TOSHIBA

New Energy Systems Utilizing Hydrogen Derived from Renewable Energy

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Toshiba's Hydrogen business domain

Production	Storage	Utilization

Hydrogen EMS Hydrogen Energy Management System

Power-to-gas

Hokkaido H_2 supply chain project

Fukushima H_2 energy research field

H_2Power Storage

Hydrogen station

Regional H2 energy supply sys.

Fuel Cell

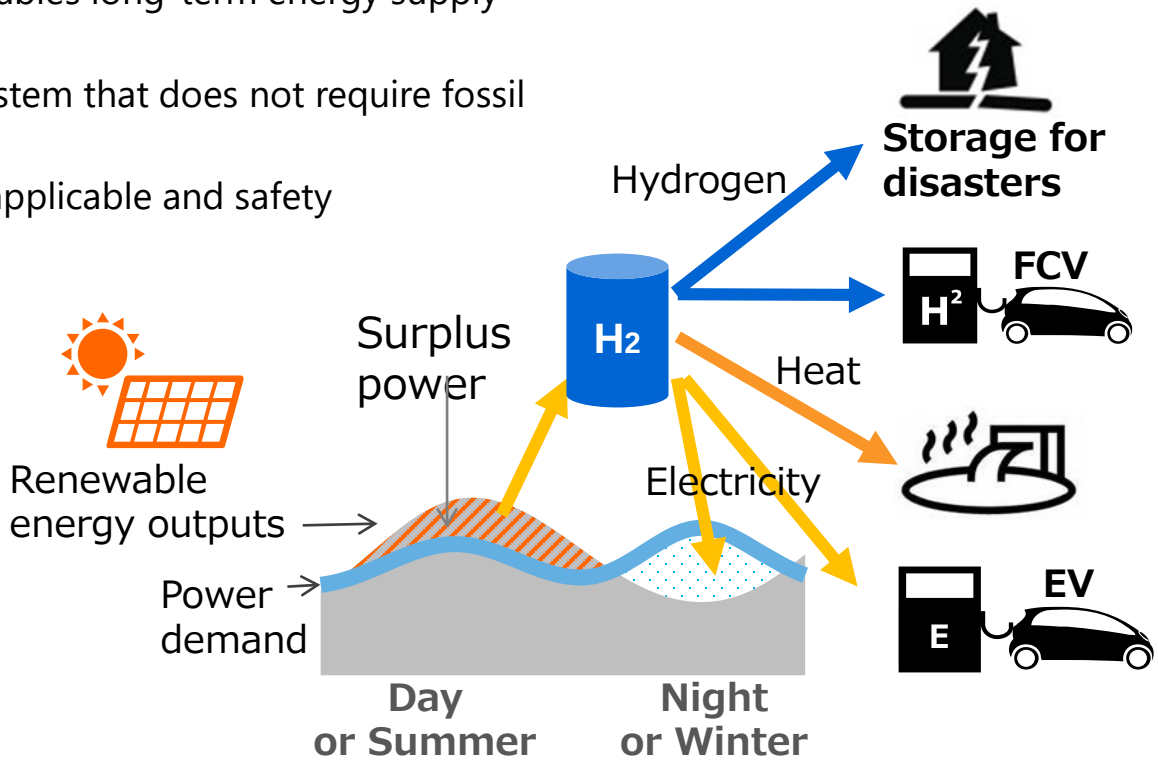
Pure Hydrogen Fuel cell

H2One™ Hydrogen-based Autonomous Energy Supply System

Not only emergency, but also as usual, independently, stable supply of energy over the long term

