CDTI-NEDO online Joint Workshop on Hydrogen Technology
- Green Hydrogen Production & Mobility -

Developments of PEM type Water electrolysis system for Power to Gas

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MINISTERIO DE CIENCIA E INNOVACIÓN

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NEDO

AeH2 ASOCIACIÓN ESPAÑOLA DEL HIDRÓGENO

1. Hitachi Zosen Overview

Company Name	• Hitachi Zosen Corporation
Date of Founding	• April 1, 1881 by E. H. Hunter from UK
Date of Establishment	• May 29, 1934
Location of Head office and Chairman	• Osaka & Tokyo, JAPAN, Mr. Takashi Tanisho
Offices	• 32 Domestic offices & 7 works in Japan • 43 Overseas offices & subsidiaries
Capital	• 45,442million JPYen
Net Sales	• 408,500million JPYen (2020FY)
Employee	• 10,580 (Consolidated)

2. Hitachi Zosen Product

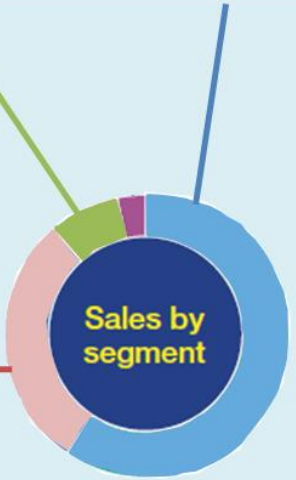
Infrastructure, Precise machinery 7.3%

Bridges

Tunneling Boring Machines

Environmental Systems & Industrial Plants 63.8%

Energy-from-Waste systems



408.5 billion JPYen
(FY2020)

Machinery, Process Equipment 26%

Marine Diesel Engines

Pressure Vessels

Waste water treatment

New Business and New Fields

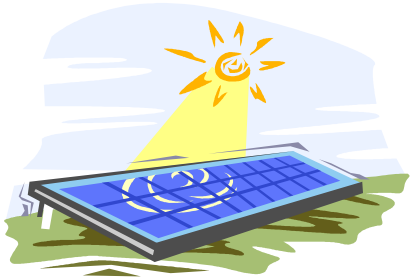
Offshore wind power generation

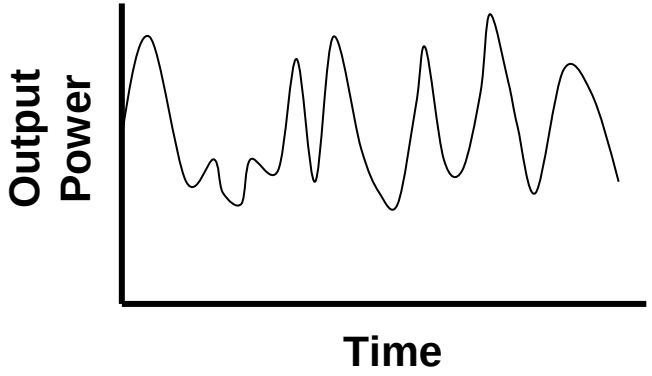
Hydrogen
Water Electrolysis (WE)

Methanation

Biogas Systems

3. Utilization of large-scale renewable energy





Power output from renewable power stations fluctuate due to sunlight and wind temporally/seasonally.

