

Hydrogen Energy Ministerial Meeting
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Hydrogen Potentials in EAS Region

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Prof. Jun ARIMA

*Senior Policy Fellow, Energy and Environment,
ERIA*

Economic Research Institute for ASEAN and East Asia



Why Hydrogen Matters?

- **Hydrogen will be sustainable energy option, which could coexist with fossil fuels and growing penetration of renewable energy**
- **The challenge is how to make hydrogen economically viable, financially attractive, and socially beneficial.**

1. ZERO CO2 EMISSIONS

Hydrogen bonds with oxygen to generate electricity/heat, with water the only by-product.

2. UNLIMITED SUPPLY

Hydrogen can be extracted from a wide range of substances including oil, natural gas, biofuels, sewage sludge, and can be produced from unlimited renewable energy by the electrolysis of water.

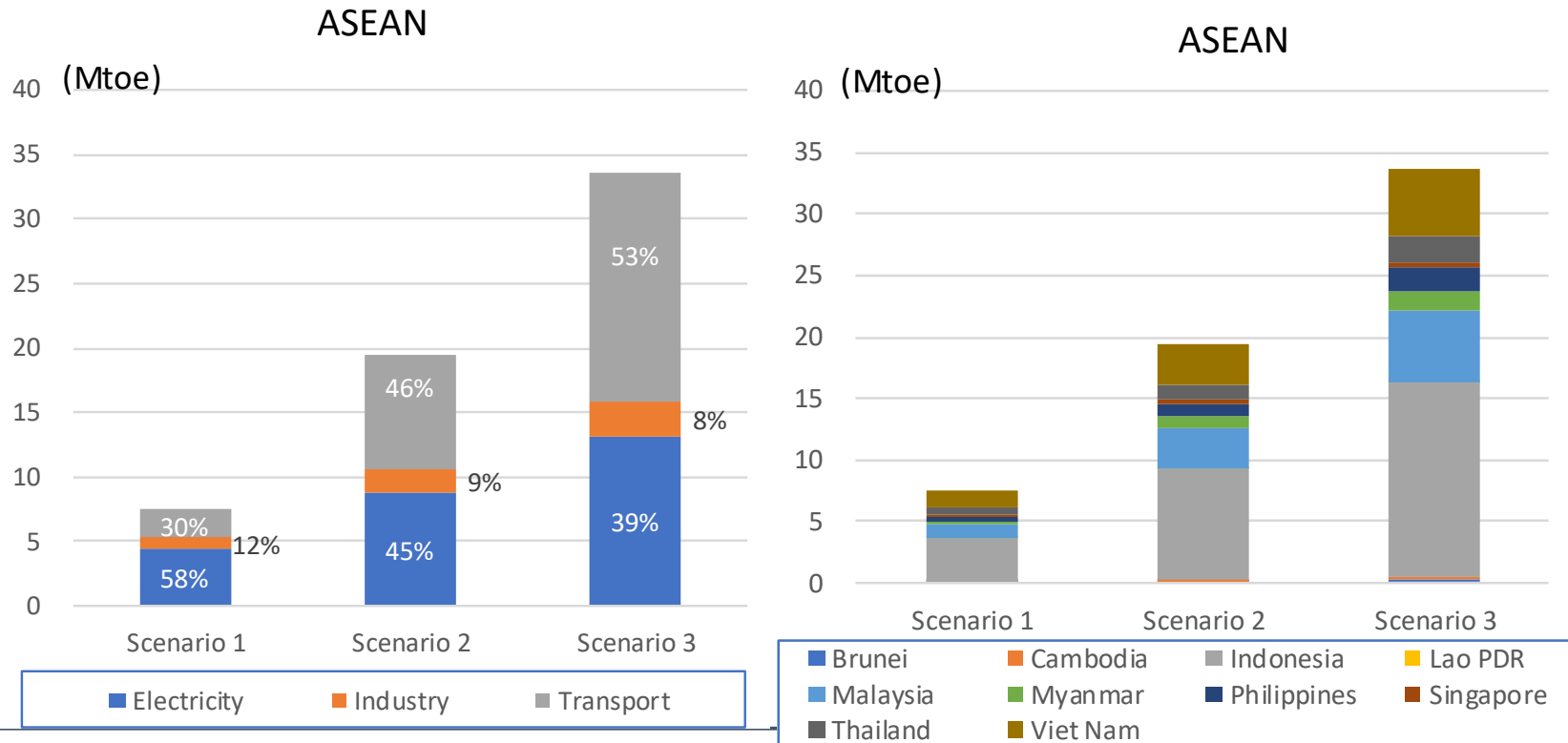
3. STORAGE AND TRANSPORTATION

Hydrogen is able to store energy across the seasons (from summer to winter) and be transported for long distance (from south to north), to effectively utilize distributed natural energy and fossil fuels.

H2 Demand Scenarios in the ASEAN Region (by Sector)

- ◆ In ASEAN, Electricity generation sector has the largest hydrogen demand potential in the Scenario 1.
- ◆ Indonesia has the largest hydrogen demand potential among ASEAN member countries, followed by Malaysia and Viet Nam.

Hydrogen Demand Potential by Sector and Countries (2040)



H2 Sources and Production Technology

- ◆ Hydrogen can be produced from any kinds of primary energy, fossil fuel and clean energy

HYDROGEN from Fossil Fuel

- **By-product hydrogen** (CCR, ethylene, methanol, chlor-alkali)
- **Reformed hydrogen** (flare gas, stranded gas)
- **Gasified hydrogen** (VR/ pitch / coke, coal / lignite)
- +
- **CCUS** (CO2-EOR, CCS, CO2 feedstock)

