THE ENGINEERING ACADEMY OF JAPAN

EAJ

About EAJ

Voluntarily, Independently, and Internationally

- Established in 1987
- Elected as a CAETS member in 1990

- The Engineering Academy of Japan Inc. (EAJ) is composed of leading experts from academia, industry, and government institutions who possess a wide range of knowledge and have made outstanding contributions in engineering and technological sciences, and closely related fields.

Basic Policy of EAJ

2017 Nov 22

Engineer the Future Society for Human Security and Well-being

- Make Policy Recommendations
- Exchange Ideas Internationally
- Foster Next Generation Leaders
- Cultivate Engineering Literacy of People
- Get Together and Co-Create

Members

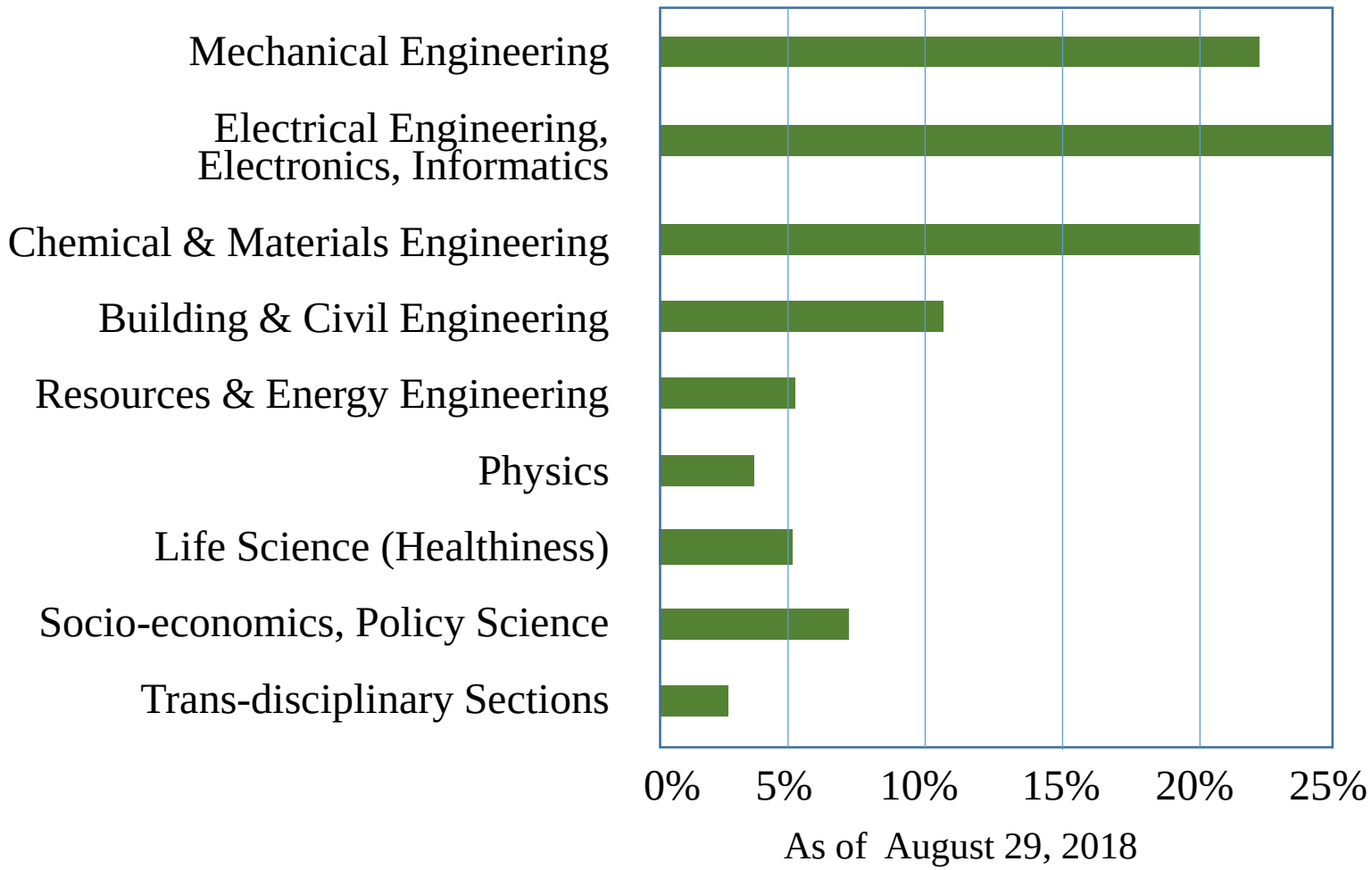
As of August 6, 2018

- Japanese Members: 752
  636 (April 1, 2017) →752 (August 29, 2018)

- Foreign Associates: <1> 12 + <2> 5 = 17
  - <1> Other Academy Members
  - <2> Non-Japanese Residents

- Supporting Corporate Members: 47

Specialties



Board of Directors 2018/2019

President	: Abé, Hiroyuki
Vice and Acting President	: Nakamura, Michiharu
Executive Vice President	: Koizumi, Hideaki
Vice President	: Nakanishi, Tomoko Kamon, Masashi
Executive Director	: Nagano, Hiroshi
Associate Executive Director	: Nagai, Kotobu Oeda, Kenji* *Full time
Director	: Arikawa, Setsuo Ishizuka, Masaru Ota, Koichi Okada, Masuo Onodera, Tadashi Kitamura, Takayuki Kyuma, Kazuo Kobori, Hiromi Saeki, Hiroshi Sakata, Toichi Takamatsu, Hiroshi Tanaka, Toshihiro Tsuji, Astuko Tsuji, Yoshiko Nakajima, Yoshikazu Hashimoto, Masahiro Baba, Naoshi Hayashi, Hideki Harayama, Yuko Hino, Shinichi Miyagi, Mitsunobu Murakami, Hideyuki Wang, Shuoyu
Inspector	: Taniguchi, Isao Hino, Mitsutaka
Executive Adviser	: Yoshikawa, Hiroyuki
President Emeritus	: Komiyama, Hiroshi
Adviser	: Hori, Yukio Aoyama, Hiroyuki Kunitake, Toyoki Ito, Yoshimi Mitsui, Tsuneo Kawasaki, Masahiro Taneichi, Takeshi Kamiyama, Shinichi Iizuka, Kozo Misono, Makoto Tsuge, Ayao Matsuo, Tomonori Kajiyama, Tisato

As of August 6, 2018 (New Selection)

Activities

Engineering Experts
Policy Proposal

Global Development
Inter-academy
Collaboration

Engineer the Future
for human security and well-being

Next generation
Human Resource
Development

Local Development
Regional Activity

Inter-academy Collaboration

Inter-academy Meetings

CAETS
(International Council of Academies of Engineering and Technological Sciences)
- 2015.10 New Delhi “Pathway to Sustainability”
- 2016.09 London “Engineering a Better World”
- 2017.11 Madrid “Challenges of the Bioeconomy”
- 2018.9 Montevideo “Sustainable Development of Agroforestry Systems”

EA-RTM
(East Asia Round Table Meeting of Academies of Engineering)
- 2015.11 18th Wuhan “Advanced Manufacturing”
- 2016.09 19th Fukuoka “Advanced Maintenance”
- 2017.09 20th Busan “Smart City”
- 2018.10 The 21st Hangzhou “New Generation of AI”

Multi-disciplinary Communication Programs for Young Leaders

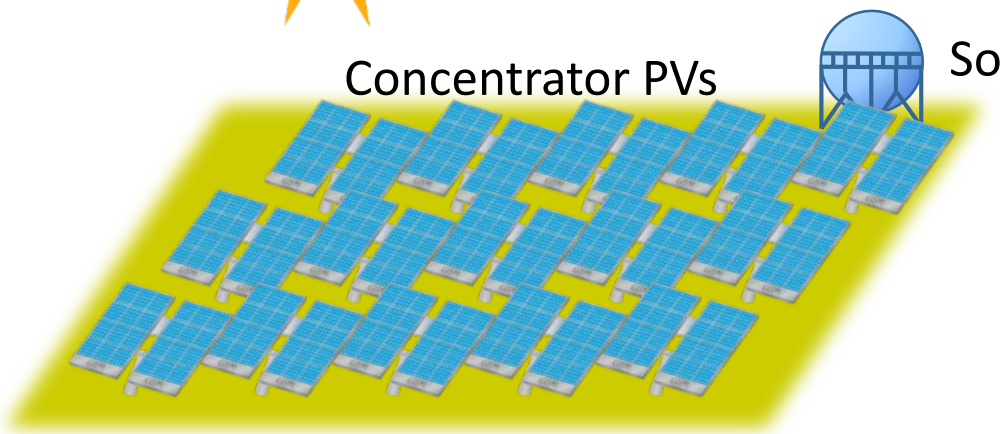
JAFOE
(Japan America Frontiers of Engineering) Symposium
(NAE-JST-EAJ)
13th August 16-18, 2016, Irvine
14th June 2018, Tsukuba

ERLEP
(Australia-Japan Emerging Research Leaders Exchange Program)
From 2009 (ATSE-JSPS-EAJ)

The Joint Symposium of
ERLEP toward the Next Big Step
ERLEP Trans-Disciplinary Forum
1st December 4-6, 2017, Fukuoka
2nd December 3-5, 2018, Melbourne

