# Thinktank Roundtable A (IEEJ)

# Energy Transition

## Shifting from Molecules to Electrons
## - Role of Innovation and Potential of Carbon-free Hydrogen -

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# Introduction

## Molecules to electrons

- Energy transition includes shifting away from fossil fuels to electricity.
- We can still use molecules in the form of “green” molecules in the zero-emission world.

## Hydrogen

- High hopes are placed on hydrogen as a carrier of zero-carbon energy.
- Hydrogen can be produced from renewable energy, fossil fuels, and nuclear.

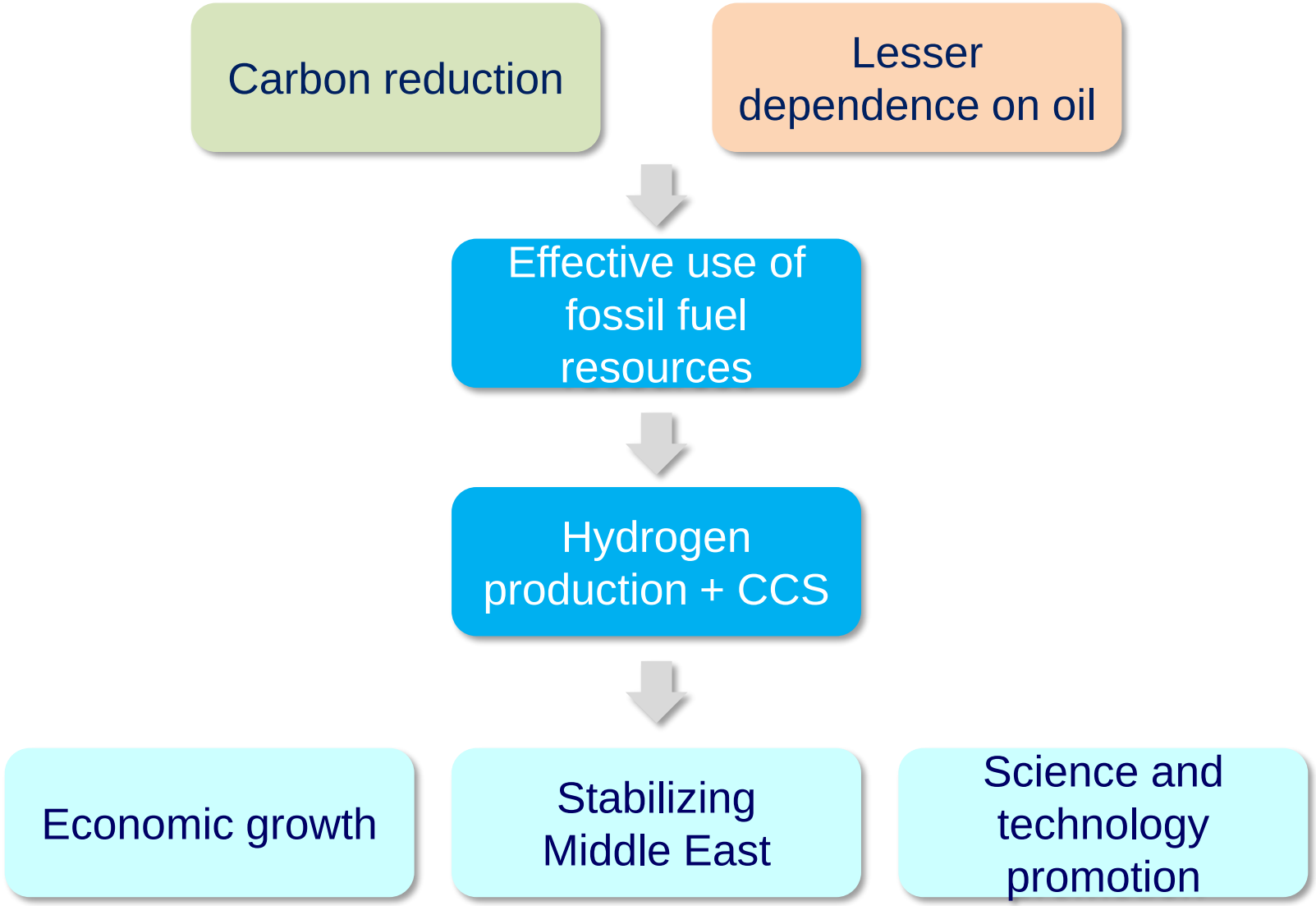
## Important Role of Hydrogen

- Number one priority is addressing Climate Change
- Potential benefits :
  - to stabilize fossil fuel rich economies in Post-Oil-Age
  - to connect energy importing Asian countries with energy exporters in the zero-emission world
  - to store surplus renewable electricity