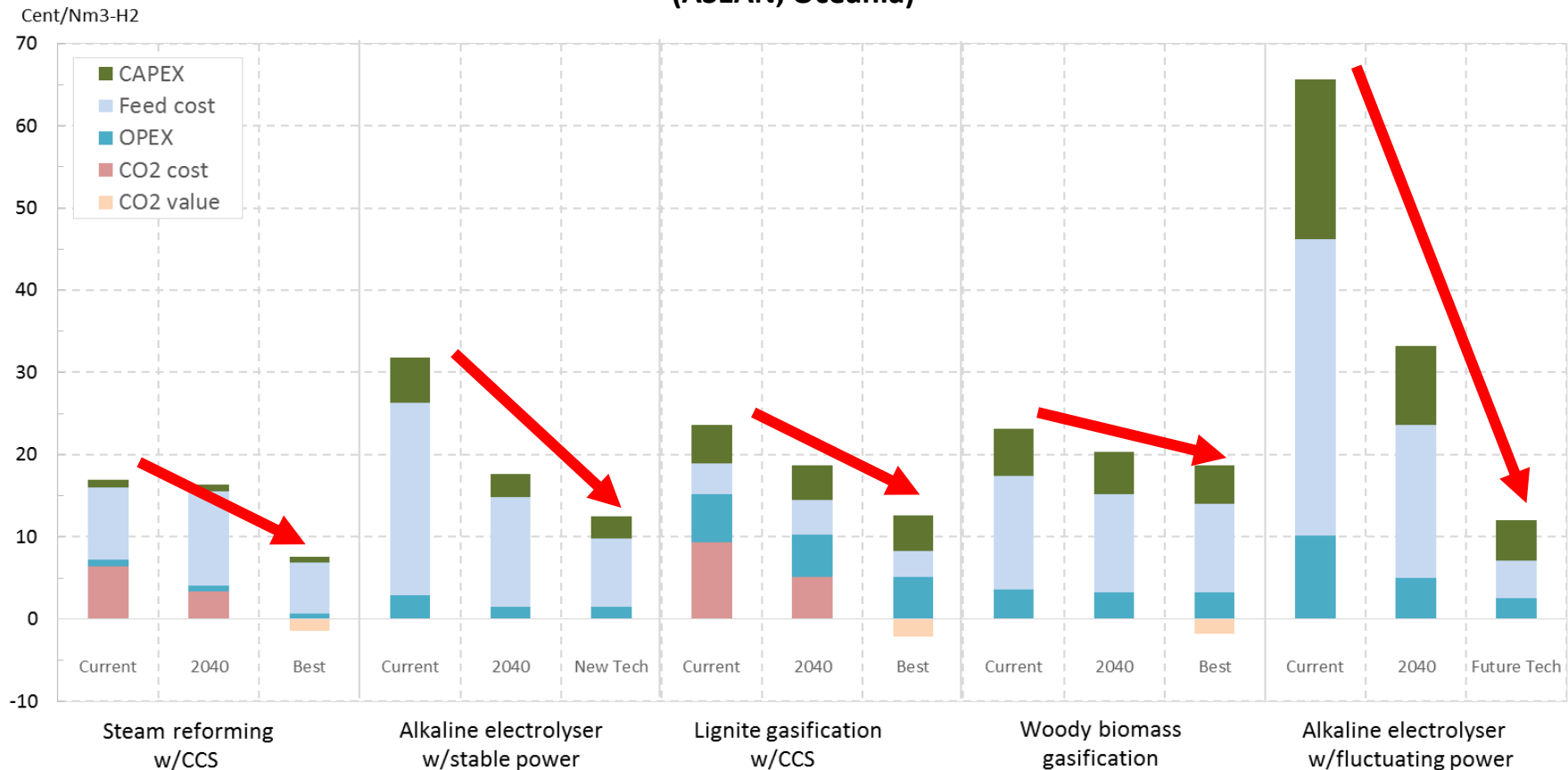
HYDROGEN from Clean Energy

- **Water electrolysis hydrogen** (solar, wind, hydro, geothermal)
 - **Biomass hydrogen** (waste, unutilized, resource crop)
- < Technology Development >
- **Biotech hydrogen** (microalgae, bacterium, etc.)
 - **Nuclear hydrogen** (electrolysis, IS method, etc.)
 - **Photo-catalyst hydrogen** (Solar)

