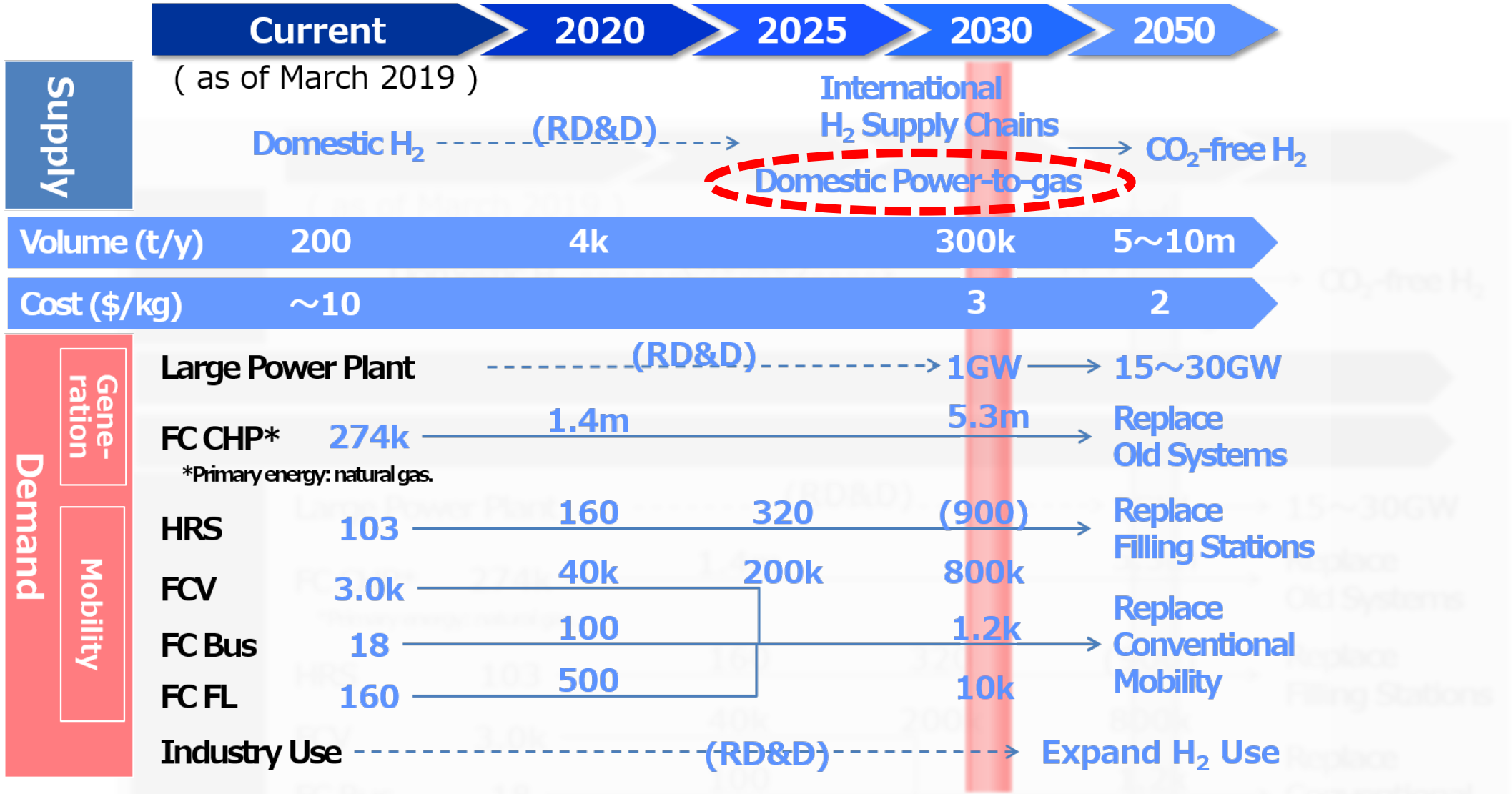
NEDO's Power-to-Gas technology development activity