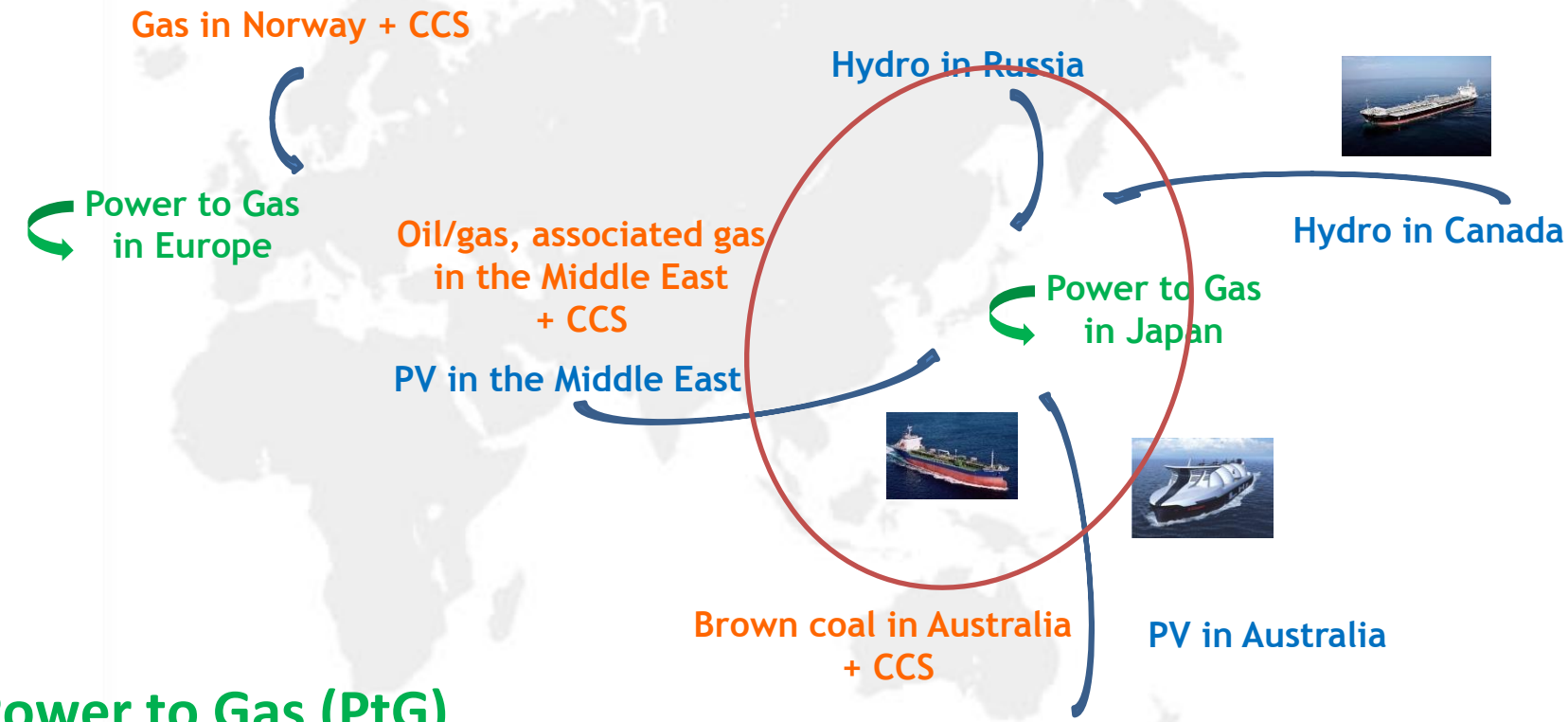
Source: IEEJ

# Reducing Carbon Footprint While Making Use of Fossil Fuel Resources



# $CO_2$-free Hydrogen

- **Large scale availability of $H_2$** (either from hydrocarbon + CCS or renewables)
  - ✓ A variety of concepts led by Japan, recently followed by Europe.
  - ✓ Around 2020, some of the ideas are to be demonstrated by Japanese companies.




- **Power to Gas (PtG)**
  - ✓ Led by Europe, recently followed by Japan.