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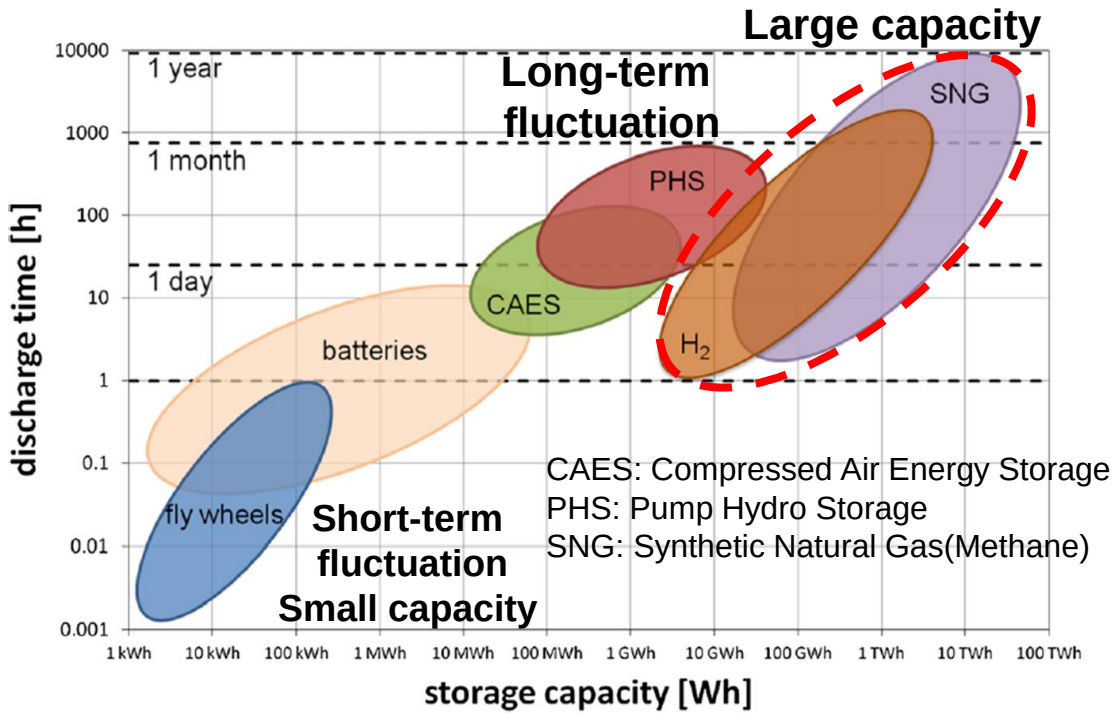
Energy storage is essential for well use of the power generated by renewable energy.



Large-scale and long-term energy storage technology is necessary

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Conversion of renewable electricity into gas fuel (hydrogen, SNG) for energy storage

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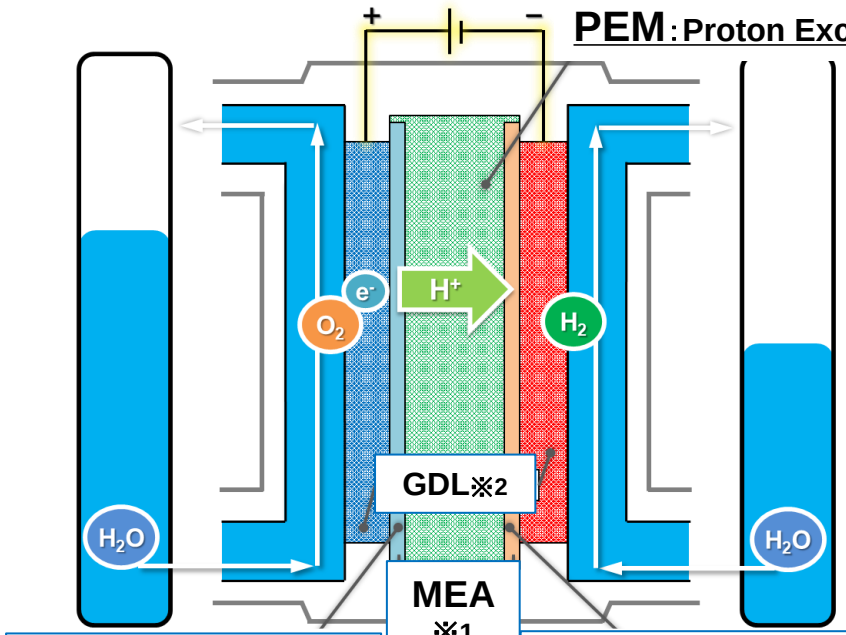
Power to Gas

