

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.

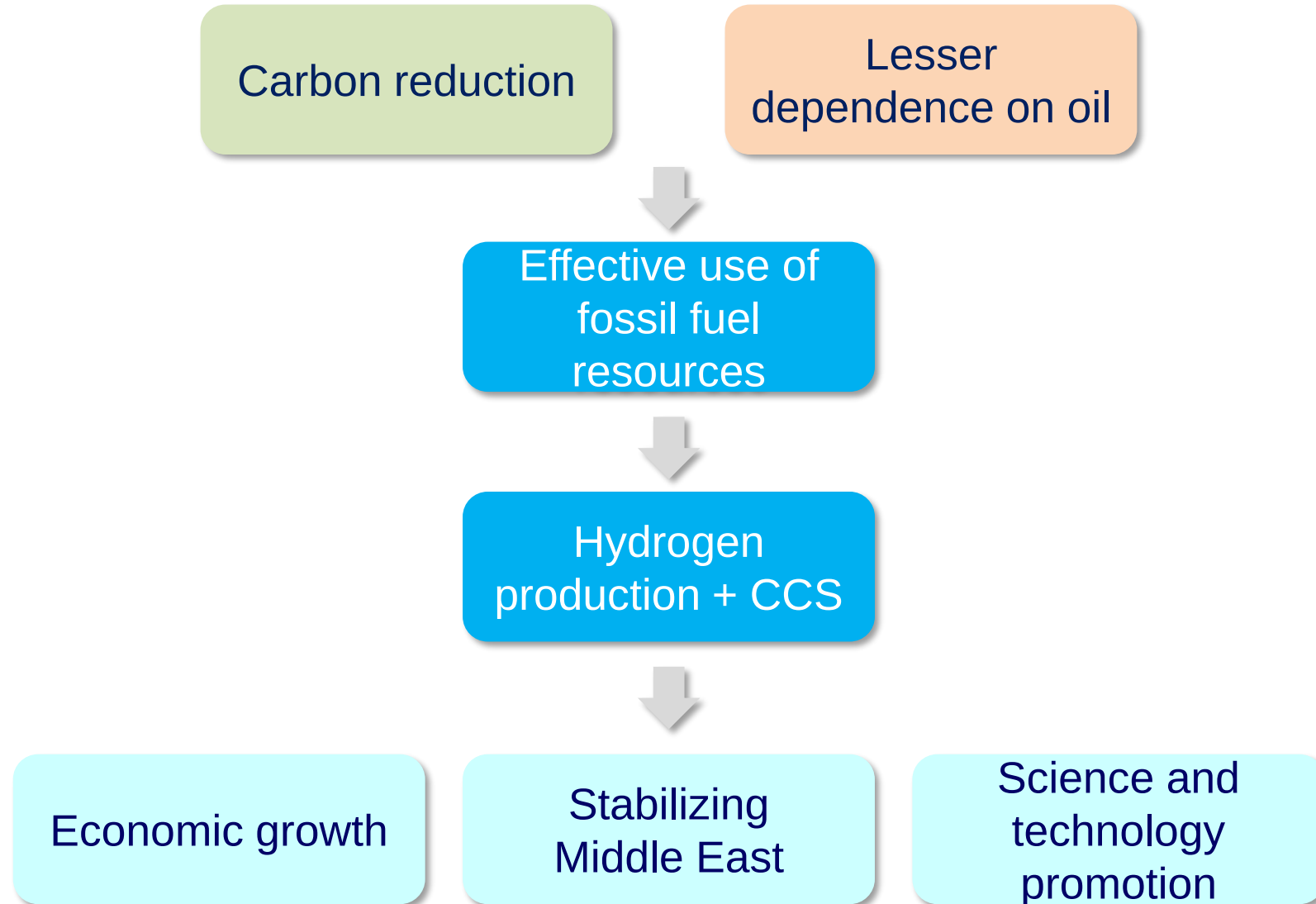
Hydrogen

- 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

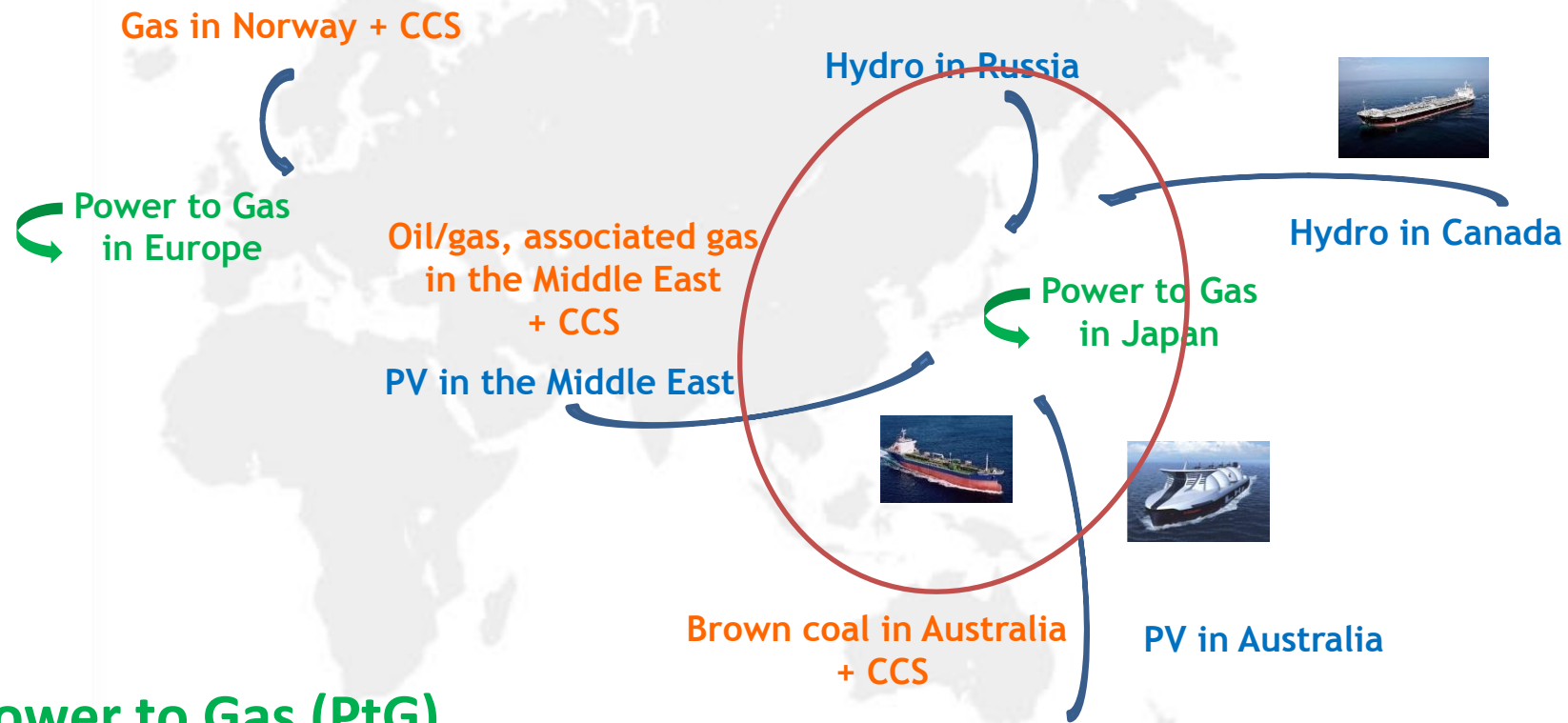
Reducing Carbon Footprint While Making Use of Fossil Fuel Resources



CO₂-free Hydrogen

- **Large scale availability of H₂** (either from hydrocarbon + CCS or renewables)