# Government Stakeholders around $H_2$ in Japan

**METI**

Industry/Technology R&D
・long term perspective

**ANRE**

$H_2$ and Fuel Cell Strategic Council
Roadmap established in 2014 and revised in2016
✓$H_2$-fired power generation
✓Power to Gas
✓Creation of $H_2$ demand

**NEDO**

Tech Demonstration
・$H_2$ supply chain
・Energy carrier
・Power to Gas

→ HySTRA(2016)
AHEAD(2017)

**Cabinet Office (SIP)**

**JST**

Energy carrier
($NH_3$, Liquefied $H_2$, Methylcyclohexane)

Green Ammonia Consortium (2017)

**MLIT**

・IMO standardization of liquefied $H_2$ shipping
・$H_2$ production from sewage

**MOE**

・Local renewable energy to $H_2$

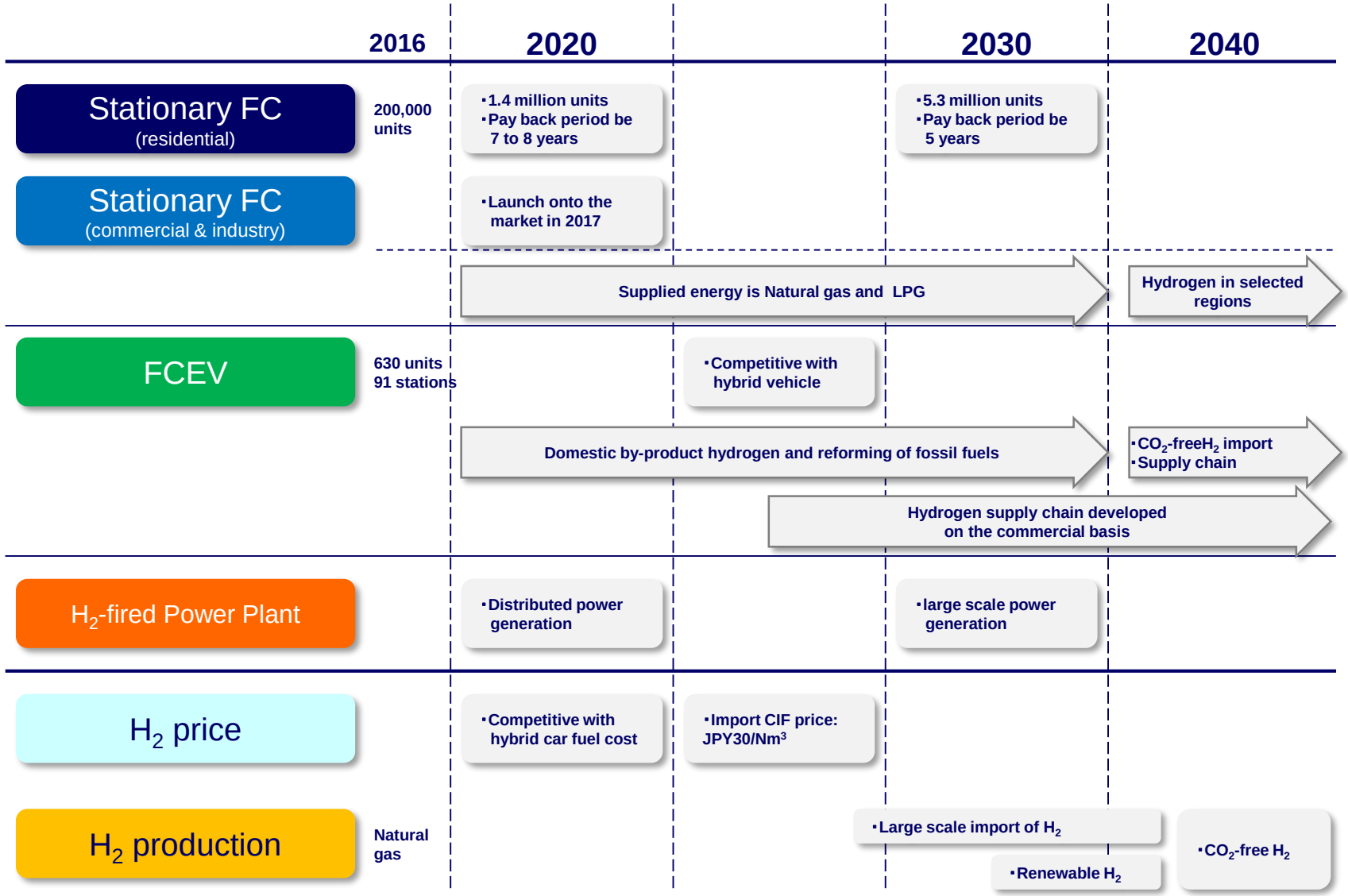
**Local government**

Roadmap
・local feature
・local resource


G20 in 2019
Japan

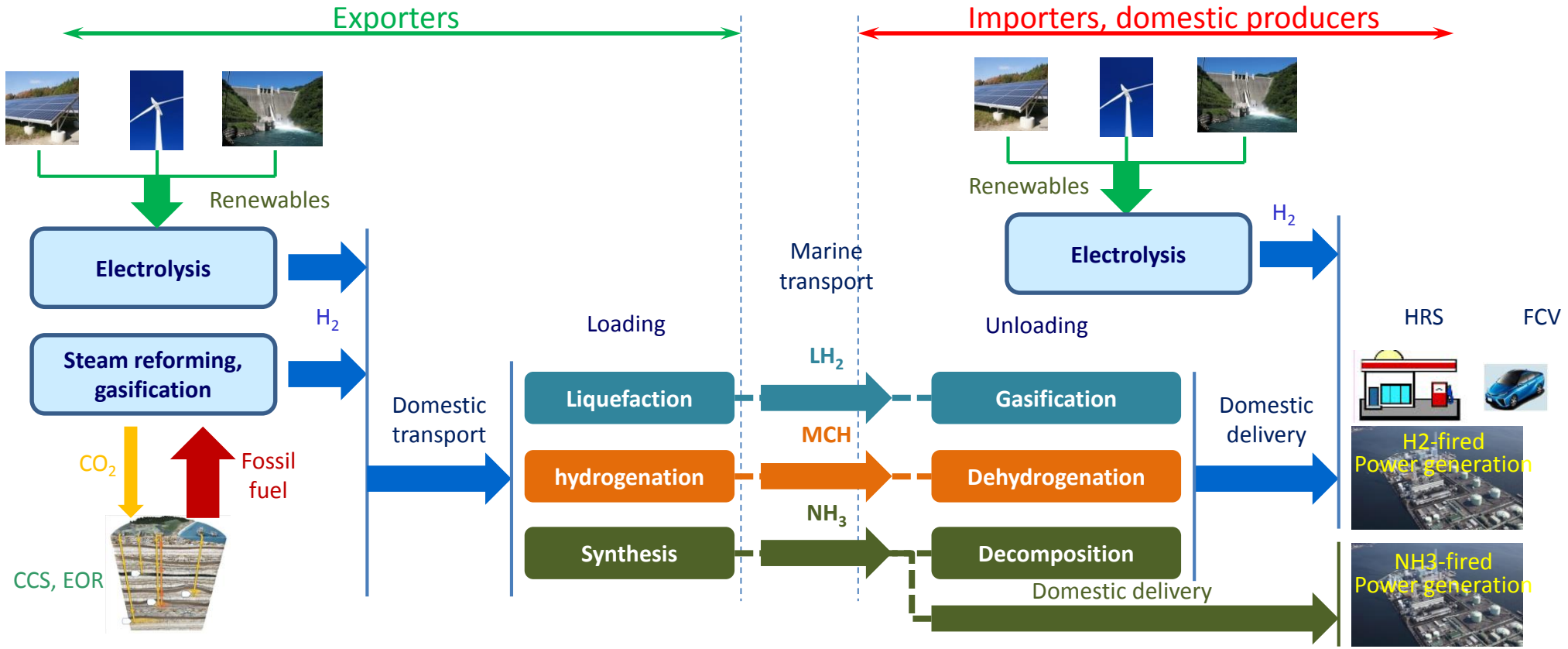
"Hydrogen Basic Strategy" (Dec 2017)
Cabinet Meeting for Renewables and Hydrogen

# Hydrogen & Fuel Cell Strategic Roadmap



# Large Scale $H_2$ Is Essential

- In terms of economics, large-scale supply chain is *sine qua non*
- Transport has three options, liquefied hydrogen ($LH_2$), methylcyclohexane (MCH) and ammonia ($NH_3$).



