

The 11th NEDO-CDTI Joint Workshop

“Technologies for Hydrogen Valley in Spain and Japan – Regional H2 Value Chain”

Hydrogen



水素が
次世代エネルギー
社会を切り拓く!

Toray's Initiatives for the Realization of a Hydrogen Society

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Yamanashi Hydrogen Company, Inc.

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January 24, 2023





Corporate Profile

Company Name:	Toray Industries, Inc.	
Established:	January 1926	
Capital Stock:	147.9 billion Yen	
Revenue:	2,228.5 billion Yen (FY Mar/22)	
Consolidated companies:	290 (Japan: 106, Overseas: 184)	
Employees:	Toray	7,175
	Japanese Subsidiaries	10,413
	Overseas Subsidiaries	31,254
	Total	48,842
	(as of Mar 31, 2022)	



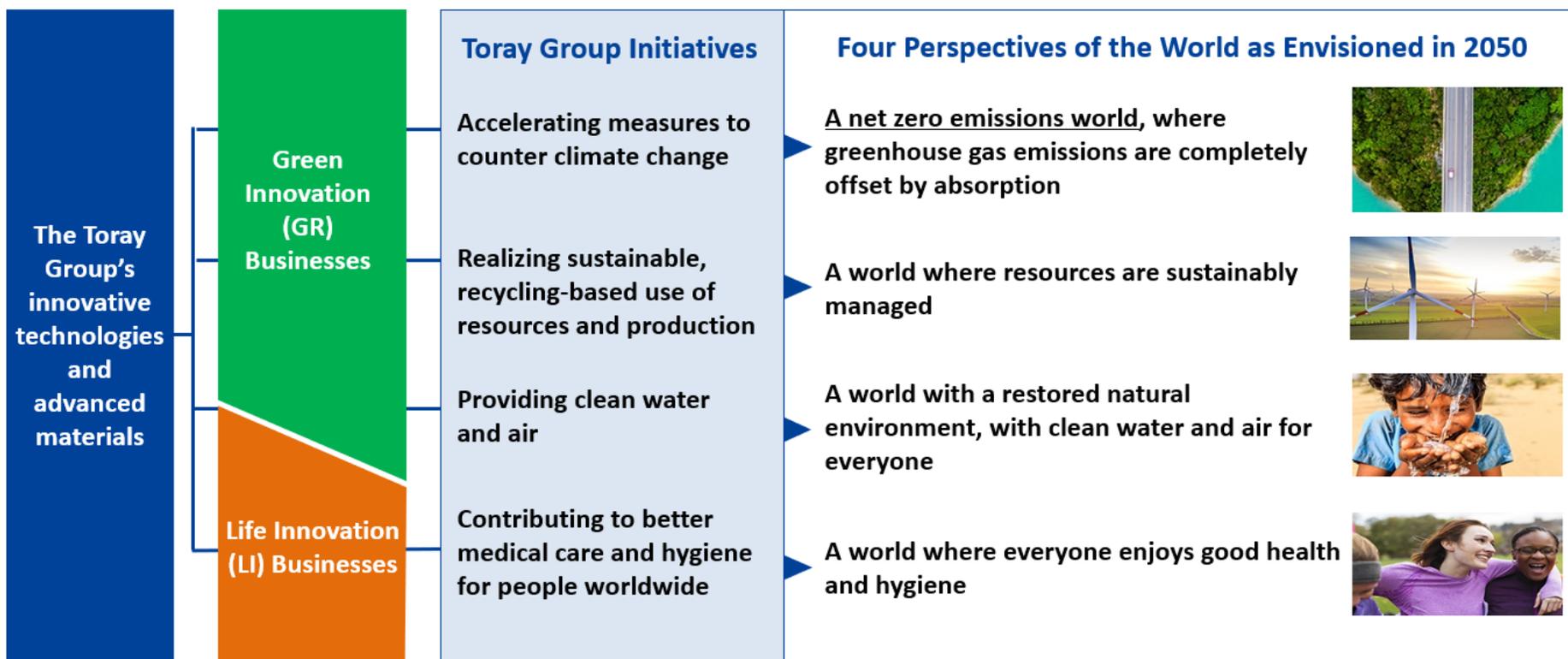
**Representative Director
& President
Akihiro Nikkaku**