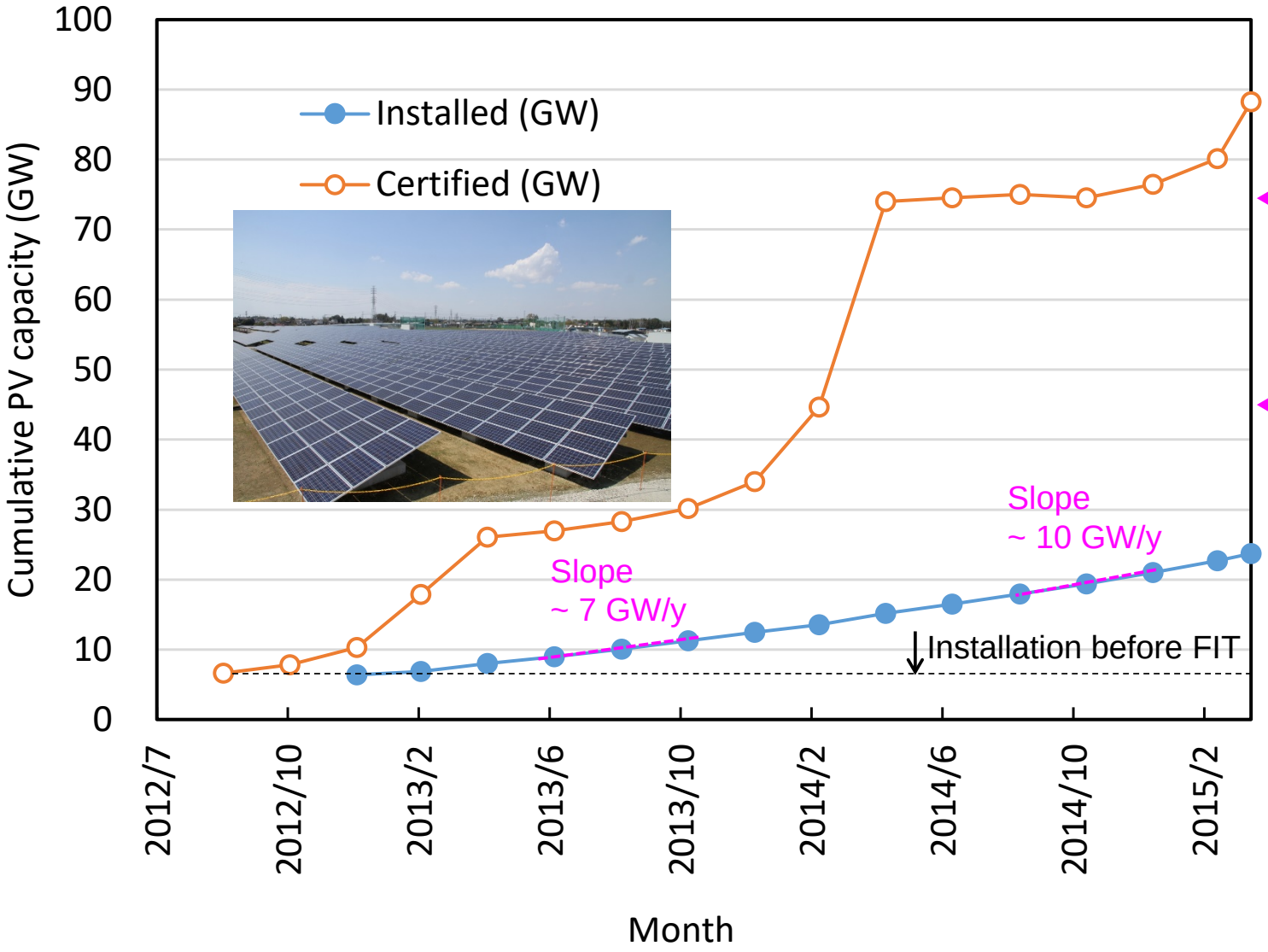
A global network of renewable hydrogen for disruptive installation of renewable energy

Prof. Masakazu SUGIYAMA
Research Center for
Advanced Science and Technology,
The University of Tokyo



Solar farm in Queensland

PV installation in Japan

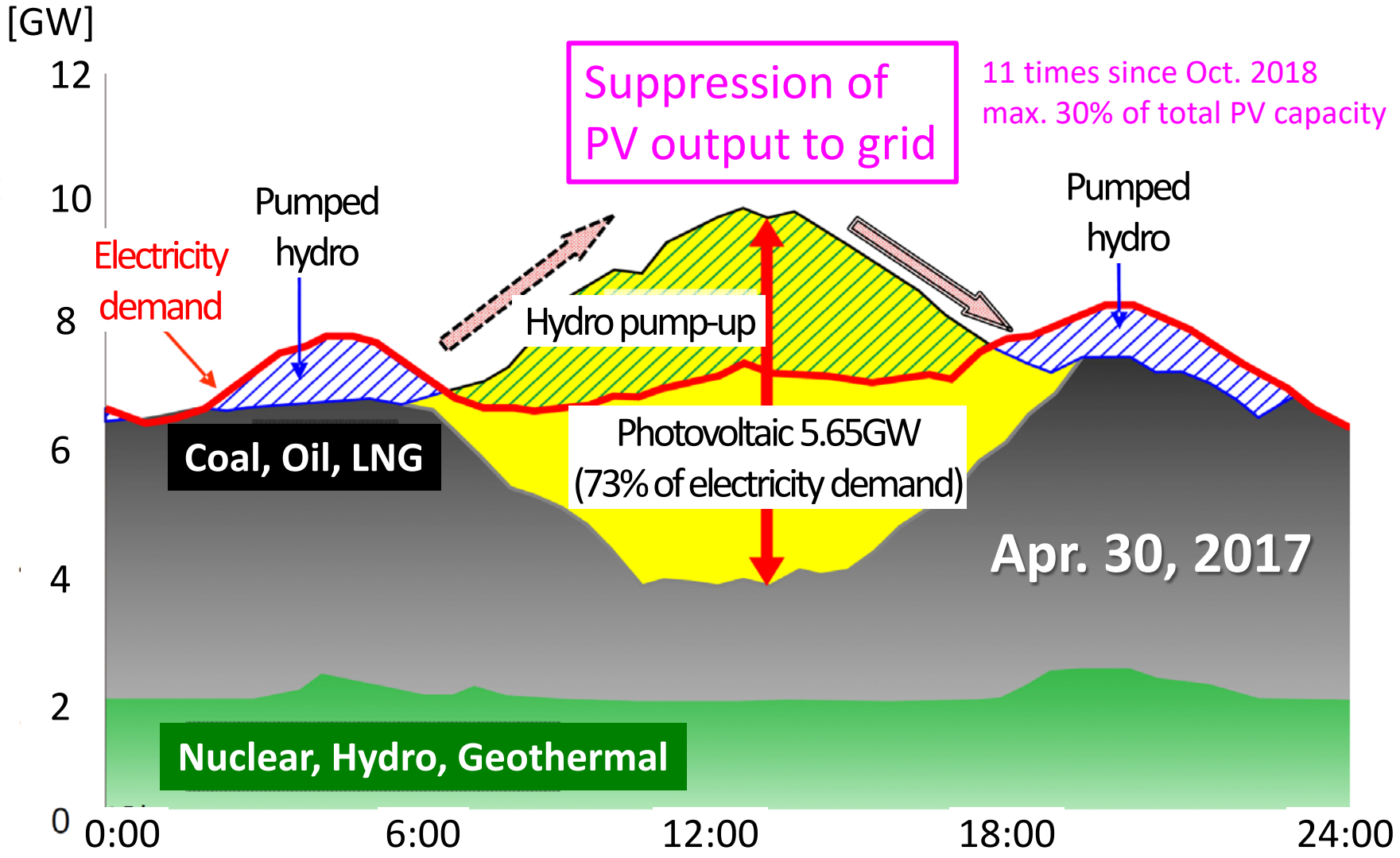


← ~75 GW certified (2018/3)

← ~44 GW installed (2018/3)

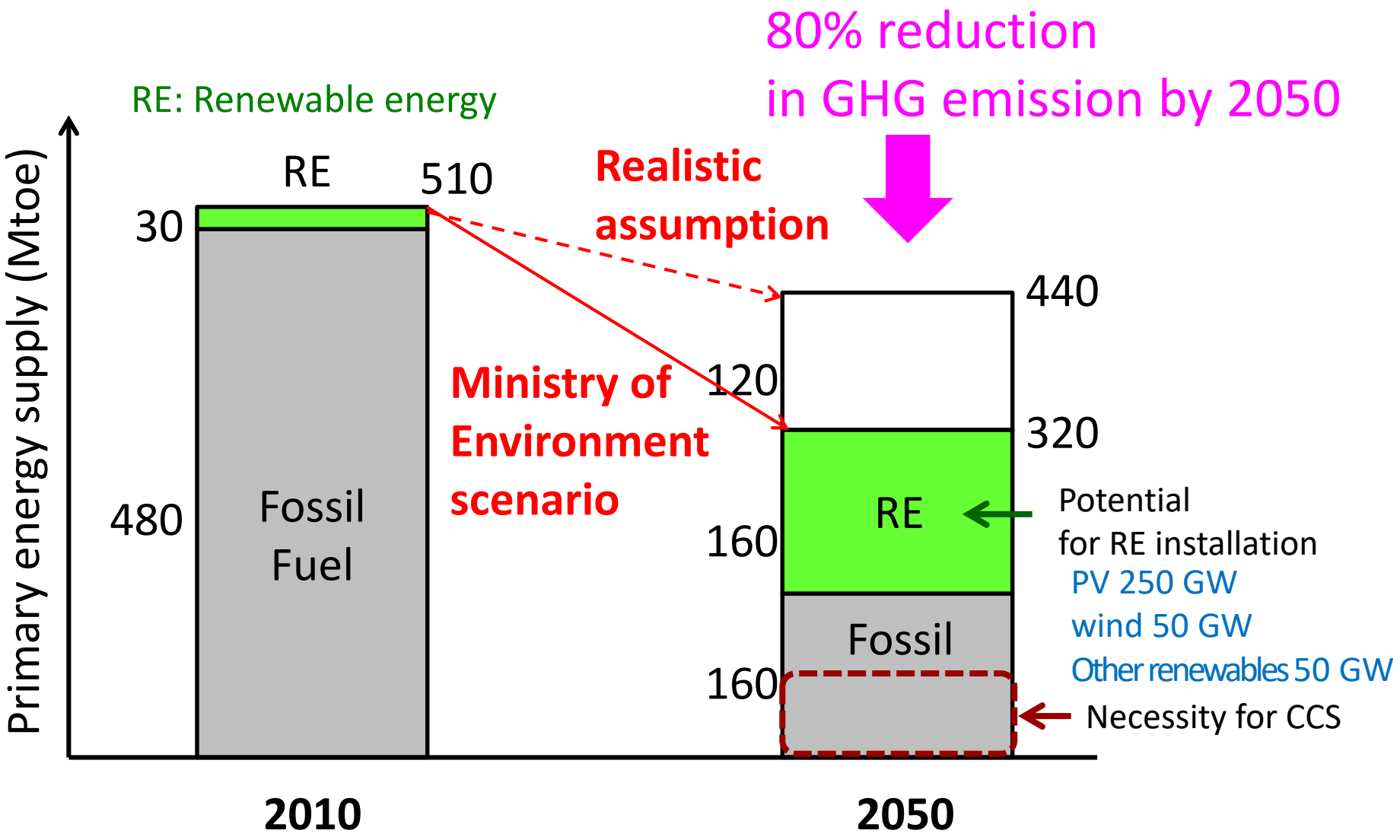
Maximum electricity generation in Japan: 153 GW (2015)