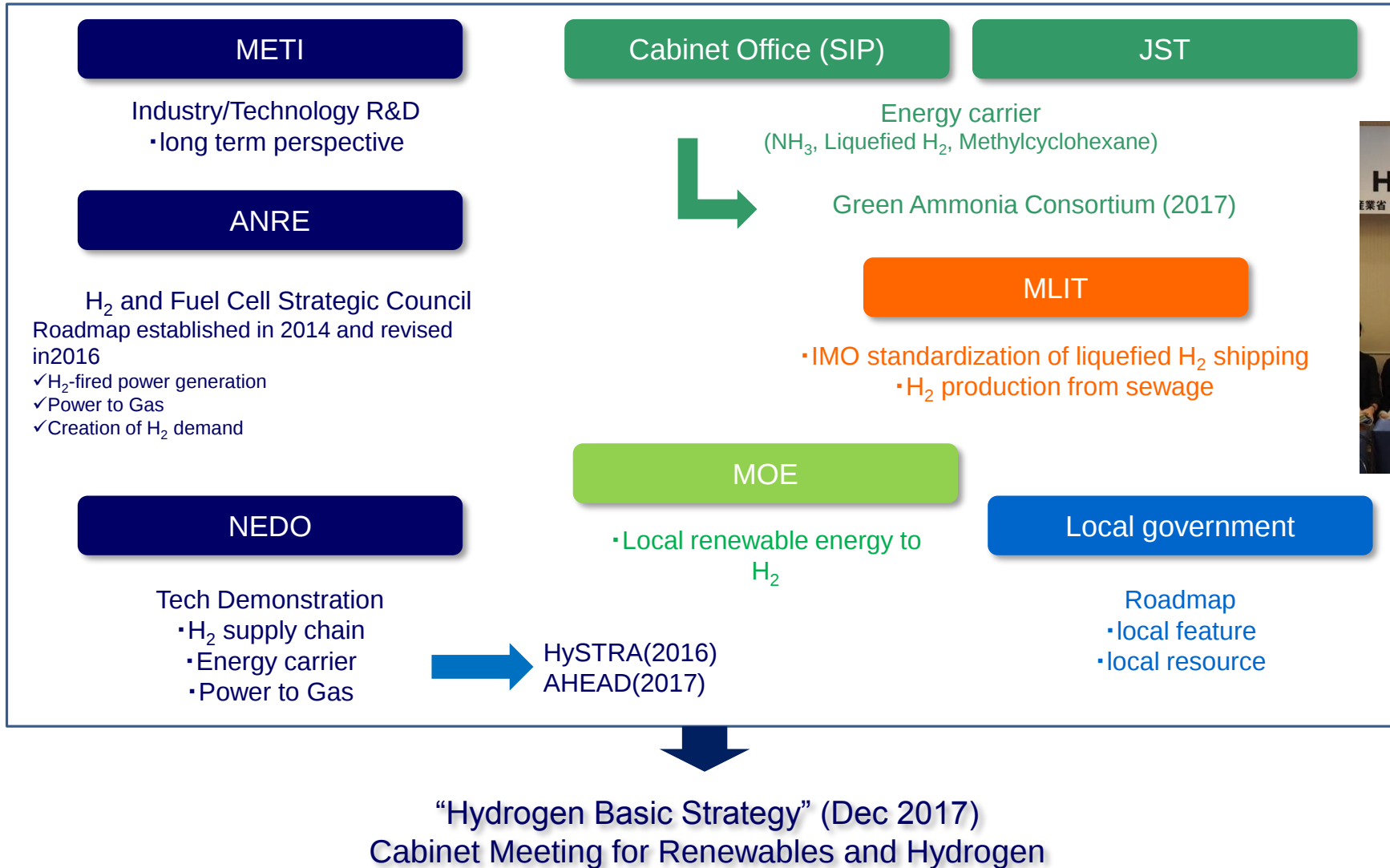
- ✓ A variety of concepts led by Japan, recently followed by Europe.
- ✓ Around 2020, some of the ideas are to be demonstrated by Japanese companies.