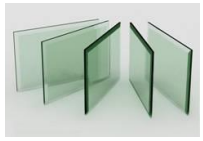

Note: $LH_2$ is liquefied hydrogen, MCH is methylcyclohexane, $NH_3$ is ammonia

# Examples of Potential Hydrogen Users: Demand Creation is Required

## Industrial Use

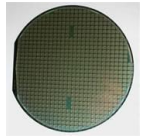
- Large-scale use
  15 billion $Nm^3$/y for oil refining, petrochemicals, ammonia, etc. in Japan
- Small-scale use
  300 million $Nm^3$/y in Japan at present

Stainless steel bright annealing



Glass

Hydrogenated fat, margarine



Semiconductor

## Energy Use

- FCV, hydrogen station

800,000 units @2030
: 800 million $Nm^3$

- Hydrogen burning power generation

1GW=2-3 billion $Nm^3$

- Industry sector

For steelmaking (hydrogen reduction steelmaking), boilers, burners, etc. in future

- Natural gas pipeline

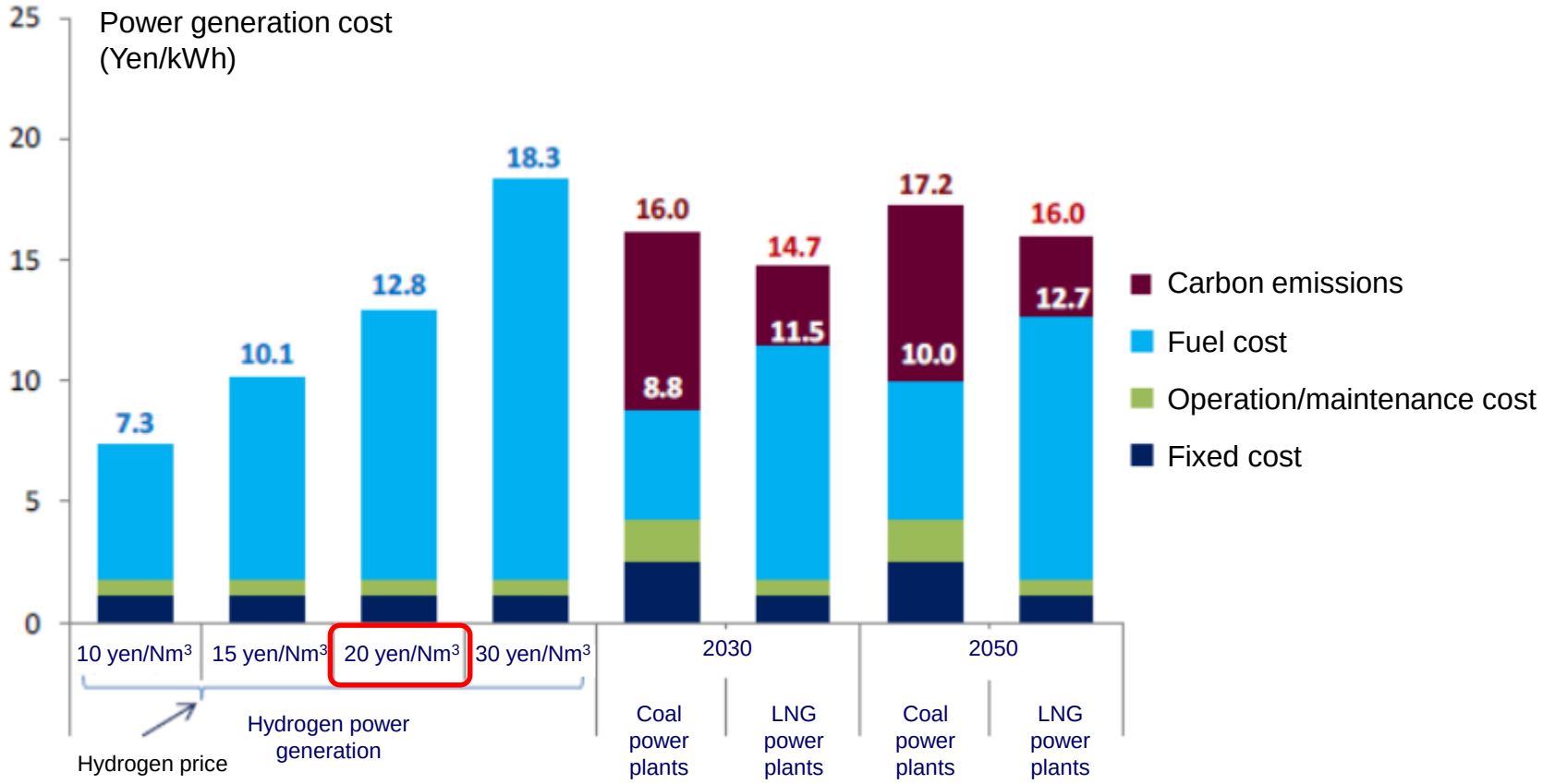
Hurdles are lower for synthetic methane

- Buildings sector

Future hydrogen town?