Difficulty in grid management in Kyushu



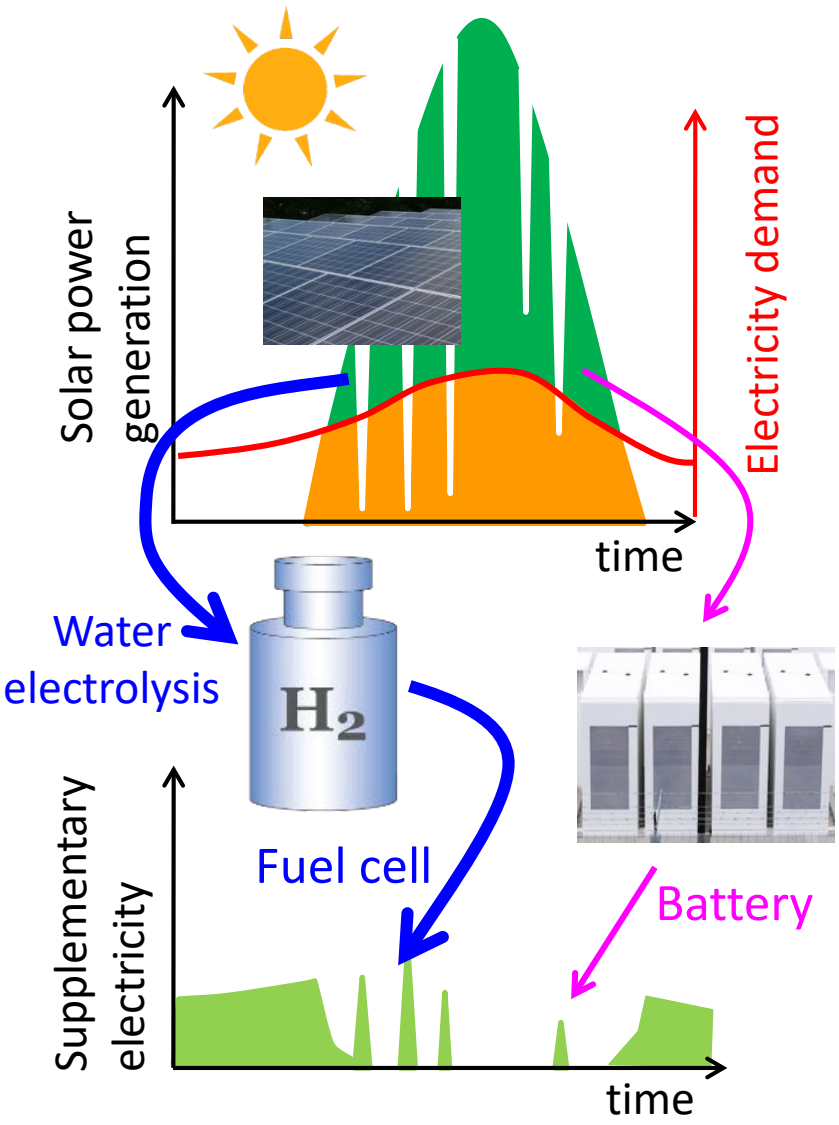
Source: Agency for Natural Resources and Energy, Japan
Translation to English: M. Sugiyama

Need for the imported renewable energy

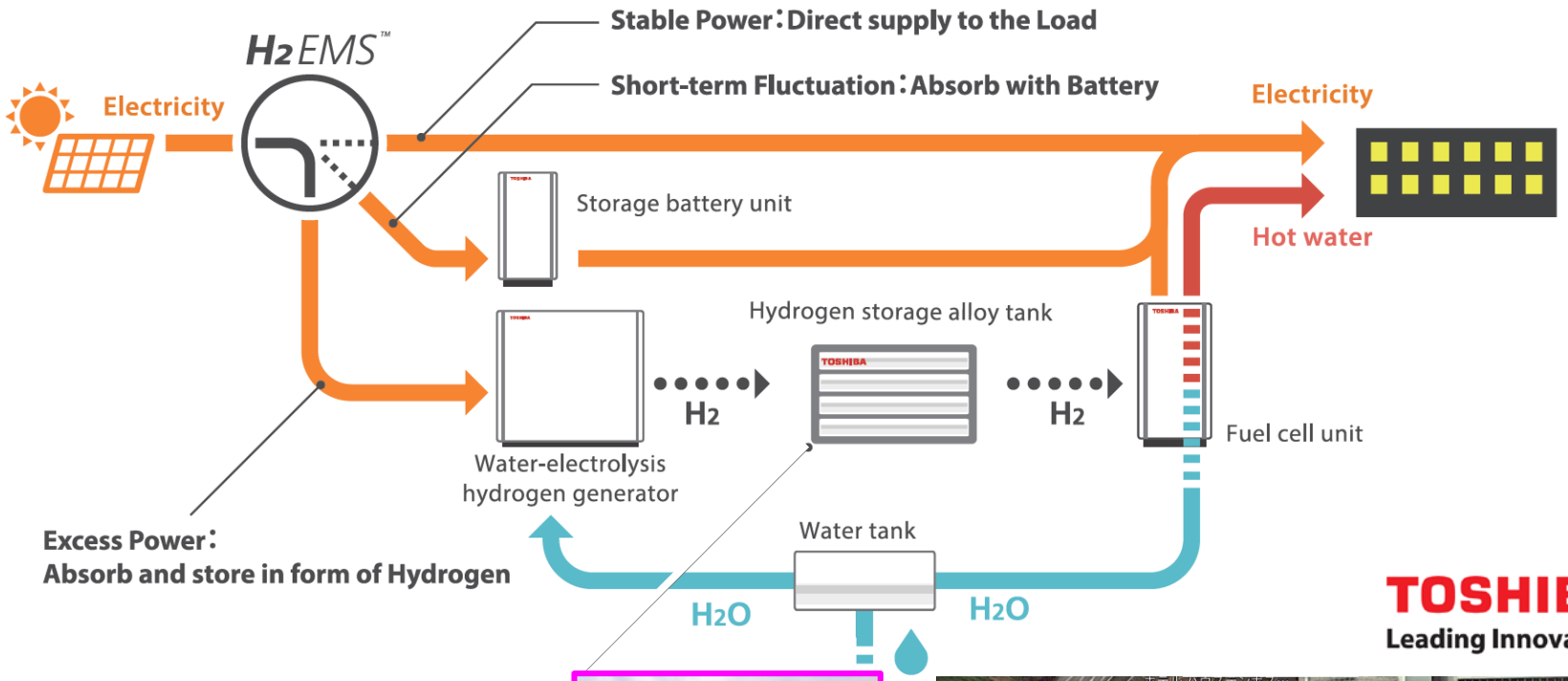


Mr. Kidoshi, Japan Research Institute

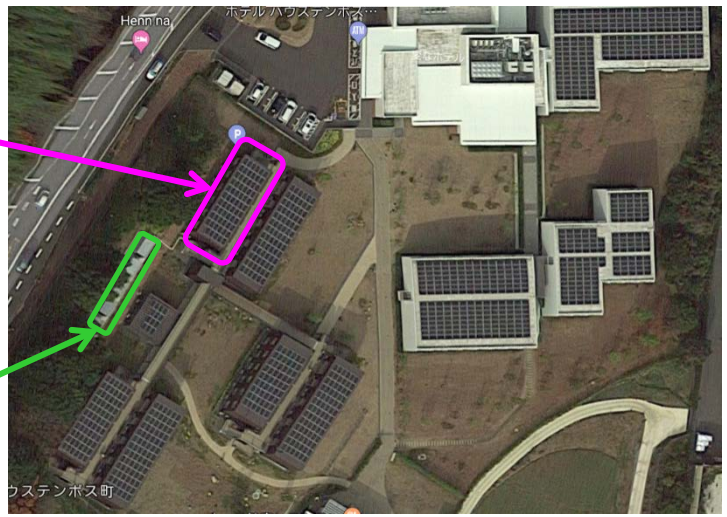
Energy Management by Stationary H_2 Storage



