

China's Emerging Hydrogen Economy: Policies, Institutions and Actors



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Xiaohan Gong & Rainer Quitzow
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the Emerging Hydrogen Economy“**
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Project: Geopolitics of the Energy Transformation: Implications of an International Hydrogen Economy

- Topic 1: Comparative Politics and Governance of Hydrogen in the EU and Other Major Economies
- Topic 2: Hydrogen Diplomacy in Africa: Dynamics of Cooperation and Competition
- Funding



Federal Foreign Office

DISCUSSION FORUM 135

The crisis in Ukraine: another missed opportunity for building a more sustainable economic paradigm

Economic disruptions caused by the war in Ukraine provide insights into how climate change may threaten global supply chains in a not-so-distant future. The EU is addressing strategic vulnerabilities, particularly in the sphere of fossil fuel supply, while seeking to maintain its climate ambition. However, the EU has failed to make more far-reaching changes to its economic model and relations with international partners. These are urgently needed to address the root causes of the current crisis.

Rainer Quitzow, Orwin Renn, Yana Zabanova

The crisis in Ukraine: another missed opportunity for building a more sustainable economic paradigm | GAIA 31/3 (2022): 1
Keywords: circular economy, climate crisis, green industrialization, supply chains, Ukraine

Russia's invasion of Ukraine has transformed the geopolitical landscape in Europe. Russia has positioned itself as openly hostile to the post-World War II security order in Europe and signaled its willingness to employ military force to pursue its geopolitical ambitions (Raval 2022). The crisis also revealed that the it also reveals in stark terms how latent risks and vulneral can rapidly transform into imminent threats to human se and major economic and social disruptions (Creutzig 20, the most immediate sense, the war represents a major h traade for the reveale of Ukraine and has led to the hio

BROOKINGS

AFRICA IN FOCUS
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Study: China's Emerging Hydrogen Economy: Policies, Institutions, Actors



Aim of the study

- Provide a detailed overview of the state of play of China's emerging hydrogen economy
 - Focus on policy, institutions and key actors (including role of SOEs)
 - Including central-level as well as relevant sub-national policy action
- Identify key features of China's approach to the hydrogen sector and its (potential) implications for the global hydrogen economy

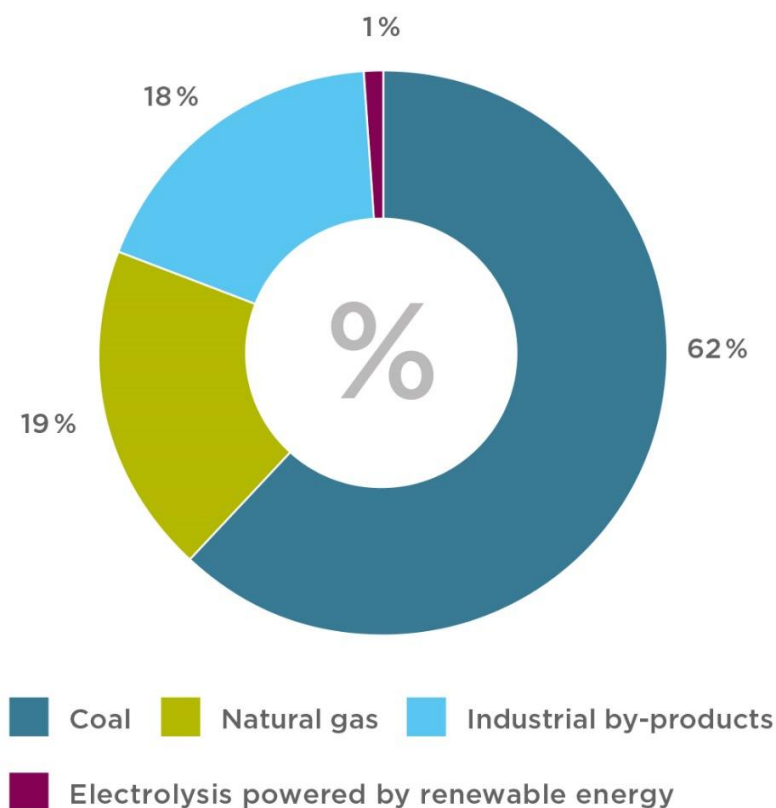
- 1. The State of China's Hydrogen Economy**
- 2. China's Institutional Landscape Governing Hydrogen**
- 3. Hydrogen-related Policy Objectives**
- 4. Support Policies for Hydrogen Development**
- 5. Discussion and Conclusions**