4. Comparison of Alkaline and PEM type WE System

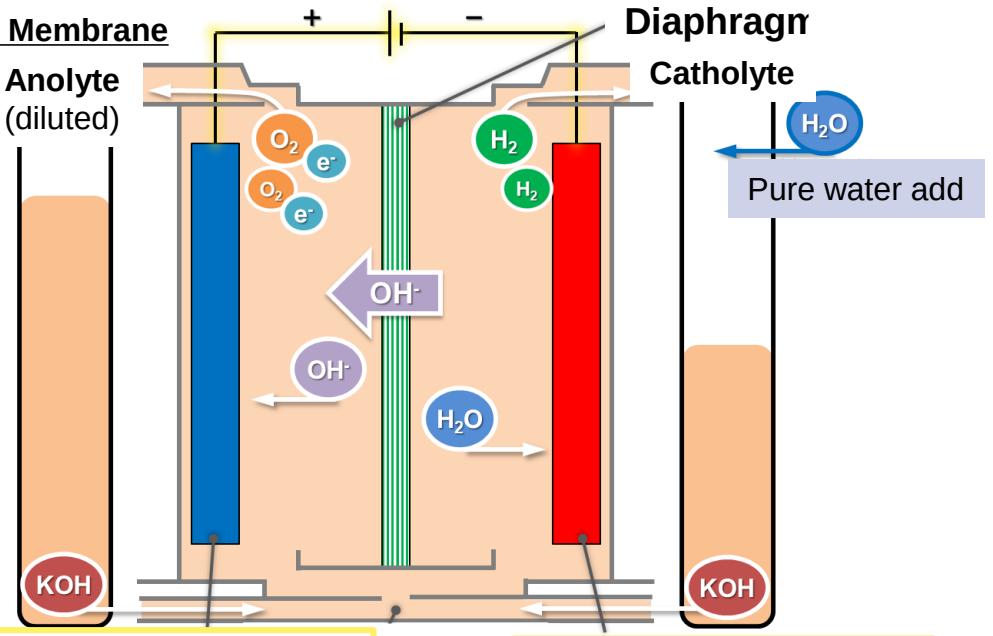
PEM Type WE System



Anode Catalyst
$2H_2O \rightarrow O2+4H^+ +4e^-$

Cathode Catalyst
$4H^+ +4e^- \rightarrow H_2$

Alkaline WE System



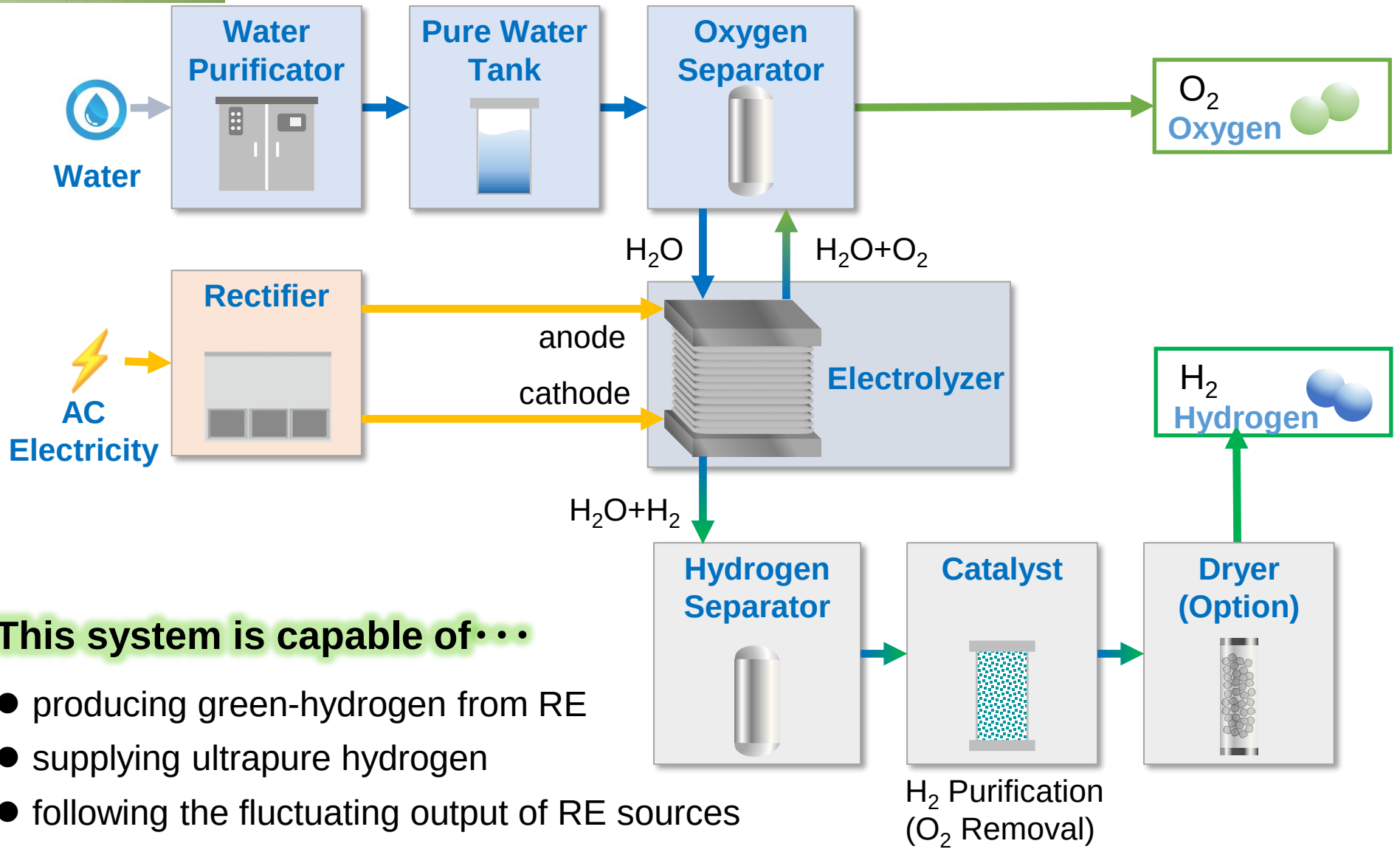
Anode Electrode
$4OH^- \rightarrow 2H_2O+O_2+4e^-$