H2 Production Cost Must be Reduced

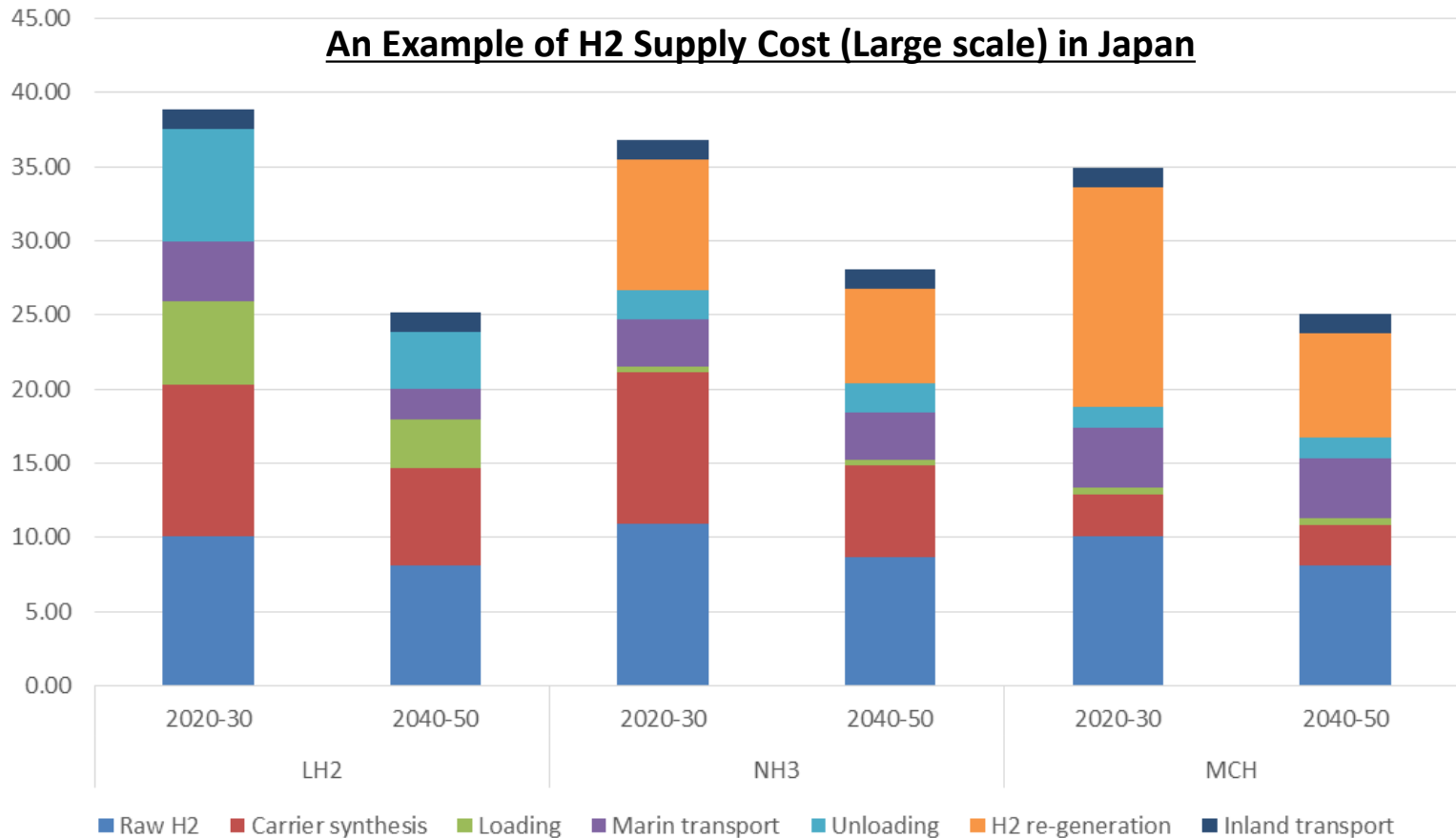
- H2 production cost needs to be reduced by;
 - ◆ Acceleration of R&D, demonstration and global collaboration for innovation
 - ◆ Boost the hydrogen demand for business scaling up
 - ◆ Government support and market mechanism

Example of Hydrogen Production Cost [larger scale] by average feed price
(ASEAN, Oceania)



