

Euro Chlor,
12th International Chlor-Alkali Technology Conference and Exhibition

Asahi Kasei's Latest Technology Innovations in Alkaline Water Electrolyzer for Green Hydrogen

Green Solution Project
Asahi Kasei Corporation

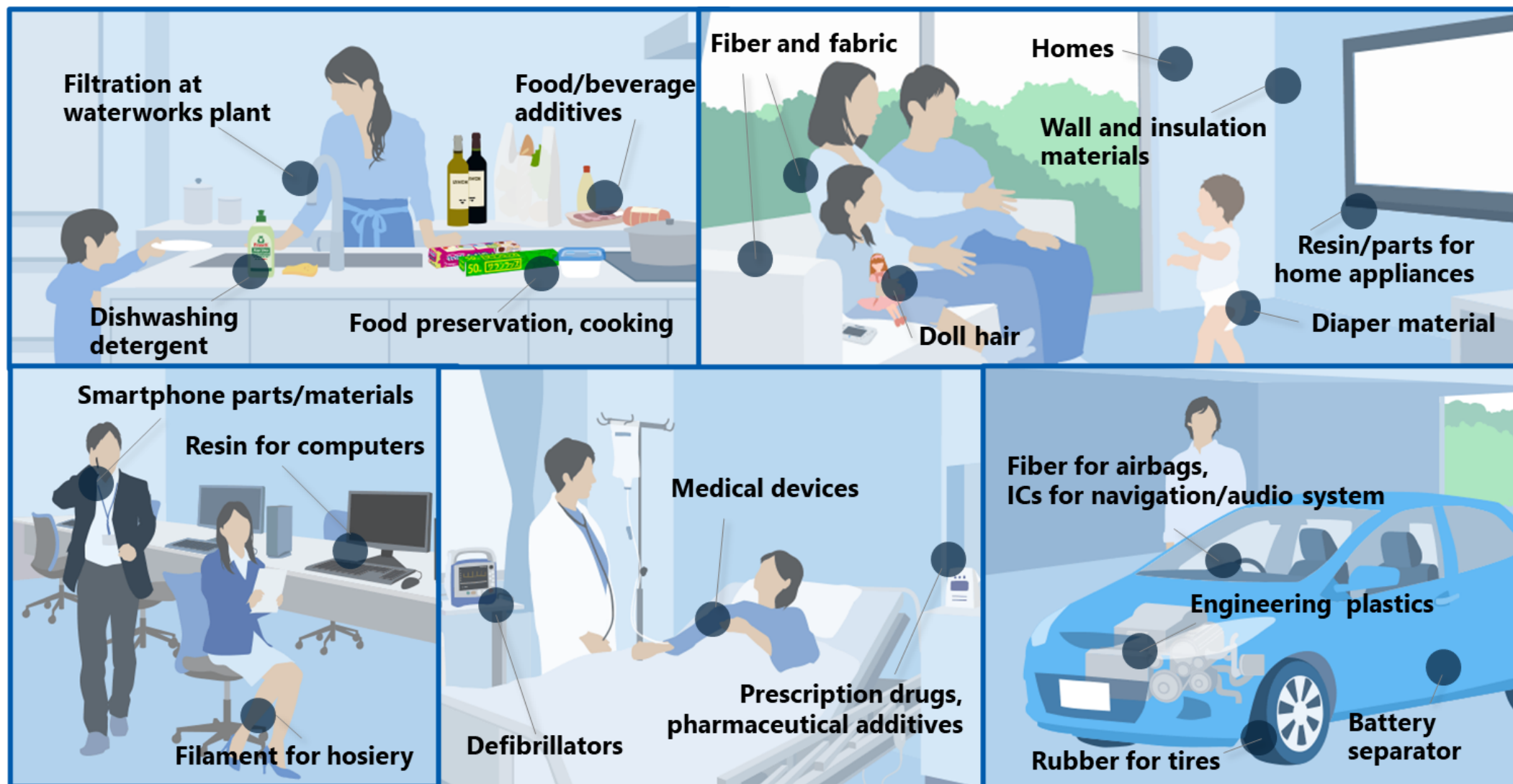


Today's Contents

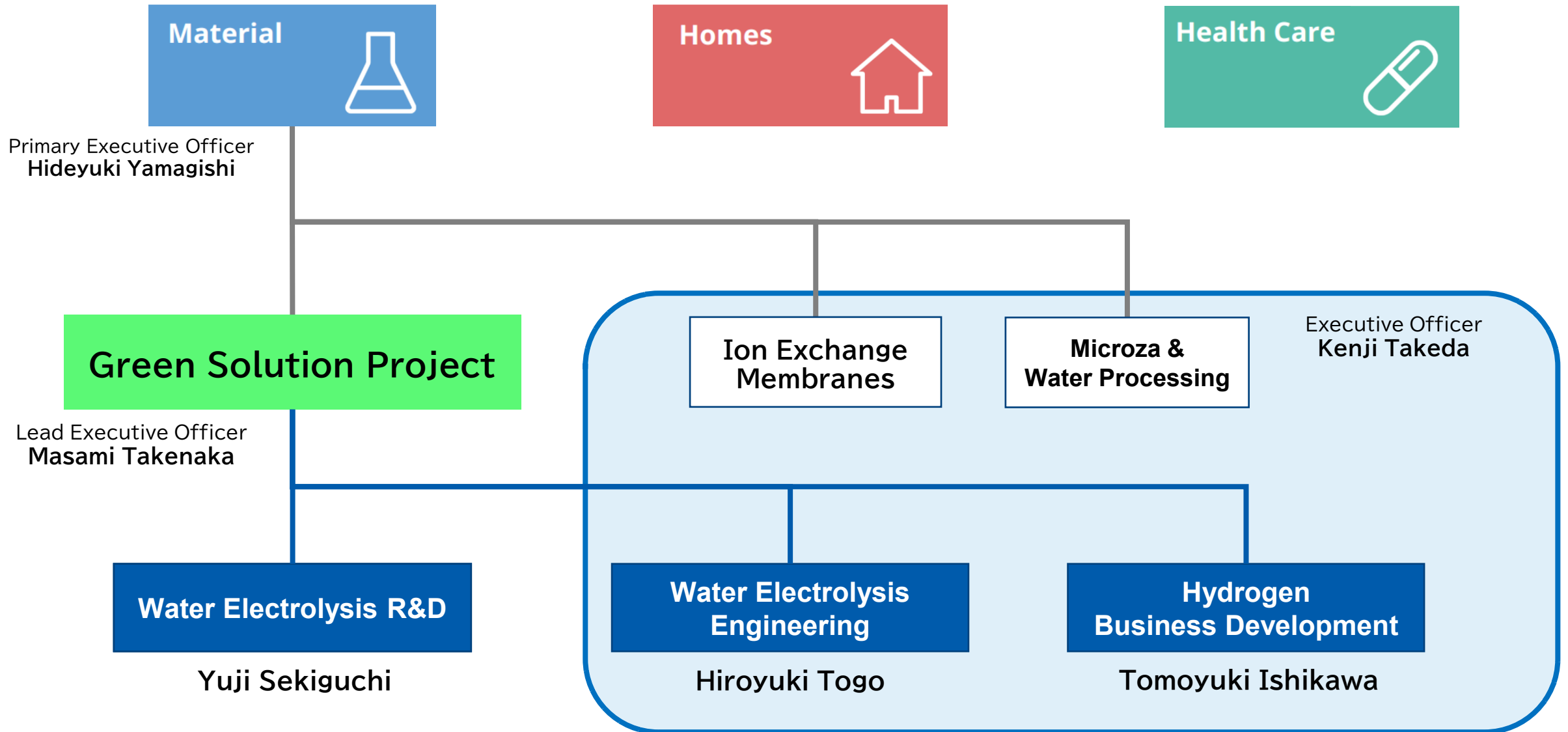
1. Introduction of Asahi Kasei and the Development History of Alkaline Water Electrolysis Technology
2. Features of the Alkaline Water Electrolyzer, Aqualyzer
3. Results from FH2R and In-House Pilot Facilities
4. Future Initiatives

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Asahi Kasei's Organization



History of Asahi Kasei's Electrolyzer

1. FH2R is a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).



1923

Started ammonia production using hydrogen from Water Electrolysis. Electricity was supplied by our own hydroelectric power plant.