Recent installation in Huis Ten Bosch Hotel in Japan

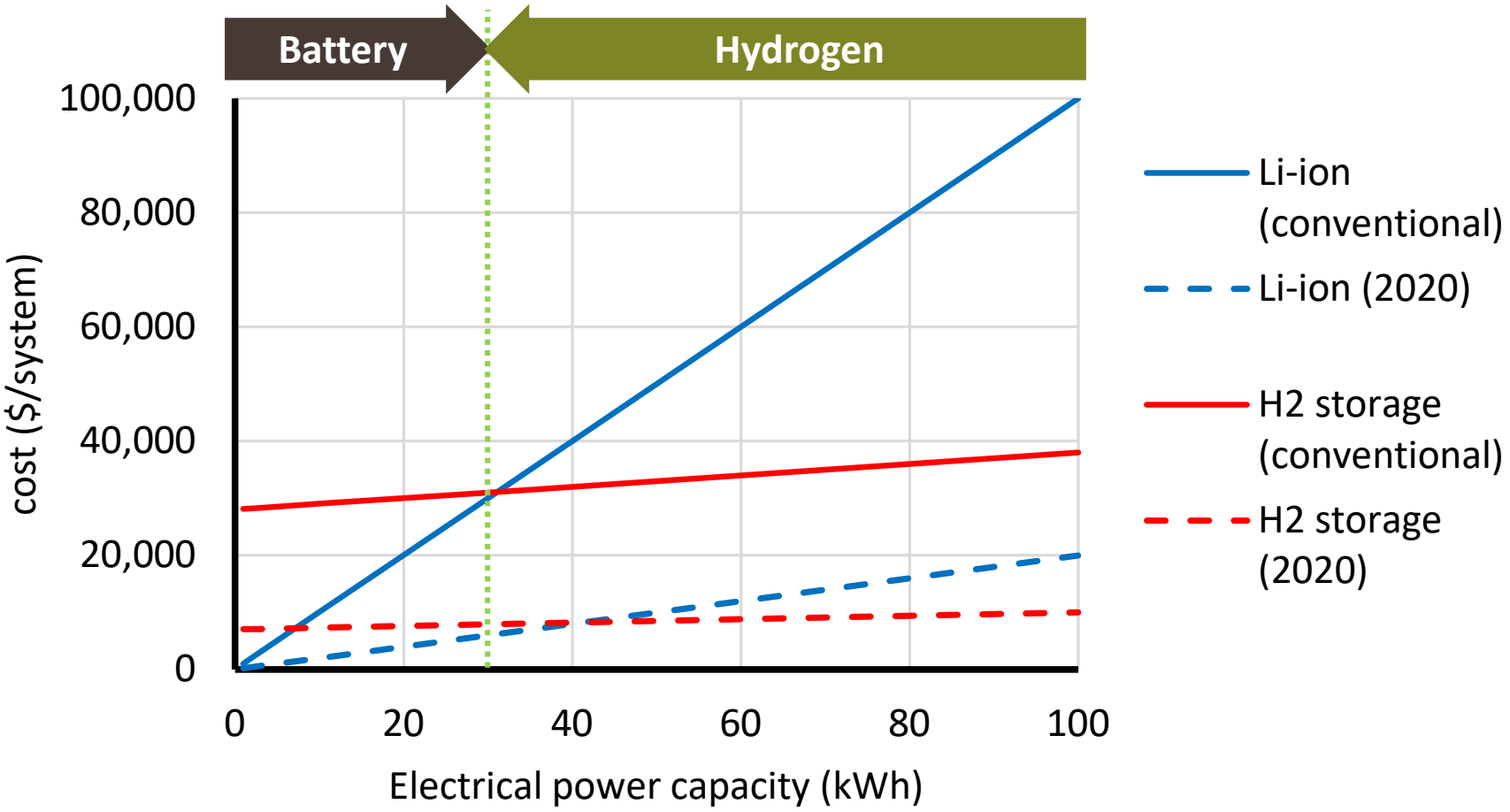


12 rooms
independent from
electricity grid

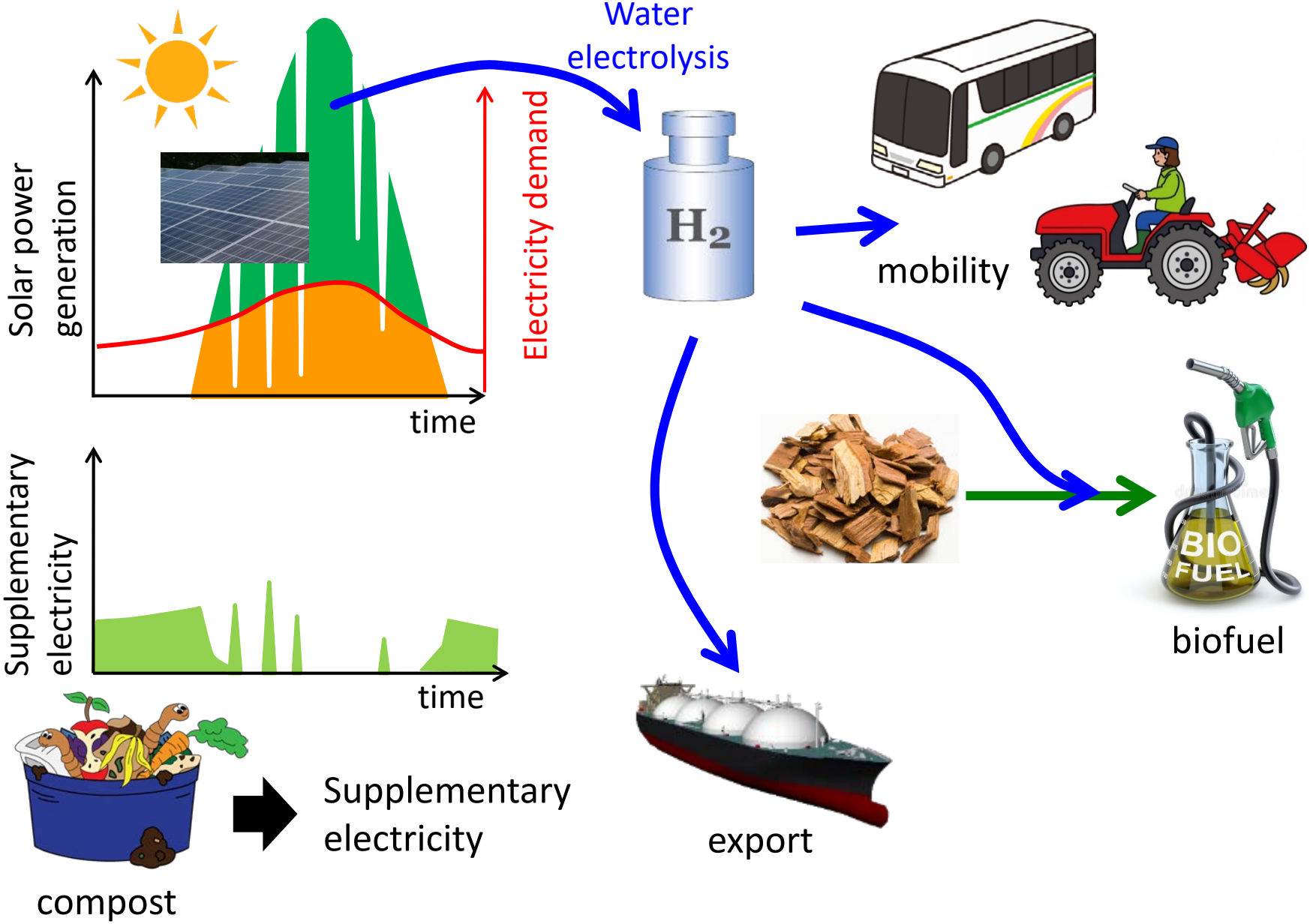


water electrolyzer
H_2 storage
fuel cell

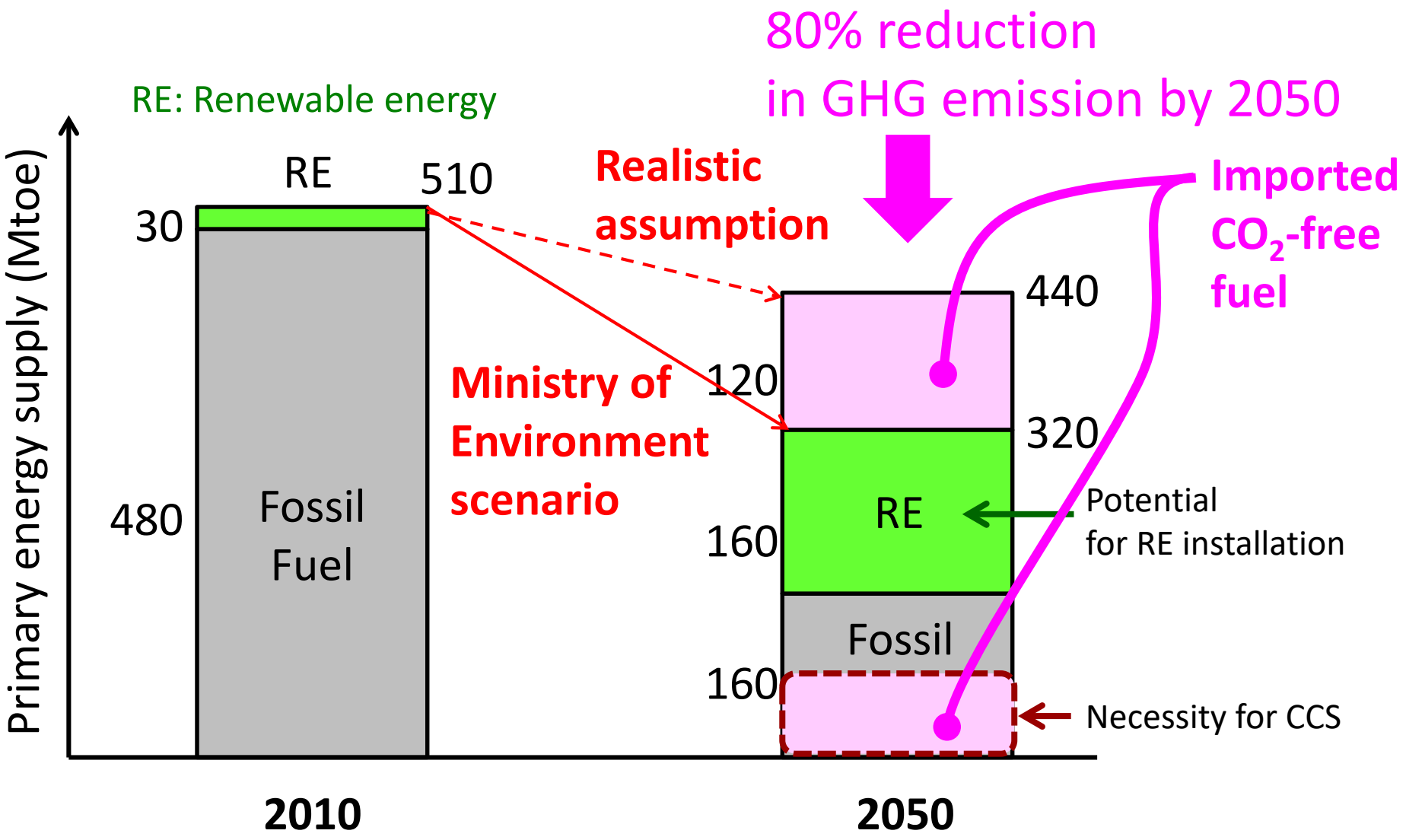
Hydrogen for long-term electricity storage