- **Power to Gas (PtG)**

- ✓ Led by Europe, recently followed by Japan.

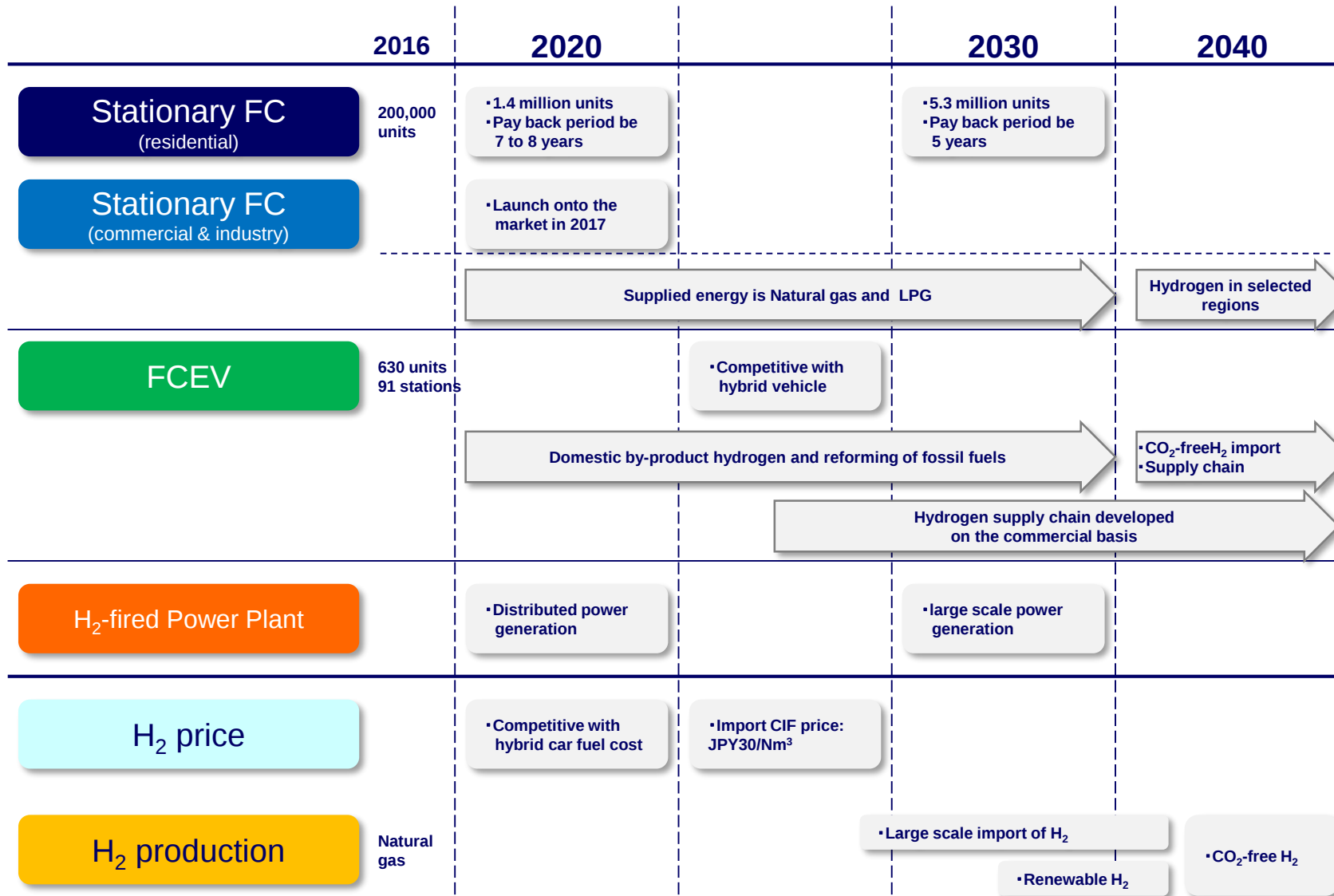
Government Stakeholders around H₂ in Japan