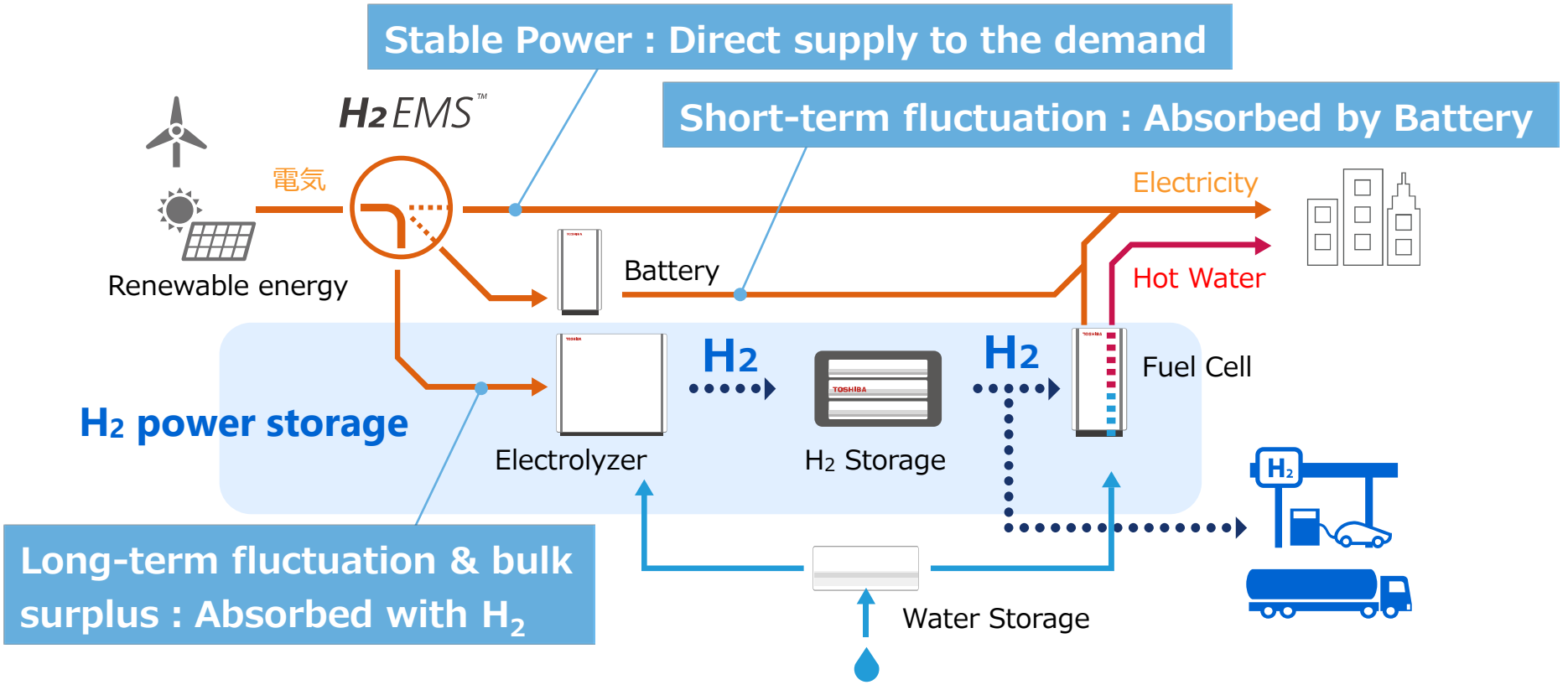
with hydrogen power storage

- Provide stable supply of electricity, heat, and hydrogen throughout the year regardless of weather with renewable energy and water
- Hydrogen electric power storage enables long-term energy supply even in the event of a disaster
- Environmentally friendly CO_2 free system that does not require fossil fuels
- High pressure gas safety law is not applicable and safety administrator is not required



H2One™ The system mechanism

Hybrid system of battery and hydrogen power storage



Realizes an energy system that can absorb short to long-term RE fluctuations with a combination of storage batteries and H_2 power storage

H2One™ Installations

BCP
Kawasaki Marien
(Supply power & Hot water for 300 refugees, 1week)

2015/4

BCP
Yokohama Port and Habor Bureau
(Supply power for 3days)

2016/4

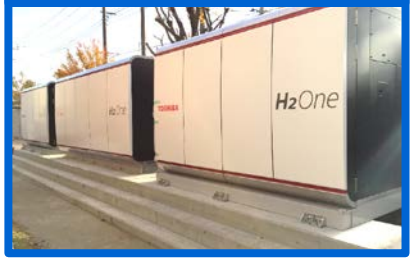
BCP
JR East Railway St.
(Supply power for 2 days)

2017/4

R&D
Tohoku EPCO
(Stabilization of renewable Energy)

2017/3

R&D
TOKYU CONSTRUCTION
(In house demonstration)



2018/1

BCP
Miyagi Prefecture
(Rakuten-Seimei Park Miyagi)

2018/3

Mobile shelter model
Two 4 tones Trucks
(Supply power & hot water)

2016/4

Hydrogen Station
Toshiba Fuchu
(FC Forklift)