Toray Group Sustainability Vision



The World as Envisioned in 2050 and Toray Group Initiatives



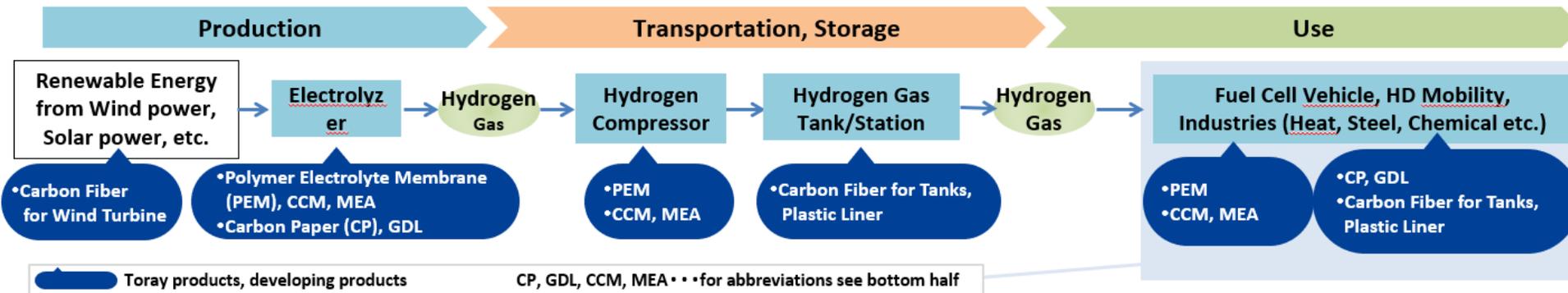
Long-term Corporate Vision "TORAY VISION 2030"

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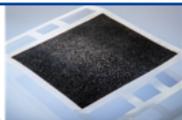


Toray Initiatives for Realization of Hydrogen Society

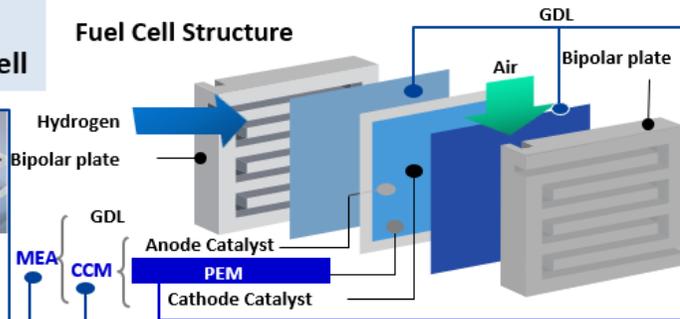


Application Example of Toray's Advanced Materials for Fuel Cell

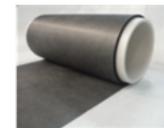
CCM (Catalyst Coated Membrane)
MEA (Membrane Electrode Assembly)
 Start operation at the second factory at a German subsidiary, Greenerity GmbH (FY 2022)



Fuel Cell Structure



Carbon Paper (CP)
Gas Diffusion Layer (GDL)
 Start full operation at Ehime Plant (FY 2020)



Hydrocarbon Polymer Electrolyte Membrane (PEM)
 Start production (FY 2019)



Medium-Term Management Program "Project AP-G 2022" (FY 2020~2022)

Toray Group has been developing various kinds of key materials for all stages of hydrogen production, transportation, storage and use.

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Principle of PEM Electrochemical Devices