The State of China's Hydrogen Economy

Production and Consumption of Hydrogen in China

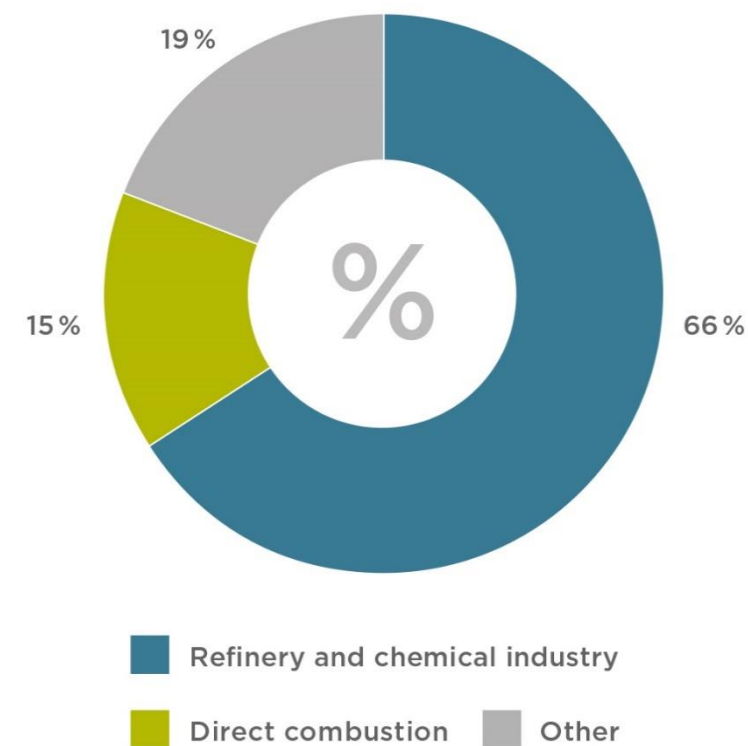
- China is currently the largest hydrogen producer worldwide.
- However, only 1 percent of hydrogen was produced from renewable energy in 2020.
- Hydrogen consumption was dominated by the refinery and chemical industry in 2020.

China's hydrogen production in 2020



Source: Hydrogen Industrial Reports published by Leadleo Industry Research Institute and AskCI Consulting in 2021