29 September, 2020
Eiji Ohira
New Energy and Industrial Technology Development Organization (NEDO)

Japan's Policy on Hydrogen



Basic Hydrogen Strategy: launched in Dec 2017

Action Plan: "Strategic Roadmap for HFC"

		Goals in the Basic Hydrogen Strategy		Set of targets to achieve	Approach to achieving target
Use	Mobility	FCV 200k by 2025 800k by 2030	2025	● **Price difference between FCV and HV** (¥3m → ¥0.7m) ● **Cost of main FCV system** (FC ¥20k/kW → ¥5k/kW; Hydrogen Storage ¥0.7m → ¥0.3m)	• Regulatory reform and developing technology
		HRS 320 by 2025 900 by 2030	2025	● **Construction and operating costs** (Construction cost ¥350m → ¥200m; Operating cost ¥34m→¥15m) ● **Costs of components for HRS** (Compressor ¥90m → ¥50m; Accumulator¥50m → ¥10m)	• Consideration for creating nation wide network of HRS • Extending hours of operation
		Bus 1,200 by 2030	Early 2020s	● Vehicle cost of FC bus (¥105m → ¥52.5m) ※In addition, promote development of guidelines and technology development for expansion of hydrogen use in the field of FC trucks, ships and trains.	• Increasing HRS for FC bus
	Power	Commercialize by 2030	2020	● Efficiency of hydrogen power generation (26%→27%) ※1MW scale	• Developing of high efficiency combustor etc.
	FC	Early realization of grid parity	2025	● Realization of grid parity in commercial and industrial use	• Developing FC cell/stack technology
Supply	Fossil Fuel +CCS	Hydrogen Cost ¥30/Nm3 by 2030 ¥20/Nm3 in future	Early 2020s	● Production: Production cost from brown coal gasification (¥several hundred/Nm3→ ¥12/Nm3) ● Storage/Transport : Scale-up of Liquefied hydrogen tank (thousands m³→50,000m³) Higher efficiency of Liquefaction (13.6kWh/kg→6kWh/kg)	• Scaling-up and improving efficiency of brown coal gasifier • Scaling-up and improving thermal insulation properties
	Green H2	System cost of water electrolysis ¥50,000/kW in future	2030	● Cost of electrolyzer (¥200,000m/kW→¥50,000/kW) ● Efficiency of water electrolysis (5kWh/Nm3→4.3kWh/Nm3)	• Designated regions for public deployment demonstration tests utilizing the outcomes of the demonstration test in Namie, Fukushima • Development of electrolyzer with higher efficiency and durability

What is NEDO?

As Innovation Hub,

- Promoting of industry-academia collaboration

- Accelerating social implementation of technology

Established in 1 October, 1980

Number of Employees: 1,095 (as of 1 April, 2020)

including temporary assignment from Central / Local Government, Private Company, Research Institute

Budget in FY 2020: JPY 159 billion (US$ 1.4 billion)

Current Agenda

1. Improving electrolysis technology

- Analyzing reaction mechanism (performance, durability, etc.)
- Develop lifetime evaluation technology
- New material / CCM / system concept
  (ex. PGM-free catalyst, Anion Exchange Membrane, etc.)
- others