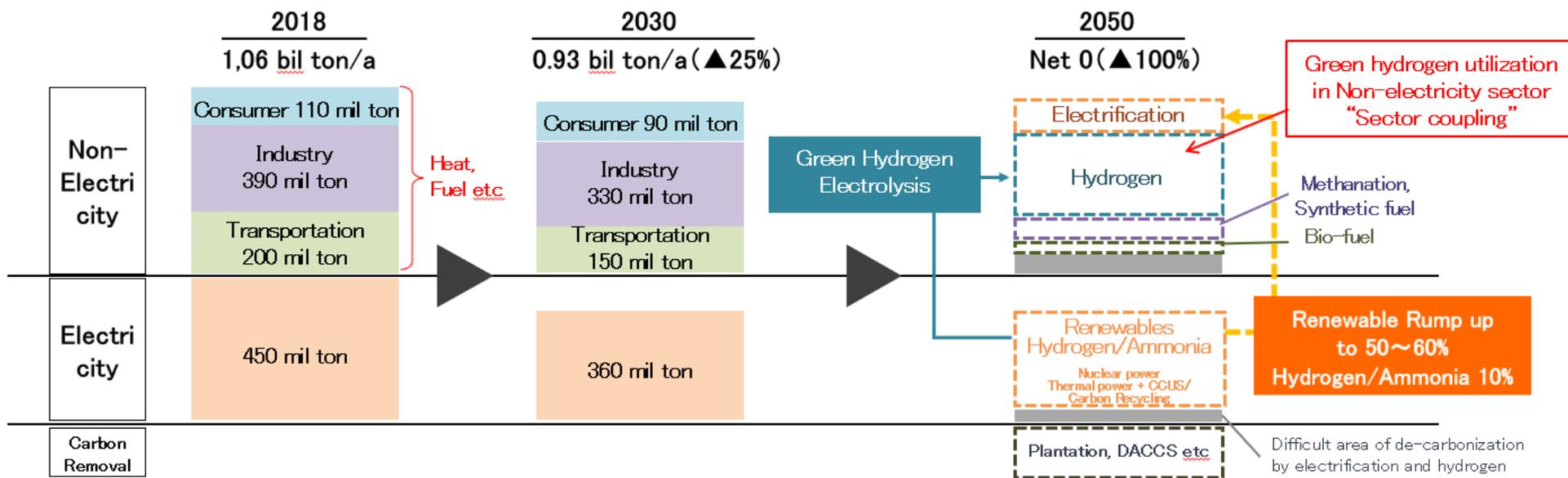
	Production	Transportation, Storage	Use
	Water Electrolyzer	Hydrogen Compressor	Fuel Cell
Cell Configuration			
Reaction	$H_2O \rightarrow H_2 + 1/2 O_2$	$H_2 (0.1MPa) \rightarrow H_2 (80MPa)$	$H_2 + 1/2 O_2 \rightarrow H_2O$

Membrane/MEA is the common key material for Fuel Cell, Compressor and Electrolyzer.