2017/6

H2One™ Latest Standard Model

One container package with Metal Hydride for

Rakuten-Seimei Park Miyagi

Operation started since Mar. 26, 2018

Emergency

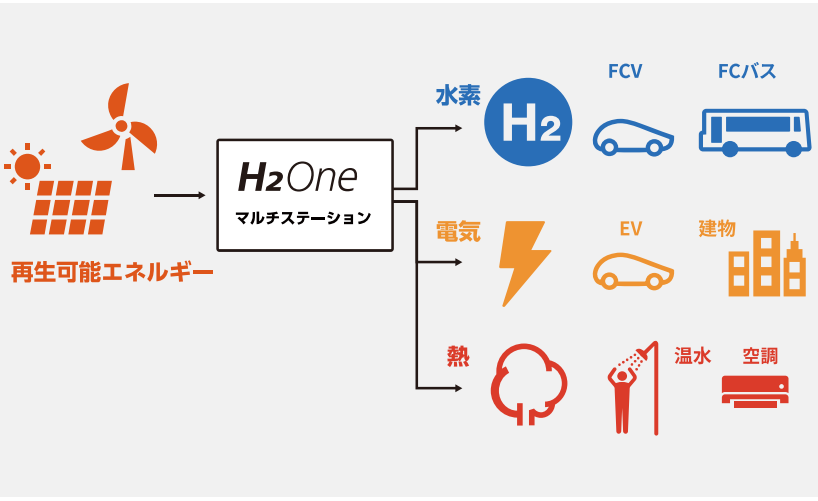
Utilizing to support evacuees at the Miyaginohara Park Playground designated as a wide evacuation site. Providing power for disaster information, lighting, charging mobile devices to evacuees, etc. at the local community FM radio station "Rakuten.FM TOHOKU"

Normal

Power supply to digital signage and local community FM radio stations.
Introduce Miyagi prefecture activities to promote renewable energy and hydrogen energy.

Packaged hydrogen supply system

- Addition of hydrogen fuel supply function for FCV to H_2One™
- H_2 Local production and local consumption system also contributes to regional revitalization / popularization enlightenment.
- Independent system can apply emergency energy supply



Normal

Fuel supply to FCV, FC bus, EV (70 MPa)

Power and heat supply to the building

Emergency

Possible for emergency operation of FCV · FC bus · EV with autonomous system to produce hydrogen even in case of power outage.

Supplies electricity and hot water for evacuation sites for three days to 300 people using stored hydrogen using BCP function

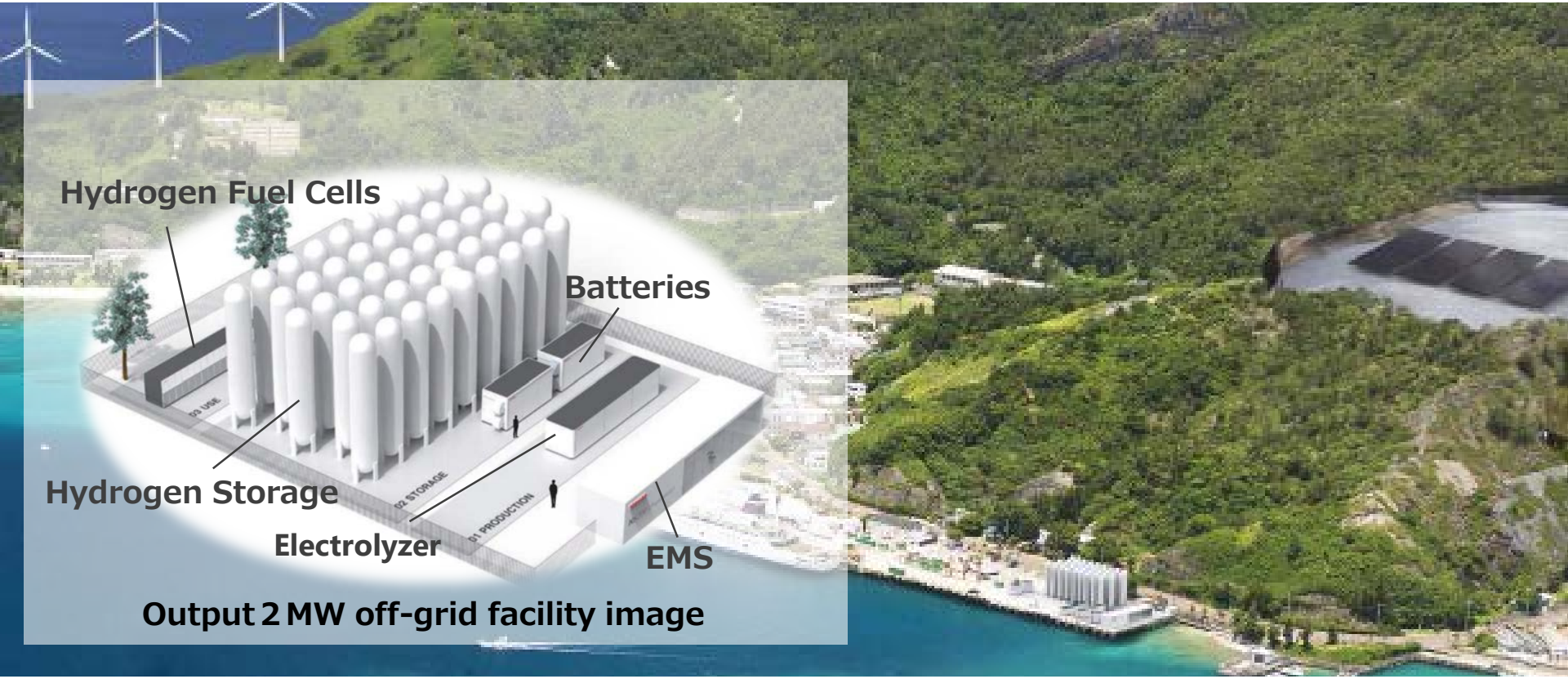
Large H_2One^{TM} for off-grid and remote areas