2. Developing System Technology

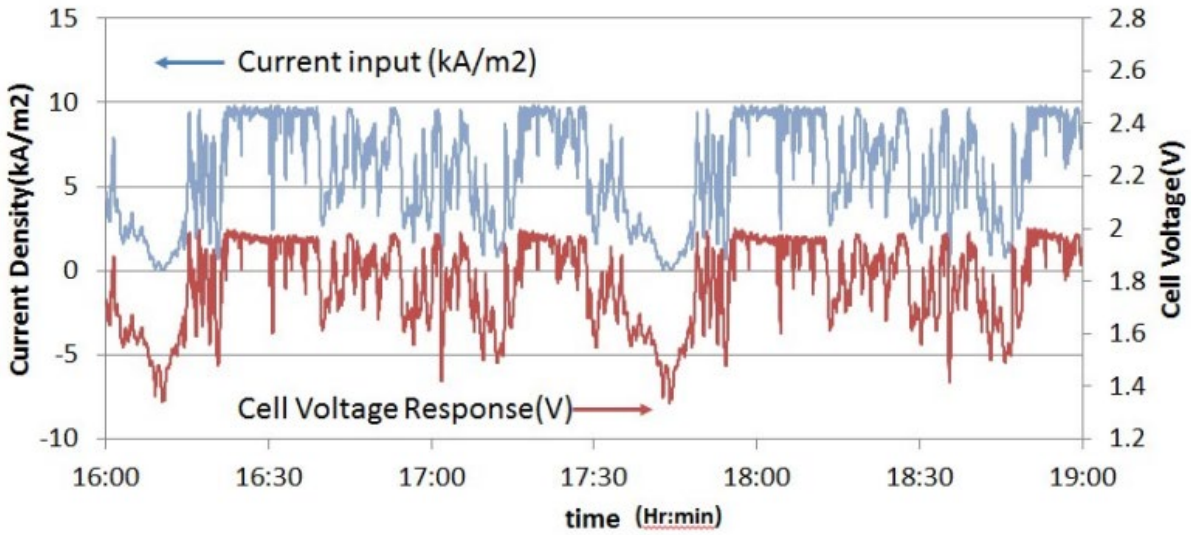
- Total system design, optimization
- Energy management based on several data
- Operation, maintenance
- Scaling-up
- others

Developing Electrolysis Technology (Alkaline)

Asahi Kasei developed large scale Alkaline Electrolysis (2013 – 2019)

Large Scale Alkaline Electrolysis: 3m²/Cell

Load Following Test:

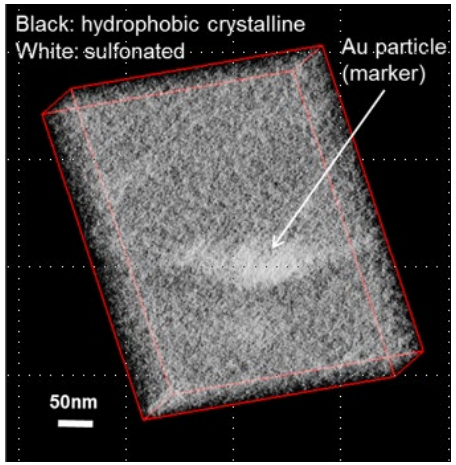


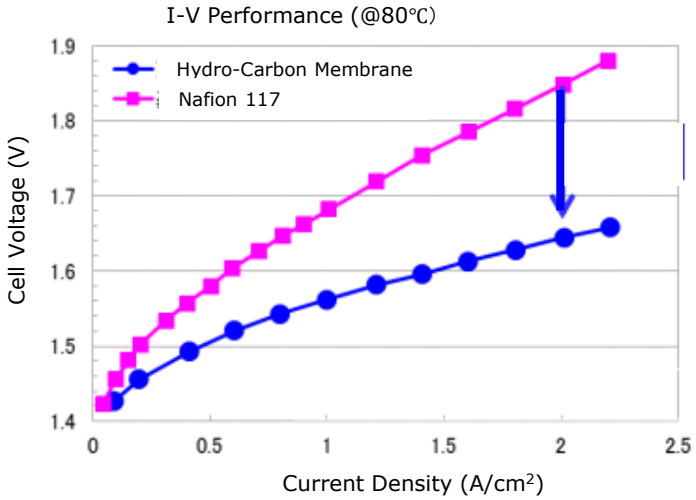
Spec:
- Cell Voltage : 1.78 V (@0.6 A/cm²)
- Cell Area : 3m² /cell
- Current Density: < 0.6 A/cm²
- Operation Temperature: <90℃
- Operation Condition: Normal Pressure