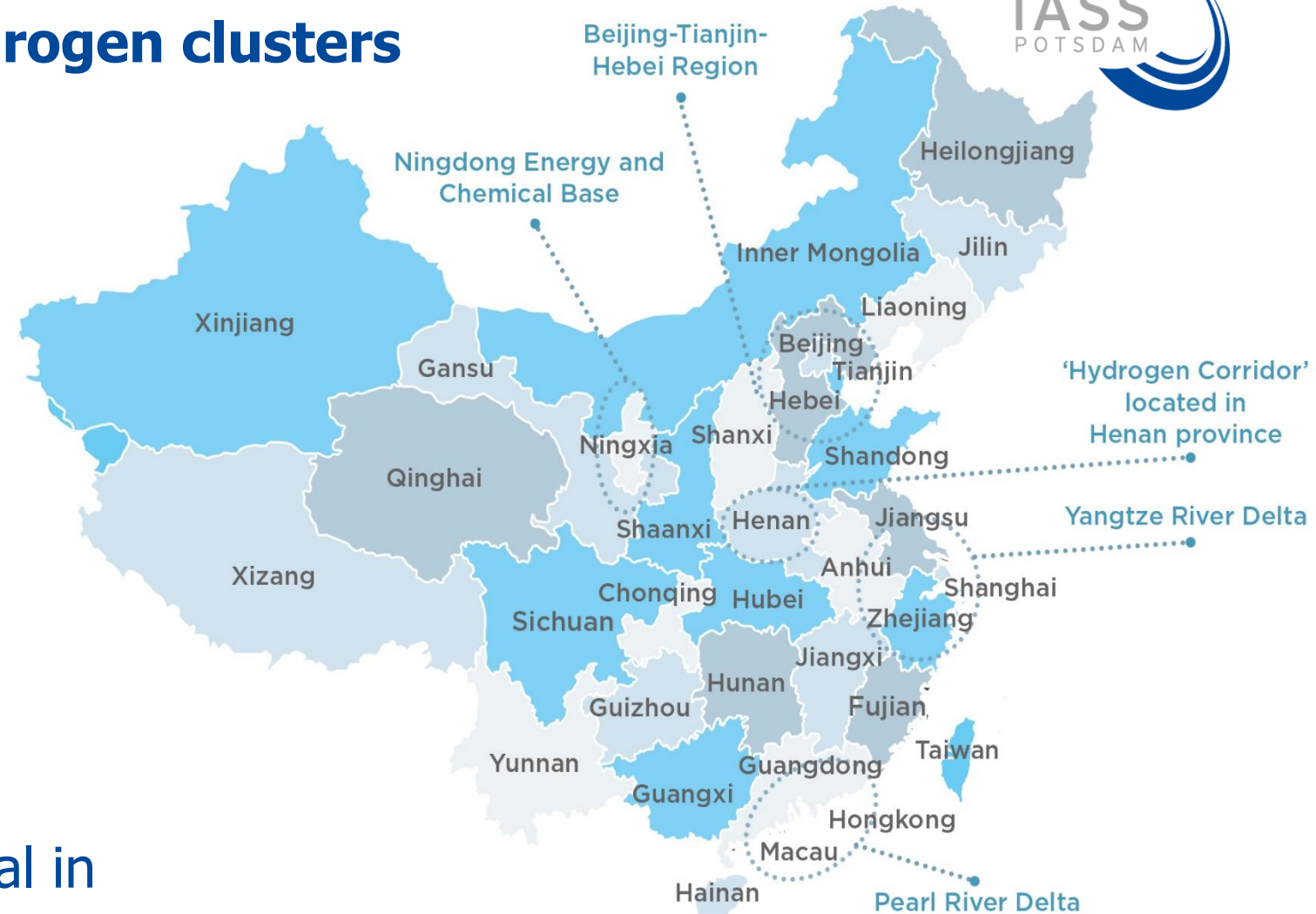
China's hydrogen consumption in 2020



Source: Haitong Securities, 'Hydrogen Energy: Challenges and Opportunities', 2021

The key role of regional hydrogen clusters

- Mostly built around efforts to build fuel cell vehicle industries
- Important production of hydrogen from industrial by-products (Yangtze River Delta, Henan Province, Ningdong Energy and Chemical Base)
- Important renewable potential in Ningxia, Henan and Hebei provinces



Source: Authors' own

Hydrogen-related Policy Objectives

Hydrogen as a vehicle for CO₂ reduction

Key targets

- ❑ **Renewable hydrogen: 100,000 to 200,000** tons of renewable hydrogen per year by 2025 and thereby **reduce 1 to 2 million tons of CO₂**
 - ❑ Selected local governments have more ambitious targets
 - ❑ **Transport: 50,000** fuel cell vehicles by 2025, expansion of refueling stations
 - ❑ **Power system:** Hydrogen-based storage for balancing renewables
 - ❑ **Industry:** Gradually decarbonize the steel and chemical industry
- *The Mid-and-Long-Term Hydrogen Industrial Development Plan (2021-2035) (2022)*
 - *The Implementation Plan of Carbon Peaking of Industry (2022)*

Hydrogen's Potential for Innovation and Industrial Development

Key targets

- Improve the efficiency of hydrogen production from renewable energy **but also fossil fuels, including coal gasification.**
 - Scale-up production of electrolyzers and reduce costs
 - Advance know-how in materials for hydrogen storage and refueling
 - Promote R&D and manufacturing of fuel cells
 - Pilot cities to promote industrial clusters for the production and use of fuel cell vehicles
-
- ***The Mid-and-Long-Term Hydrogen Industrial Development Plan (2021-2035) (2022)***
 - ***The 14th Five-Year Plan of Energy Technology Innovation (2022)***