Cathode Electrode
$2H_2O+2e^- \rightarrow 2H_2+2OH^-$

※1：Membrane Electrode Assembly　※2：Gas diffusion Layer

	PEM Type	Alkaline
Electrolytic Temperature	60～90 °C	40～80 °C
Electrode area	≤ 0.2 m^2	≥ 3 m^2
Current density	10～30 kA/m^2	2～10 kA/m^2
System cost	High	Low

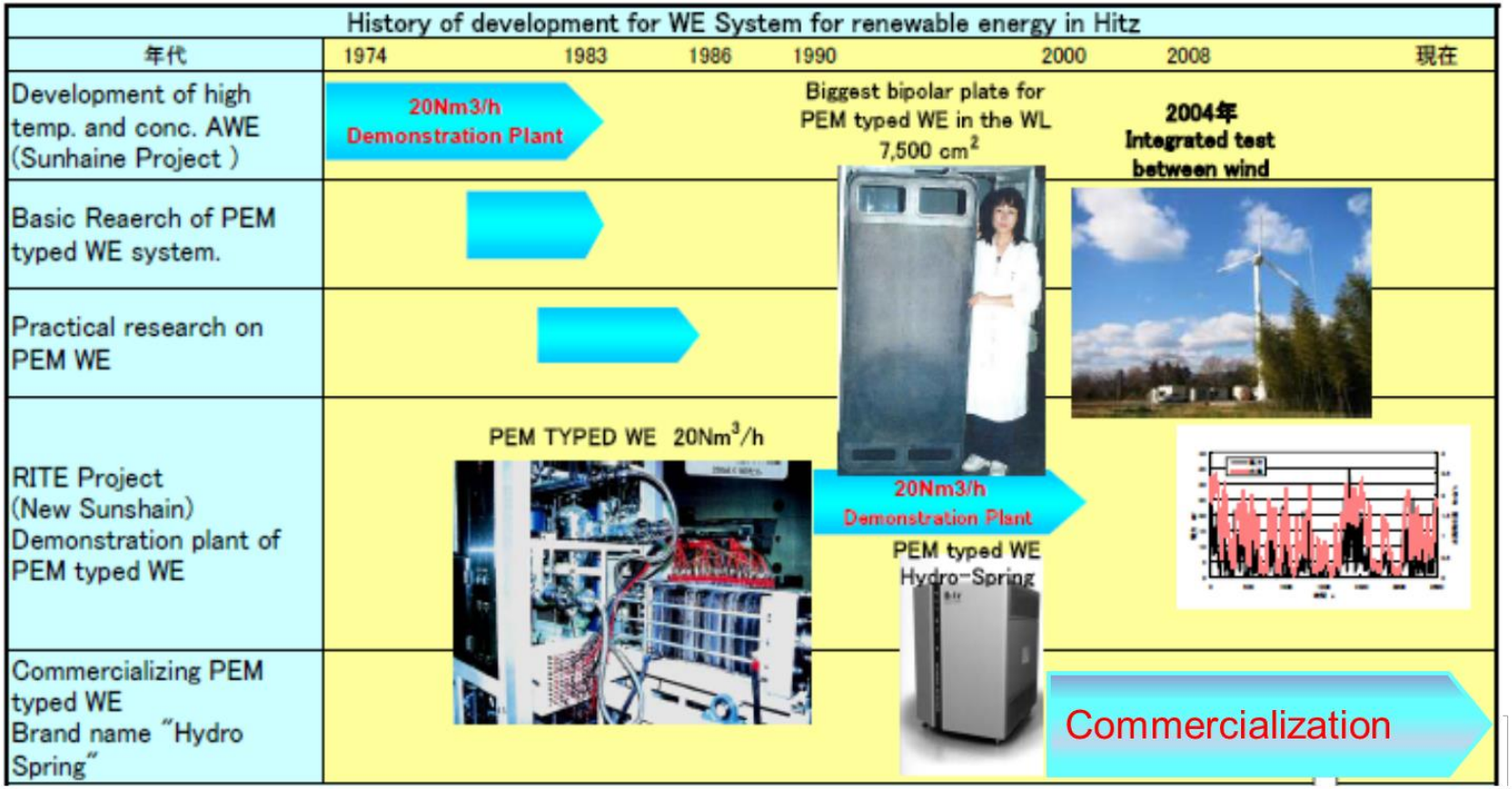
5. Configuration of PEM type WE System



This system is capable of・・・

- producing green-hydrogen from RE
- supplying ultrapure hydrogen
- following the fluctuating output of RE sources

6. History of Hitachi Zosen's R&D for WE System



