

2022 CEEPR & EPRG International Energy Policy Conference

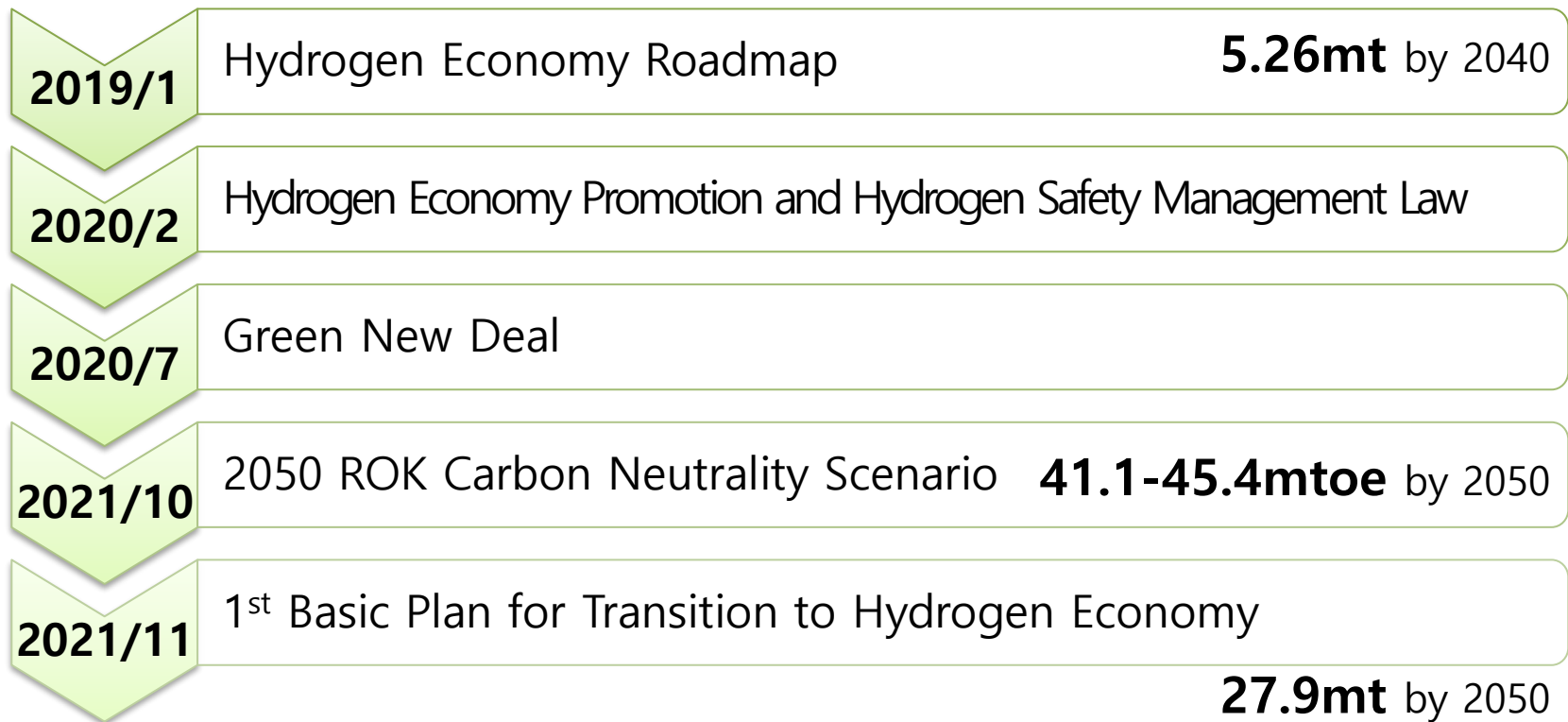
Overseas Hydrogen Imports and Energy Security in Korea

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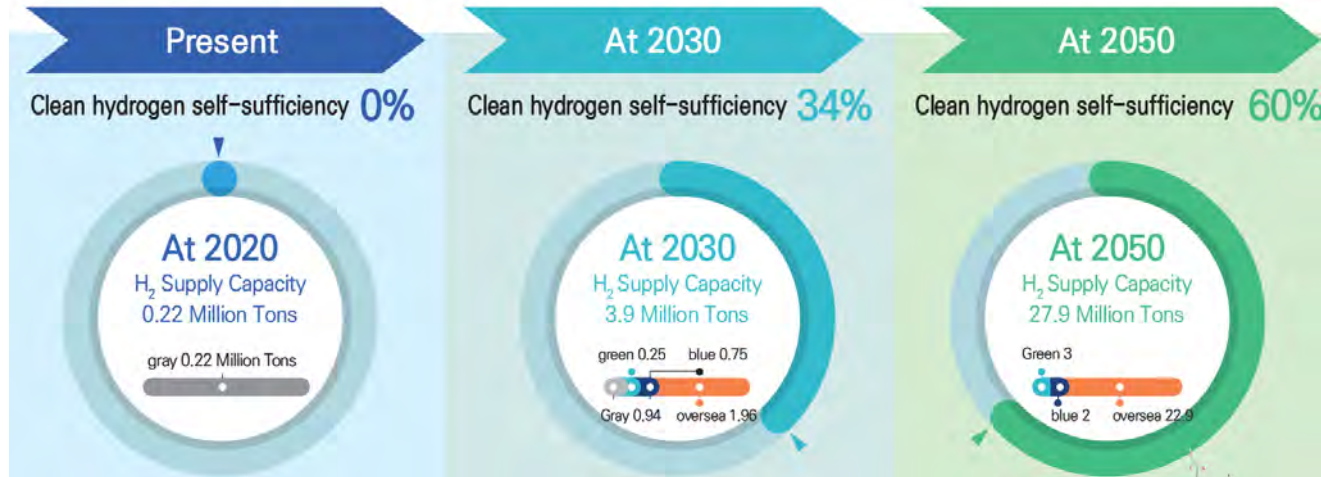
Hydrogen in Korea – Recent History