Fuel cell vehicles and refueling stations: The importance of local-level targets

Industrial Clusters	Provinces/Cities	Target for building hydrogen refueling stations (by 2025)
Yangtze River Delta	Changshu	4
	Ningbo	10-15
	Jiaxing	20
	Shanghai	70
Beijing-Tianjin-Hebei Region	Beijing	37
	Hebei province	50
Pearl River Delta	Foshan	30
	Guangzhou	>50
	Shenzhen	10
	Maoming	>10
Hydrogen Corridor in Henan province	Henan province	>80
Ningdong Energy and Chemical Base	Ningxia province	1-2

Industrial Clusters	Cities	Target volume for hydrogen fuel cell vehicles (by 2025)
Yangtze River Delta	Ningbo	600-800 (by 2022)
	Jiaxing	1,500
	Shanghai	More than 10,000
Beijing-Tianjin-Hebei Region	Beijing	More than 10,000
	Hebei province	10,000
Hydrogen Corridor in Henan province	Henan Province	More than 5,000
Pearl River Delta	Foshan	30,000
	Maoming	600

Source: Hydrogen Development Plans issued by respective local governments

Standards for Renewable, Clean and Low-Carbon Hydrogen

	Low-carbon hydrogen	Clean hydrogen	Renewable hydrogen
Maximum CO ₂ emissions per kilogram of hydrogen	14.51 kg	4.9 kg	4.9 kg
Hydrogen production from renewable energy	Not required	Not required	Required

Source: China Hydrogen Alliance, *Standard and Evaluation of Low-carbon Hydrogen, Clean Hydrogen and Renewable Hydrogen*, 2020

- Standards issued by China Hydrogen Alliance, not yet endorsed or used by government
- Low-carbon hydrogen more carbon-intensive than natural gas-based hydrogen (around 9 kg CO₂/kg H₂ production).
- National hydrogen development plan does not discuss carbon capture and storage for use in hydrogen production.

Support Policies for Hydrogen Development

Fuel Cell Vehicles as Major Policy Priority: Support from the Central Budget

- Incentives for manufacturers of fuel cell vehicles via the **New Energy Vehicles credit system** (system of fleet-based emissions standards)
- **Direct consumer subsidies**

Types of fuel cell vehicles	Subsidies to each vehicle in 2016 (CNY)	Reduction in 2017 (base year: 2016)	Reduction in 2019 (base year: 2016)	Reduction in 2021 (base year: 2019)	Reduction in 2022 (base year: 2021)
Passenger vehicles	20,000	20 %	40 %	20 % (private use)	30 % (private use)
Light vehicles	30,000				
Heavy/medium-size bus or vans	50,000			10 % (public use)	20 % (public use)

Source: MOF, MOST, MIIT and NDRC, Notice of the Fiscal Subsidy Policies for the Promotion and Application of New Energy Vehicles (2016-2020) (2015); MOF, MIIT, MOST and NDRC, Notice of Further Improving the Fiscal Subsidy Policies for the Promotion and Application of New Energy Vehicles (2020); MOF, MIIT, MOST and NDRC, Notice of the Policies on Fiscal Subsidies for Promotion and Application of New Energy Vehicles in 2022 (2021)

Fuel Cell Vehicles as Major Policy Priority: Pilot Cities

- MOF, MIIT, MOST, NDRC and NEA, Notice of the Pilot Application of Fuel Cell Vehicles (2020)
- Gradually replacing the subsidy regime since 2020
- Central government provides rewards for pilot cities for promotion of fuel cell industry
- Selected cities in 2021: Beijing, Shanghai, Guangzhou, Zibo in Shandong province

Support mechanisms for hydrogen refueling stations: Pilot cities

- Rewards to pilot cities or city clusters to promote the R&D of hydrogen refueling stations since 2014
- Subsidies granted by local governments to the construction and/or operation of hydrogen refueling stations

Notes: Unless otherwise stated, these subsidy rates are effective in 2022.