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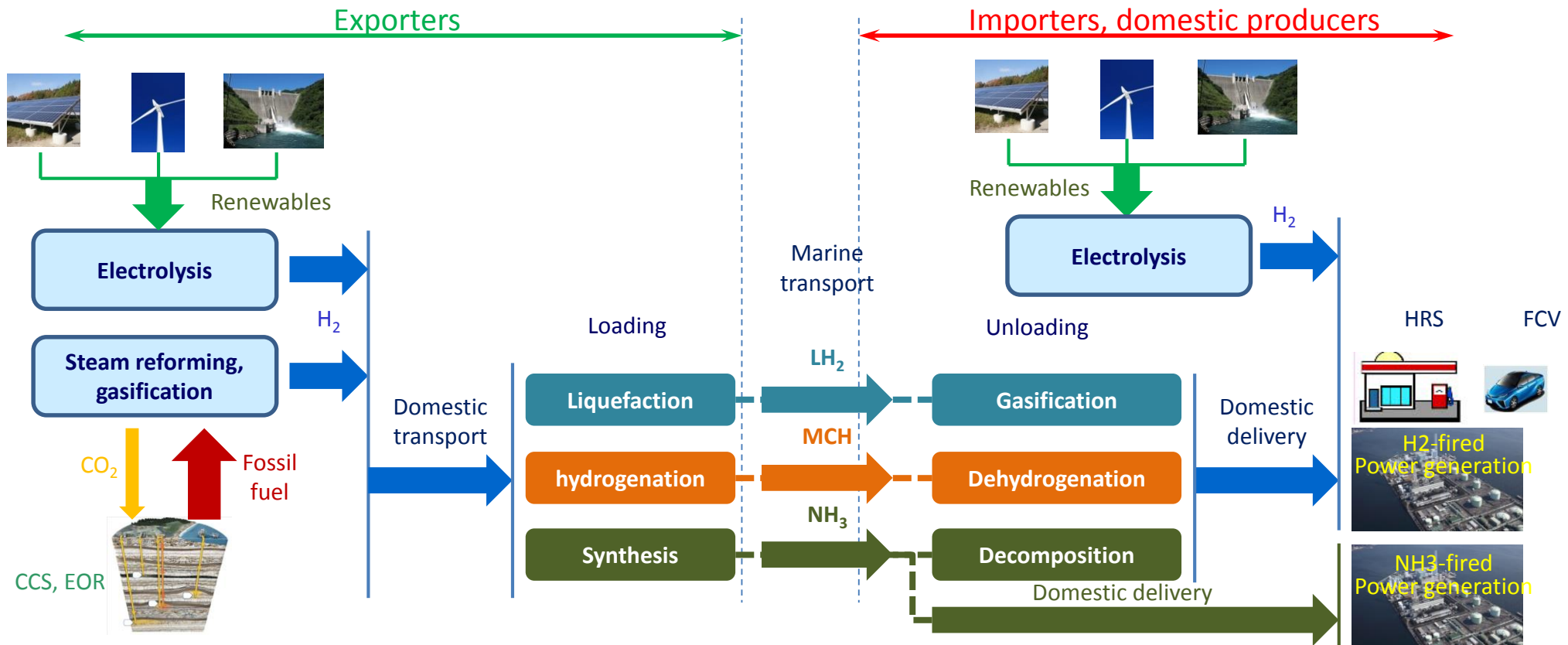
**G20 in 2019
Japan**

Hydrogen & Fuel Cell Strategic Roadmap



Large Scale H₂ Is Essential

- In terms of economics, large-scale supply chain is *sine qua non*
- Transport has three options, liquefied hydrogen (LH₂), methylcyclohexane (MCH) and ammonia (NH₃).