Hydrogen in Korea

1st Basic Plan for Hydrogen Economy – supply

Source: MOTIE(2022)

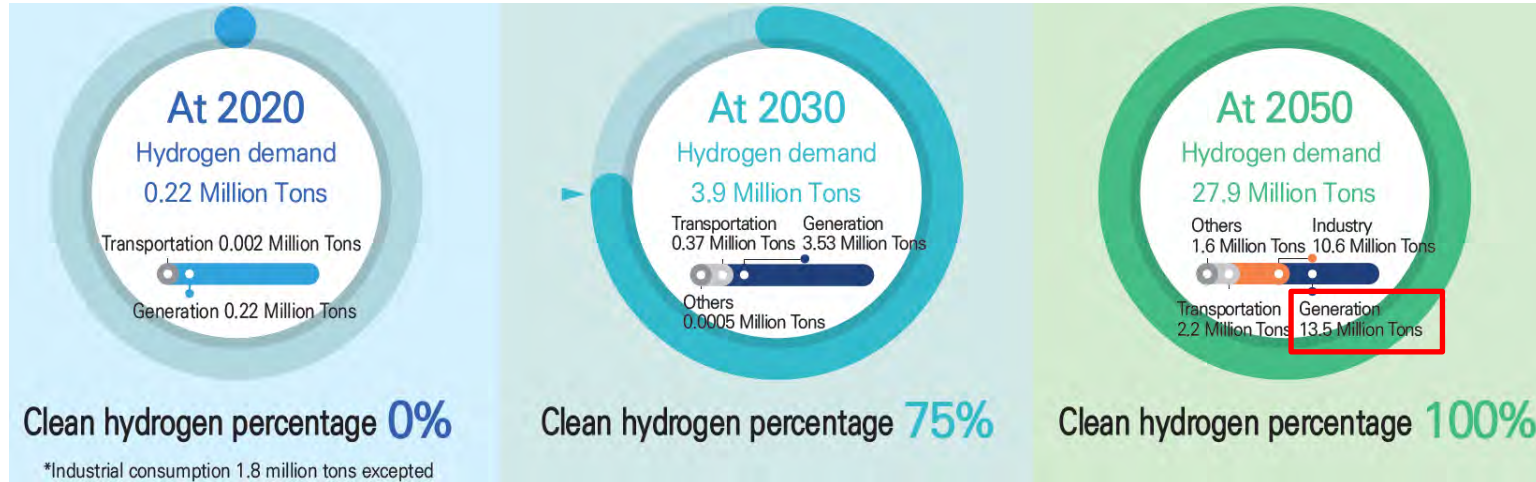


- Plans to supply 27.9 million tons of hydrogen per year (100% green/blue)
- Self-sufficiency rate will be more than 60% by 2050, importing 22.9 mtH₂
- 40+ global renewable energy-hydrogen production projects by 2050

Hydrogen in Korea

1st Basic Plan for Hydrogen Economy – demand

Source: MOTIE(2022)



- Starts with ammonia mixed- and LNG hydrogen mixed-source power generation
- Will introduce a mandatory clean hydrogen power generation system (CHPS)
- H₂ will account for 33% of energy consumption and 23.8% of power generation

Hydrogen in Korea

From fuel-cells

Source: DIT, UK(2021)