More value on H_2: regional energy management



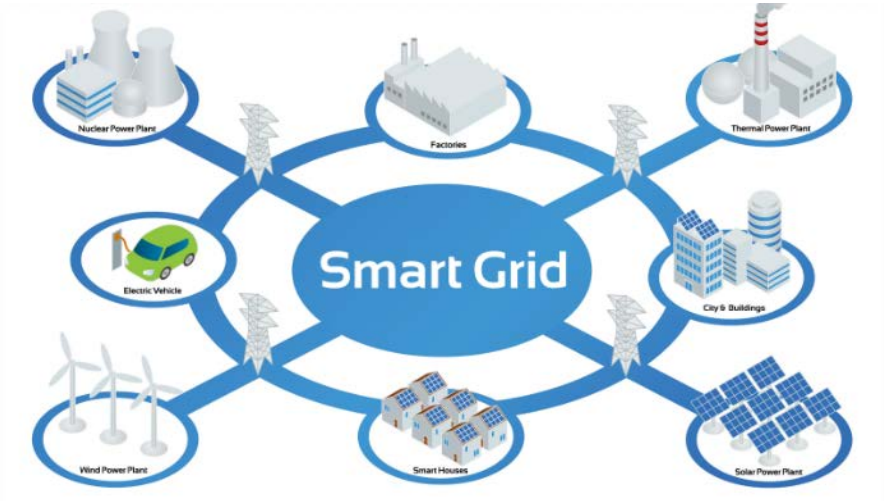
Need for the imported renewable energy

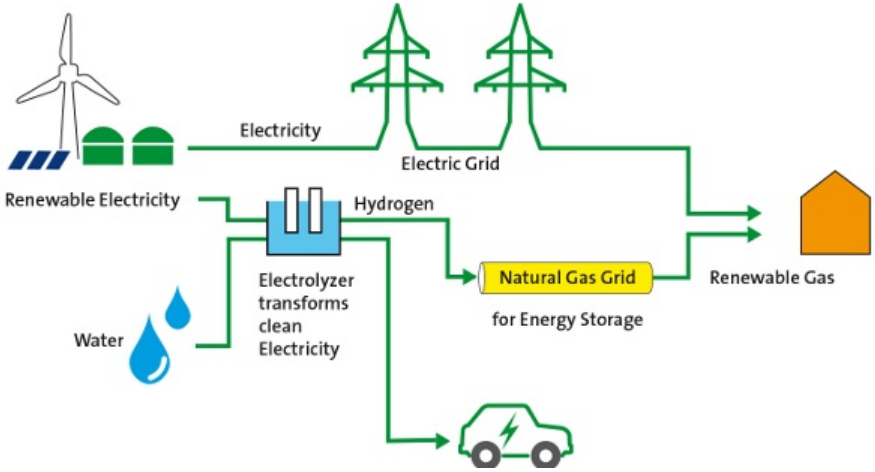


Mr. Kidoshi, Japan Research Institute

Renewable energy management

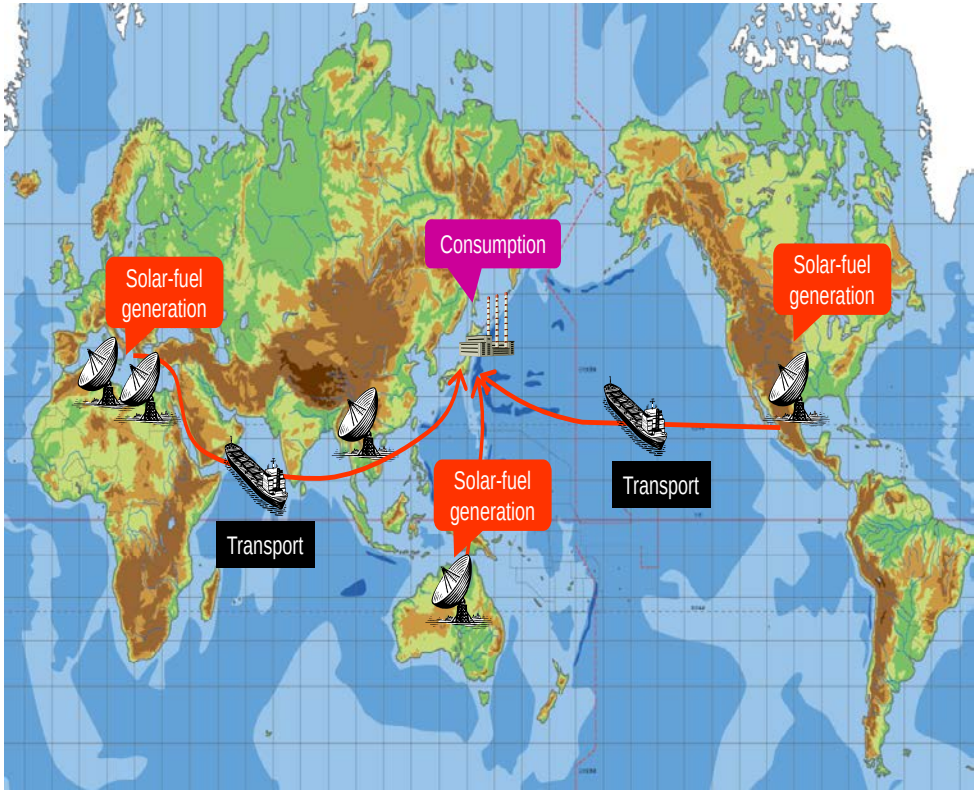
- Time-average



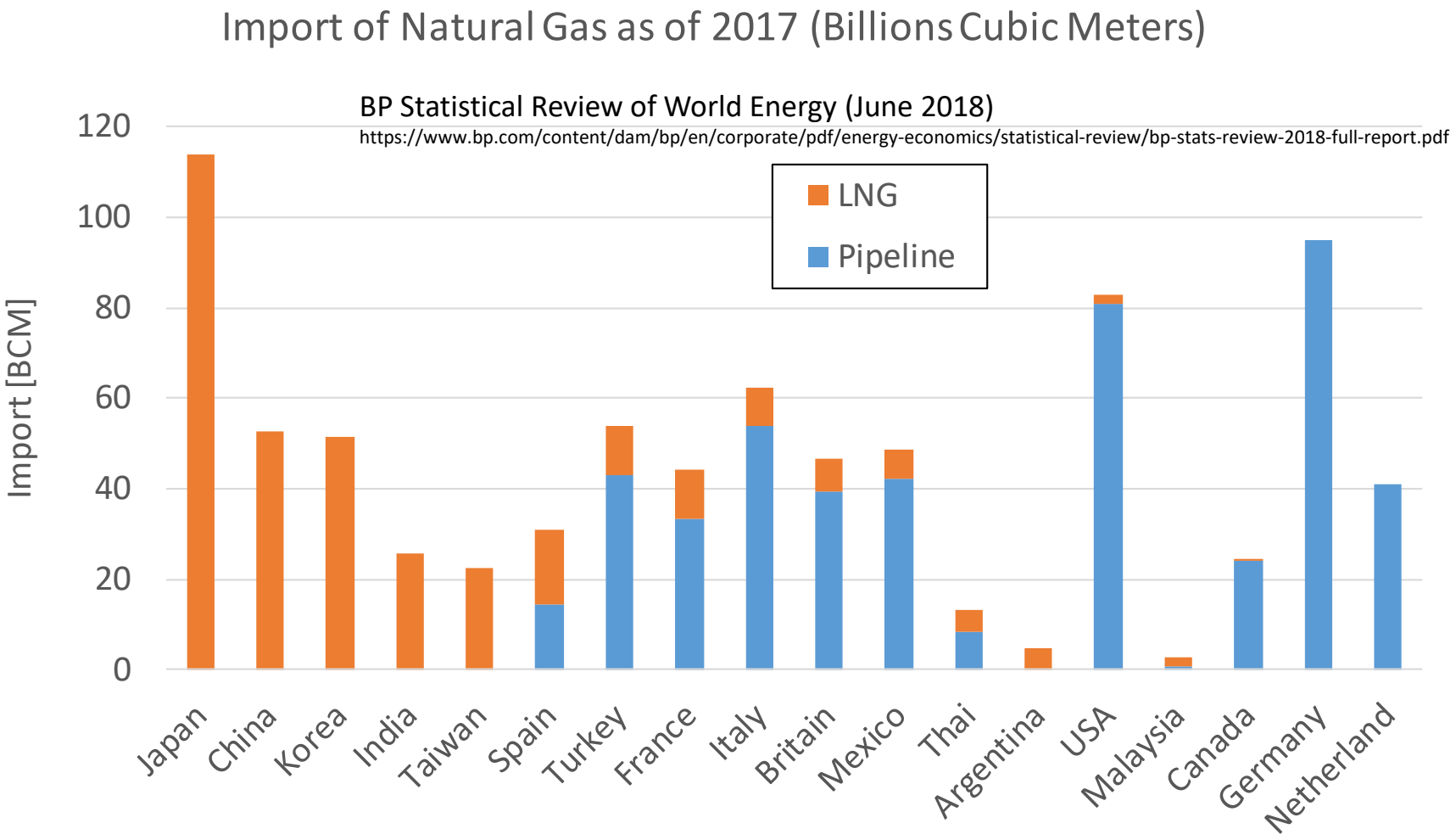


Power to gas

- Spatial-average
  - Solar-fuel production
  - Long-distance transport



Which country necessitates solar fuel import?



Pipeline → power to gas

LNG → oversea transportation of CO_2-free hydrogen

Intercontinental hydrogen transport: intensive R&D

Australia

SUMITOMO ELECTRIC

Concentrator photovoltaic

Inexpensive electricity

Water purification

Water electrolysis

Renewable H_2

CO_2 source

methanation (catalysis)

H_2 addition (catalysis)

H_2 addition (catalysis)