Hydrogen in Japan's Green Growth Strategy

Amounts of CO2 emission derived from energy in Japan

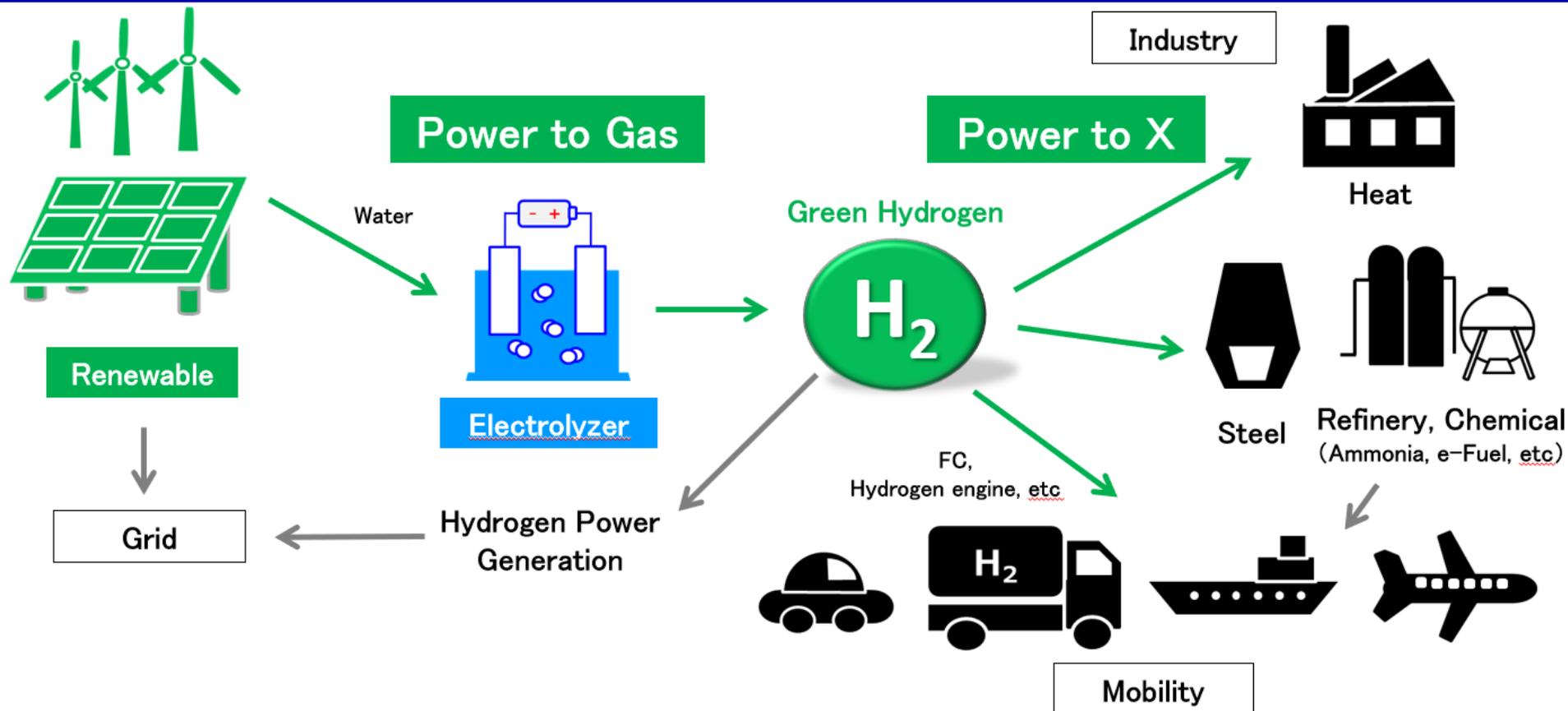


Source: METI

Renewable expansion, and Green hydrogen utilization in non-electricity sector will be vital to achieve carbon neutrality by 2050



Hydrogen in a Carbon-Neutral Society



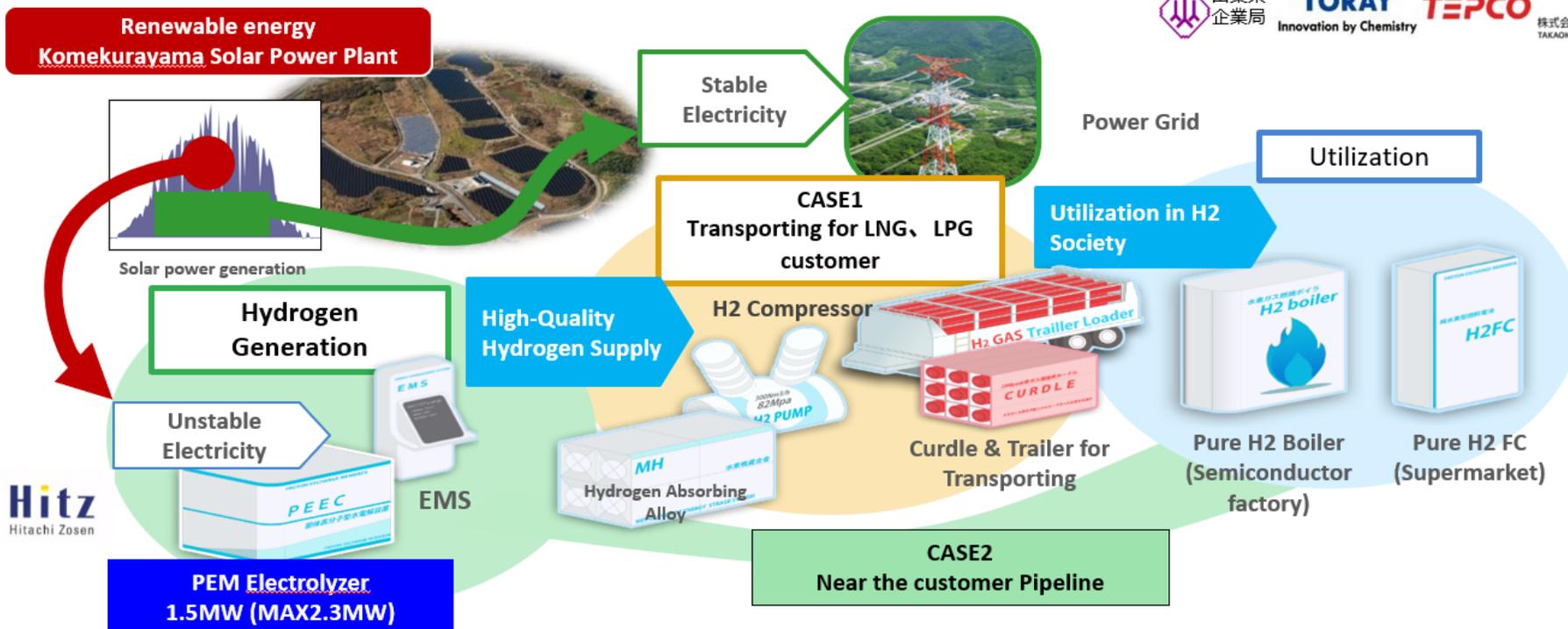
Sector coupling using green hydrogen enables de-carbonization in the energy, mobility, and industry sectors