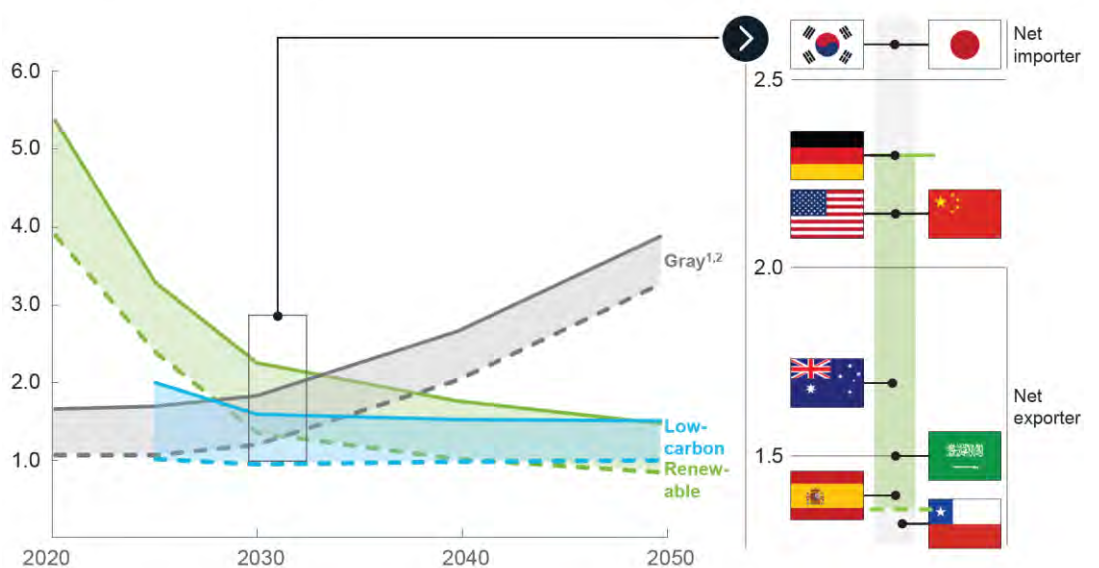
Company	Product Type	Capacity	Original Technology	Application Field
POSCO Energy	MCFC	300kW, 2.5MW	FuelCell Energy	Utility
Doosan	PEMFC	600W, 1kW, 5kW, 10kW	Fuel Cell Power	Residential/ Commercial
	PAFC	400kW	Cleardge Power	Utility
	SOFC	5~20kW	Ceres Power	Commercial
S-FuelCell	PEMFC	1~10kW	CETI, GS Fuel Cell	Commercial
	PAFC	100kW	S-FuelCell	Utility
SK E&C	SOFC	300kW	Bloom Energy	Utility

To gas turbines

Overseas Hydrogen Imports

Korea announced
22.9 million tons of
overseas hydrogen imports
by 2050

Production cost of hydrogen
USD/kg



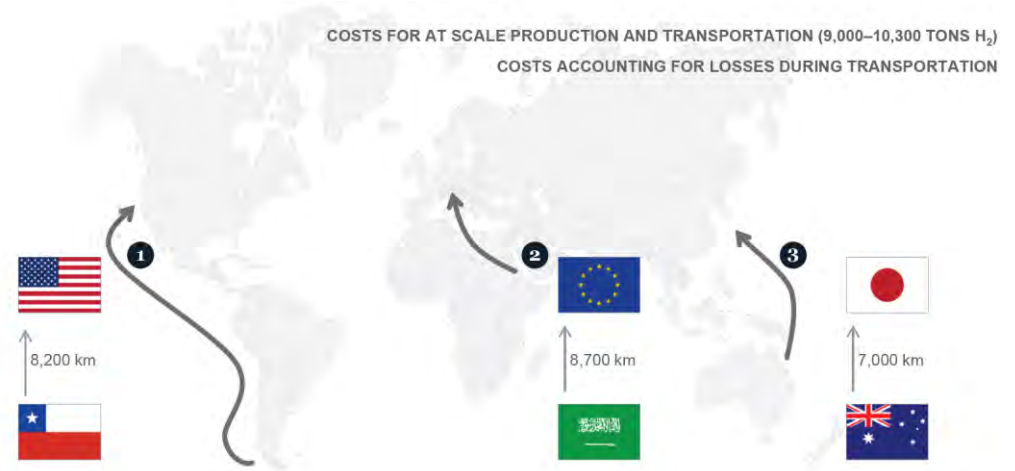
Key assumptions

- Gas price 2.6–8.8 USD/Mmbtu
- Cost USD/Ton CO₂: 30 (2020), 50 (2030), 150 (2040) and 300 (2050)
- LCOE USD/MWh 25–73 (2020), 13–37 (2030) and 7–25 (2050)

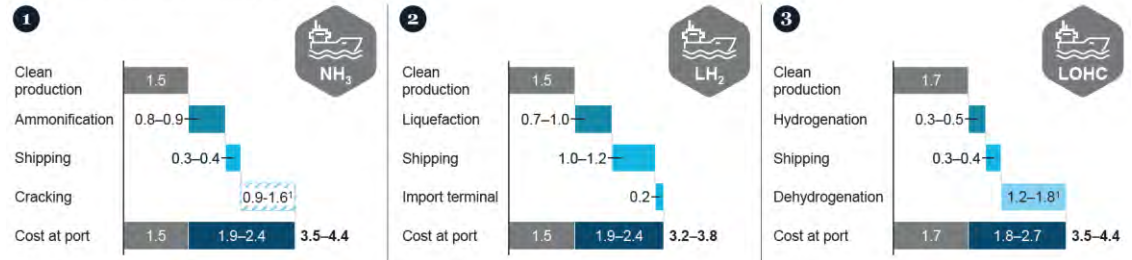
Source: Hydrogen Council(2021)