・100kW to MW scale autonomous energy supply suited to island and remote areas/ even with long-term windless / shortage of sunshine, 365 days power supply with RE

・Competitive total cost against DG in remote areas (¢40/kWh～ ¢ 100/kWh)

・Improve disaster resilience

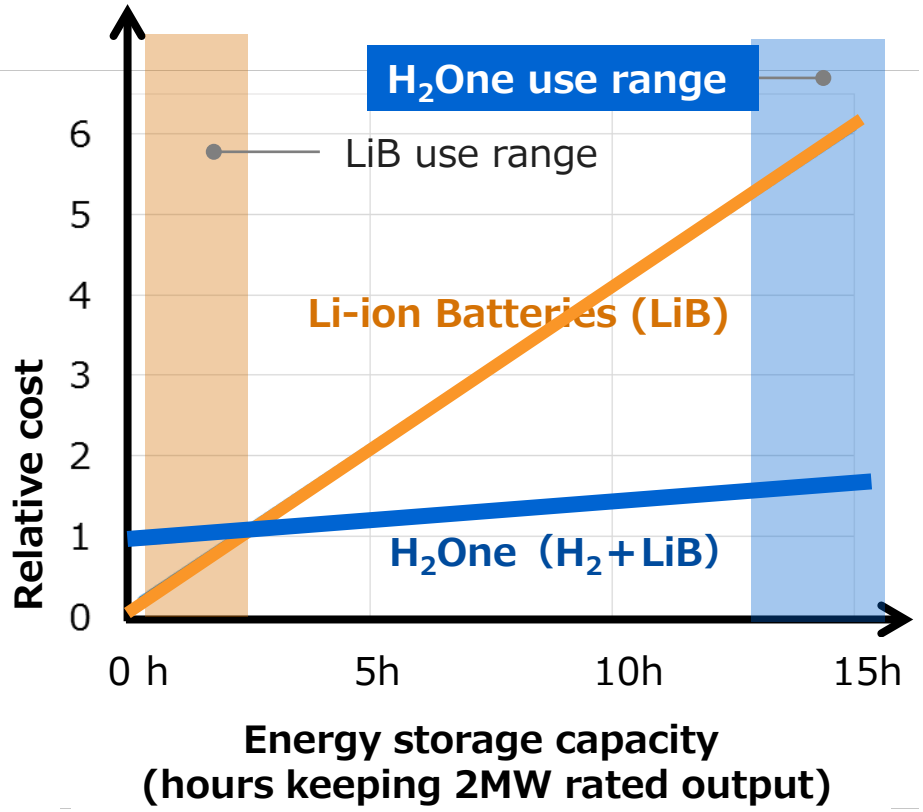
・Practical use is planned for 2020



Comparison of our hydrogen storage and storage batteries

Characteristics of our Hydrogen Electricity Storage (H_2One^{TM} System)