H2 Transport Options

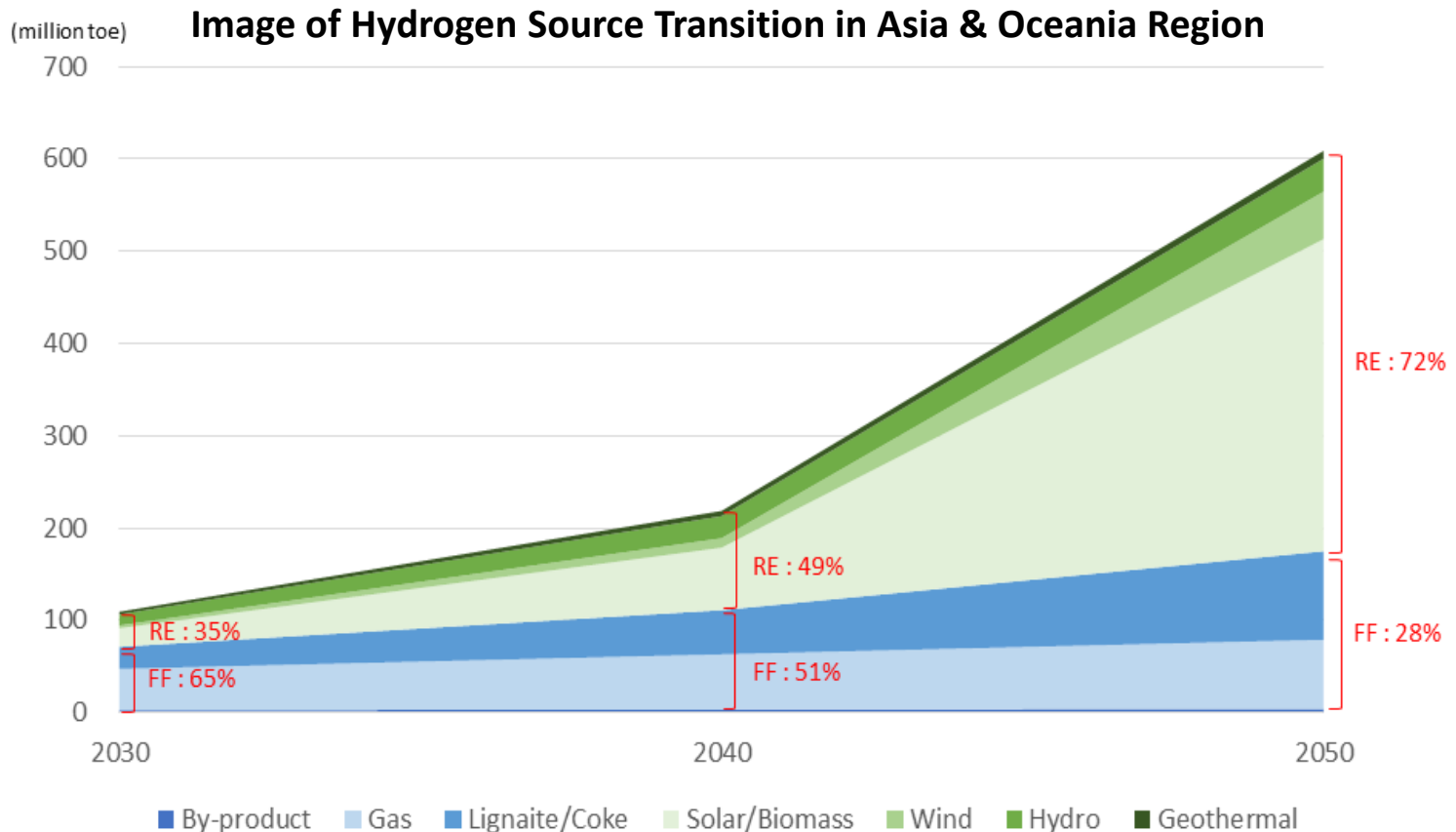
- ◆ There are several options (LH2, NH3, TOL-MCH, Compressed, etc.) to transport and storage hydrogen, and better option will be selected in proper application and in proper timeframe depending on technology development.



(Source) MIZUNO ET AL 2017, *Economic Analysis on International Hydrogen Energy Carrier Supply Chains*
* Reviewed and updated by Chiyoda corporation

H2 Production and Sources

- ◆ Considering its production cost, hydrogen will be introduced by the order of
1) Gas 2) Stable RE 3) Coal 4) Biomass 5) Intermittent RE
- ◆ Above order will depend on the feasibility of CCS/CO2-EOR and technology development of each hydrogen production including water electrolysis and CCUS.