Industrial Clusters	City	Subsidies to companies
Yangtze River Delta	Jiaxing, Zhejiang province	■ 20 yuan/kg (around US\$ 3.13/kg) for operation
		■ Annual decrease of 5 yuan/kg (around US\$ 0.78)
Beijing-Tianjin-Hebei Region	Tianjin, centrally-administered city	■ Up to 5 million yuan (around US\$ 783,712) for construction
	Zhangjiakou, Hebei province	■ Up to 8 million yuan (around US\$ 1.25 million) for construction
Pearl River Delta	Foshan, Guangdong province	■ Up to 5 million yuan (around US\$ 783,712) for construction
	Guangzhou, Guangdong province	■ Up to 2.5 million yuan (around US\$ 391,856) for operation
Hydrogen Corridor in Henan Province	Puyang, Henan province	■ Up to 10 million yuan (around US\$ 1,500,000) for construction
		■ 2022-2023: 15 yuan/kg (around US\$ 2.14/kg) for operation
		■ 2024-2025: 10 yuan/kg (around US\$ 1.43/kg) for operation
Others	Chengdu, Sichuan province	■ Up to 5 million yuan (around US\$ 783,712) for construction
		■ 20 yuan/kg (around US\$ 3.13/kg) for operation

Source: Hydrogen Development Plans issued by local governments

Other Support Mechanisms for Hydrogen Development

- **Investment support** by local governments and financing institutions is encouraged for:
 - clean hydrogen production
 - fuel cells
 - fuel cell vehicles
 - refueling stations
 - storage
 - hydrogen blending in pipelines
 - **Support mechanisms** include:
 - Local industrial funds
 - Preferential tax treatment
 - Discounted electricity prices
 - China's **emission trading system** could provide incentives in the future if expanded to transport and relevant industrial sectors.
- ***The Green Industry Guidance (2019)***
 - ***The Notice of Issuing the Catalogue of Projects Supported by Green Bonds (2021)***

Synthesis & Conclusions: H₂ policy priorities

Hydrogen policy is dominated by considerations of innovation and industrial development.

- Obtaining **capabilities in “key technologies”** and equipment for their industrial production is an important concern.
- **Fuel cell vehicles** remain the most prominent target sector.
- China is promoting **demand for hydrogen**, although this effort mainly lies in the transport sector (i.e. **fuel cell vehicles**).
- **Other dimensions of hydrogen are gradually emerging** as priorities, in particular hydrogen production and transport.

Synthesis & Conclusions: H₂ governance

Local clusters are driving the development of H₂ value chains, while energy SOEs are building on their assets to develop H₂ infrastructure.

- **Local clusters** and pilot cities are crucial for hydrogen development at this stage.
- **Local targets frequently surpass central targets**, both for deployment of fuel cell vehicles and for renewable hydrogen.
- **Rewards for pilot cities** are starting to replace direct consumer subsidies for fuel cell vehicles.
- **SOEs are key players** for developing transport (e.g. pipelines) and storage infrastructure (e.g. refueling stations).

Synthesis & Conclusions: H₂ and decarbonization

At present the role of hydrogen as a vehicle for decarbonization remains an uncertain prospect.

- Hydrogen is seen as a vehicle for decarbonization and stabilization of an electricity system based on renewables **in the long term**.
- In the short term, hydrogen **production from any source** is being supported.
- Standards for **low-carbon hydrogen** relate to **coal-based** hydrogen.
- **Priority is not necessarily given to hydrogen use in the hardest-to-electrify sectors** (e.g. industry) but in transport.
- It remains **unclear how demand for renewable or clean hydrogen** will be supported.

Synthesis & Conclusions: International H₂ implications

Focus on geoeconomics / technology leadership.

- China does not appear to be positioning itself as a large-scale importer or exporter of (renewable) hydrogen, favoring **domestic hydrogen production**.
- Potential **energy security benefits of hydrogen do not figure prominently** in China's hydrogen policy.
- While China's **standard for "clean hydrogen" seems to align with the EU CertifHy** approach, standards for "low-carbon" and "renewable" hydrogen are likely to be less stringent than EU equivalents in the short term.
- China is **prioritizing competition in fuel cell technologies**, while deploying efforts to close gaps in clearly defined technologies.
- **Electrolyzers technologies and fuel cell vehicles offer potential for BRI.**

Contact



Xiaohan Gong

gongxiaohan@link.cuhk.edu.hk

Rainer Quitzow

Rainer.Quitzow@iass-potsdam.de

Institute for Advanced Sustainability Studies e.V.
Berliner Straße 130
D – 14467 Potsdam
Web: www.iass-potsdam.de