Hydrogen Production through Water Electrolysis Using Power from Renewables at NEDO Projects

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NEDO Green Innovation fund Hydrogen Production through Water Electrolysis Using Power from Renewables

Project Features

○ Technology development for increasing the size of water electrolysers, and Power-to-X large-scale demonstrations.
In order to realize technologies capable of **reducing the cost** of **alkaline type and PEM type water electrolysers by 2030**, R&D will take place on technology for **increasing in size** and modularizing scalable water electrolysers that can be mass produced.
(Asahi Kasei Co./ Yamanashi Prefectural Enterprise Bureau)

○ Establishment of performance evaluation technologies for water electrolysers

Technologies will be developed for evaluating stack performance, including levels of efficiency and durability, under various operating conditions (e.g., output fluctuations by simulating renewable energy and high-voltage operations) for alkaline type and PEM type water electrolysers. (AIST FREA)

https://green-innovation.nedo.go.jp/en/project/hydrogen-production-water-electrolysis-utilizing/

Power-to-X large-scale demonstrations Ⅰ

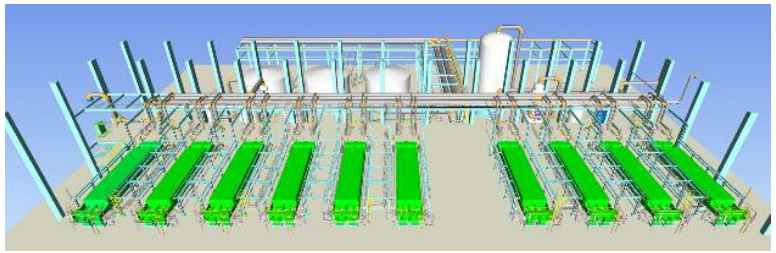
Large-scale Alkaline Water Electrolysis System Development and Green Chemical Plant Demonstration

Asahi Kasei Corporation/JGC HOLDINGS CORPORATION

FH2R (10MW ELY)

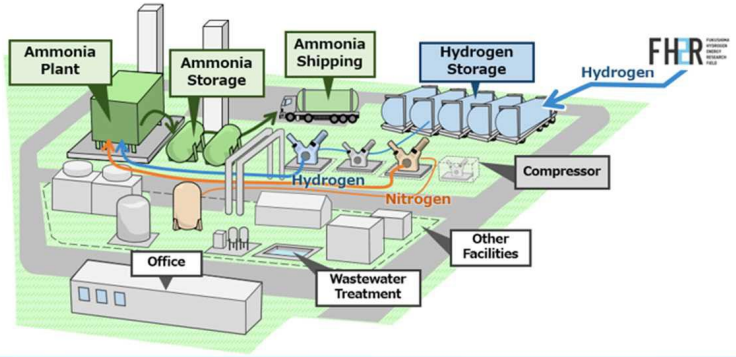
By combining the single-module FH2R water electrolysis system with the multi-module water Electrolyser pilot plant, the project aims for a 100 MW class commercial system through increasing the scales of demonstrations step by step.

Multi-module water ELY.



100 MW ELY

Power to Chemical (Ammonia) JGC



Power-to-X large-scale demonstrations Ⅱ

Development of energy demand conversion and utilization technology using a large-scale P2G system for achieving carbon neutrality

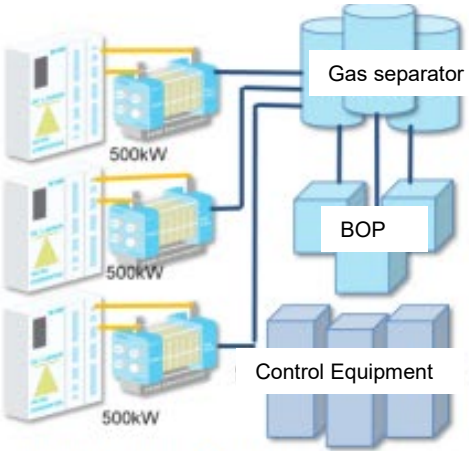
Yamanashi Prefectural Enterprise Bureau

Tokyo Electric Power Company Holdings, Inc.
TEPCO Energy Partner, Incorporated Toray Industries, Inc. Kanadevia Corporation
Siemens Energy K.K. MIURA CO.,LTD. KAJI TECHNOLOGY CORPORATION

16MW-class PEM water electrolysis will be modularized with related equipment and installed as a package at consumer sites.
A hydrogen boiler will be used to demonstrate the decarbonization of heat.