1975

Launched Chlor-Alkali Electrolyzer system using Ion Exchange Membranes



2010

Started the development of the Alkaline Water Electrolyzer (AWE) system based on our Chlor-Alkali know-how



2020

Joined Germany ALIGN-CCUS project as an AWE supplier
Started 10MW scale AWE to FH2R¹ project in Japan

2024

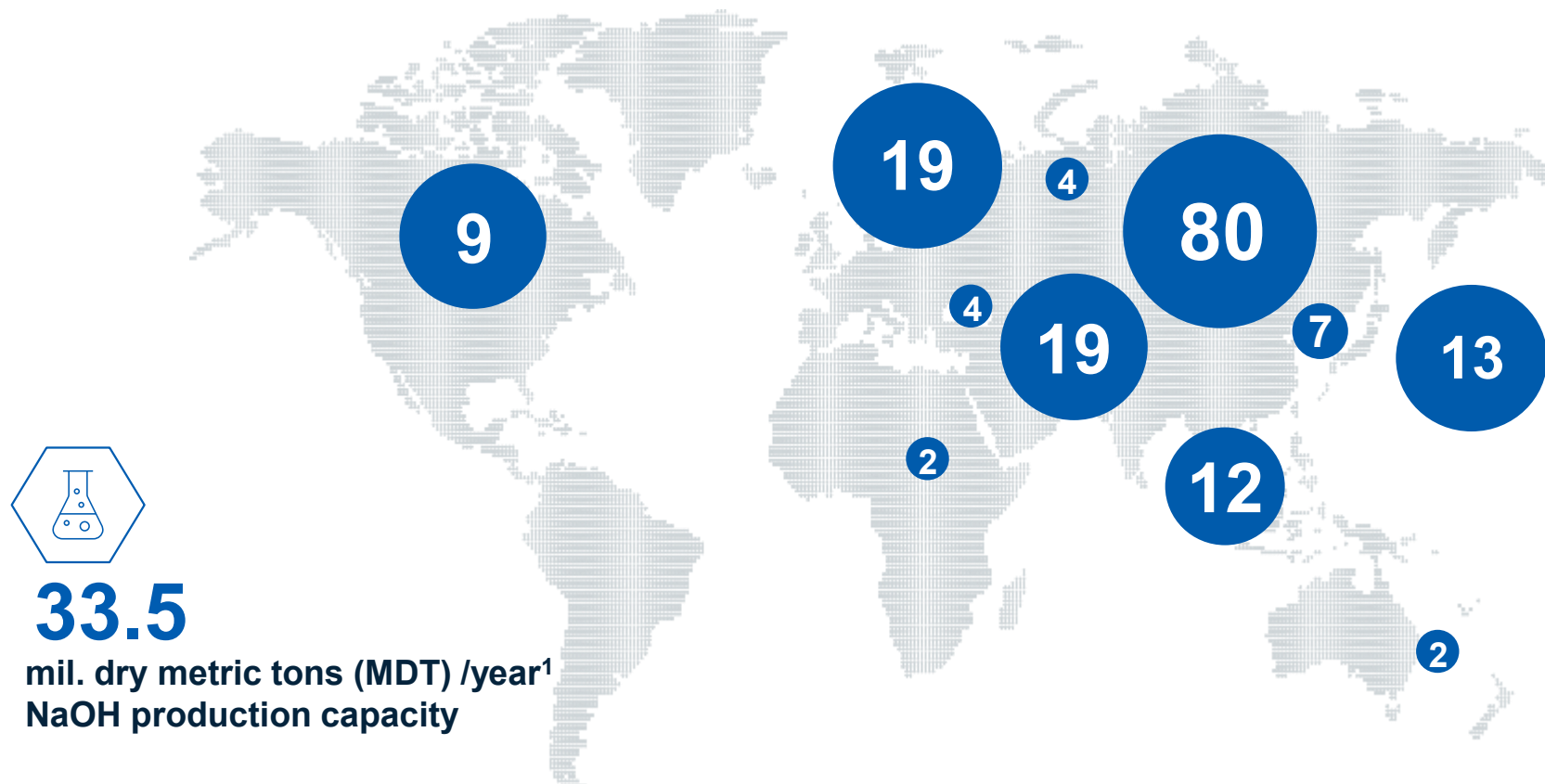
Started the operation of AWE pilot plant in Kawasaki to demonstrate the multi-modules control system
Collaborated with DeNora on the development and sales of a containerized AWE system.



2025 Launch Product

Asahi Kasei's chlor-alkali business at a glance

Number of plants using our electrolyzer



>50 years experience

supplying high reliability electrolyzer systems

Membrane supply

Aciplex™-F membranes are also supplied to major Chlor-Alkali customers

Maintenance facilities

close to customers on each continent to transfer maintenance know-how

>1GW of electrolyzer

manufacturing capacity in Japan + Additional expansion planned for AWE to increase 2GW capacity

Worldwide

installations at 171 end user plants

1. As of July 2024, including KOH

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»» 2. Features of the Alkaline Water Electrolyzer, Aqualyzer™

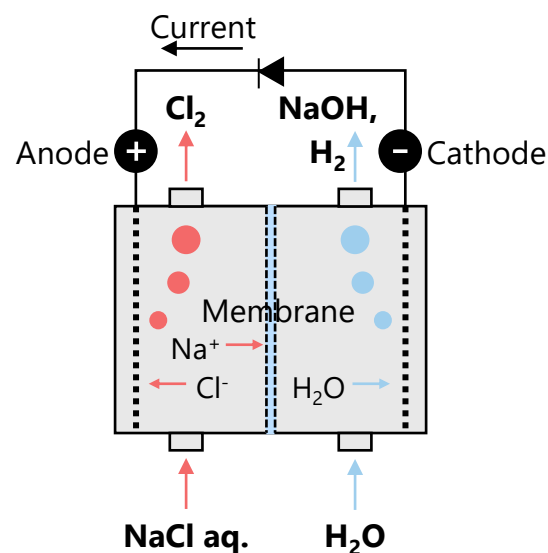
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The Transition from Chlor-Alkali to Green Hydrogen