Scaling up

Developing Electrolysis Technology (PEM, SOEC)

Toray: Hydro-Carbon Membrane for PEM Electrolysis

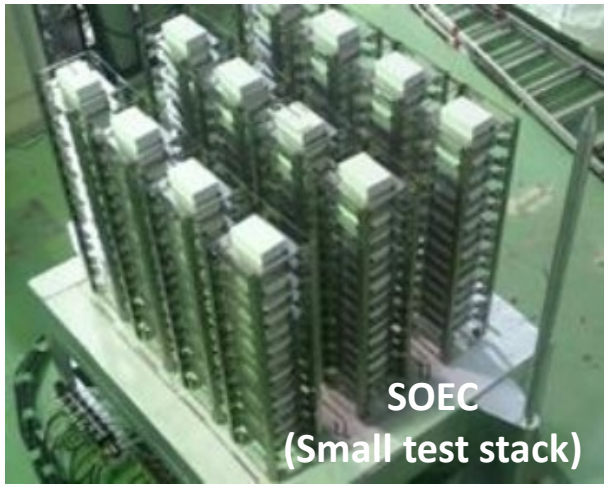




25kW Test System

Scaling up

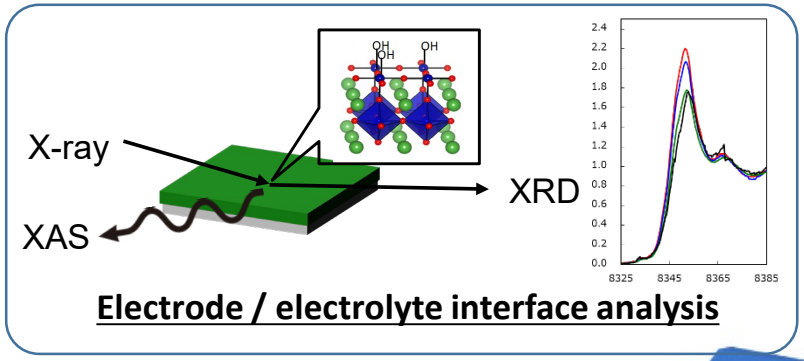
Toshiba: SOEC



Basic Research on…

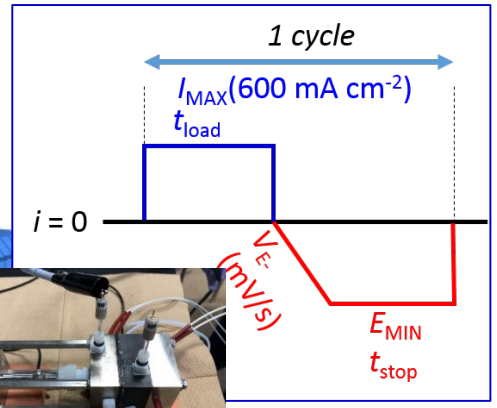
- Elucidation of cell/stack deterioration mechanism
- High durability cell/stack design guideline
- Performance evaluation

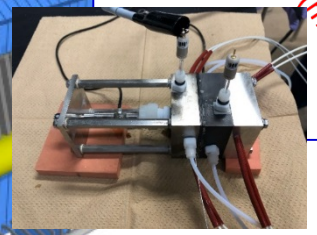
Developing Electrolysis Technology (Analysis)