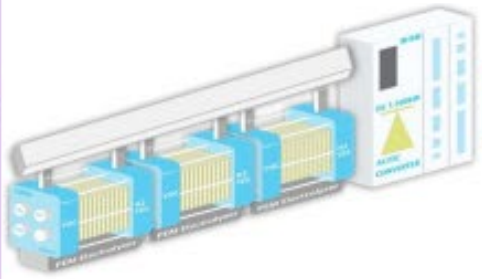
Hydrogen used in boilers for refining bottled water

Yamanashi/Komekurayama
1.5MW PEM ELY



Project Scope

Development of standard modules for several MW



Standard module ELY image

Prototype of modules connection ELY is manufactured and demonstrated

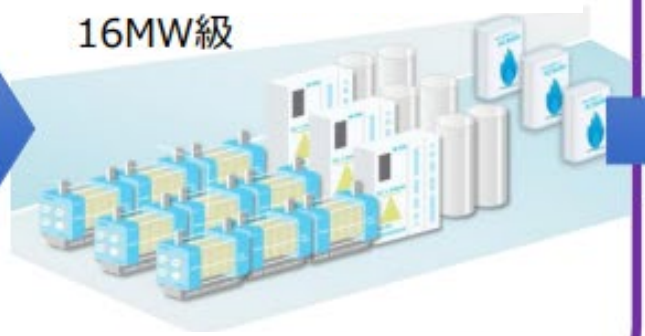


Image of modules connection ELY

Image of 100MW module connected ELY system

Establishment of performance evaluation technologies for water electrolysers

Aug. 2021～　March 2026

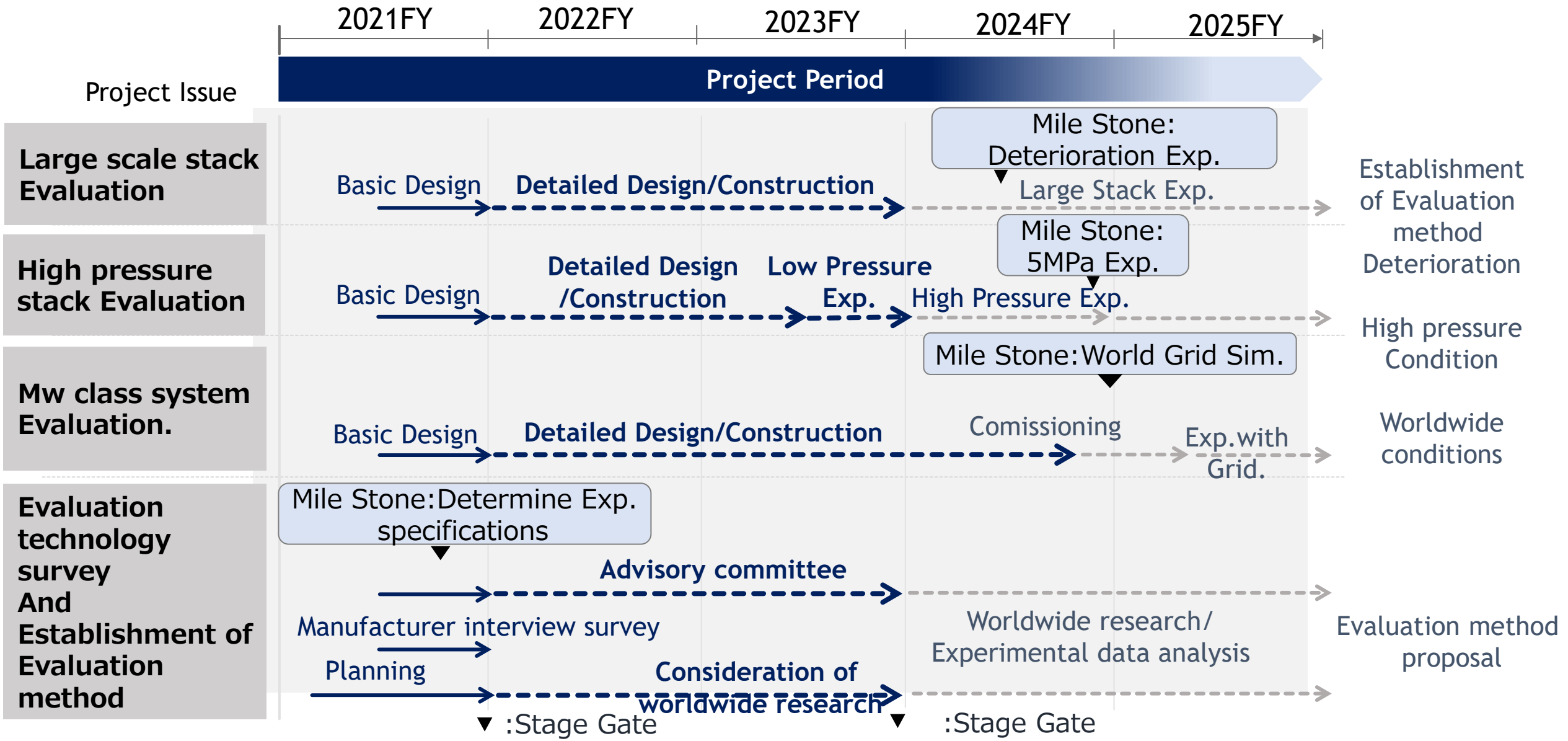
Fukushima Renewable Energy Institute, AIST (FREA)

The total budget is 3.6 billion yen over 5years.