Overseas Hydrogen Imports

LCOE of renewables
is not so attractive
to produce hydrogen
in Korea



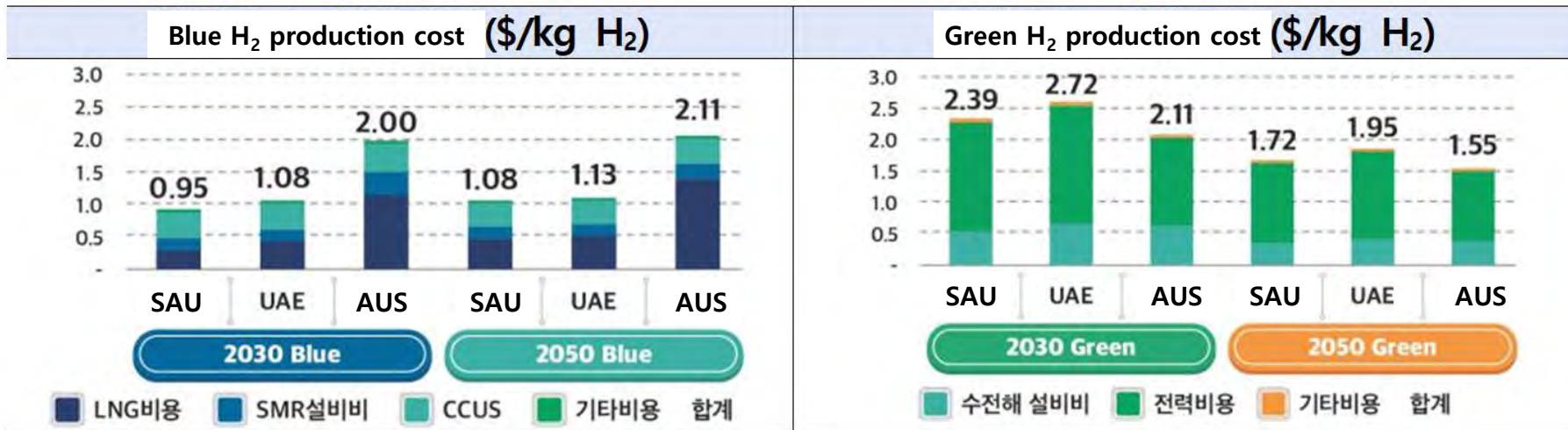
Illustrative routes modeled, USD/kg H₂



Source: Hydrogen Council(2021)