- 1970～ Development of water electrolysis system (alkaline type)
- 1990～ R&D of PEM-type water electrolysis system
- 2000～ Launched PEM type electrolysis system "HYDROSPRING®"
- 2004 Demonstration of converting wind power into hydrogen using HYDROSPRING®

7. Cases of renewable energy deliveries to HYDROSPRING®

2010 Tsukuba University (2Nm³/h)

2012 Fukushima Renewable energy Institute (FREA), AIST(5.5Nm³/h)

2015 Hydrogen station in Kyushu Univ. (1Nm³/h)

2017 FREA, AIST (5Nm³/h)

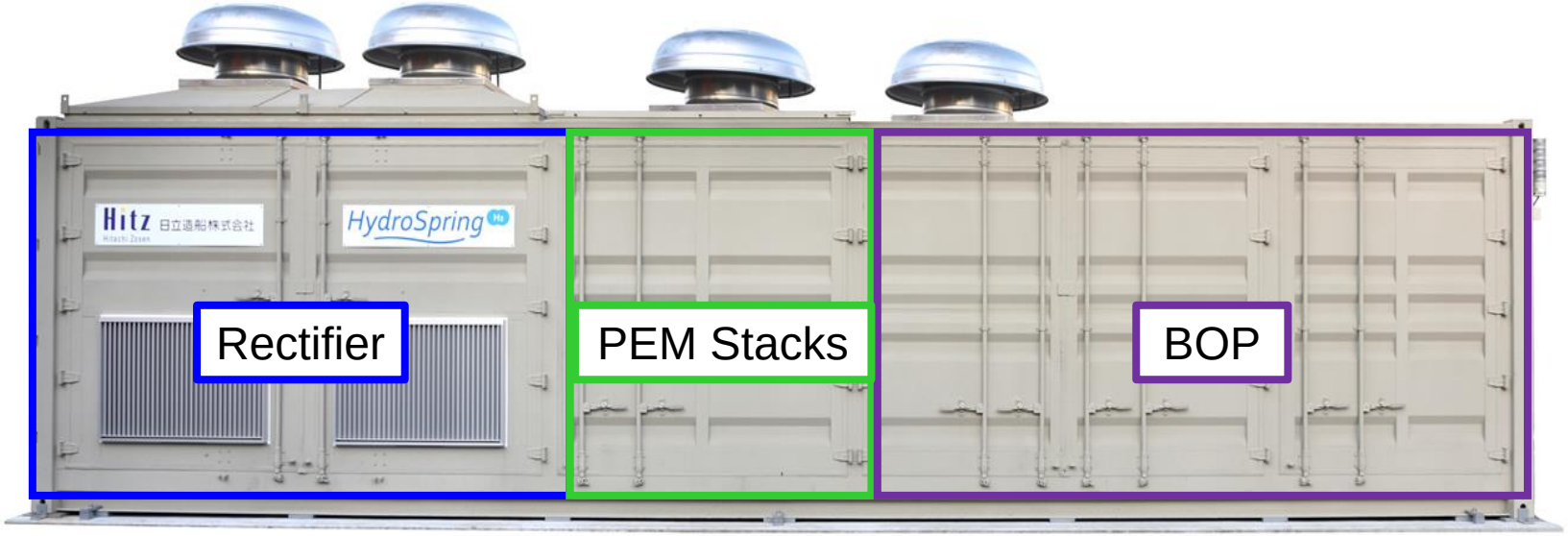
2017 Toyota Motor Kyushu, Miyata Works for FC Folk Lift (24Nm³/h)