Project Issues and KPIs

Issues	KPI
① Stack Evaluation	Establishment of a deterioration evaluation method for **500kW class** water electrolysis stack in a renewable energy environment
②High pressure Stack Evaluation	Establishment of stability evaluation method for electrodes and membranes under **high pressure** environment (**5MPaG**)
③ MW class electrolysis system evaluation under worldwide power conditions	Establishment of evaluation method for large water electrolysis system packages up to **MW Class**
④ Evaluation technology survey and Establishment of evaluation method.	We will conduct a **needs survey for electrolyzer** and reflect it in the **development of evaluation testbed and evaluation methods.**

Project detail and schedule



Large Scale Stack /High Pressure Testbed

Large Scale Stack & High-Pressure Testbed

- ○ Exp. Building
  (Oct. 2023)
- ○ Hydrogen Tank 1000Nm^3
  (Nov. 2023)
- ○ Scattering Prevention Cover
  (Nov. 2023)

Large Scale Stack Testbed

PEM type Electrolyzer　(Feb. 2024)

75 cells
Hydrogen production rate　100Nm^3/h
Rated input　500kW 150V / 3300A

Now Checking operating procedures and measurement equipment.

500kW　DC supply (Mar. 2024)

To support evaluation of various stacks.
Designed to be able to supply voltage up to **700V**, current **10000A** up to **500kW.**

Superimposed AC supply(Mar. 2024)

For impedance measurements inside the stack.
0.1-5kHz Maximum 400A can be superimposed on DC power supply.

Fuel Cell (Feb. 2024)

For hydrogen use.
100kW Output.
Hydrogen supply about 70Nm^3/h
Cold region specifications　(latest model)

Large Scale Stack Testbed

High Pressure Stack Testbed

Scattering Prevention cover (Nov.2023)

It is possible to conduct high-pressure electrolysis experiments inside.
W×D×H=3×5.5×2.8m
Thickness SS400 **12mm**

The interior can be replaced with nitrogen and ventilated. Temperature can be controlled from outside.

50kW class High Pressure PEM type Electrolyzer (Nov. 2023)
Electrolysis pressure up to 5MPaG

50kWclass DC power supply superimposed AC supply（Mar. 2024）
DC supply ~75V ~5000A
For impedance measurements inside the stack.
0.1-5kHz Maximum 400A can be superimposed on