Overseas Hydrogen Imports

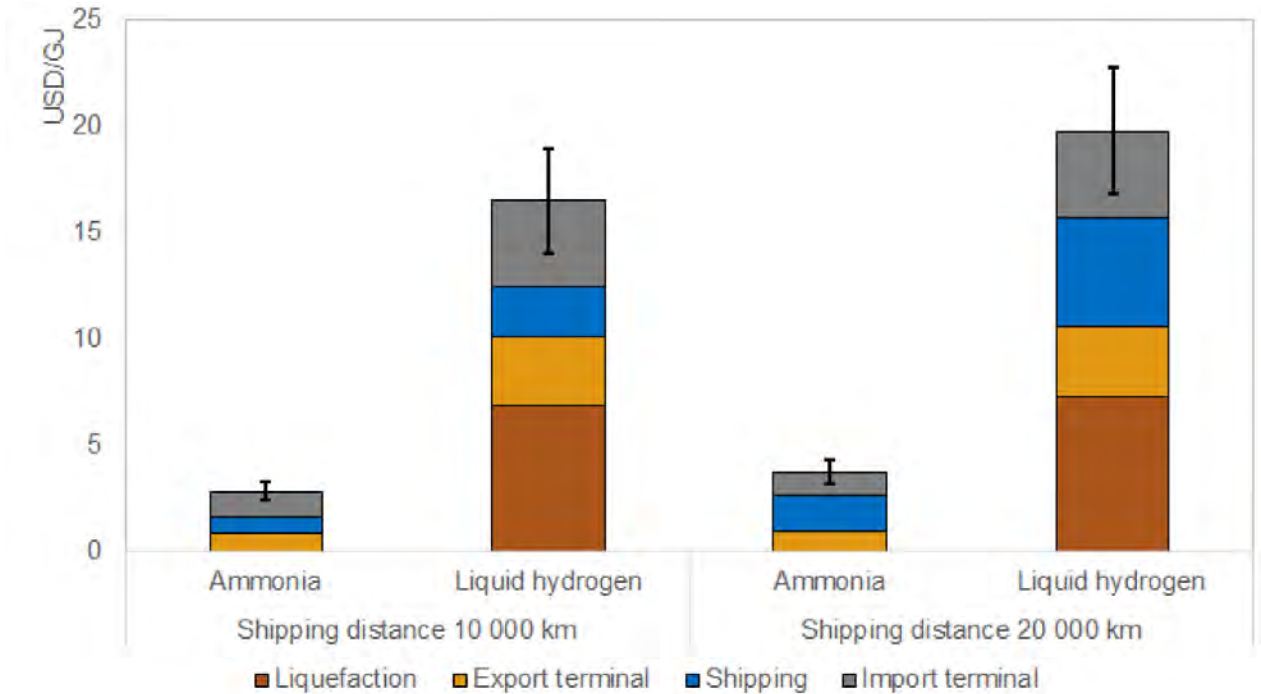
Our expectation



Source: MOTIE(2021)

Overseas Hydrogen Imports

Ammonia is a cost-competitive option for power generation in terms of overseas imports



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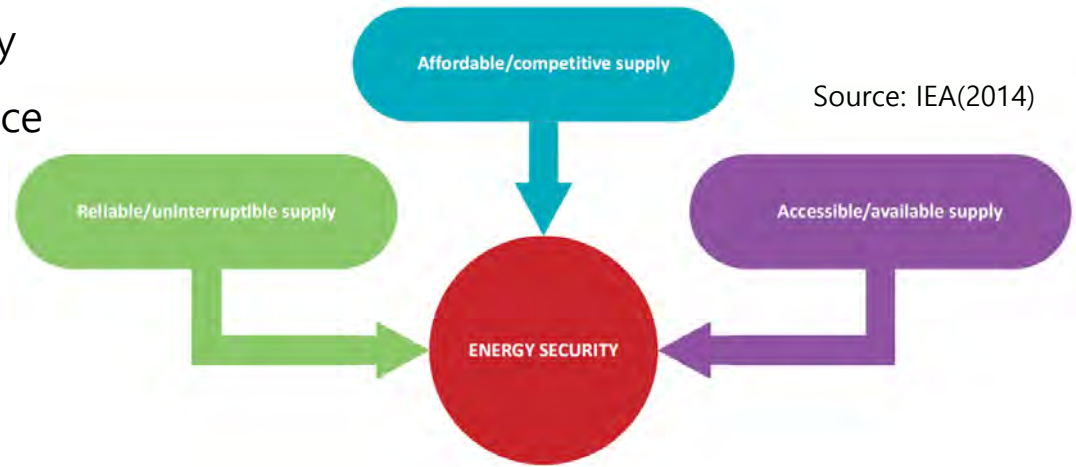
Source: IEA(2021)

Note: WACC 5%; energy consumption of H₂ liquefaction 6 kWh/kgH₂. Storage costs included in the cost of terminals. All assumptions available in the Annex.

Energy Security Issues

Classical definition

- Availability of a regular supply of energy at an affordable price (IEA, 2001)
- Availability, Accessibility, Affordability, Acceptability (APERC, 2007)
- Reliable and adequate uninterrupted supply of energy at reasonable prices (KEEI, 2009)
- Affordability, Reliability, Availability, Sustainability (UK ERC, 2018)



Energy Security Issues

Paradigm changes...

- Climate crisis and energy transition, including transport sector
- Competitive renewable sources
- Oil peak debates and the U.S. – oil and gas exporter
- War and geopolitics
- Critical minerals for energy transition
- Energy resilience: the ability of an energy system to retain, react, overcome and overpass perturbations caused by a shock in economic, social, environmental and institutional terms, coming from the learning capacity to adapt to change (Gatto and Drago, 2020)