Power storage facility cost comparison
(2 MW base output for remote island model)



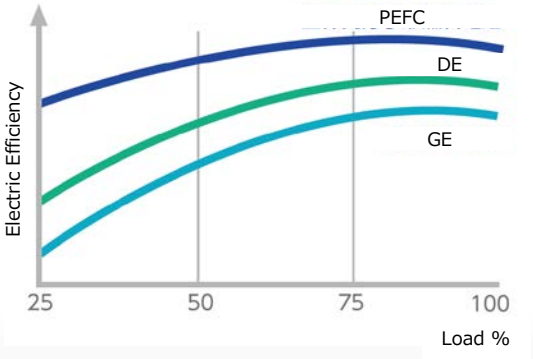
Storage time	<4 hour	>4 hour
Batteries (LiB)	Cost advantages	
Hydrogen storage		Cost advantages

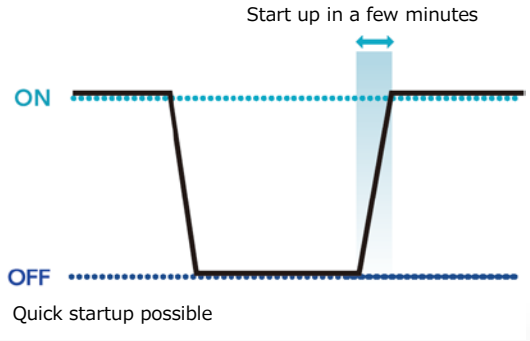
- **Battery and hydrogen system can be divided according to application**
- **Hydrogen is advantageous for large capacity storage required for off grid**

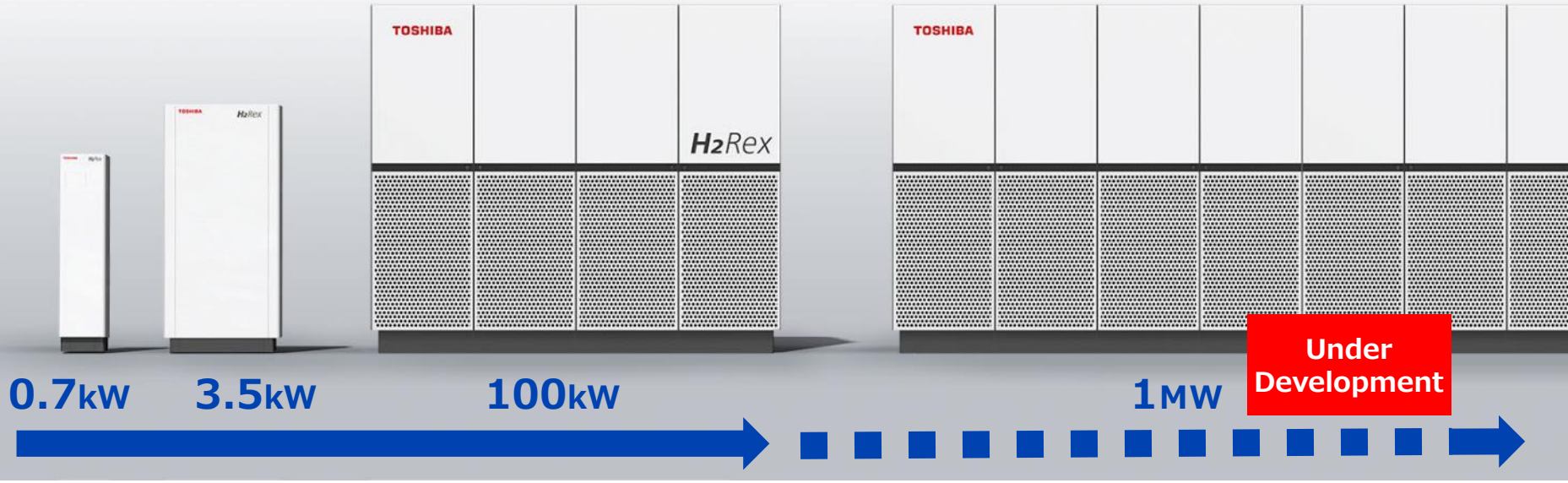
H2Rex™ Hydrogen Fuel Cell system

Commercialization of pure hydrogen fuel cell system with high efficiency

- PEFC
- Electric Efficiency 50～55%
- Total Efficiency 95%
- Start up in a few minutes