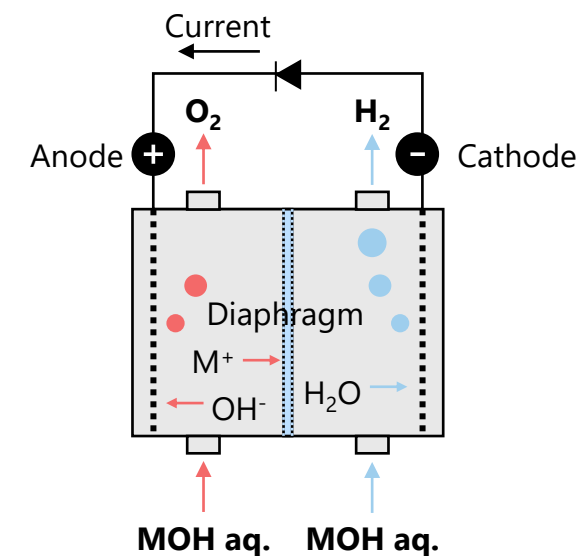
Asahi Kasei's chlor-alkali (CA) electrolyzer know-how forms the basis of our alkaline water electrolyzer (AWE) technology

Chlor-Alkali Electrolyzer **Acilyzer™**



- Membrane technology →
- Electrode technology →
- Common Components →
- Manufacturing capacity →
- Supply chain network →

Alkaline Water Electrolyzer **Aqualyzer™**



Technology know-how backed by Asahi Kasei's intellectual property enables

- High performance
- High reliability
- High quality

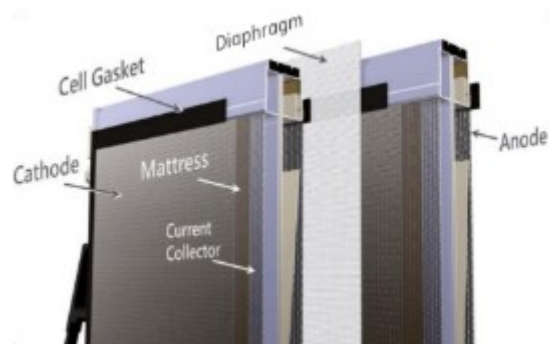
Established supply chain network and existing manufacturing capacity drive

- Cost effectiveness
- Faster scale-up
- Lower CAPEX

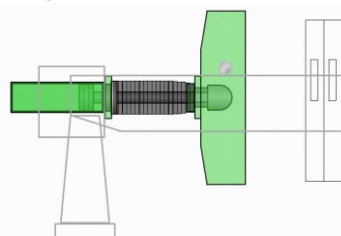
Aqualyzer™ | Features

Applying Asahi Kasei's chlor-alkali technology and business experience to development of water electrolysis systems

Cell design and performance improvement



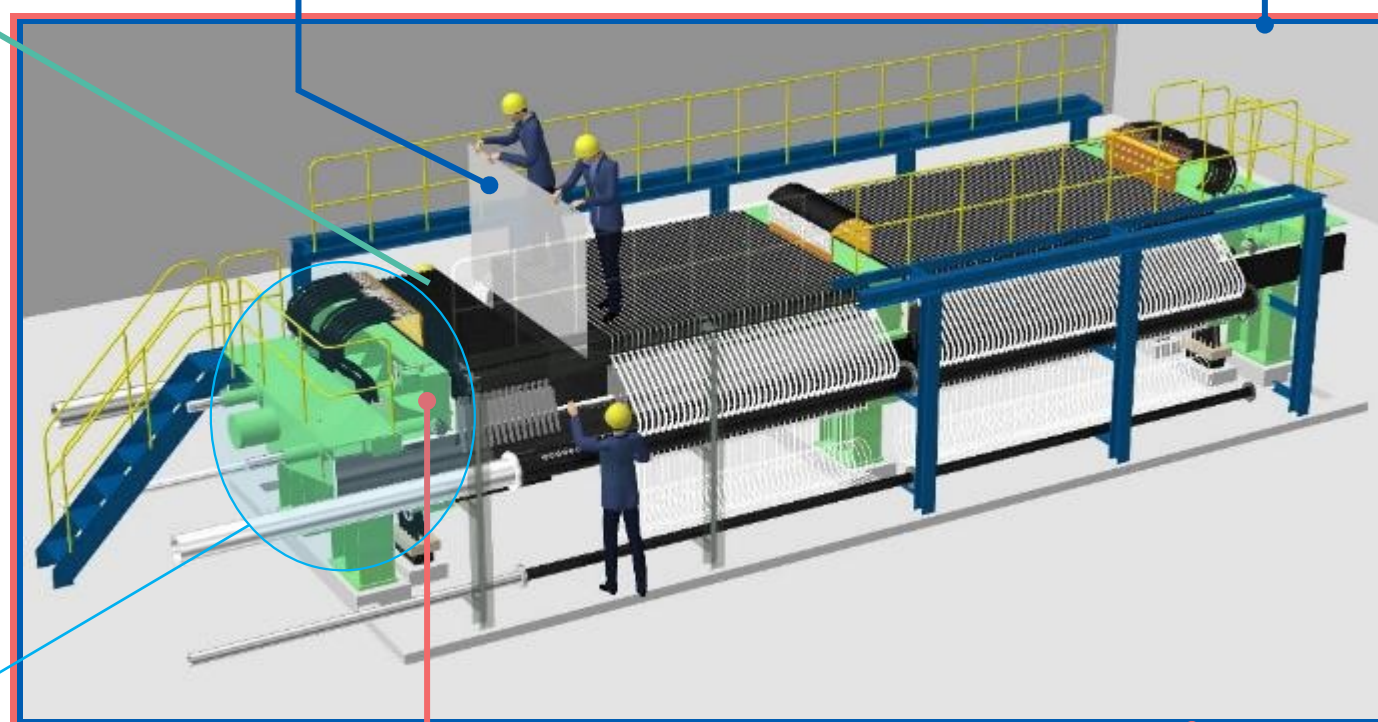
- ✓ Improved cell cost performance
- ✓ Improved internal circulation and uniformity
- ✓ Optimized with diaphragms, membranes, electrodes, and gas/liquid separation



Downtime reduction

Easy replacement of diaphragms, membranes, electrodes and gaskets

Automatic sequence



Enhanced safety

Automatic lock adjustment

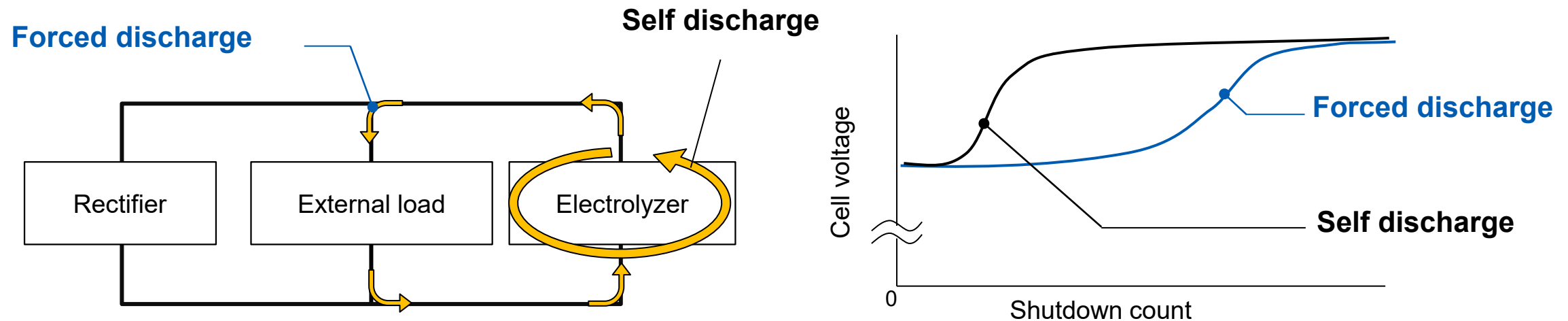
R2

- Performance monitoring and optimized operation control
- Predictive maintenance