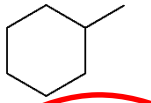
cooling

Intercontinental transport

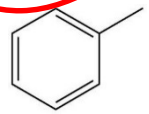
Methane

Hitz
Hitachi Zosen

NH_3



Chemical Hydride



CHIYODA CORPORATION

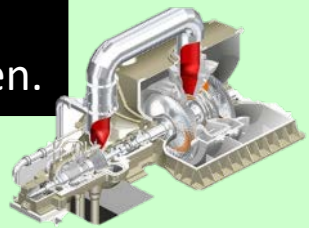
Liquid H_2

Kawasaki

Japan

Utilization with existing infrastructure

Combustion Electricity gen.



H_2 separation

H_2 separation

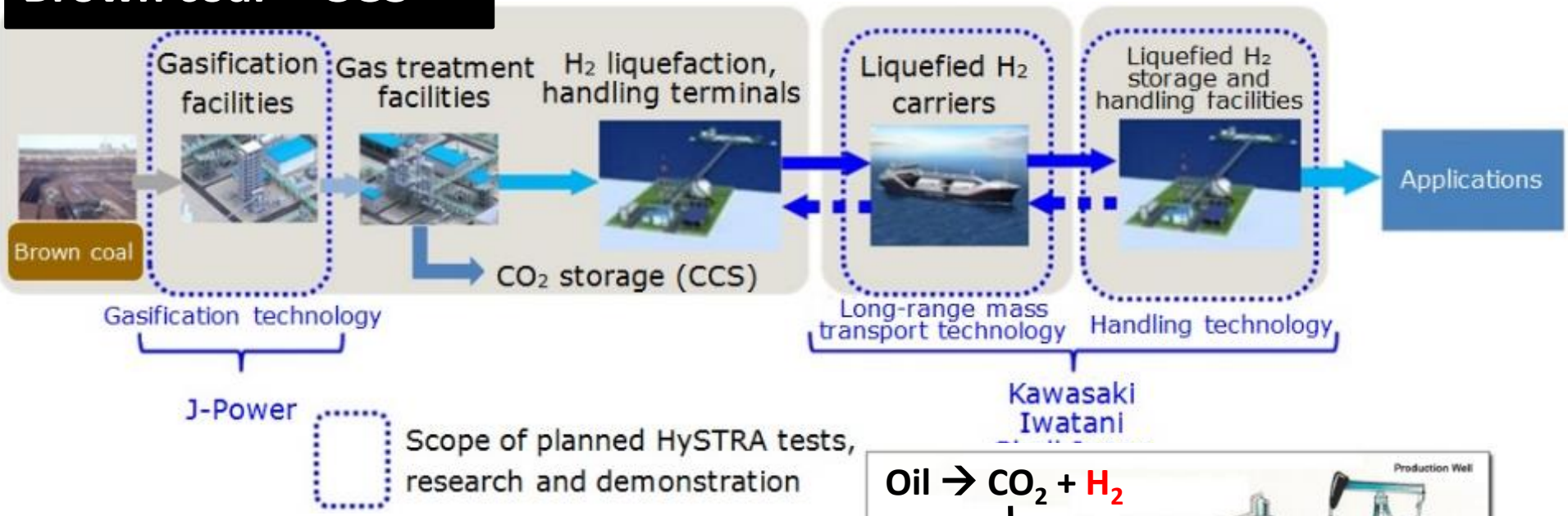
Mobility powered by H_2

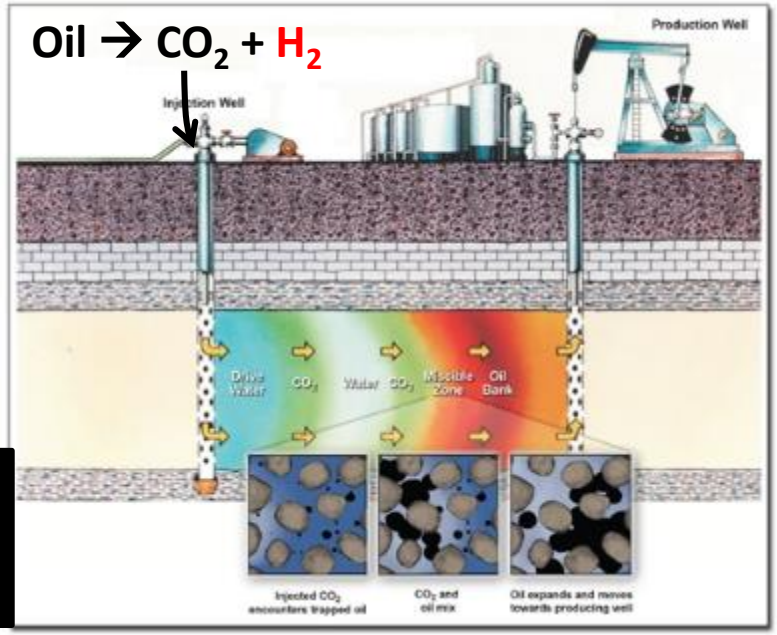
TOYOTA

TOYOTA

CO_2-free hydrogen

Brown coal + CCS





EOR
(Enhanced Oil Recovery)

Renewable hydrogen

Wind

Solar

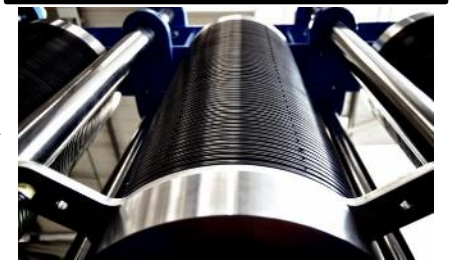
Panel

Concentrator

Hydrogen:
An interface between renewable electricity and chemical substances

Renewable electricity

Water electrolysis



www.itm-power.com

Renewable hydrogen

Water treatment

water

Membrane distillation etc.