Note: LH₂ is liquefied hydrogen, MCH is methylcyclohexane, NH₃ is ammonia

Examples of Potential Hydrogen Users: Demand Creation is Required

Industrial Use

- Large-scale use
15 billion Nm³/y for oil refining, petrochemicals, ammonia, etc. in Japan
- Small-scale use
300 million Nm³/y in Japan at present



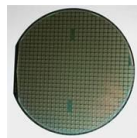
Stainless steel
bright annealing



Glass



Hydrogenated fat,
margarine



Semiconductor

Energy Use

- FCV, hydrogen station



800,000 units @2030
: 800 million Nm³

- Hydrogen burning power generation



1GW=2-3 billion Nm³

- Industry sector



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

- Buildings sector



Future
hydrogen
town?

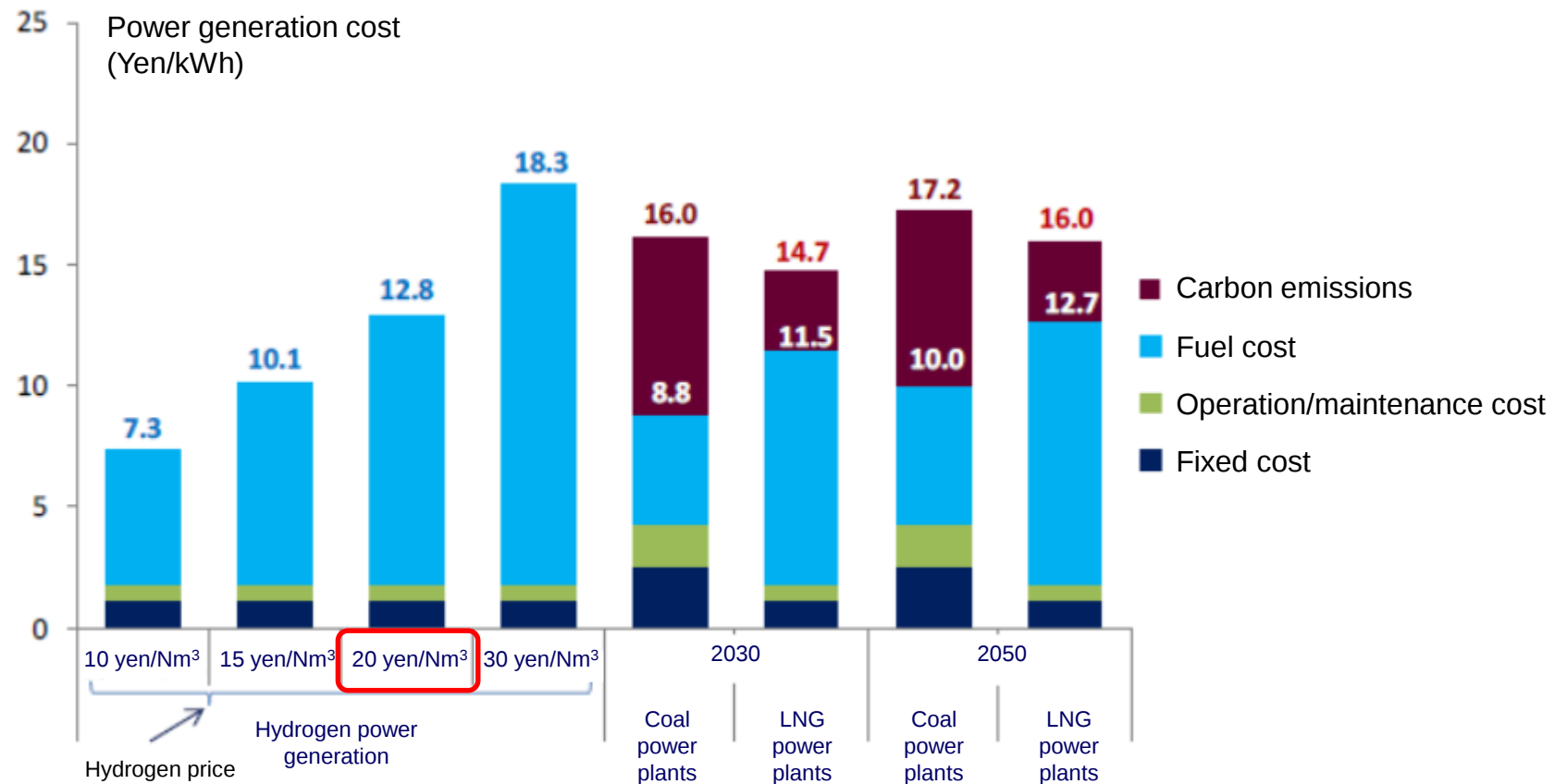