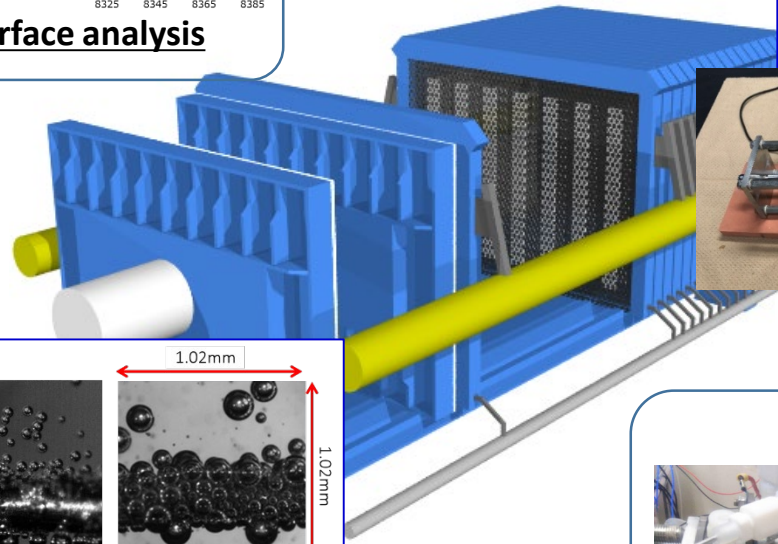


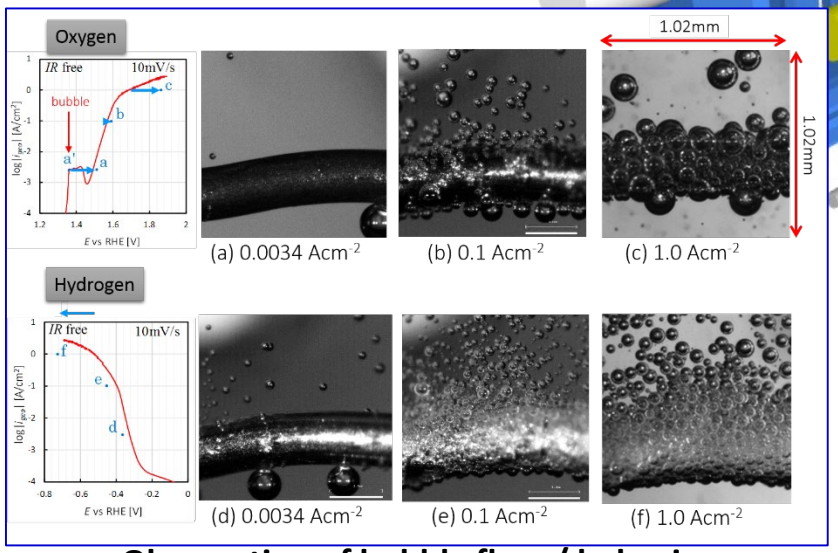
Electrode / electrolyte interface analysis