Aqualyzer™ | Fluctuation response technology

■ Improved durability of starting and stopping

■ Control of discharge behavior by external load

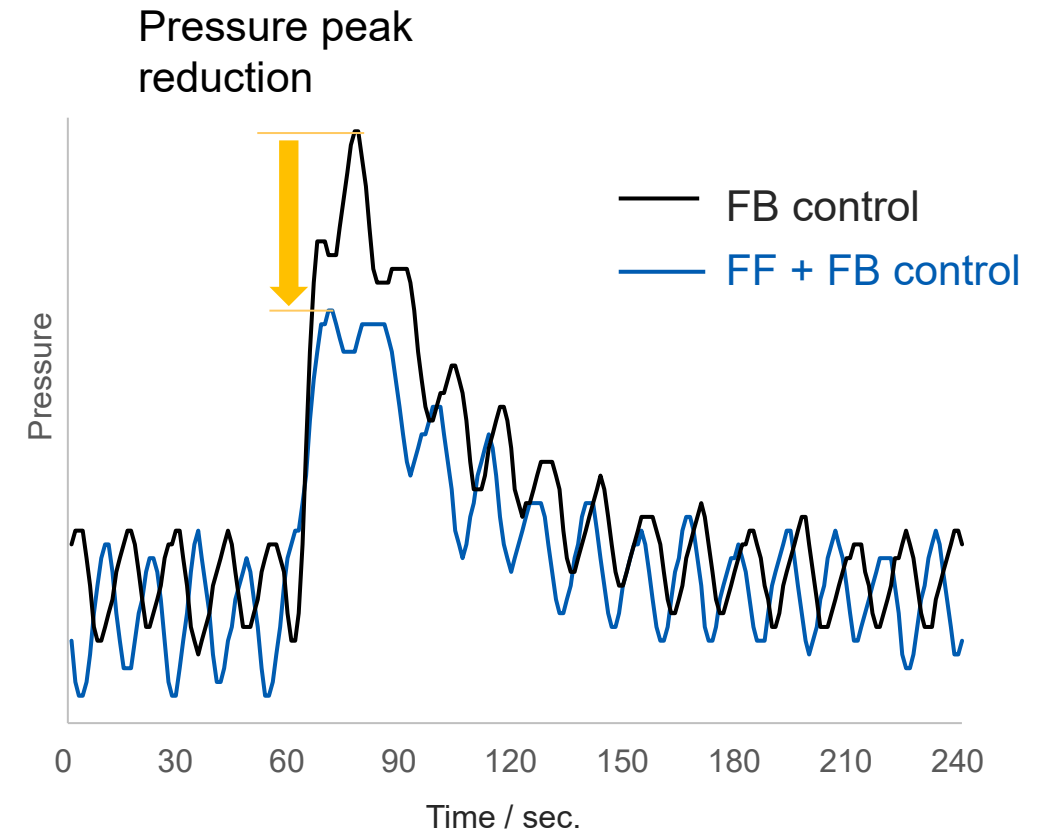
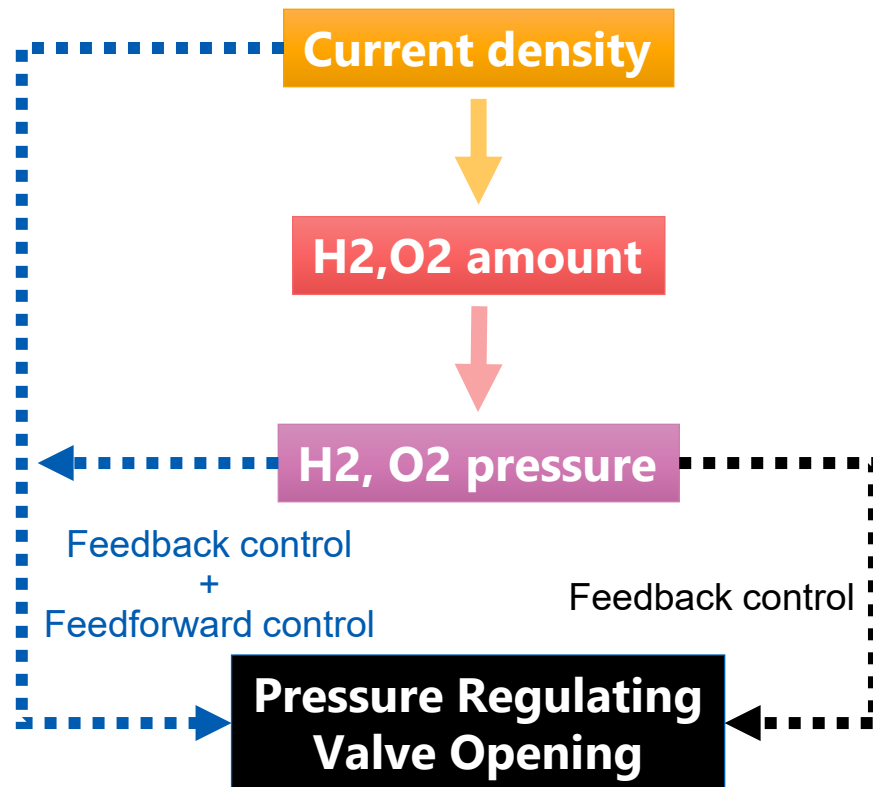


- ◆ Acceleration of discharges when electrolysis is stopped due to external load
- ◆ Extension of electrode-life by shorter discharge time

Aqualyzer™ | Fluctuation response technology

Oxygen/hydrogen gas pressure control

■ Mixed control of feedback and feedforward

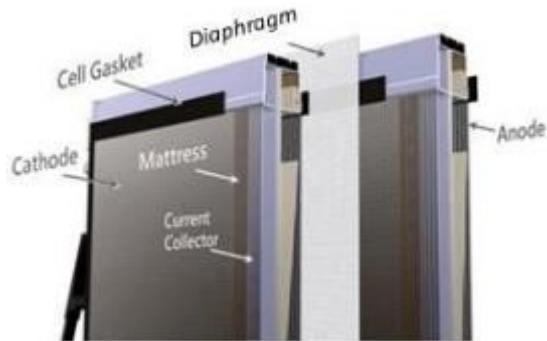


◆ Prevention of damages to electrolyzer from abnormal pressure

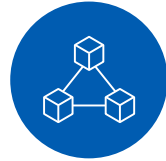
Easy expandability of Aqualyzer™ 10MW module