Partnership with Australia: a necessity

2050 Target in Japan

Electricity generation with **renewable H_2**
20% share in total electricity generation
(capacity 30GW, **H_2 10mil. ton/year**)

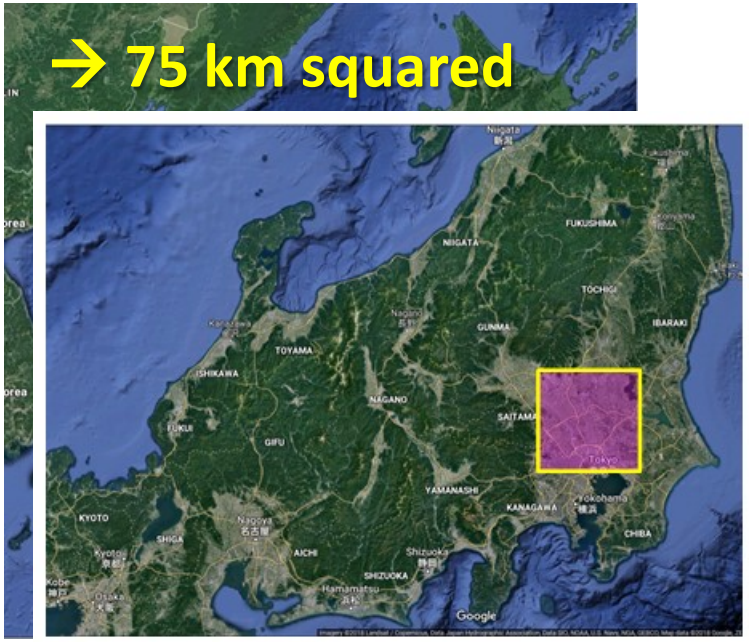
500 TWh/year electricity for water electrolysis

In Australia

PV capacity ~300 GW
(19% system utilization ratio)

In Japan

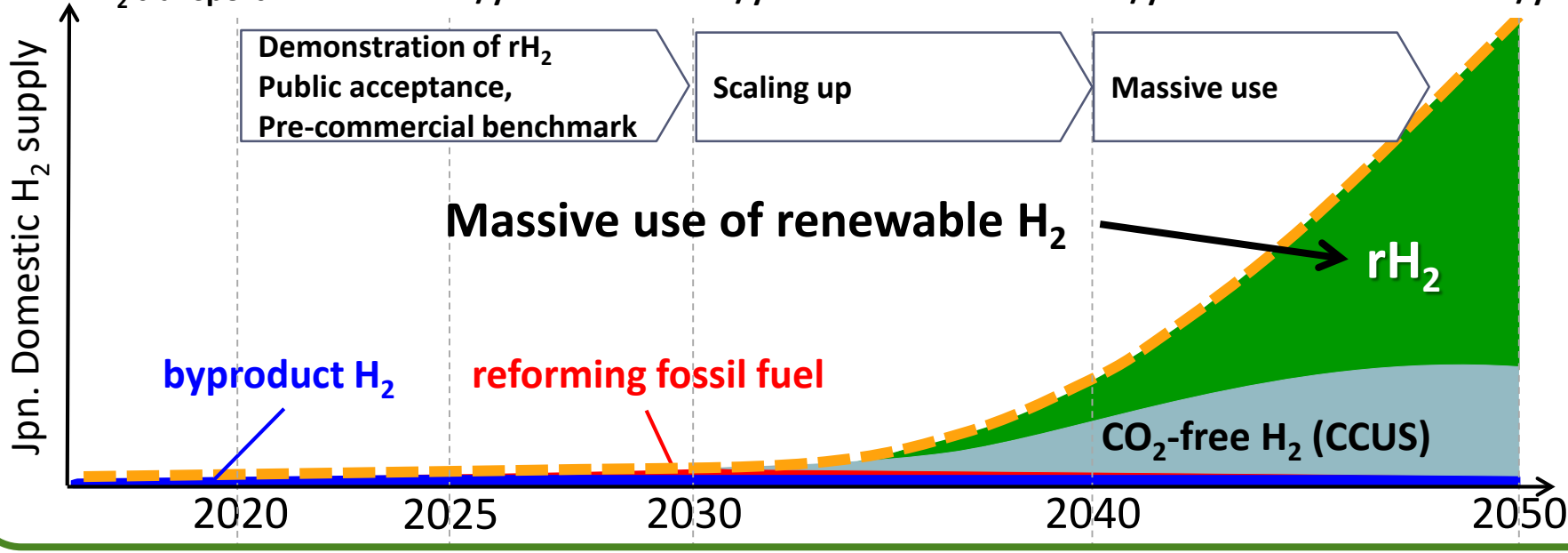
PV capacity ~450 GW
(13% system utilization ratio)



Perspective for global renewable hydrogen

Our wish **Massive import of renewable H_2 (rH_2) in 2050**

Overseas small demo of rH_2	Transport to Jpn. demo	Partial substitution of fossil-based H_2 with rH_2	Power generation with rH_2	Jpn. → Asia extended use of rH_2
Demonstration	**Benchmark**	**Pilot use**	**Commercialization**	**rH_2 society**
generation : 30 kW	20 MW	200 MW	20 GW	~ 200 GW
electrolysis : 5 kW	10 MW	100 MW	10 GW	~ 100 GW
H_2 transport: —	1k ton/y	10k ton/y	1M ton/y	~ 10M ton/y