Development and Demonstration of P2G System Technology Aiming to Build a CO2-Free Hydrogen Society



Demonstration from Green hydrogen production to utilization in real H2 society of Yamanashi Prefecture



Toray has been leading the development and demonstration of Japan's 1st MW-Class PEM electrolyzer in cooperation with Hitachi Zosen.

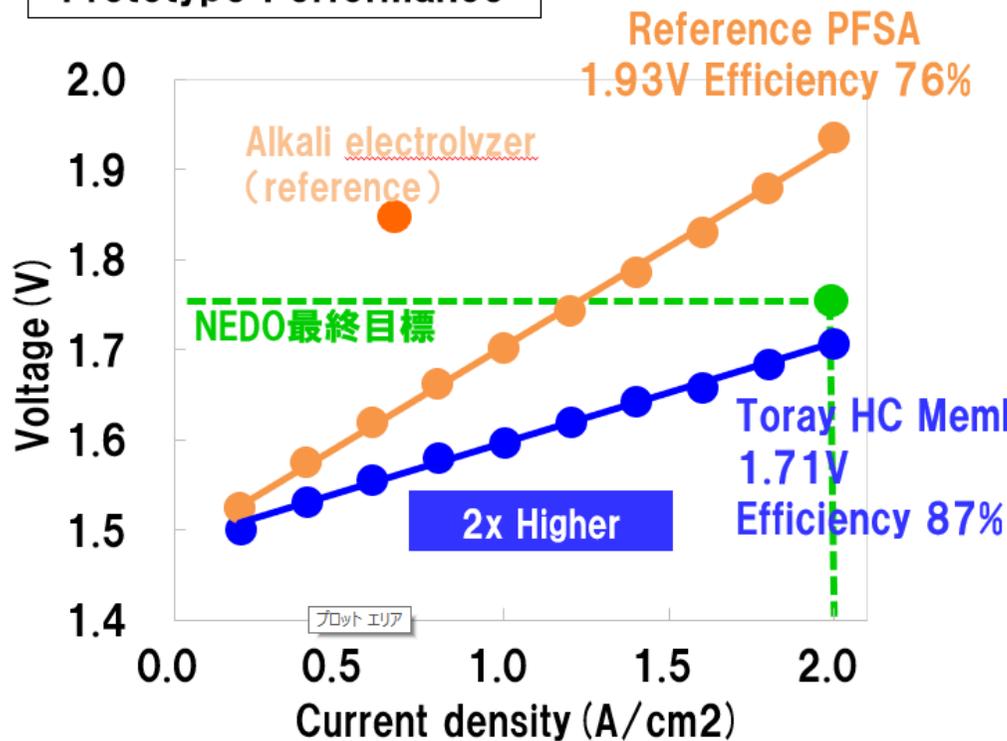




Potential Benefit of Toray HC Membrane in Electrolyzer



Prototype Performance



Hitachi Zosen Prototype in Toray



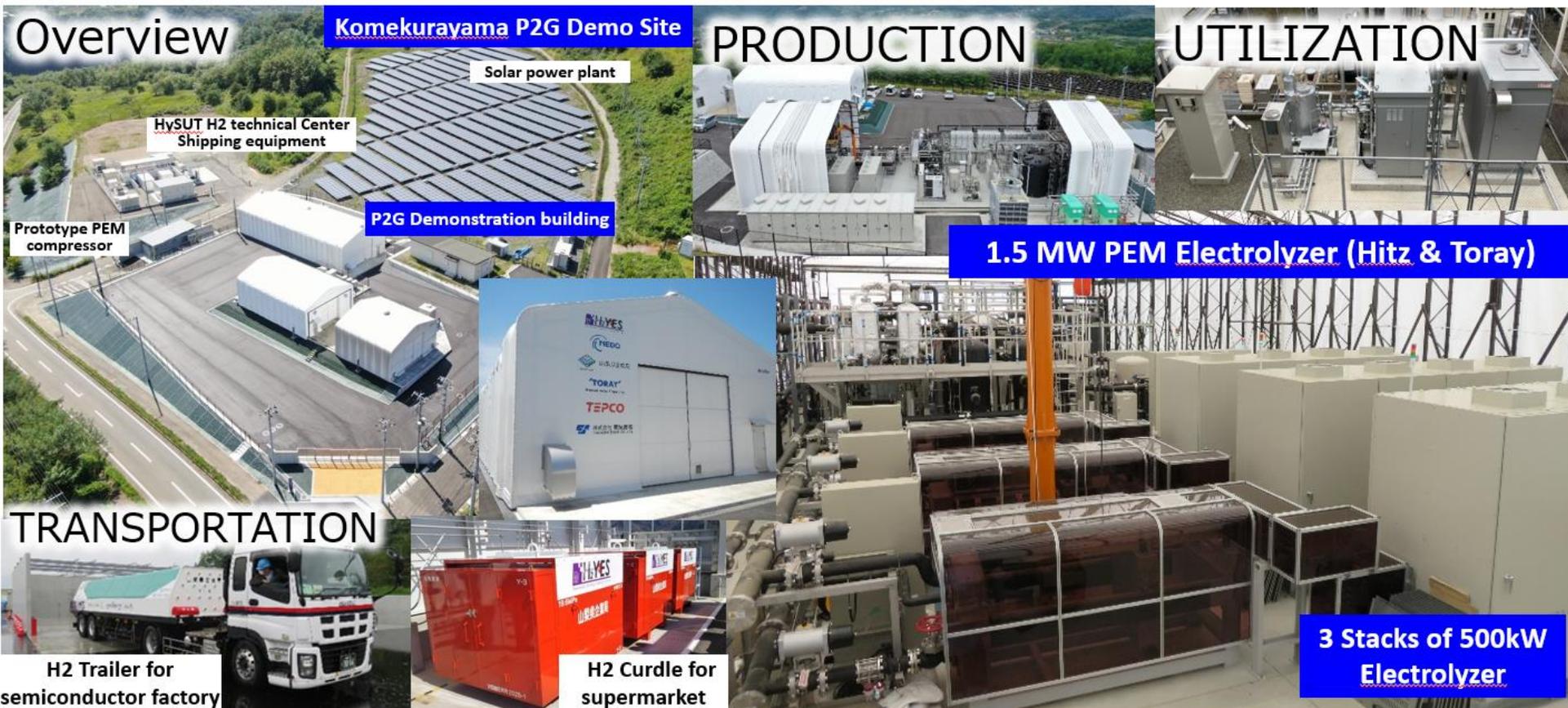
Toray HC Membrane

		Reference PFSA	Toray HC Membrane	
Efficiency	%	76	→ 87	Higher
Current density	A /cm ²	1	→ 2	Stack cost reduction
Low gas crossover	a.u.	1	→ 1/3	Safer, operation time

Toray would be able to contribute the reduction of green hydrogen cost through high performance electrolyzer



Status of Yamanashi P2G Demonstration Site



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Green Hydrogen Production Project under METI/NEDO Green Innovation Funding Program (FY2021-2025)



Industrial PEM electrolyzer development, De-carbonization of Heat

Project target & outline

- To develop electrolyzer technology using renewables in Japan, and to reduce electrolyzer system cost to 500€/kW@2030 to gain global green hydrogen market
- To achieve the above target utilizing the results from existing NEDO project, technological development of scale up and modularization of PEM electrolyzer, implement of new membrane technology into industrial PEM electrolyzer, and technological development of hydrogen boiler with higher efficiency
- To demonstrate total 16MW class PEM electrolyzer as one of total solution, and to demonstrate to decarbonize heat by hydrogen boiler