8. Development of Large-scale WE System

MW-class HYDROSPRING® was developed
to meet the growing demand for high-capacity water electrolysis system

Features of MW-class【HYDROSPRING®】

1. Main unit stored in a 40 ft container
2. Easy for transportation
3. Easy for installation and less cost for local construction



Rated pressure :0.8 MPaG
Electric capacity :1 MWel
Dimension:12.2m×2.4m×2.9m

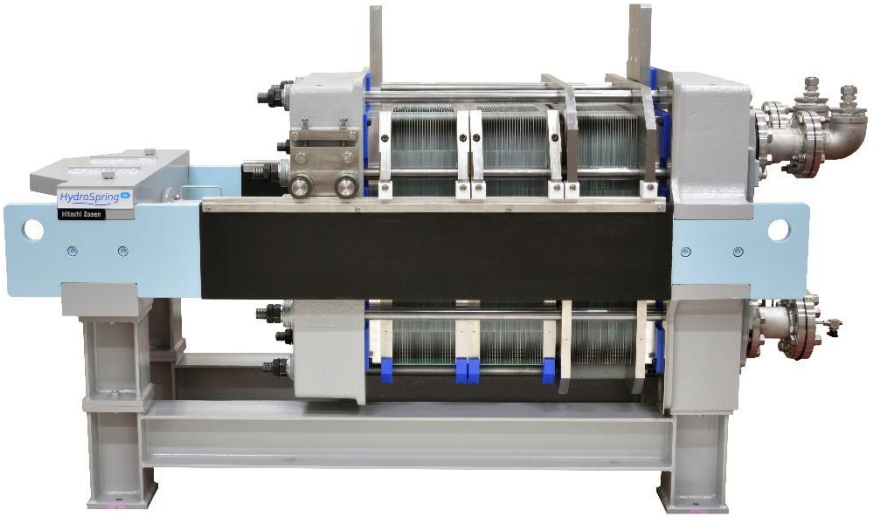
Rated hydrogen capacity：200Nm^3/h
Hydrogen purity：99.999%-dry

9. Development of Large-scale Electrolyzer

Increased the number of cells per electrolyzer by adopting a new stacking method

- 3 times larger electrode area than conventional electrolyzers
- Cost reduction and space saving

Conventional electrolyzer
(25Nm^3/h/stack)



New Type electrolyzer
(100Nm^3/h/stack)

10. 1.5MW WE System for P2G demonstration in Yamanashi

- Delivered a 1.5 MW class PEM WE system to the Komekurayama site in Yamanashi Pref., Japan under the NEDO※ demonstration support program.

  ※ the New Energy Industry Technology Development Organization

- The project is to promote the technologies contributing to the realization of the hydrogen society, which is one of the strategy of GOJ. The project is for the converting the surplus electricity from solar power stations into hydrogen, and further, for storage, transportation and utilization thereof.