H2Rex™ Installations

700W *1
Tokuyama zoo
Shunan City

2014/3

700W
Hydrogen station
Shibakoen
Iwatani Corporation

2015/4

3.5 kW *2
Roadside station
Solene Shunan

2016/4

3.5 kW× 2
FU boat Raicho-N
Tokyo Univ. of
Marine Sci.&Tech

2016/11

100 kW *2
Shunan swimming club
Shunan City

2017/3

100 kW *2
Swimming pool
Hokkaido Shiranuka
town

2018/5

100 kW *2
TOKYU REI HOTEL
in KING SKYFRONT
Kawasaki

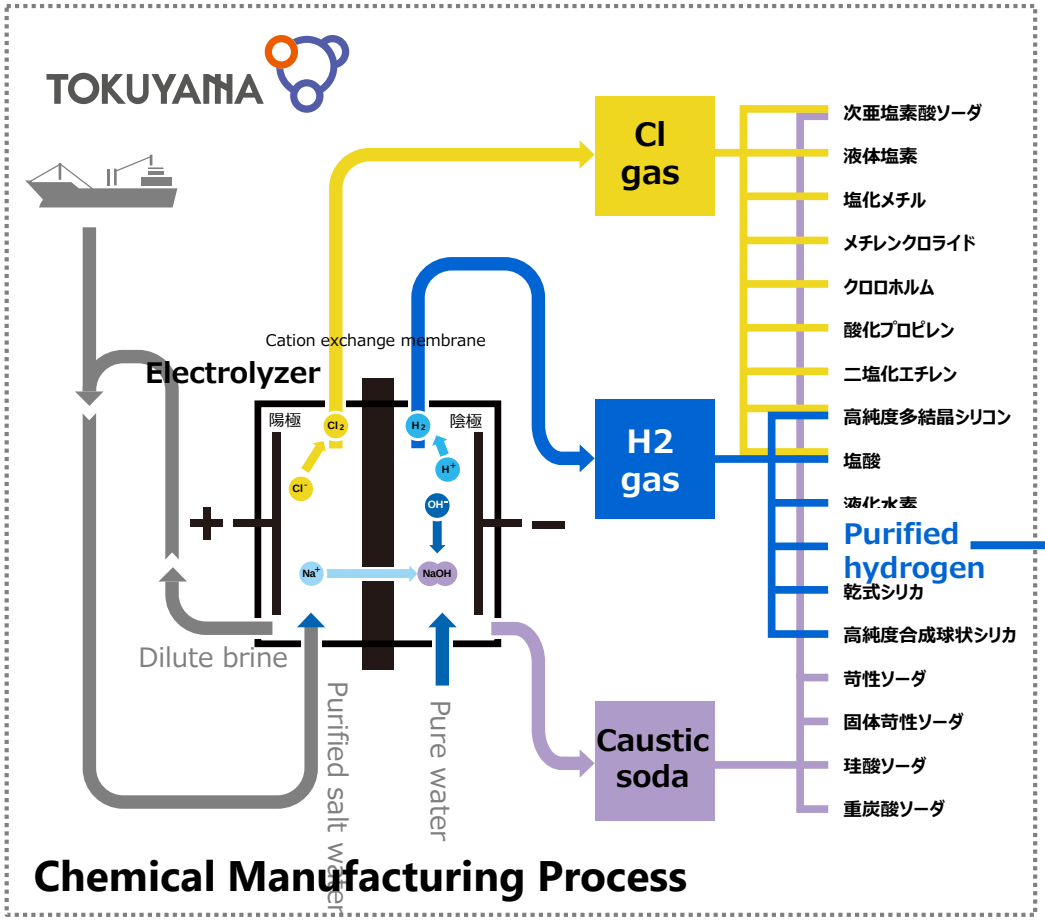
2018/6

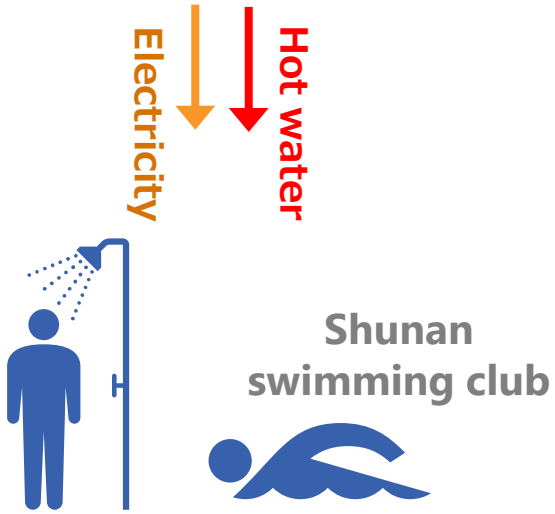
*1: Funded by Yamaguchi prefecture Government
*2: Funded by Ministry of Environment