Project Owner

- Yamanashi, TEPCO, Toray, Hitachi Zosen, Siemens Energy KK, Miura, Kaji tech

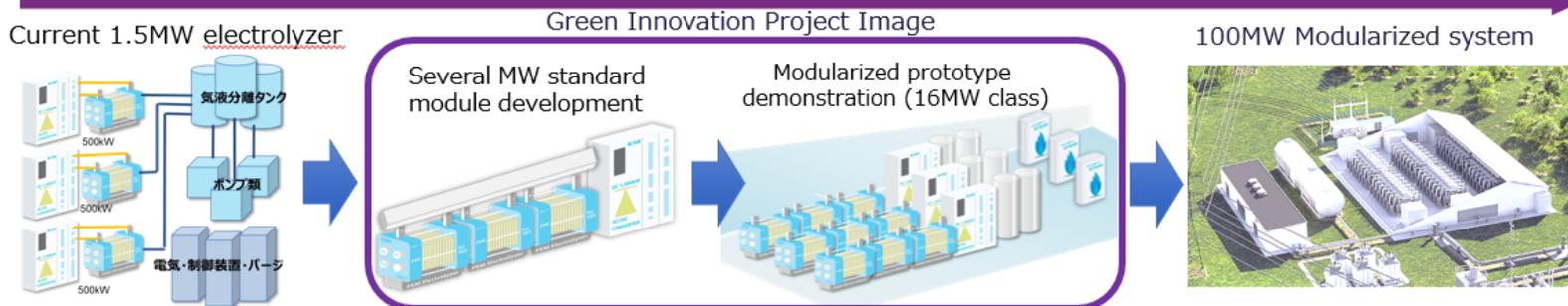
Project Period

FY 2021~ FY 2025 (5 years)

Project Image

Project Budget

- Total : 108M €
- Funding : 78M €
- *including incentive, actual contract is only until stage gate
- Funding rate : 2/3 → 1/2 (+ incentive 10%) 000000



Source: NEDO

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“Yamanashi Hydrogen Company” Foundation as the first P2G Business Company in Japan



Overview



H₂ PRODUCTION



TRANSPORTATION UTILIZATION



Established in 2022 Feb



YHC's Company Vision
Realization of Carbon Neutrality
in Industrial Sector

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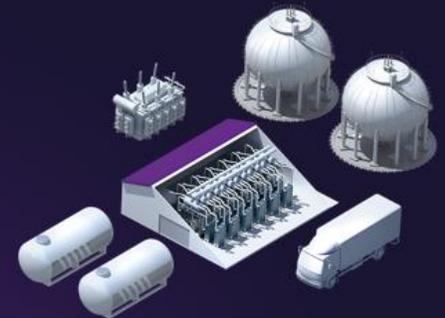




Siemens Energy and Toray to Develop Partnership

Contributing to a carbon-neutral society through PEM water electrolysis based on a new membrane technology

SIEMENS ENERGY



Siemens Energy and Toray will work together to develop global Green Hydrogen supply chain through Siemens Energy's large industrial scale PEM water electrolyzer with Toray's proprietary hydrocarbon electrolyte membranes

TORAY
Innovation by Chemistry

© Siemens Energy, Toray, 2021

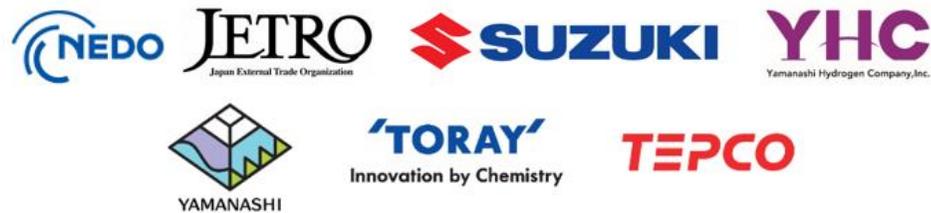
13



NEDO Japan-India International Demonstration Project



Multi Suzuki Manesar Plant in India



Achievement of
Green Innovation Funding Project



Overseas Deployment

YHC and Suzuki Initiated Feasibility Study of Deploying Power-to-Gas (P2G) Systems to Decarbonize the Heat in Multi Suzuki Manesar Plant in India in 2022



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NEDO Japan-Scotland International Demonstration Project Innovation by Chemistry

Toray Part of Team Initiating Scottish Feasibility Study for Green Hydrogen-Based Power-to-Gas System

Nov. 25, 2022

Toray Industries, Inc.



Tokyo, Japan, November 25, 2022 – Toray Industries, Inc., announced today that it will collaborate with Marubeni Corporation, Yamanashi Hydrogen Company, Inc., and Siemens Energy K.K. in a study in Glasgow, Scotland, to demonstrate the feasibility of deploying power-to-gas (P2G) systems to decarbonize energy supplies in cities with cold climates. P2G technology uses electricity from solar and other renewable energy sources to produce hydrogen through electrolysis.

