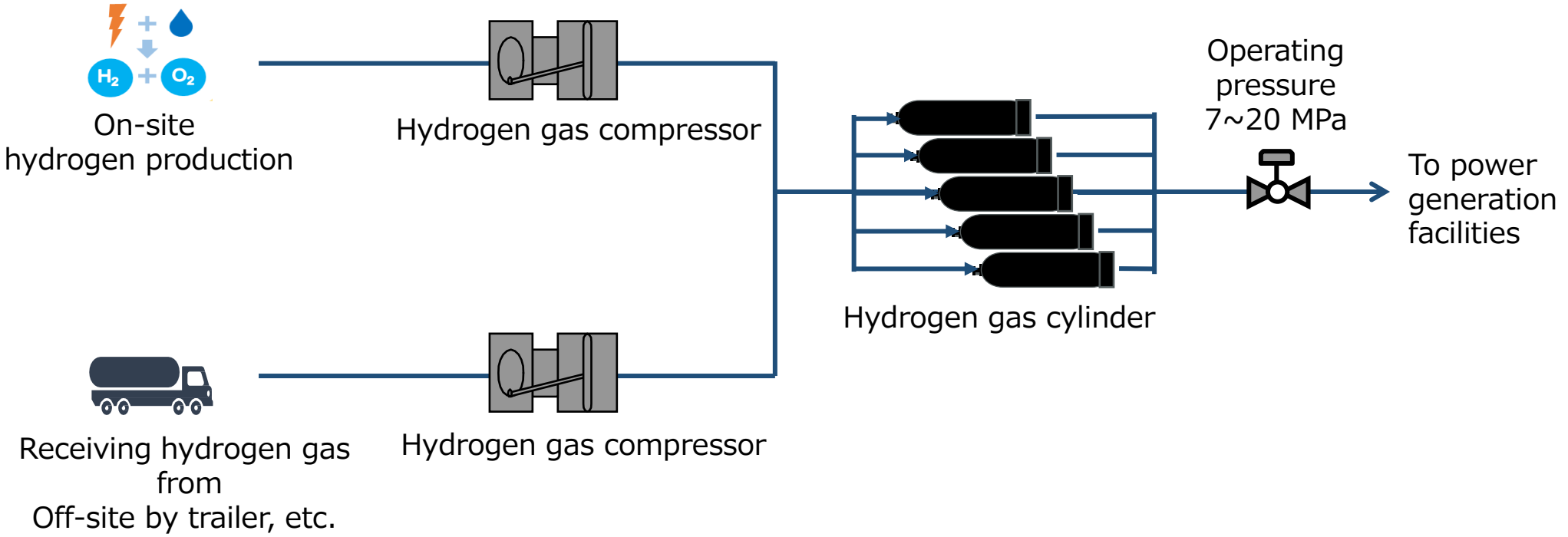
Results of exclusive natural gas firing

Items to be checked during the test	Confirmation Purpose	Result
Gas turbine combustion conditions	Confirmation that there is no abnormal combustion and that the combustion conditions is stable	favorable
Exhaust gas Properties Soot and smoke treatment conditions	Confirmation that NOx, which affects the environment, has not deteriorated	favorable
Load response	Confirmation that load response can be performed as in normal operation	favorable

Specifications of hydrogen supply facilities to be newly installed

- Hydrogen required for co-firing power generation is produced by installing water electrolysis system on site.
- The produced hydrogen gas is stored in hydrogen gas cylinders through a hydrogen gas compressor and supplied to the gas turbine.
- Facilities for receiving and storing hydrogen gas from off-site are also constructed.