H2Rex™ Example for applying a heated pool

High-purity by-product hydrogen derived from caustic soda is used for power generation

Utilized by Ministry of the Environment Regional Collaboration / Low Carbon Hydrogen Technology Demonstration Project





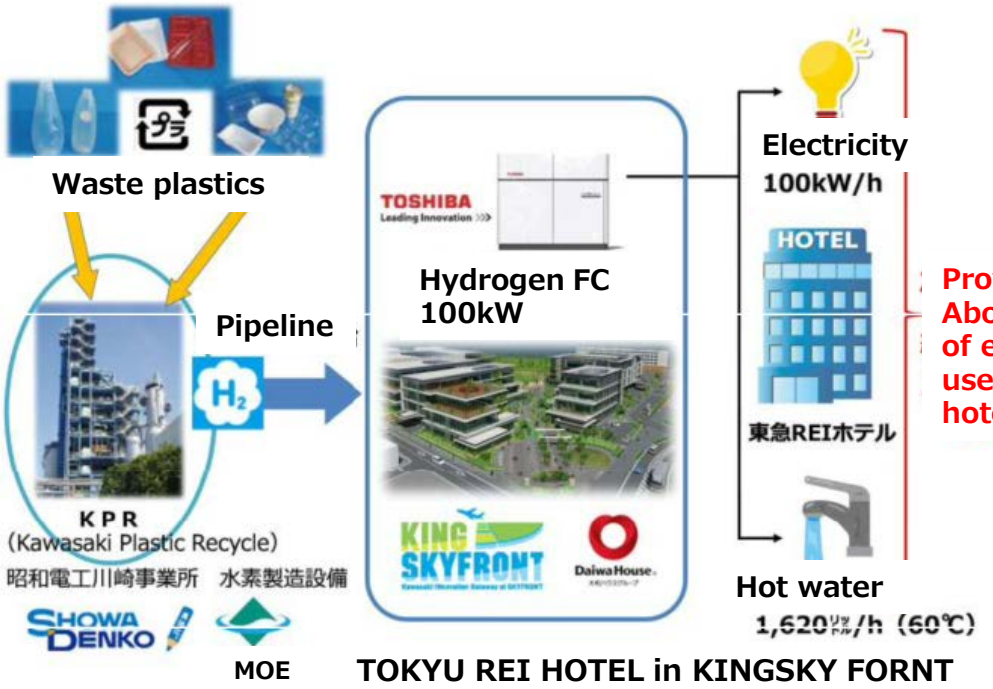
Funded by Ministry of Environment

H2Rex™ 100kW Pure hydrogen FC

Installed in TOKYU REI HOTEL in KINGSKY FORNT in Kawasaki

World first hotel equipped with fuel cell system used hydrogen from recycled plastic