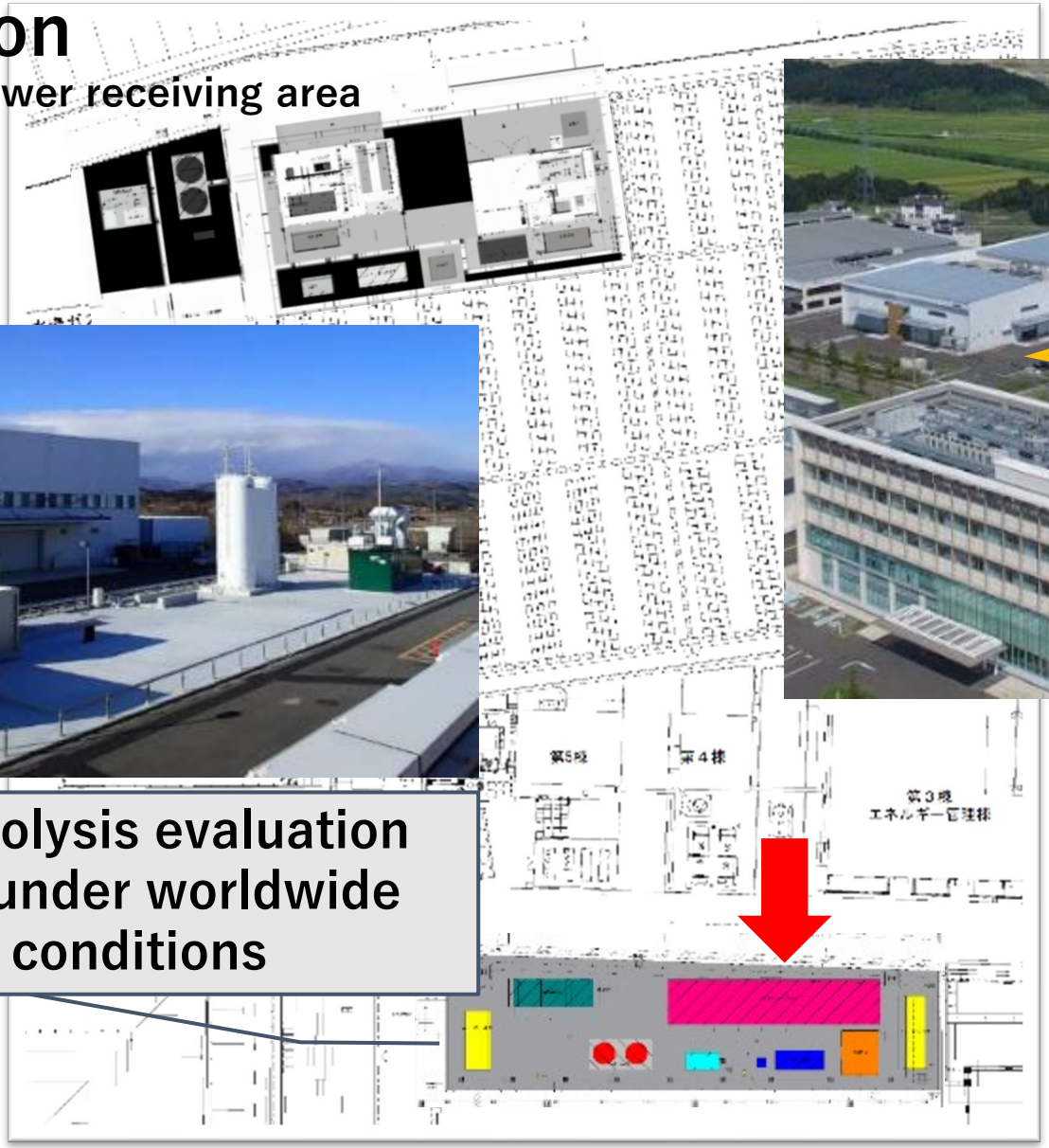
High pressure electrolysis test in progress.
Measurement of hydrogen leakage, etc.

MW class System Testbed

FREA Location

Special high voltage power receiving area

66kV Power reception



Water electrolysis evaluation equipment under worldwide power conditions

- ○ Evaluation equipment basics completed (Oct. 2023)
- ○ Hydrogen engine generator (installed in Dec. 2023, operational in Mar. 2024)
- ○ Installation of hydrogen tank (Dec. 2023)
- ○ Hydrogen piping with Experiment Large Scale stack testbed (Feb. 2024)

MW class System Testbed

We have established a test bed that enables the evaluation of MW class electrolyzers (packages).
(Alkaline electrolysis equipment scheduled to be introduced at the end of 2024)

AC 1MW
400 or 6600V, 50Hz

Commercial Grid
66kV→6.6kV

BTB
(AC/DC/AC)

AC Simulator
(Independent)

AC 1MW
400 or 6600V
50～60Hz
Various
Voltage, current,
wave, frequency

6600V

400V

Basis size: 5.74m×27m

ELY System
(Alkaline or PEM type)

H2

100Nm³/h
(Maximum
200Nm³/h)

Alkaline waste

Pure Water

N2

Cooling tower

Waste Liquid Tank

Hydrogen Engine Generator
(115kW)

Hydrogen Tank
1000Nm³
(＋tubing 1000Nm³)
Total 2000Nm³
Max. Pressure 1MPaG

Hydrogen Engine Generator
Rated Power 115kW
Hydrogen supply　100Nm³/h
Hydrogen 99%more

Alkaline electrolyser being installed (2024.Nov.)

Alkaline electrolyser being installed（2024.Nov.）

DC power supply

Hydrogen Compressor

Hydrogen Dryer

Future Plan

○ Green Innovation Project period (from August 2024 until March 2026)

① Evaluating the performance for fluctuation input and Developing accelerated deterioration evaluation using 500kw PEM ELY stack.

② Evaluating the performance and amount of gas crossover and performance in a high pressure 50kW PEM stack.

③ Evaluating the performance for fluctuation input and Accelerated deterioration evaluation mode using Alkaline ELY.

○ After Green Innovation Project period (After April 2026)

We will promote collaboration with companies related to water electrolysis and encourage their use in joint research.
We aim to use the equipment and methods developed in this project to conduct tests aimed at commercial-scale facilities.

This Presentation is based on results obtained from a project, JPNP21014, subsidized by New Energy and Industrial Technology Development Organization (NEDO).