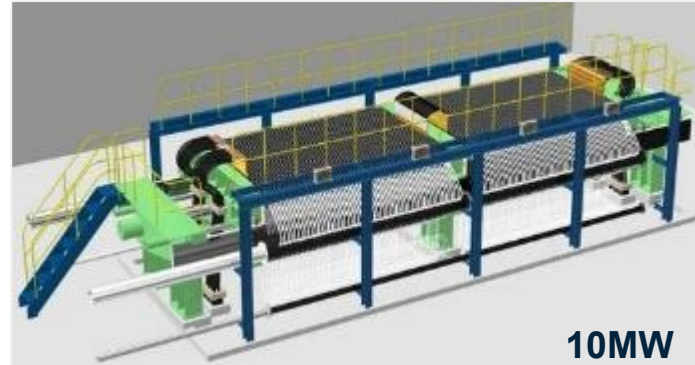
Cell



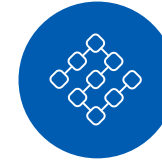
Basic unit of electrolyzer



10 MW module



10 MW modules can be used individually or as a standard building block for larger systems



100 MW multi modules



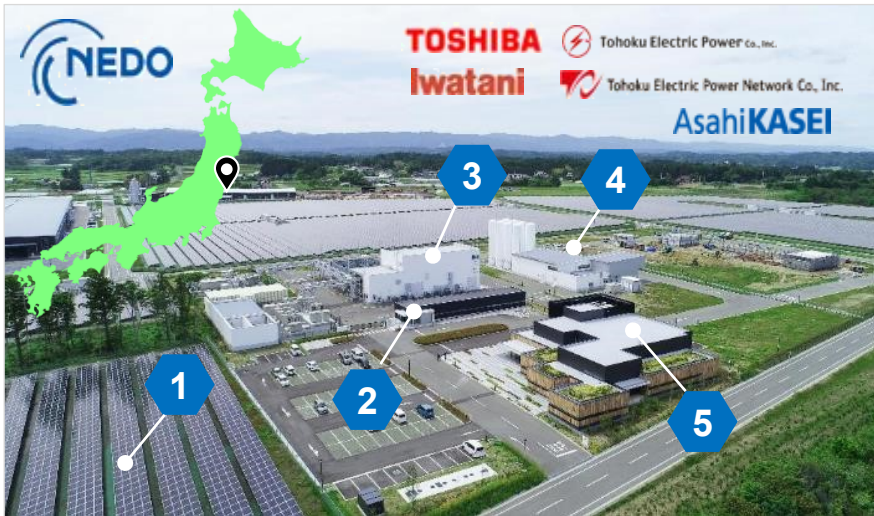
Expandable by connecting the 10 MW modules

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Aqualyzer™ | Demonstration facilities

Fukushima Hydrogen Energy Research Field (FH2R)*1



- 1 PV (20MW)
- 2 P2G Control system
- 3 10MW alkaline water electrolyzer facility



- 4 H₂ compression and loading facility
- 5 Visitor center

- ◆ In operation **since March 2020**
- ◆ Multiple test protocols have been completed. Performance under fluctuating input power, shutdown/restart has been confirmed
- ◆ FCV-class (ISO14687-2) hydrogen has been supplied to the local Hydrogen Refueling Station and Stationary Fuel Cells

In-House pilot facilities

Asahi Kasei is setting up two new in-house demonstration facilities in Kawasaki plant.

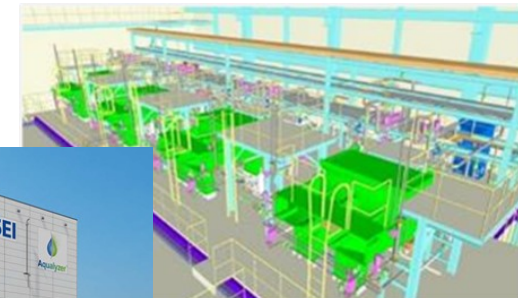
1 module facility

- In operation since Q2 2023
- Acceleration of material development



4 modules facility*2

- Start Q1 2024
- Multi-module operation



*1: FH2R is a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO)

Development of Technologies for Realizing a Hydrogen Society / Development of Hydrogen Energy Utilization Systems / Technical development concerning business model construction and large-scale proof of a hydrogen system for energy reuse


*2: Green Innovation Fund / Hydrogen Production through Water Electrolysis Using Power from Renewables / Technology development for increasing the size of water electrolyzers, and Power-to-X large-scale demonstrations / Large-scale Alkaline Water Electrolysis System Development and Green Chemical Plant Demonstration

Fukushima Hydrogen Energy Research Field (FH2R)



TOSHIBA
Iwatani

 Tohoku Electric Power Co., Inc.
AsahiKASEI

 Tohoku Electric Power Network Co., Inc.

10MW Alkaline
Water Electrolyzer
by Asahi Kasei

Hydrogen
storage and
supply facility

R&D center

P2G Control
system

PV (20MW)

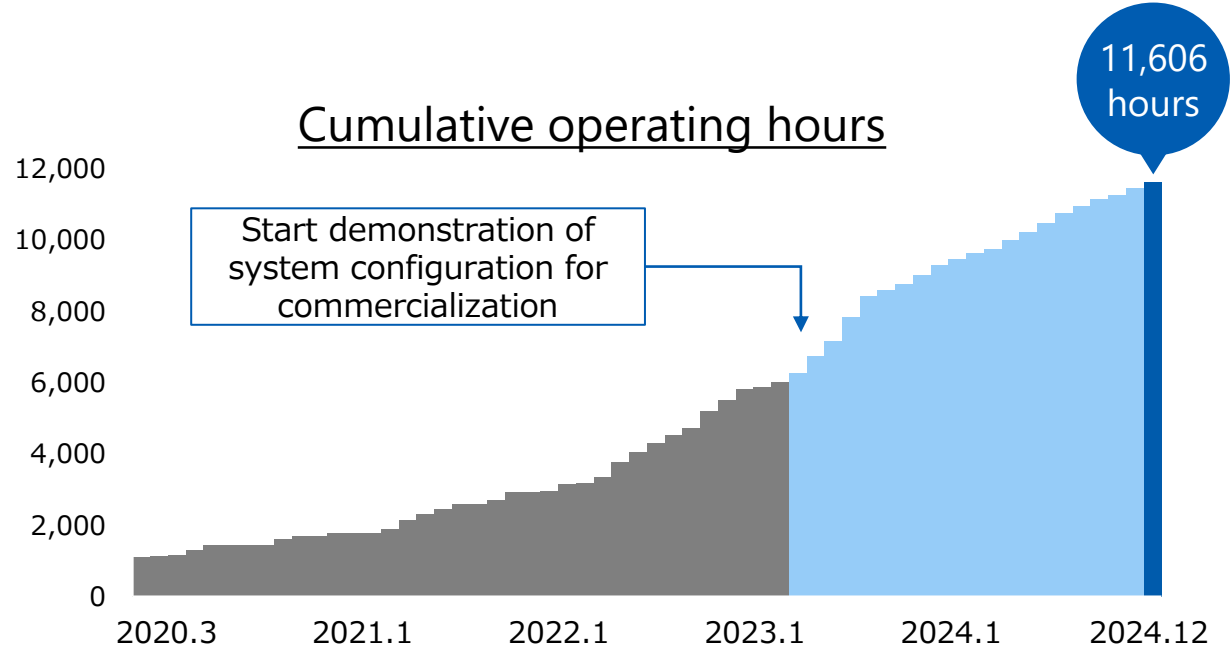
FH2R is a 10MW-class hydrogen production plant with 20MW PV + Grid in operation since March 2020