Energy Security Issues

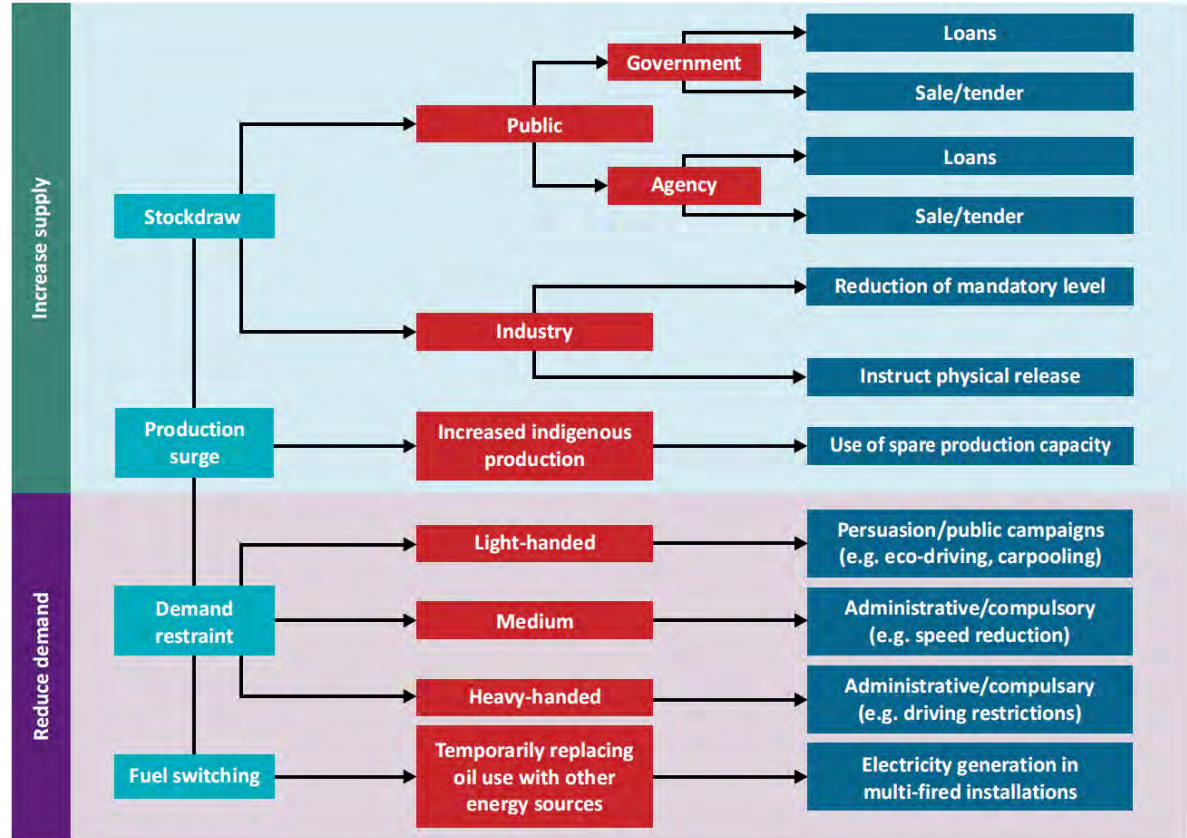
In 2050, Korea plans to import 22.9 million tons of hydrogen, and power sectors will consume 13.5 million tons of them.

➡ Stable supply and energy security matter!

It would be good to ruminate on the lessons from natural gas imports experiences, particularly for Korea.