These four companies proposed this initiative in the second public solicitation round of the New Energy and Industrial Technology Development Organization for the fiscal 2022 International Demonstration Project for Japanese Technologies Contributing to Efficient Energy Consumption. That organization adopted their proposal on October 27, 2022.

The study will explore the feasibility of Marubeni's plan to undertake a green hydrogen project in Scotland with the local government. That effort would tap the region's abundant renewable energy sources and employ a polymer-electrolyte membrane electrolyzer manufactured by Siemens Energy incorporating a Toray proprietary hydrocarbon polymer electrolyte membrane. Yamanashi Hydrogen Company will draw on its prowess in P2G systems technology to conduct the feasibility study.

These four companies will mull installing and running a new energy supply and demand system using green hydrogen to meet cold urban area heating needs. They will also assess using green hydrogen to fuel heating equipment for large facilities and industrial boilers.

Toray is leveraging its top-notch materials to help the world economy become sustainable by balancing greenhouse gas emissions and absorption. The company hopes to contribute to Scotland's decarbonization through this study. It will also explore ways for Japan to tap the European market's advanced renewable energy expertise, playing its part in building a value chain that encompasses producing and using green hydrogen in Japan and the United Kingdom as part of efforts to create a hydrogen economy.

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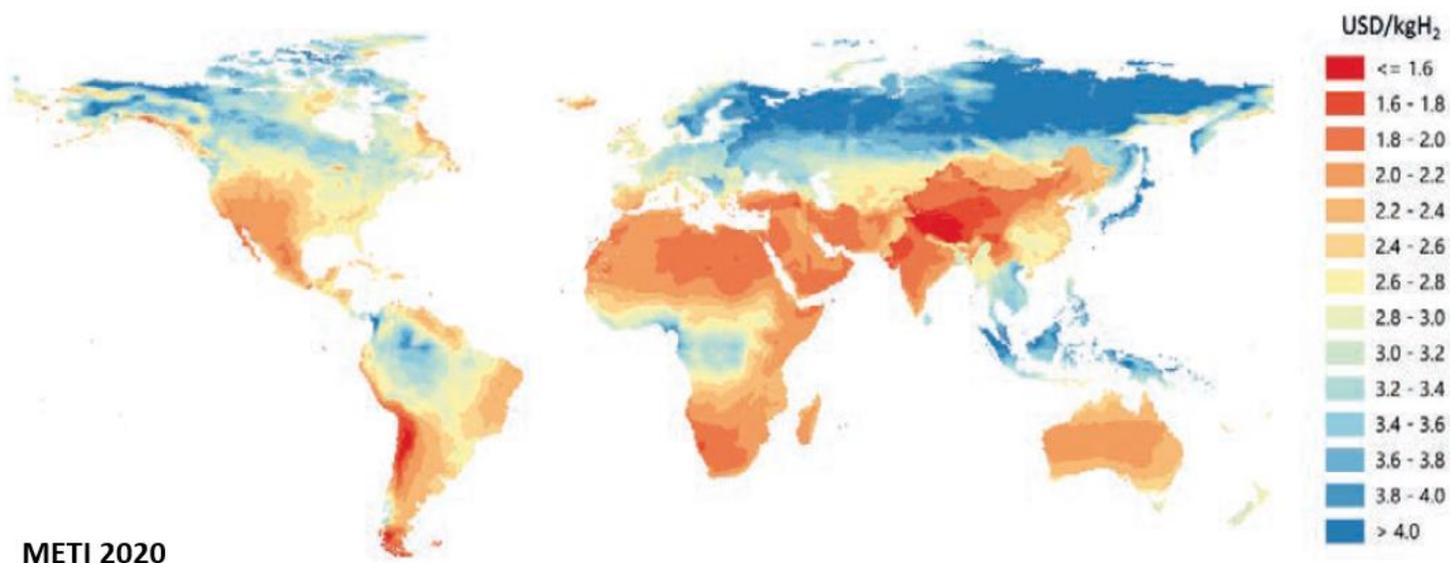




Toward Carbon Neutrality in 2050



Hydrogen cost from solar and onshore wind system in long the term



Toray will contribute to develop global supply chain for green hydrogen through our advanced materials.

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TORAY

Innovation by Chemistry

MATERIALS CHANGE OUR LIVES.
素材には、社会を変える力がある。

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