

글로벌 탄소중립 혁신과 연대를 위한 협력 포럼

International Innovation Forum on Solidarity and Cooperation for Carbon Neutrality

Session 2

수소전략 경로의존성 연구: 한국, 독일, UAE 등 The Path Dependence of Hydrogen Strategies on Fossil Fuel Based Policy Pathways

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The Path Dependence of Hydrogen Strategies on Fossil Fuel Based Policy Pathways

Focusing on Regional Key Countries

(South Korea, Japan, Argentina, Chile, Germany and UAE)

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Sang Wook PARK

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Disclaimer

The content of this presentation is based on the research article preparing for the submission to an academic journal
and the research has not been finished yet.

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The transition to renewables is reshaping energy relationships. Traditional energy markets and trade patterns shaped by the geopolitical and technological features of fossil fuels will change (IRENA, 2019).

Hydrogen, like renewables, is distributed all around the world and has an infinite supply. However, it requires human ingenuity, including labor and capital (Rifkin, 2022).

Trading hydrogen is less asymmetric than that of Oil & Gas. As a result, many countries can become prosumers of hydrogen. This characteristic of hydrogen makes it impossible for exporting countries to use it as a trade weapon or form cartels. This will fundamentally reshape the existing energy trade landscape and create new energy exporters (Van de Graaf et al., 2020).

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In 2020, Federal Ministry for Economic Affairs and Energy of Germany defined:

Base Substance.

Energy Storage Medium.

Hydrogen is **Energy Source.**

Key Role for Sector Coupling.

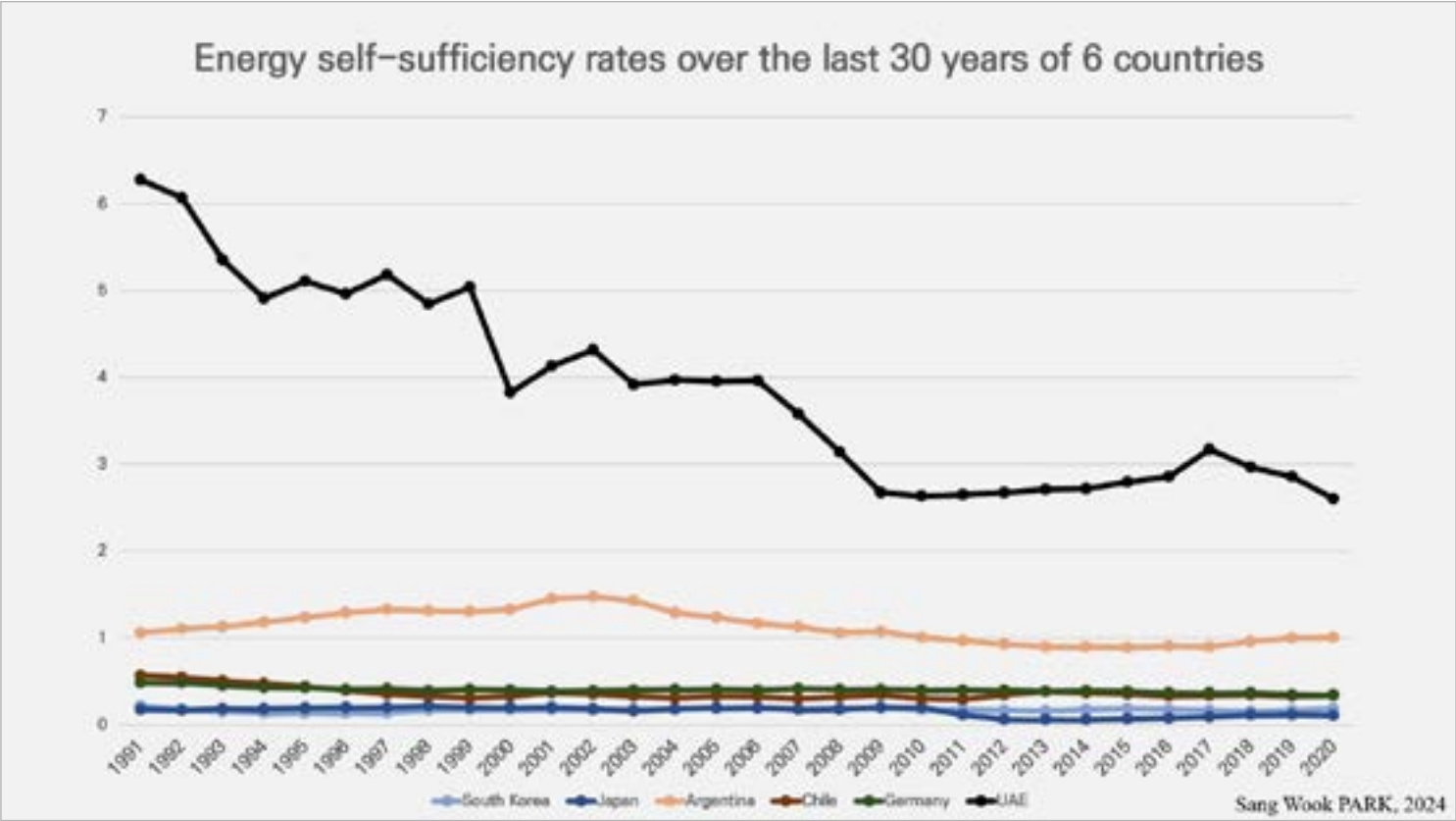
Required Certain Types of Carbon Emissions from the Industrial Sector.