Multiple test protocols have been completed. Performance under fluctuating input power, shutdown/restart has been confirmed

FCV-class (ISO14687 Type I, grade D) hydrogen has been supplied to the local Hydrogen Refueling Station and Stationary Fuel Cells

10MW Alkaline Water Electrolyzer demonstration in Fukushima Hydrogen Energy Research Field (FH2R)

Building a system with over **10,000** hours of operational experience, ensuring **high reliability and robustness**



	Energized time	No. of Failures	Availability※
Stack	Approx. 6,000 hr	0	>99%
Stack + BoS	Approx. 6,000 hr	2	

※ Estimated as inherent availability under specified operating conditions after March 2023
Failures were caused by Balance of Stack, and no trouble occurred in the AWE



H2 produced is used for various purpose



H2 station



Stationary FC



H2 boiler

Image sources: public documents from each company

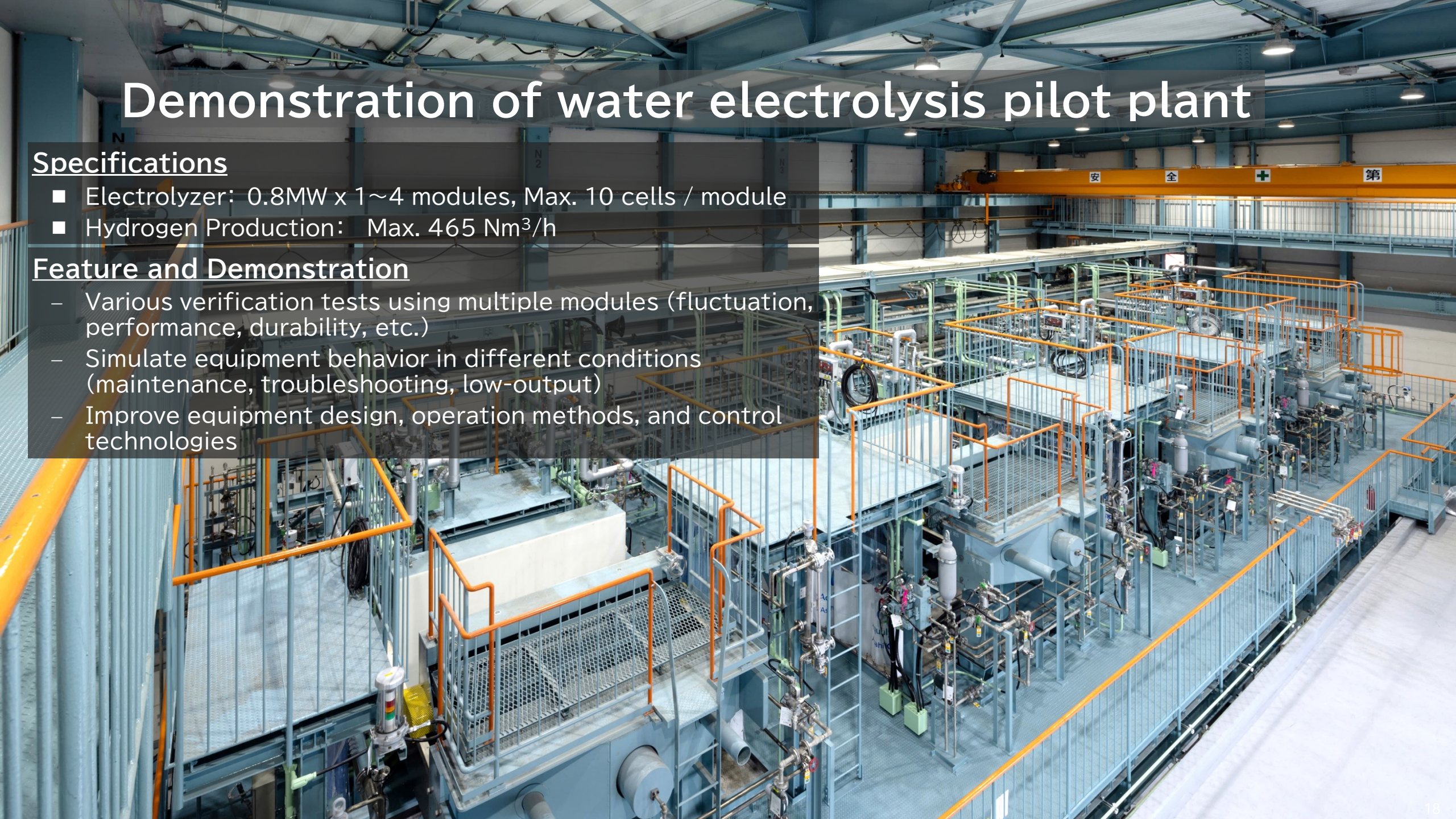
Demonstration of water electrolysis pilot plant

Specifications

- Electrolyzer: 0.8MW x 1~4 modules, Max. 10 cells / module
- Hydrogen Production: Max. 465 Nm³/h