Accelerated degradation evaluation protocol

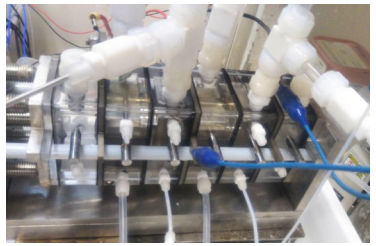


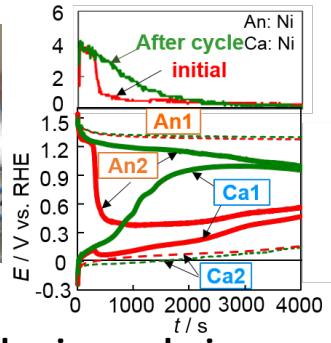






Observation of bubble flow / behavior



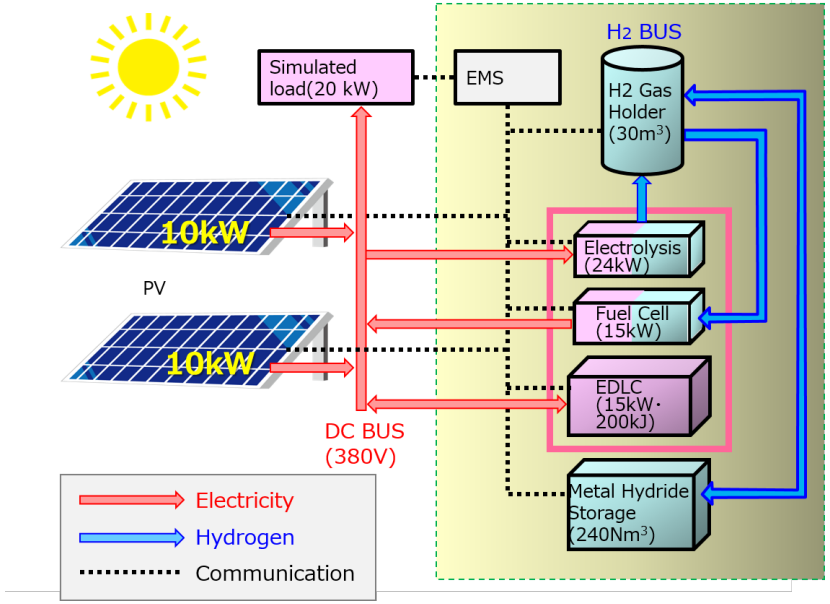


Reverse current behavior analysis

Feedback to Material / CCM Development

Developing PtG Technology (Small scale)

@ Sendai city, Miyagi Prefecture
(Water purification plant)
PV + 24kW PEM electrolysis
- Leveling PV output power
- Emergency power supply by Fuel Cell
Electric double layer capacitor
Compressed & Metal Hydride H2 storage



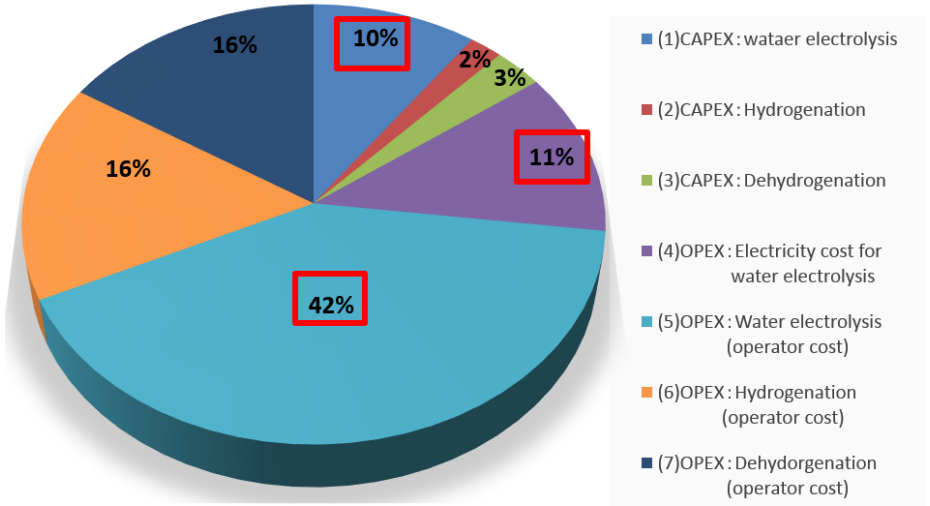
Developing PtG Technology (Small scale)

@ Toamame town, Hokkaido

WT + 135kW Alkaline electrolysis

- Enhancing WT capacity factor
- Thermal energy (H2 boiler)

OCH H_2 storage / transport



Developing PtG Technology (MW class)