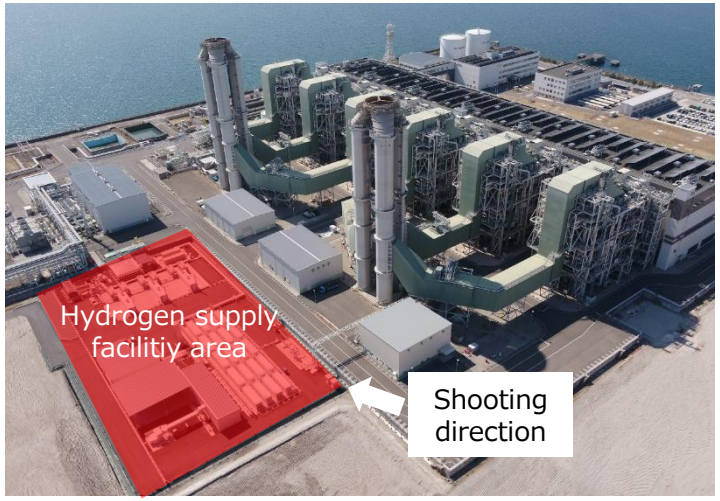
Equipment Specifications



Specifications of the hydrogen supply facility to be newly installed(general view)

Hydrogen supply facility local photo

Entire power plant



Before construction (as of December 2023)

Hydrogen supply facility area as of January 2025

Specifications of the hydrogen supply facility to be newly installed (Hydrogen gas cylinder/Hydrogen production equipment)

Equipment Specifications

Hydrogen production equipment	
Hydrogen gas production volume	200Nm3/h x 3 units
Hydrogen gas supply pressure	0.8MPa

Image

Ref) Kanadevia Inc.

Equipment Specifications

Hydrogen gas cyllinder	
Number of cylinders	600 pcs. (1 set of 30 cardles x 20 units)
Hydrogen gas supply pressure	Approx. 20 Mpa (at full capacity)
Storage capacity	Approx. 84,000Nm3

Image

Specifications of hydrogen supply facilities to be newly installed (hydrogen compressor)

Equipment Specifications

Hydrogen Compressor	
Number of unit	8 units
Rated pressure	20.7MPa
flow rate/unit	108Nm3/h (at suction pressure of 0.8 MPa)

Image

Specifications of hydrogen supply facilities to be newly installed (Off-site hydrogen receiving facilities)

- The hydrogen required for the demonstration test is basically produced by the water electrolyzer on site, but the system can accept hydrogen from outside for emergency (hydrogen produced in a different project is planned to be accepted).

Equipment Specifications

External hydrogen receiving facility (receiving method)	
H2 trailers (2 units)	Assumes approx. 15,000L
Hydrogen Gas Cardle	Assumes approx. 20-pack x 47L
Receiving units (3 units)	–