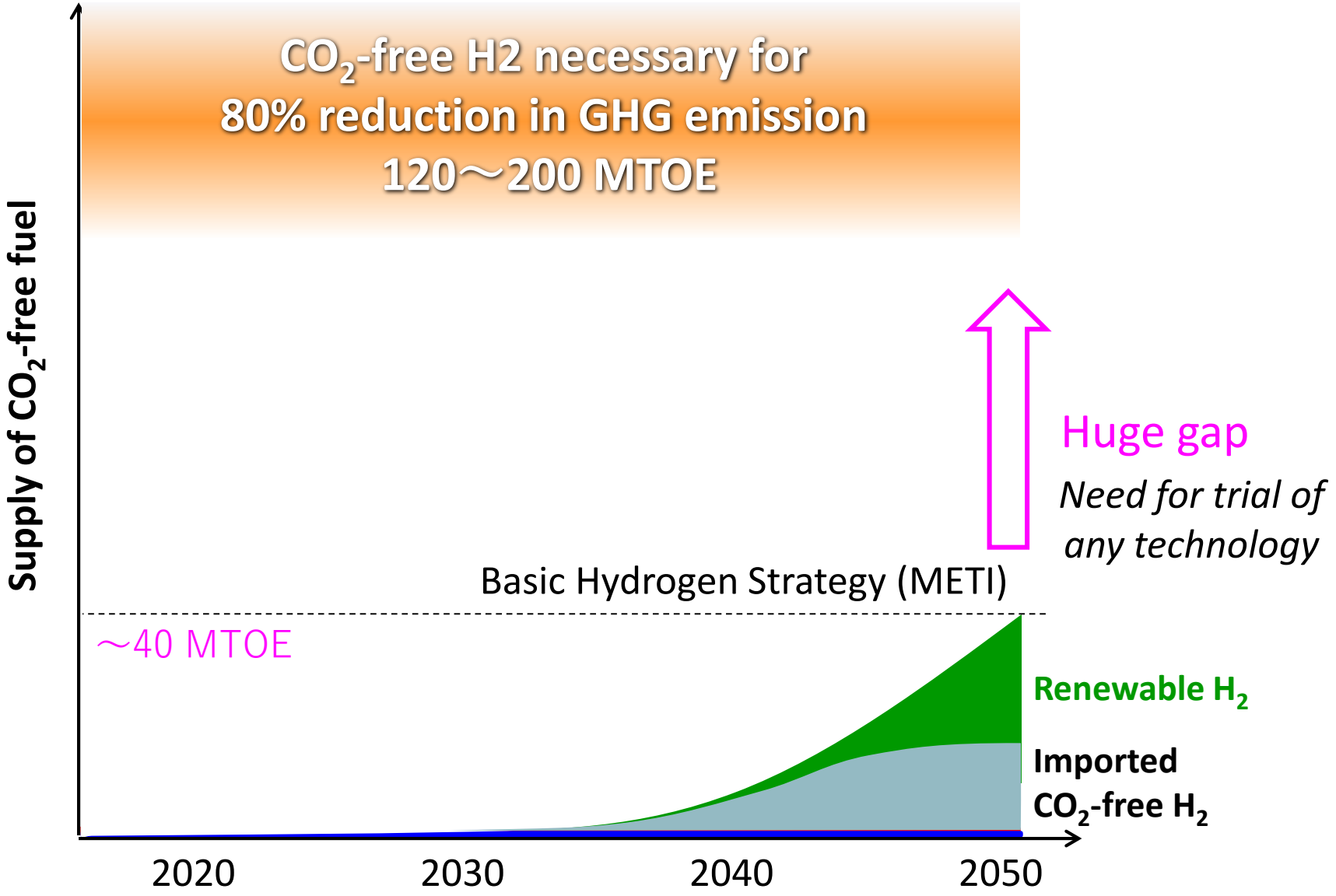


Govt. strategy

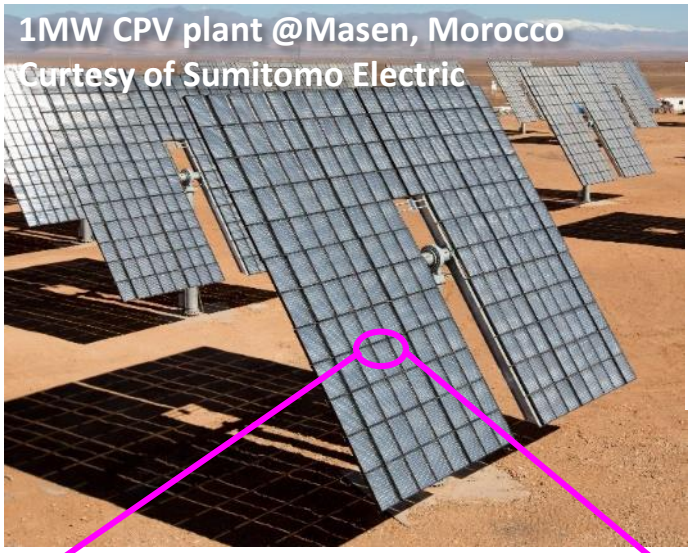
H_2 from fossil fuel → CO_2-free H_2

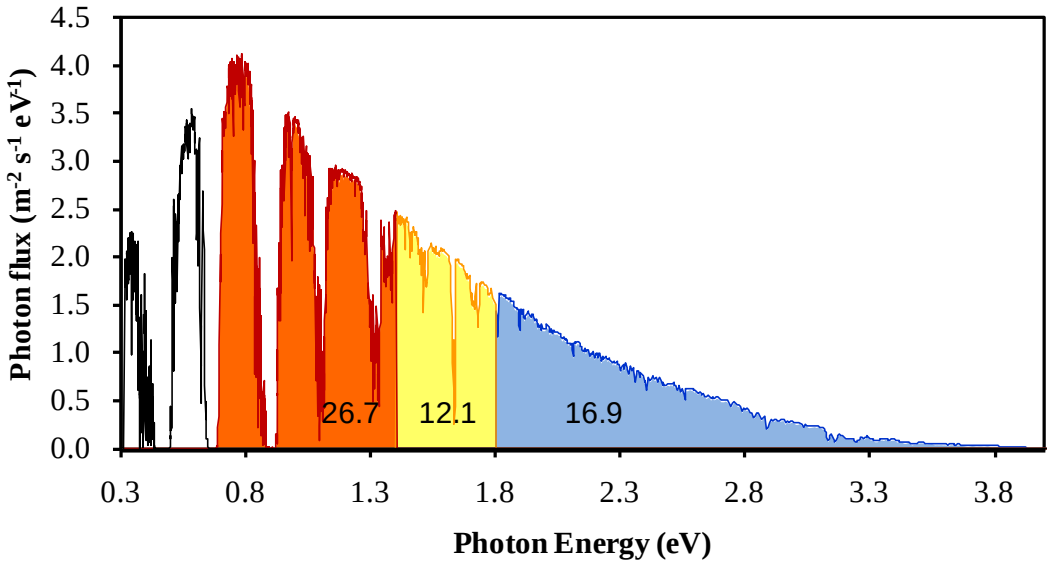
H_2 supply	4k ton/y	300k ton/y (equiv. 1 power plant)	10M ton/y (~20% of electricity)

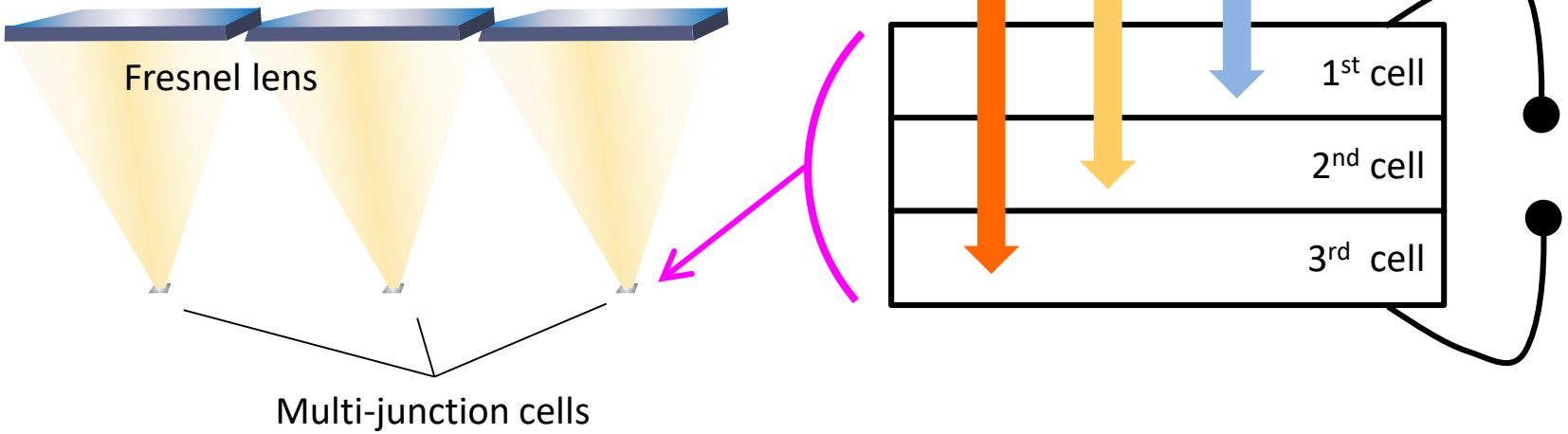
Towards 80% reduction of GHG emission



Concentrator PhotoVoltaic (CPV) modules







Continuous solar hydrogen production benchmark

Prof. Nishioka, Miyazaki Univ.

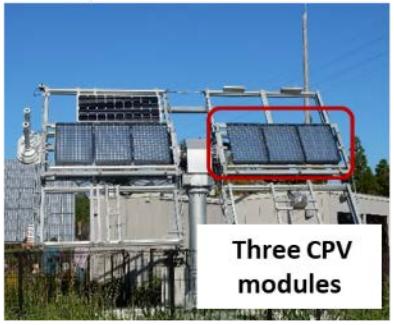
Solar-to-hydrogen energy conversion efficiency

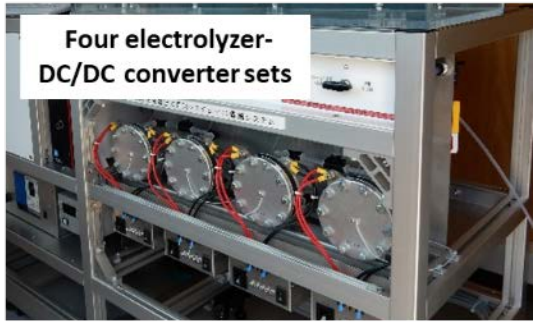
$$\eta_{STH} = \eta_{CPV} \times \eta_{DCDC} \times \eta_{EC} \times \eta_{F}$$

PV — Voltage conversion — overpotential — current

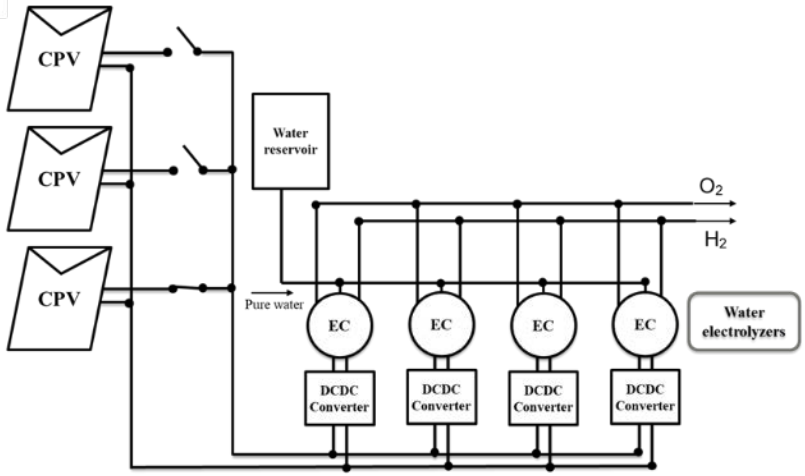
~20% energy conversion efficiency achieved

(a)

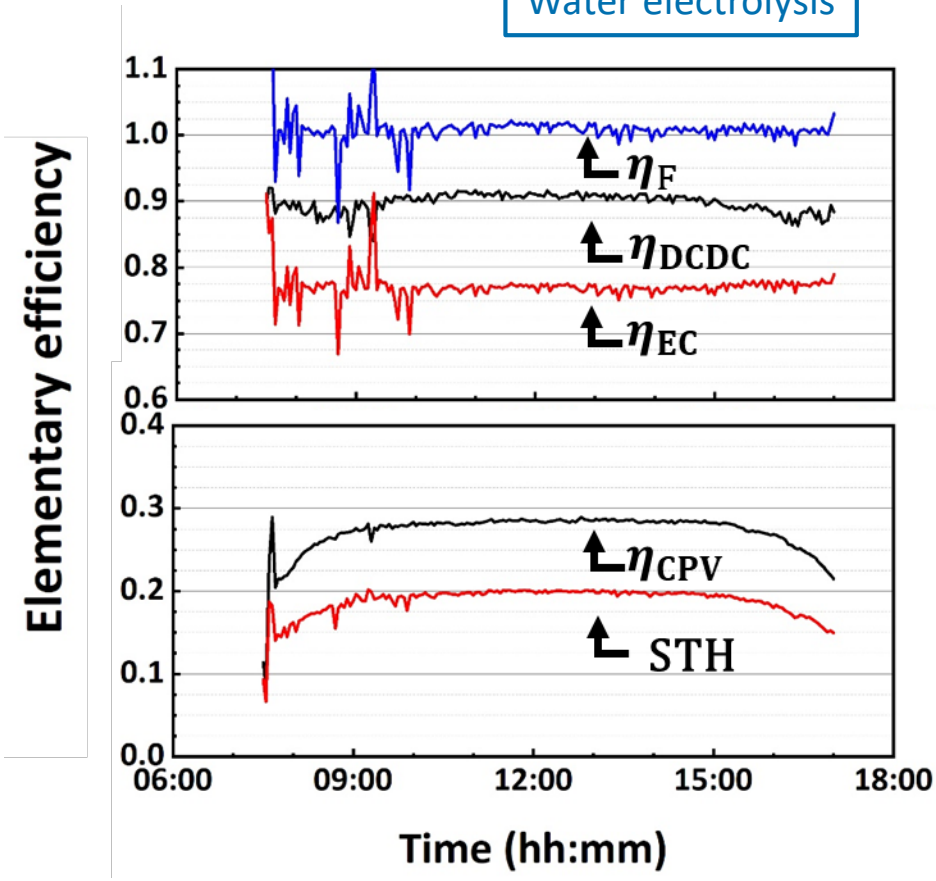




(b)



Water electrolysis



H_2Xport project in Queensland, Australia

Conventional photovoltaic

ARENA QUT Griffith UNIVERSITY SUMITOMO ELECTRIC Energy Developments

Cost-effective production of renewable H_2
- System engineering
- Demonstration