Strategies

Classical options

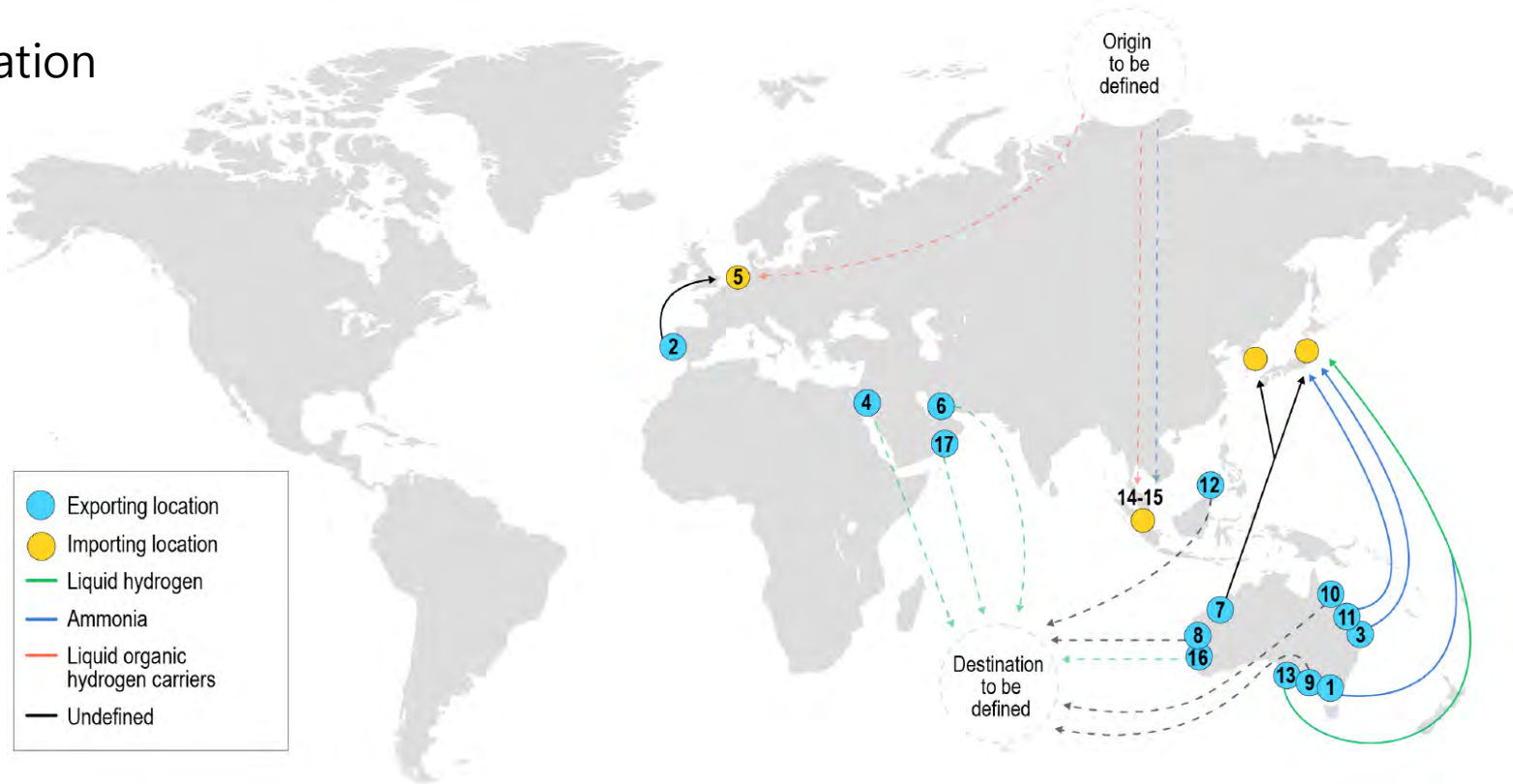


Source: IEA(2014)

Strategies

Diversification

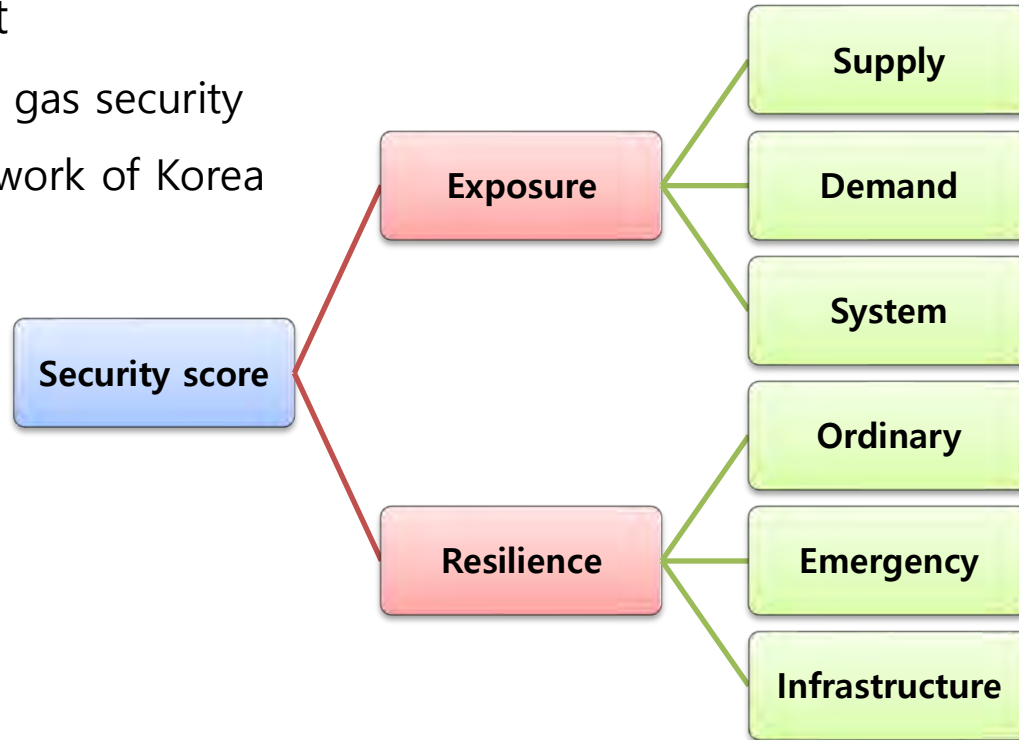
Source: IEA(2021)



Strategies

Security assessment

- Example – oil and gas security assessment framework of Korea



Strategies

Direct investment in the overseas H₂ production projects

- Utilize competitive hydrogen ecosystem



- Introduce investment risk mitigation measures

Source: DIT, UK(2021)