Yamanashi Komekurayama Site

Stable power

To system power

Komekurayama solar power plants

Unstable power

H_2 Hydrogen Tank H_2 Hydrogen Delivery Equipment H_2 To Hydrogen Users

Electrolysis of water

Inside the P2G Demonstration Building

Source: Hitachi Zosen Corporation WEBSITE News Release
https://www.hitachizosen.co.jp/newsroom/news/release/assets/pdf/15dbc628bd4e6f3184c4ccba46f2874b_1.pdf (Speaker translation)

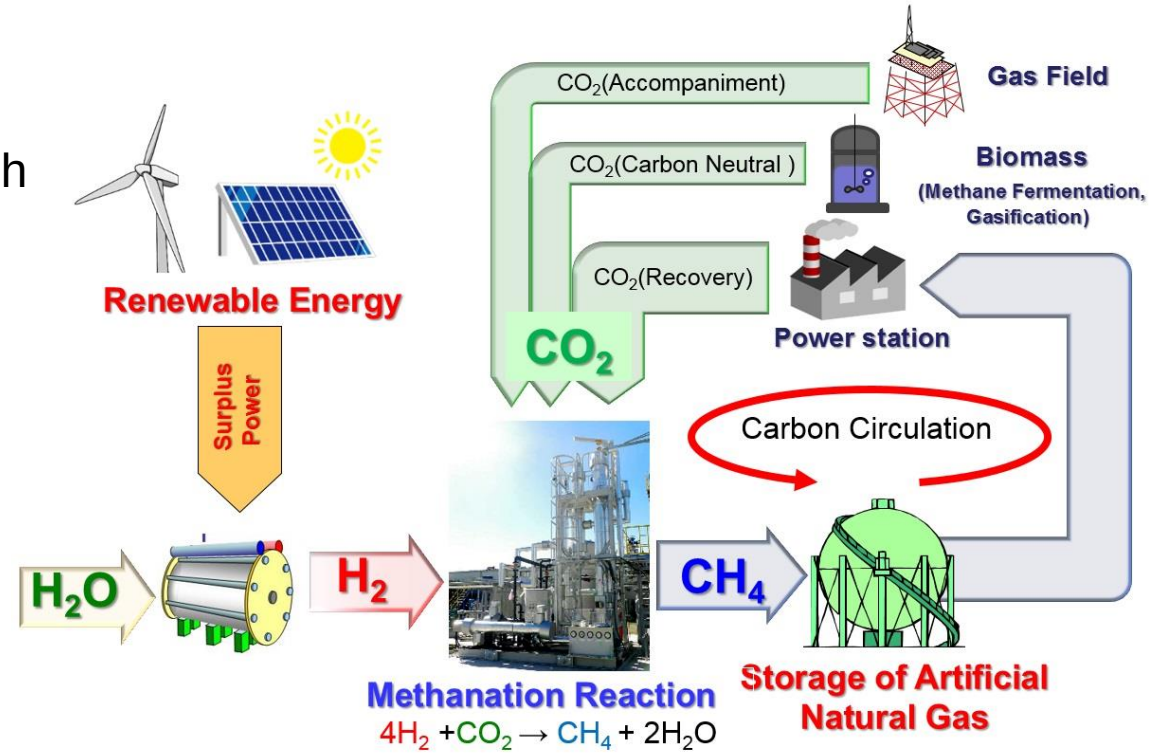
Source: Yamanashi Prefecture Enterprise Bureau, New Energy System Promotion Office WEBSITE
https://www.pref.yamanashi.jp/newene-sys/documents/p2g_pic_210609.jpg

11. Conversion of Hydrogen into Methane to usable Fuel

Methanation:
Production of synthetic methane from green hydrogen and CO_2.

Synthetic methane has an excellent affinity for existing infrastructure, such as the following