Image

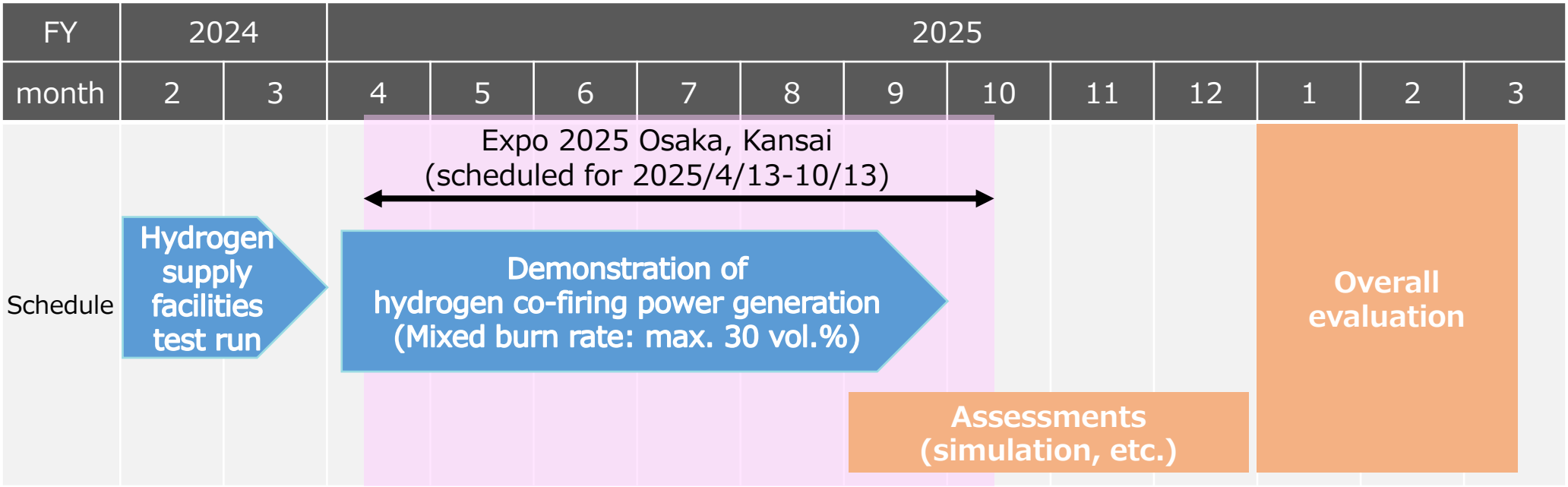
Safety Measures

- The results of the study of explosion protection scope and methods organized.
- In addition to equipment aspects, safety measures related to operation and maintenance were implemented to ensure that all possible safety measures are in place for demonstration.

Direction		Examples
Prevention of abnormalities	Equipment	(Leakage prevention) • In principle, welded joints are used for piping connections which pass hydrogen (Prevention of stagnation) • Forced ventilation and forced exhaust in enclosures
	Human Error	• Tag shows the open/close status of gauges, valves, etc. • Attach warning nameplates to instruments and valves that could lead to serious accidents (trip, personal injury, etc.)
Early detection of abnormalities	Equipment	• Installation of leak detectors
	Operational	• In the event of a backfire, the system detects changes in temperature deviation in the backstream of the combustor, automatically cut off the hydrogen and safely shutdown plant at the same time.
Accident escalation prevention	Equipment	• Installation of fire extinguishing and water sprinkler systems • Explosion-proof specification for hydrogen gas is adopted.
	Operational	(Explosion prevention) • Replace fuel gas with nitrogen gas if necessary • Interlock added to immediately cut off hydrogen if overdose occurs • Release hydrogen to safe area via exhaust pipe in case of abnormal pressure increase • Cylinders are covered with perforated metal to avoid abnormal pressure because of direct sunlight and watering facilities are installed to control temperature.