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In reality, however,
the actual new and renewable energy policy
or the implementation of the policy in real world
is a bit different from the theory.

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Geopolitical classification of the countries under research			
East Asian Advanced Country	Central and Southern American Developing Country	Western Advanced Country	Middle Eastern Oil Producing Country
South Korea, Japan	Argentina, Chile	Germany	UAE
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Classification of the countries by averaged ESR over the last 30 years

Low	Moderate	High	Very High
Japan (0.157), South Korea (0.176)	Chile (0.367), Germany (0.404)	Argentina (1.133)	UAE (3.863)

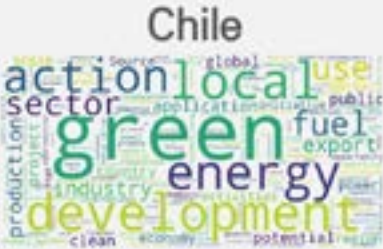
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List of national hydrogen strategy documents

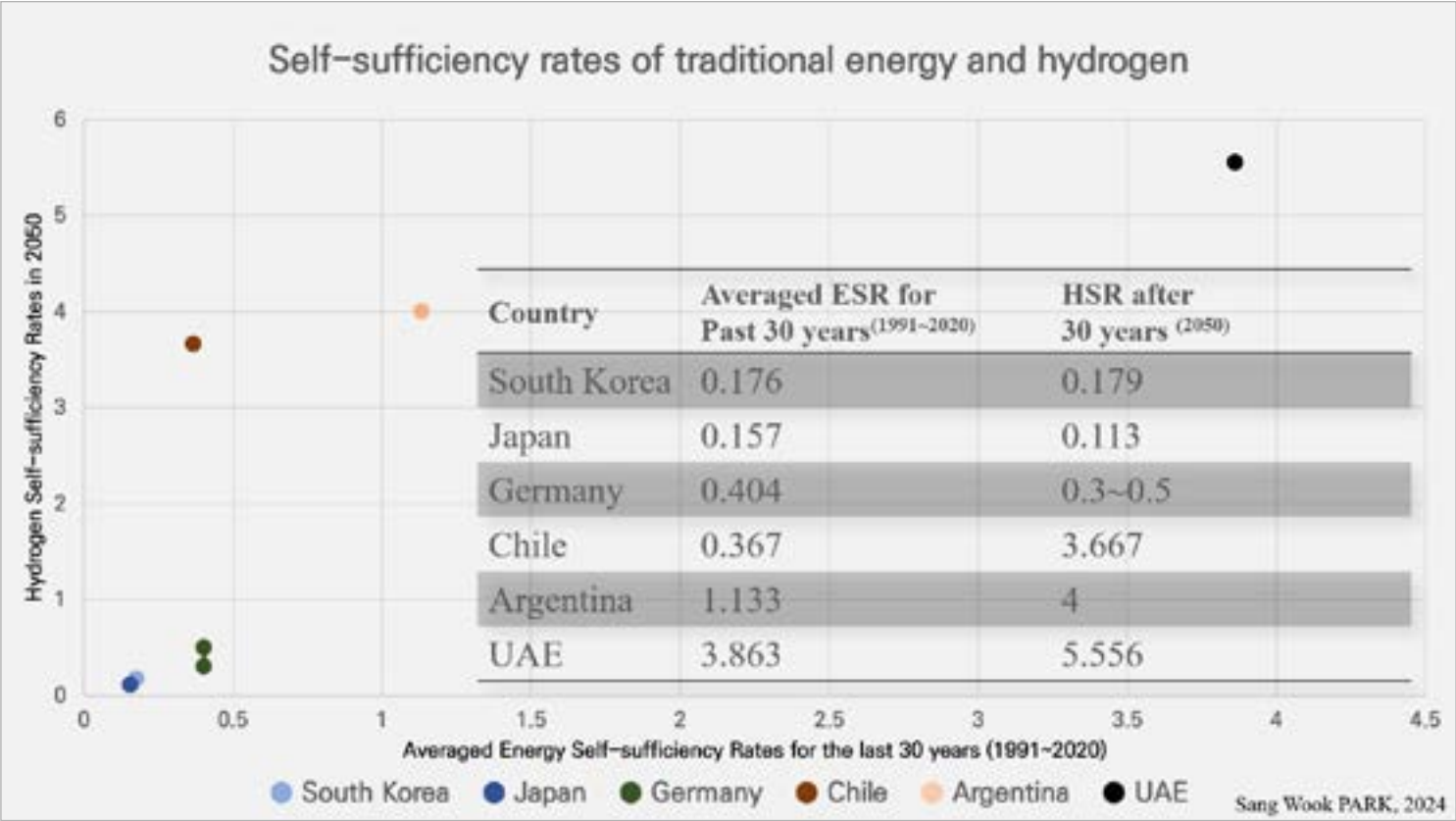
Country	Name of Document
South Korea	The First Basic Plan for the Implementation of the Hydrogen Economy (November, 2021)
Japan	Basic Hydrogen Strategy (June, 2023)
Argentina	National Strategy for the Development of the Hydrogen Economy (September, 2023)
Chile	National Green Hydrogen Strategy (November, 2020)
Germany	National Hydrogen Strategy Update (July, 2023)
UAE	UAE Hydrogen Leadership Roadmap (November, 2021)