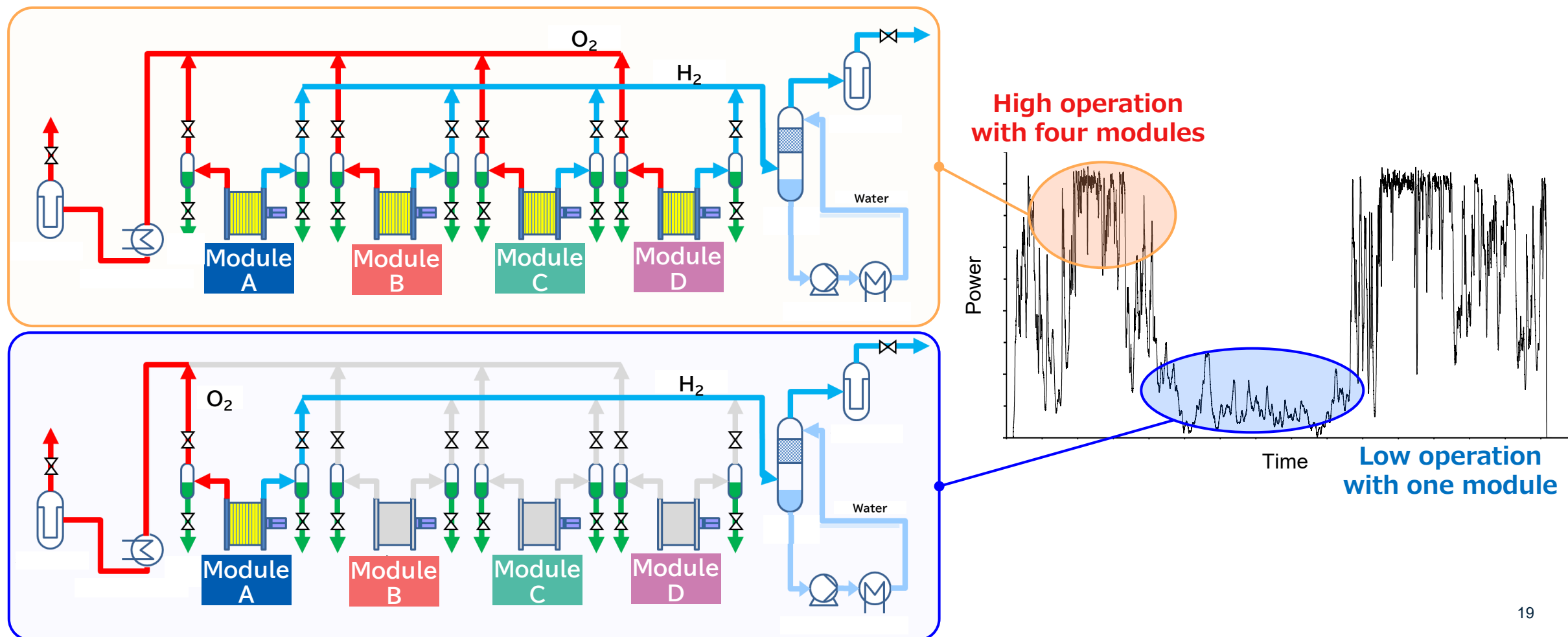
Feature and Demonstration

- Various verification tests using multiple modules (fluctuation, performance, durability, etc.)
- Simulate equipment behavior in different conditions (maintenance, troubleshooting, low-output)
- Improve equipment design, operation methods, and control technologies



Overview of the Pilot facility

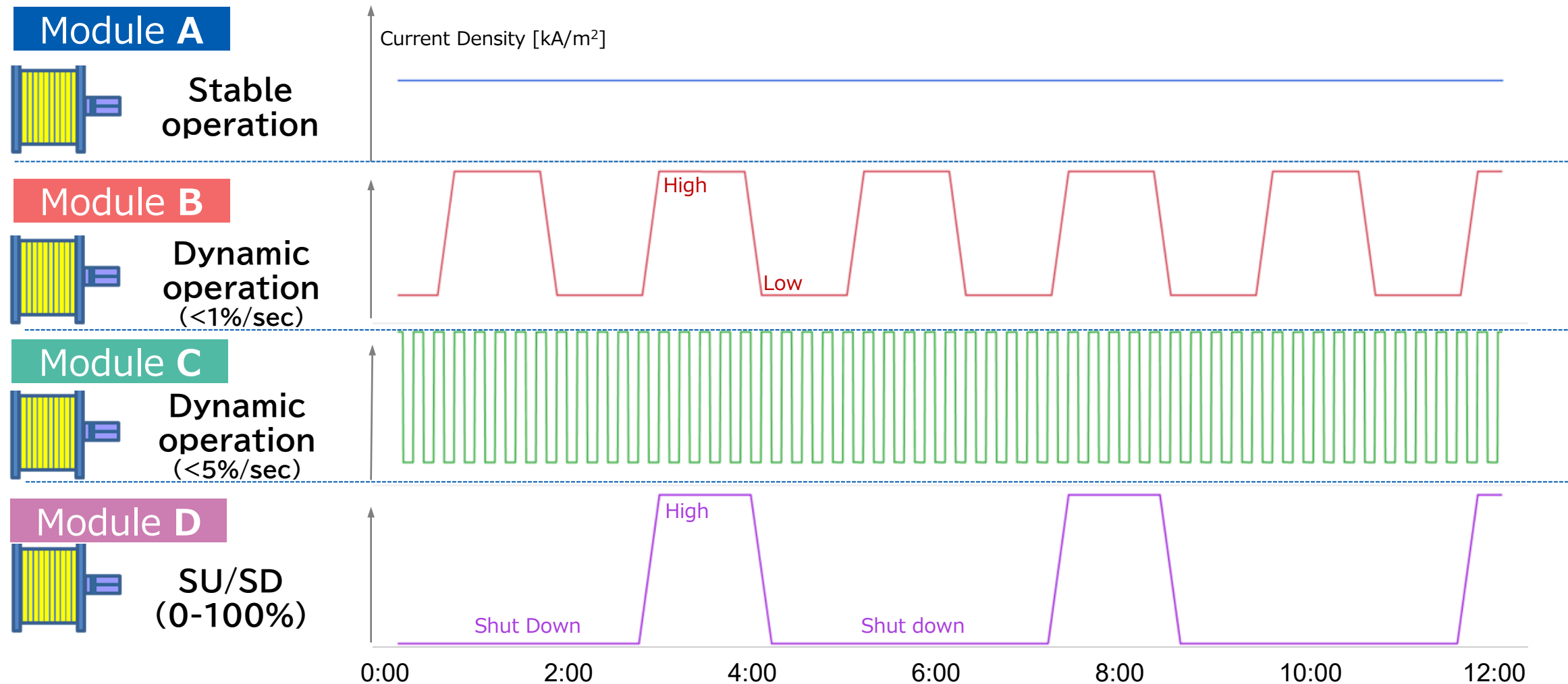
- ❑ Put **four modules** with the **size of commercial** cell in parallel
- ❑ Be able to control the power input to electrolyzer based on hydrogen production rate and power consumption
- ❑ Be able to do tests **in different operational condition** in each module



Operational condition in each module

Test different condition in each module to check the performance, durability and control system

Operational condition of each module



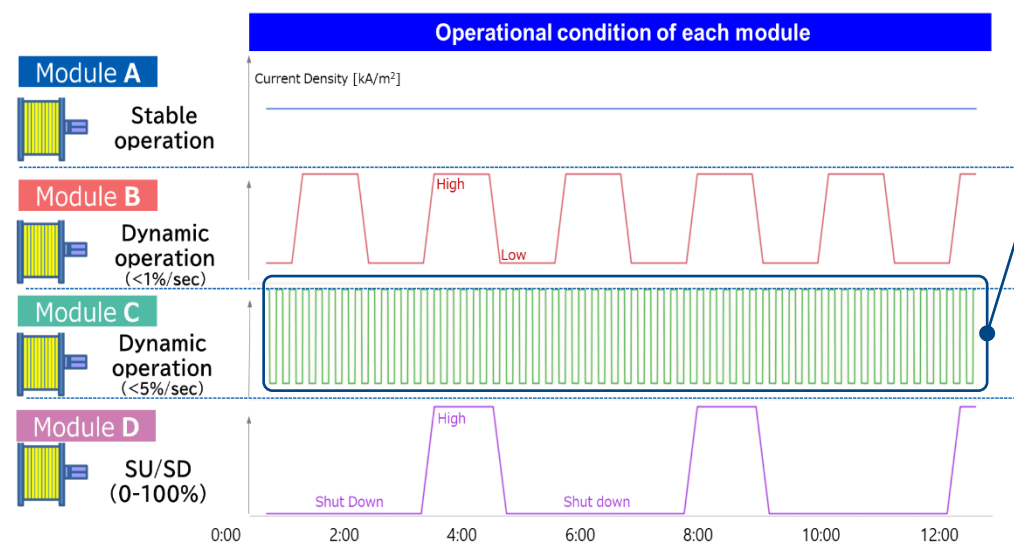
*This shows image of the operation, and it might be difference from the commercial specification