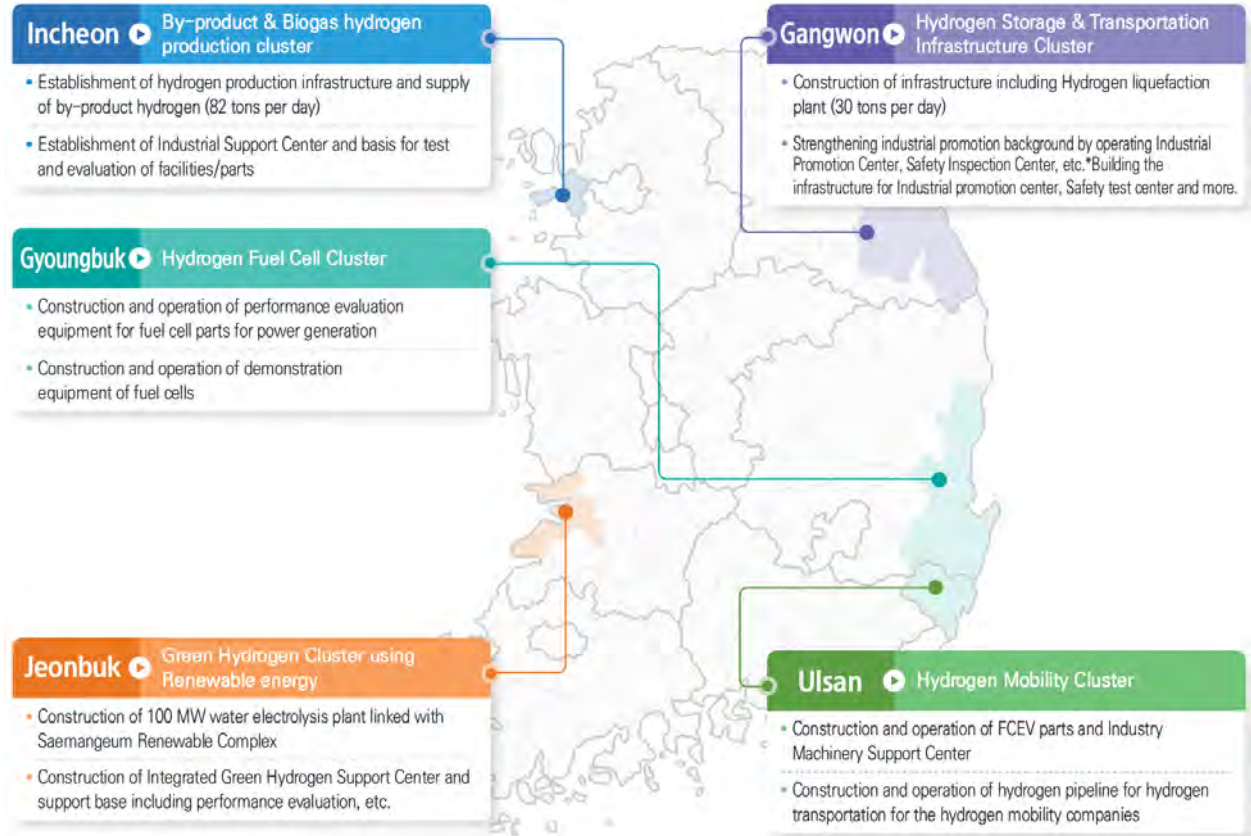
Strategies

Strengthening H₂ industry ecosystem and market development

- Setting up stockpile warehouses and international hydrogen exchanges
- Establishing an international clean hydrogen certification and origin verification system
- Building hydrogen ports near LNG and coal-fired power plants and industrial complexes
- Hydrogen pipelines around major bases for production or ports
- Hydrogen-ready (domestic) infrastructure to secure infrastructure

Strategies

R&D will also play a pivotal role in securing a stable H₂ supply









Source: MOTIE(2022)

Strategies

International cooperation

Source: MOTIE(2022)

	Australia	<ul style="list-style-type: none">• HYUNDAI MOTORS-FMG-CSIRO signed an MOU on hydrogen supply infrastructure cooperation• MOU signed among POSCO-FMG-ORIGIN for green hydrogen production and V/C cooperation
	UAE	<ul style="list-style-type: none">• Established GS Energy & ADNOC for Blue Ammonia Supply Chain Business Partnership• Korea National Oil Corporation, SK Gas, and ADNOC for Low-Carbon Hydrogen-Ammonia Joint Research (JSA) Implementation
	Saudi Arabia	<ul style="list-style-type: none">• Hyundai Heavy Industries and Aramco signed an MOU for hydrogen ammonia production and utilization cooperation• KEPCO & Aramco signed an MOU for blue hydrogen and ammonia development cooperation• Signed an MOU for feasibility study and promotion of green hydrogen development among POSCO, Samsung C&T, and PIF• Hyundai Oilbank & Aramco signed an MOU for blue hydrogen and ammonia development cooperation• S-Oil & Aramco Signed an MOU for cooperation to build hydrogen supply chain
	Malaysia	<ul style="list-style-type: none">• Samsung Engineering, Lotte Chemical, POSCO, and SEDC signed an MOU to develop a clean hydrogen project in Sarawak
	Oman	<ul style="list-style-type: none">• Korea Gas Technology Corporation & Oman Petroleum Company OQ Company signed MOU for commercialization of renewable energy green hydrogen and ammonia
	France	<ul style="list-style-type: none">• Signed MOU with POSCO & France energy company ENGIE for hydrogen supply chain project development

Thank you for your attention