# Target Hydrogen Import Cost

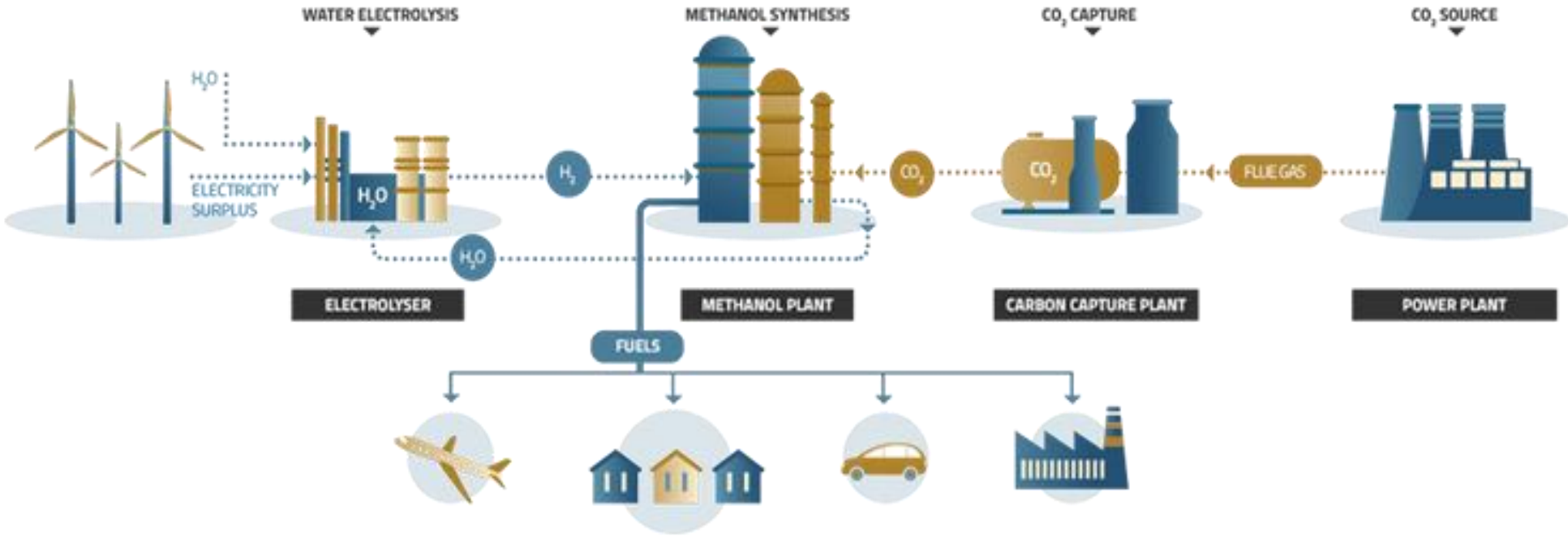
- Given Japan's hydrogen use for power generation, the desirable hydrogen CIF import price is 20 yen /$Nm^3$ or less.
  The Japanese government has set its target at 30 yen /$Nm^3$.




Source: IEEJ

# A Variety of PtG Configuration in Europe: One Example

## Synthetic Methanol



# Hydrogen Council

- Established in 2017: *A global CEO-level initiatives to promote $H_2$ as low-carbon energy*
- Members increasing: from 13 to about 50



Source: Hydrogen Council

# Conclusion

- **Hydrogen will play important roles** in the “post oil age”
  1) To address Climate Change
  2) To stabilize fossil fuel rich economies

- **Possible ways to produce zero carbon hydrogen**
  a) from fossil fuels in combination with CCS
  b) through electrolysis from green electrons

- **Challenges are;**
  i) To reduce the cost of zero-carbon hydrogen
  ii) To diversify the use of hydrogen;
  not only for transportation use but for power generation and industry

**Therefore**;

**International collaboration** is essential for speeding up this process

## General Questions for the Panel

- How can hydrogen contribute to the “energy transition”?
- What specific areas, usage, systems and technologies have potential applications for hydrogen?  Any examples and best practices of ongoing projects?
- What are the foreseen challenges ? How can we address them?
- What is our way forward?

# Panelists

(in alphabetical order)

- Dr. Arij van Berkel,
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  Lux Research

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- Mr. Quentin Vaquette,
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  ENGIE Factory Asia Pacific