Demonstration status of the facility

✓ Number of **5%/sec fluctuation** reached to **2,500 times**

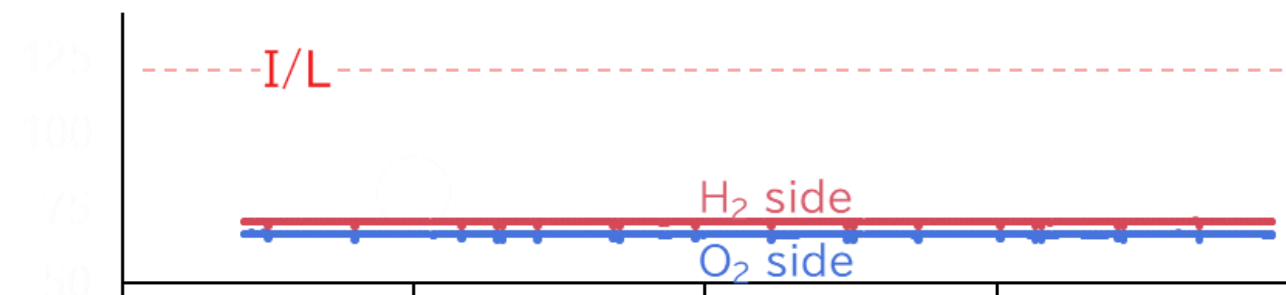
✓ **No issues** in pressure in module and H₂% in O₂

Operation in each module

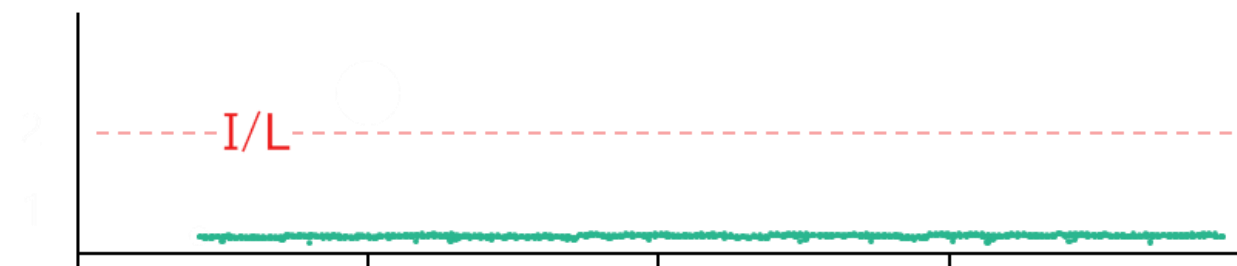


Durability in fluctuating operation

Pressure in module [kPa]



H₂% in O₂ [%]



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Aqualyzer™ : Key Differences in Size, Integration, and Installation

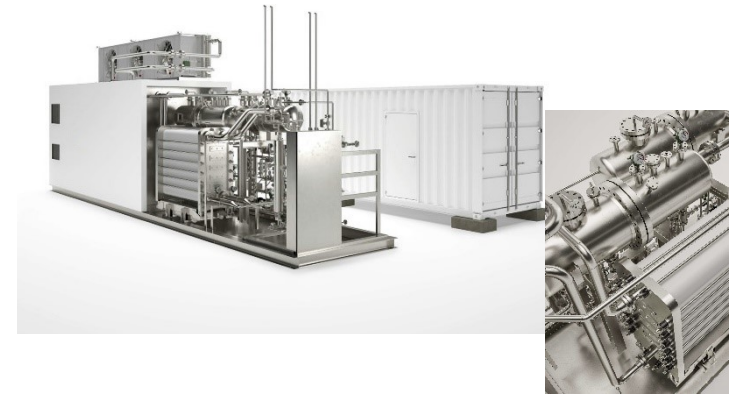
1 Lager scale type

- ✓ Target size: large scale more than 10MW
 - ✓ Type: Alkaline Water Electrolyzer, Atmospheric & Chlor-Alkali type
 - ✓ Actual Operation Experience:
 - More than 167 installations all over the world as Chlor-Alkali electrolyzer and 50 years experience of maintenance for “chemical plant”
 - 4 years of operating experience at Fukushima demonstration plant as Alkaline Water electrolyzer
- ※Fukushima Hydrogen Energy Research Field (FH2R)



2 Container type Aqualyzer™ C³

- ✓ Target size: 1MW ~ several MW
- ✓ Type: Alkaline Water Electrolyzer, pressurized & container type
- ✓ Features
 - Reduction of foot-print and easy engineering + construction
 - “Plug and Play” philosophy

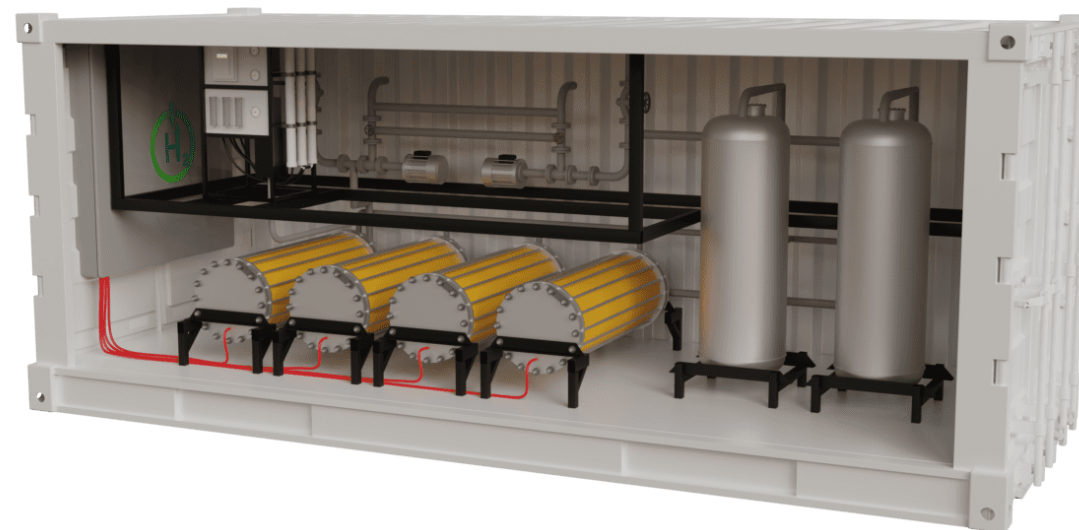


Extension to Next Generation Water Electrolysis Technology

Investing in Ionomr and P2H2 for AEM electrolysis technology.
Enhancing collaboration to advance next-gen water electrolysis.



AEM, 「Aemion+」 by Ionomer, Inc.



High pressure water electrolysis system by P2H2

Summary

■ Development of Aqualyzer:

Since 2010, Asahi Kasei has been developing the alkaline water electrolyzer, Aqualyzer, aiming for commercialization by 2025.

■ Hydrogen Production at FH2R:

Since 2020, Asahi Kasei has achieved hydrogen production using a 10MW alkaline water electrolyzer at FH2R.

■ In-House Pilot Facilities:

Pilot facilities have been conducting tests under various conditions simulating actual renewable energy fluctuations, and operations have been running smoothly so far.

■ Future Initiatives:

Asahi Kasei plans to introduce a few MW-sized pressurized alkaline water electrolyzers as entry models.

Asahi Kasei has invested in ventures developing AEM technology.



Creating for Tomorrow

THE COMMITMENT OF THE ASAHI KASEI GROUP:

To do all that we can in every era to help the people of the world make the most of life and attain fulfillment in living.

Since our founding, we have always been deeply committed to contributing to the development of society, boldly anticipating the emergence of new needs.

This is what we mean by “Creating for Tomorrow.”