About the Demonstration Phase

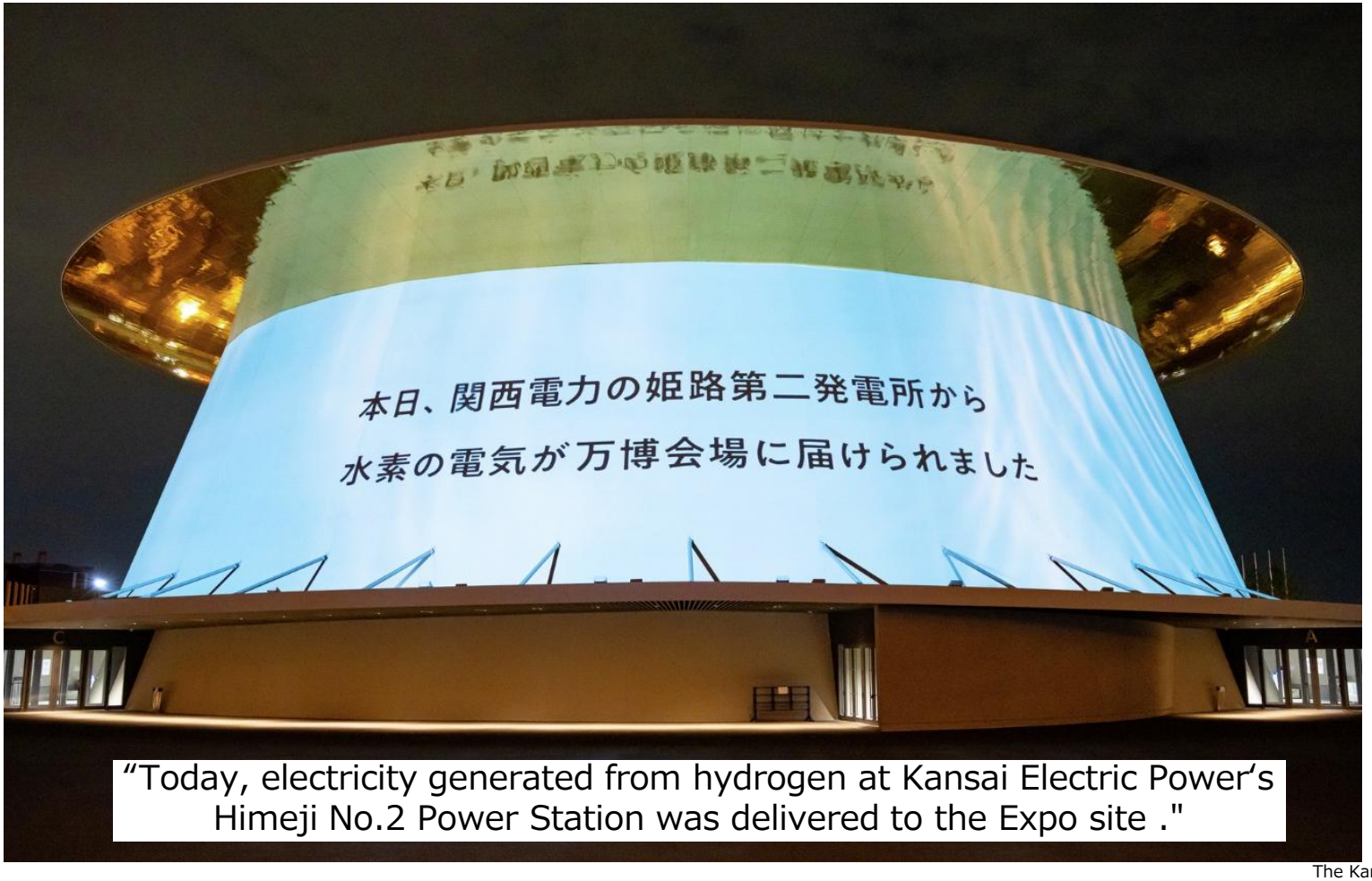
- The co-firing demonstration test has already started in April, the test is scheduled to be conducted once or twice a week.
- Conduct demonstration aiming for a target of up to 30vol% co-firing.
- After the completion of the demonstration test, issues for commercialization will be sorted out based on the test results, and overall evaluation will be done.



Supplying electricity to Expo 2025 Osaka, Kansai site

- A portion of the electricity generated by the hydrogen co-firing is supplied to the Osaka-Kansai Expo site.
- On April 9, 2025, a ceremony was held at the Expo site and a special projection mapping was shown at the "Shine Hat" in the EXPO Hall.

"Shine Hat" of the Expo site



"Today, electricity generated from hydrogen at Kansai Electric Power's Himeji No.2 Power Station was delivered to the Expo site ."

Summary

- ✓ In Zero Carbon Vision 2050, we set Zero carbon emissions on the supply side and Creation of hydrogen-driven society as the pillars of our efforts and we commit to exploring and demonstrating initiatives toward a hydrogen society. As part of these efforts, we will promote the co-firing and even exclusive-firing of hydrogen with thermal power generation.

- ✓ The detail design had been almost completed by FY2023, and the on-site construction was started in December 2023, and had been completed in March 2025. Demonstration has already started during EXPO 2025 OSAKA, KANSAI, JAPAN.

- ✓ By verifying the safety and reliability of hydrogen co-firing power generation through demonstration, the project aims to establish comprehensive operation technologies for hydrogen power generation facilities, including operation, maintenance, and safety measures, which will be necessary for commercialization. Furthermore, we aim to develop specialized personnel in hydrogen through practical work.

Thank you!