- Natural gas pipeline



Hurdles are lower for
synthetic methane

Target Hydrogen Import Cost

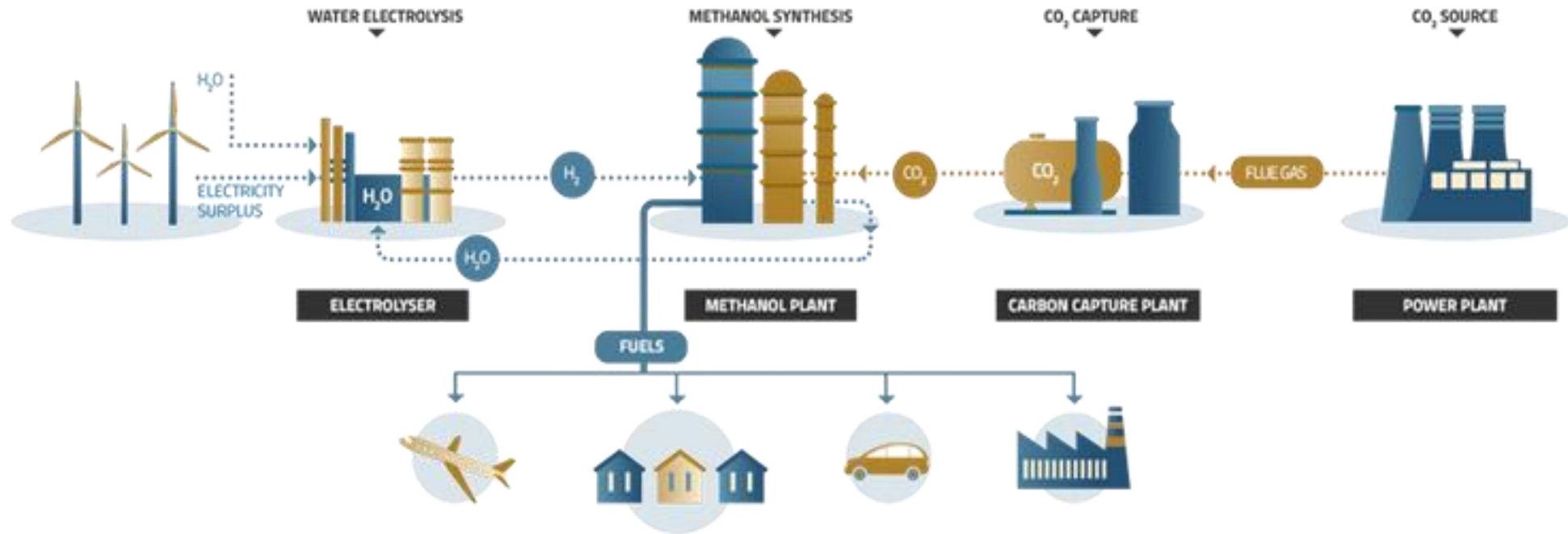
- Given Japan's hydrogen use for power generation, the desirable hydrogen CIF import price is 20 yen /Nm³ or less.
The Japanese government has set its target at 30 yen /Nm³.



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



Hydrogen
scaling up

A sustainable pathway for the global energy transition

Hydrogen Council November 2017

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

Energy Transition and Role of Hydrogen

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?

(in alphabetical order)

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