Text Mining
(Term Frequency Analysis + Word Cloud Generation + Connection Strength Analysis)
+
Exploratory Research

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Distinctive Keywords
Safety, Fuel cell, Vehicle

Further Explanation



Facing low public acceptance of hydrogen due to safety incident. FCEVs are the only leading edge that country got in global scope. But failed to establish a global market for passenger FCEVs. Focusing on downstream, using hydrogen; FCs, Hydrogen DRI, etc. Relying on imports for much of the hydrogen supply.

Developed with fossil fuel-based product+vehicles, iron, vessels, chemicals, etc. under no reserves of fossil fuel, and same pathways on hydrogen.

Path dependence (self-reinforcing: A → A → A → A → A)

Distinctive Keywords

Support, Cost, Supply, Safety

Further Explanation

Main goals are; 1) Securing hydrogen supply, 2) Economic growth and enhancing industries' competitiveness, and 3) decarbonization.

Maximizing supports; trading companies are focusing on establishing hydrogen supply chain with financial and institutional supports.

After the Fukushima incident, 3E^{Energy security, Economic Efficiency, Environment} became 3E+S^{Safety} and the principal is same to hydrogen.

During the World War and Oil Crisis, learned the importance of securing the supply chain of energy sources. Trading companies tried to retain oil & gas and the government eliminated all the barriers and fully supported by establishing ANRE^{Agency of Natural Resources and Energy}.

Path dependence (self-reinforcing: $A \rightarrow A \rightarrow A \rightarrow A \rightarrow A$)

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Distinctive Keywords

Import, Funding, Network, Transport

Further Explanation

Focusing on the network or pipe-line to secure the stable supply; establishing 2 tracks^{within and across EU} of hydrogen pipe line.

Raising fund to foster own technology and foreign partnership.

Continuously Adopting to the transition; after the oil crisis in 1970s, installed nuclear power plant, then transitioned towards renewables. From oil & gas, to renewables, the network has been a key to promote the energy security.

Path dependence (reactive sequences: $A \rightarrow B \rightarrow C \rightarrow D \rightarrow E$)

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Distinctive Keywords

Export, Local, Renewable, Public

Further Explanation

Prioritizing energy self-sufficiency on top by making full use of its abundant renewable energy; welcoming foreign investment. Establishing the governance for equitable and universal energy supply and empowering local governments to set their own energy policy. Repositioning its status from energy importer heavily relied on fossil fuels to energy exporter based on green energy.

Path break-out

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Distinctive Keywords

Economy, Storage, Low emission

Further Explanation

Maintaining its exporter's position in the region under the fossil fuel-based system by smoothly transitioning to new energy system. Using existing infrastructures – originally made for natural gas – for the hydrogen economy. Dissolving to the hydrogen economy; in the early stage of transition, focusing on low-carbon hydrogen from its gas reserves.

Path dependence (self-reinforcing: $A \rightarrow A \rightarrow A \rightarrow A \rightarrow A$)

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Distinctive Keywords

Leadership, Low carbon, Domestic, Iron

Further Explanation

Maintaining its exporter's position under the fossil fuel-based system by smoothly transitioning to new energy system.

Using existing infrastructures and partnerships for the new energy; blending the institutional and financial frame work of the oil industry with that of hydrogen, extending the lifespan of its hydrocarbon resources by promoting CCS or CCUS technologies while expanding renewables for the competence of green hydrogen production.

Endeavoring to broaden its impact not only from the energy sources to the final products; made numerous agreements for hydrogen reduced iron projects to deploy the plant in the country.

Emphasizing the leadership as the most important factor to make all of this happen.

Path dependence (self-reinforcing: $A \rightarrow A \rightarrow A \rightarrow A \rightarrow A$)

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Policy formulation and implementation is a complex process involving policy designers, ministries, local governments, national leadership, and the perceptions of civil society.

Quantitative studies, such as economic assessments, are not sufficient to fully describe and understand a country's energy policy and its capacity.

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An ideal hydrogen strategy would include securing a stable international or regional supply chain, R&D to build a domestic hydrogen electrolysis system, and expanding renewable energy-based electricity to back up the green hydrogen electrolysis.

This will help achieve a stable hydrogen supply and make both the LCOE of renewable energy and the LCOH of green hydrogen competitive.

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The result would be the decarbonization of the industrial structure, the country's transition to carbon neutrality, and increased energy self-sufficiency.

If any one of these elements is compromised, progress will be compromised on all of them.

This is why national hydrogen strategies need to be more specific, long-term, and interdisciplinary.

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