Hotel open since June, 2018

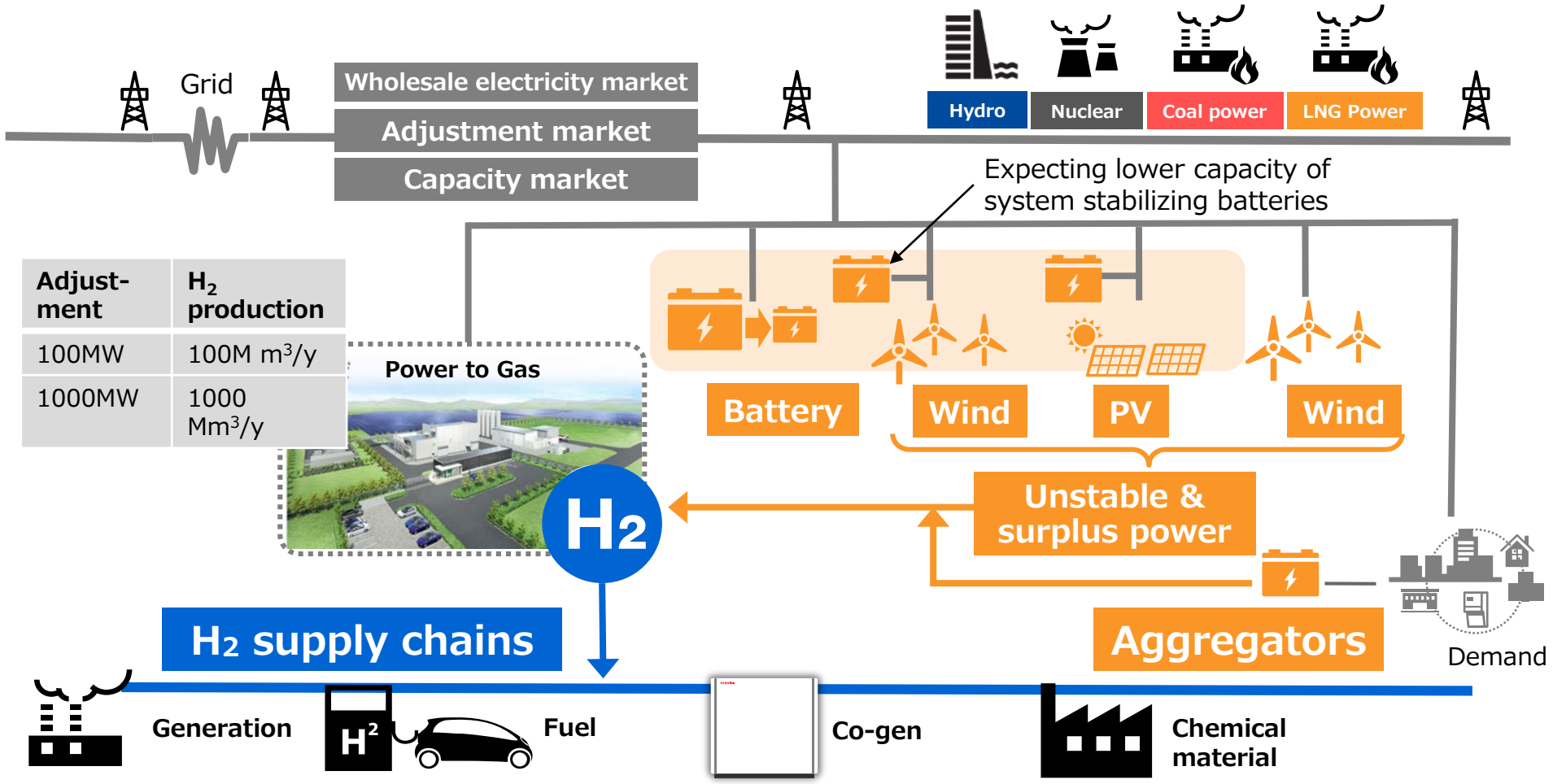


Reference information
http://www.city.kawasaki.jp/170/cmsfiles/contents/0000087/87303/170516-2.pdf

Inexpensive Hydrogen Production with Restrained Renewable Energy Power

Realize an environment to procure renewable energy at low cost with P2G's powerful system adjustment power

Image of 2030s



Adjust-ment	H_2 production
100MW	100M m^3/y
1000MW	1000 Mm^3/y

Fukushima Hydrogen Energy Research Field (Rendering Image)

FH2R FUKUSHIMA HYDROGEN ENERGY RESEARCH FIELD

Solar power generation facilities

Hydrogen storage and supply facilities

Water electrolysis system

Hydrogen transport vehicles

Receiving and transforming facilities
Utility facilities

Control room
(Control system)

Project Head
New Energy and Industrial Technology Development Organization (NEDO)

Related Organizations
Agency of Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI), Reconstruction Agency, Cabinet Office, Fukushima Prefecture, The Town of Namie Project

Members
Toshiba Energy Systems & Solutions Corporation, Tohoku Electric Power Co., Inc., Iwatani Corporation

New business created by hydrogen economy

Distributed energy business

Regional revitalization by local energy enterprises

Energy service

Power supply
Fuel supply for FCV/EV
Hot water
BCP

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Social service

Activation support
Logistics
Telecoms
Watching over

P2G H_2 supply chain business

A new supply chain that maximizes the potential of RE and hydrogen