@ Namie town, Fukushima

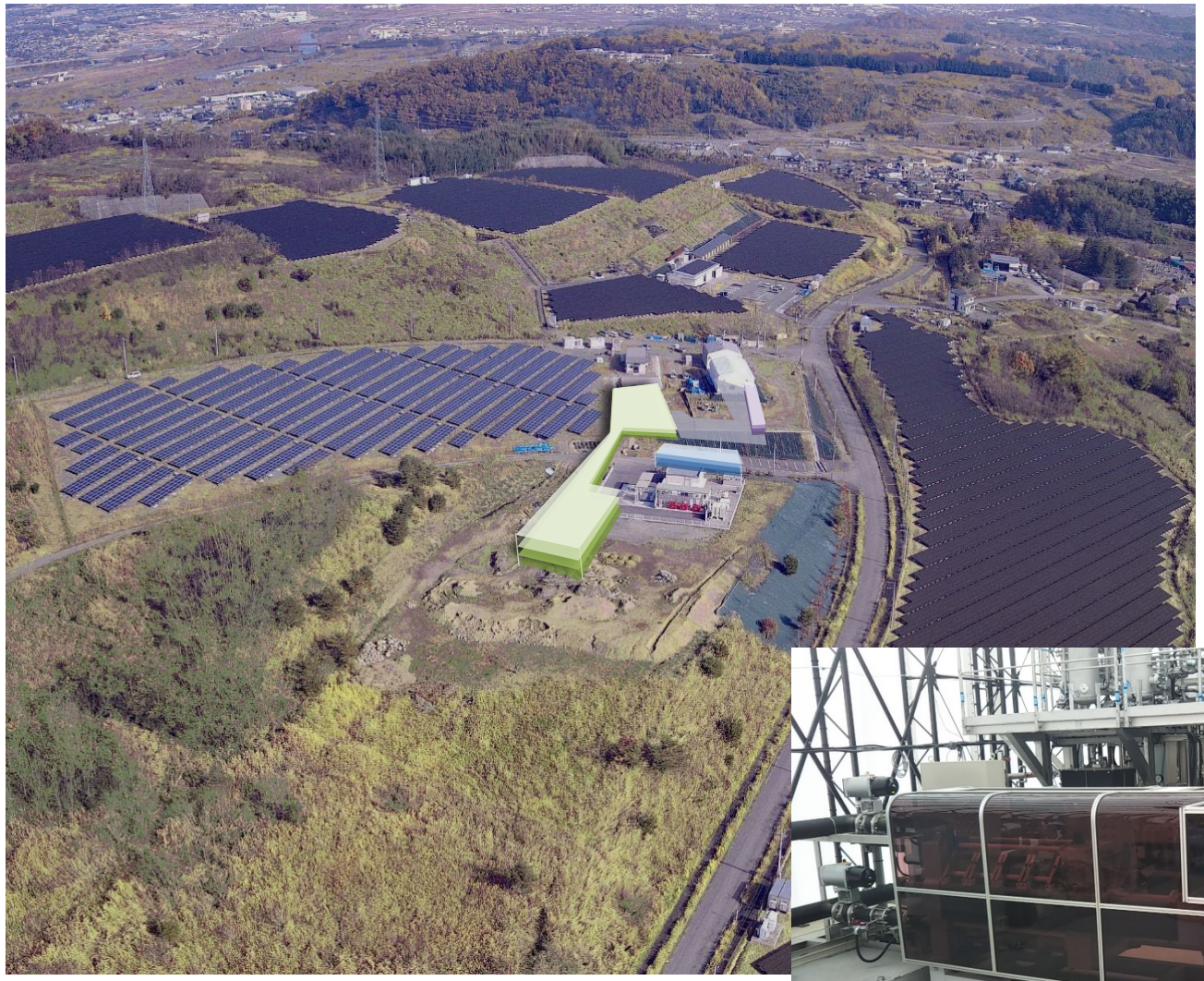
PV(20MW) + 10MW Alkaline electrolysis

- Maximize utilizing PV power
- Grid balancing

x 12 Compressed hydrogen trailer for storage

1.5MW-10MW input power for electrolysis

Developing PtG Technology (MW class)



@ Kofu city, Yamanashi
PV + 1.5MW PEM electrolysis with Hydro-Carbon membrane
- Maximize utilizing PV power

Compressed & Metal Hydride H_2 storage

Conclusion

- *Government leadership should be required*
  - *Developing market environment, roadmap, etc.*
  - *Reducing uncertainty to invite "players"*

- *Technical challenge needs to be continued*
  - *Reliability, durability, efficiency, etc.*
  - *System optimization, operation, EMS…*
  - *Integration: Basic research – Field test*

- *How to develop business model*
  - *Developing opportunity for "Experience"*

Thank you!