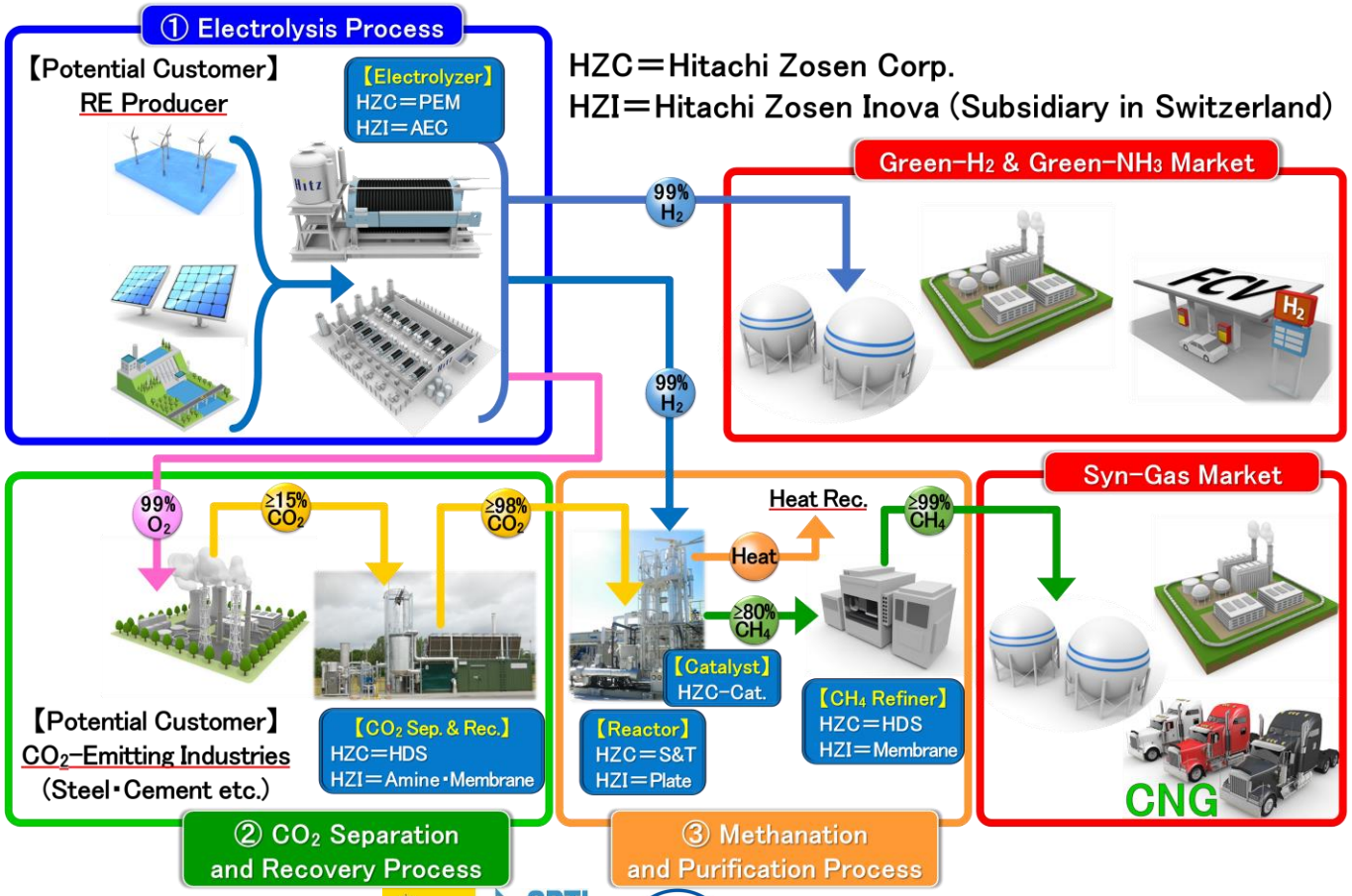
- Transportation
  (Gas grids, LNG Tankers)
- Storage
  (LNG Tanks, Grids)
- Utilization
  (Gas Engine/Turbine etc.)



Power to SNG(Methane) system
= Carbon Circulation by using of Renewable Energy

12. Hitachi Zosen's Target of PtG Market

- Hitachi Zosen has wide range of products and systems for PTG, such as wind power, waste incineration, electrolyzer, methanation, ammonia converter and fuel cells. .
- It is the strategy of Hitachi Zosen to combine these products and systems to implement the business model of the carbon neutral gas business model in society, including green hydrogen, synthetic methane and green ammonia.



Thank you for your attention!

Some of the announcements are related to projects commissioned by NEDO.

We would like to express my gratitude to everyone at NEDO
and deeply thank everyone involved.

Technology for People, the Earth, and the Future

Hitachi Zosen creates links between mother nature and our future

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