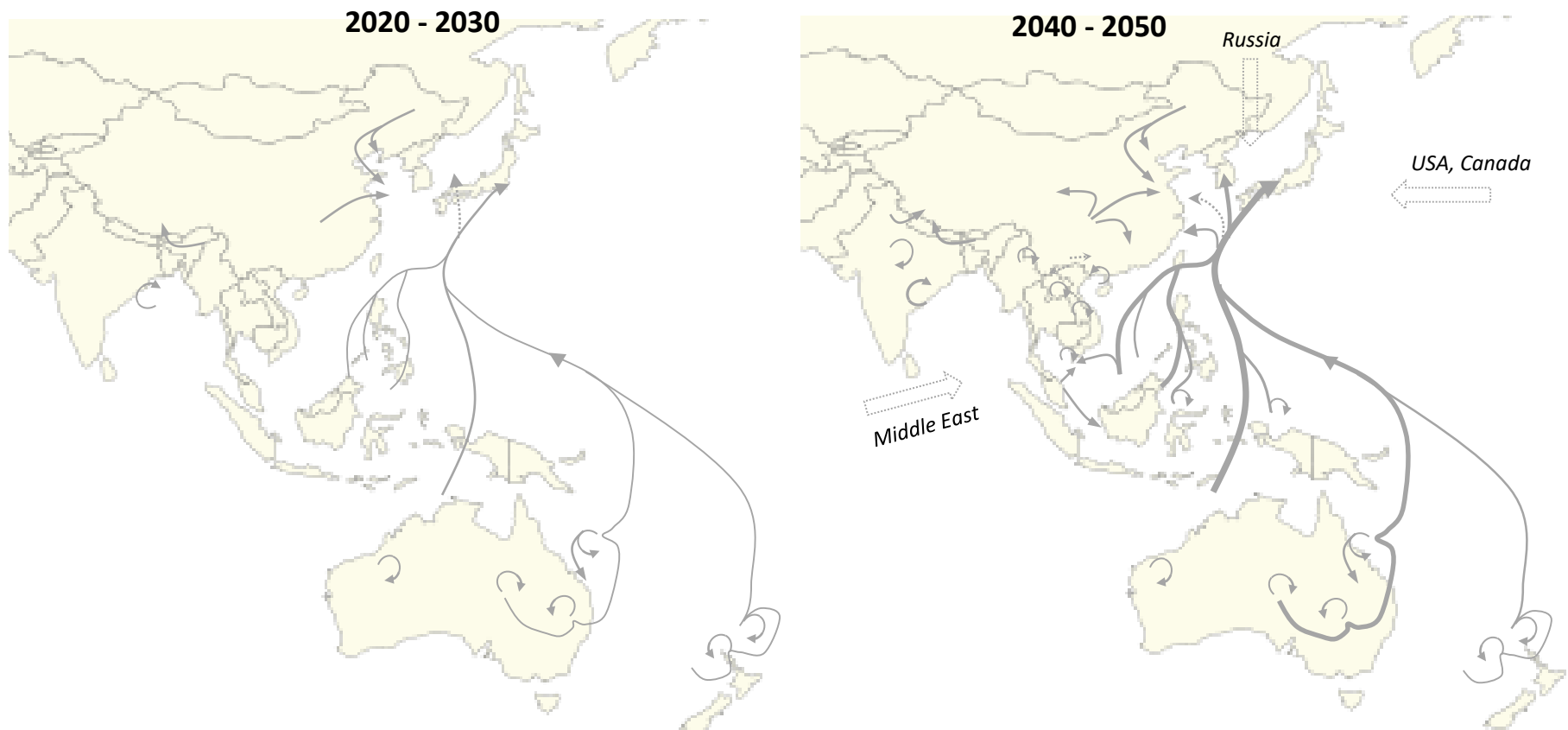
Note) Biomass hydrogen will be included into the portion of solar hydrogen.

Potential volume of hydrogen from by-product and VR/Coke is limited, and it will be positioned as supplementary supply.

H2 Supply Trade Flow (2030-2050)

- ◆ In early stage (2020-30), local supply chain and global trading to Japan will start, and will grow up to global H2 energy supply chain network in this region in 2040-50.

Image of Hydrogen Trade Flow in ASIA and Pacific Regions



Key Messages

◆ **Hydrogen is becoming an realistic option according to technology development in both demand and supply sides**

Production: From fossil fuel with EOR/CO₂ & CCUS and renewable energy

Logistic: Demonstration of international supply chain (MCH)

Demand: FCV and hydrogen power generation

◆ **Significant potential of hydrogen in EAS region**

Demand potential from FCV and power generation

Production potential from fossil fuel and renewable electricity

Supply chain to bridge between hydrogen demand and production area

◆ **Steps to shift hydrogen society**

Increase of hydrogen demand: start from power generation and after that road transport sector

Increase of hydrogen production: start from reforming gas and hydro power generation due to relatively lower costs

◆ **Towards global hydrogen market**

It is taking time to formulate hydrogen market and network infrastructure

It is necessary that developed countries will lead policy planning, technology development and investment to infrastructure

Thank you!

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