

ECECP Dissemination Event Opportunities in LNG, CCUS and Green Hydrogen sector in China for EU Business: enabling policies and financing needs

François ISSARD under EU-China Energy Cooperation Platform (ECECP)
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Opportunities in LNG, CCUS and Green Hydrogen sector in China for EU Business: enabling policies and financing needs

- Study results and recommendations outlined in this presentation are based on authors' research and interviews with european and chinese entities representatives in China and in Europe conducted in August and September 2023
- Additional research provided by EnerScen (re. Hydrogen) and ICF (re. CCUS) research officers are included in the dedicated ECECP final report and form part of this presentation
- The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the European Union, the China National Energy Administration or ECECP.



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LNG 2023 Markets Update

- After a complex and tense year 2022, global gas markets eased somewhat in 2023
- LNG acted as a buffer between a strong (despite dropping in Europe) global demand and a lagging supply as this resource fed more than half of global gas trade (56%) overtaking pipe gas
- Europe is steadying its strategy to substitute LNG imports to Russian gas
- Asia-Pacific LNG demand is also increasing, not only China's
- Gas storages are at historical highs both in Europe and Asia responding to compelling national security requirements
- Uncertainties remain on the evolution of markets for the coming few years on the backdrop of global instability, stubborn inflation, high interest rates, energy transition challenges, and new supplies deliverability.



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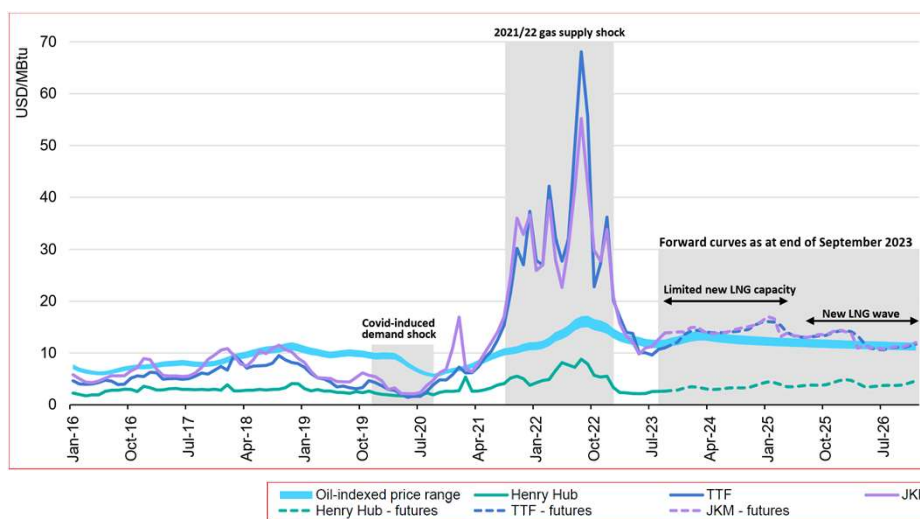
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Global Natural Gas Prices: « calm after storm »

Forward curves show prices above historical averages in the short to medium term



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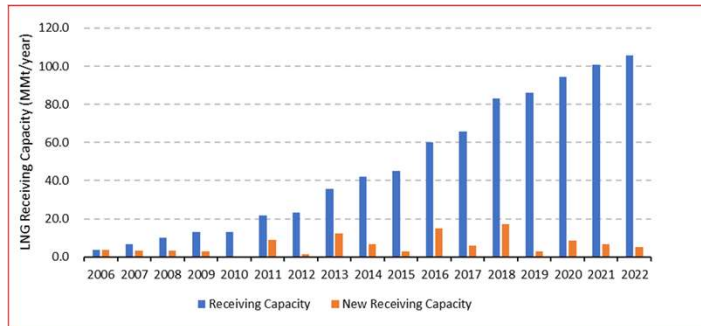
Source: IEA Medium Term Gas Report 2023

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China LNG import capacities rebounded in 2023

- 24 LNG receiving terminals in operation in 2022, representing 106 Mt/y capacity
- Operation starts rebounded in 2023 w. 3 new terminals online, i.e a total of **27 terminals for 120 Mt/yr installed capacity**
- Such construction rate apparently aligns w. NDRC's overall plans for **LNG demand to reach 200-240 Mt** w. Gas demand to peak around 550-650 bcm/y **by 2040** (i.e 12-15% of the mix).



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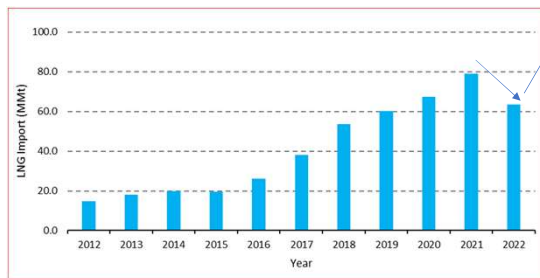
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China LNG Imports declined in 2022 but are rebounding sharply in 2023

- China imported only 63Mt of LNG in 2022, down 20% from their 2021 peak of 79Mt
- A strong rebound is going on in 2023 which could make China the largest global LNG importer again
- China is also back to the upstream side of the equation with strong contracting activity



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2023: A very active contracting year for Chinese companies establishing LNG sourcing as a major component of China Energy Security

- 10 LNG PSA executed (PetroChina/CNPC, Zhejiang, ENN, China Gas)
- 10.9 Mmtpa annual contract quantity added
- Some Long-Term (20 years+) contracts
- Some including equity stakes in Liquefaction Projects (Qatar North Field)

signed date	Seller	buyer	contract type	ACQ mmtpa	start date	contract duration
Sep-23	PetroChina	EGAT	LNG SPA	1.2	2025-01-01	3
Sep-23	ADNOC LNG	PetroChina	LNG SPA	0.2	2028-01-01	5
Jul-23	Mexico Pacific Limited	Zhejiang Energy Group	LNG SPA	1	2028-12-01	20
Jun-23	Cheniere Marketing	ENN Natural Gas	LNG SPA	1.8	2030-01-01	20
Jun-23	Cheniere Marketing	ENN Natural Gas	LNG SPA	0.9	2026-07-01	4
Jun-23	QatarEnergy	CNPC	LNG SPA	4	2026-01-01	27
Apr-23	PETRONAS	PetroChina	LNG SPA	0.6	2025-01-01	5
Apr-23	PETRONAS	PetroChina	LNG SPA	0.4	2023-05-01	9
Feb-23	Venture Global LNG	China Gas Holdings	LNG SPA	1	2027-07-01	20
Feb-23	Venture Global LNG	China Gas Holdings	LNG SPA	1	2026-07-01	20



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LNG Recommendations for a better Business Environment i.e better than « business as usual »

- LNG, a mature energy industry, operates in a remarkably globalised and efficient, flexible market model
- Powerful inter-regional Partnerships, implemented during the last 2 decades, are in place and pro-actively linking Multi-National Companies (Chinese SOEs and European IOCs) as well as States' energy institutions
- From today's cooperative achievements, further global integration in LNG global business requires greater opening of the Chinese Gas market to global (European) operators
- European enterprises, generally in joint ownerships with Chinese partners, need to be given further opportunities to optimise and develop their Chinese operations
- In return Chinese companies will gain wider integration into global energy flows ...
- Ultimately contributing to international stability and ensuring energy security thanks to the buffer role played by LNG (availability, reliability) in the global energy system as was demonstrated in Europe during the 2022 crisis (and continuing)
- Some level of coordination related to LNG market evolutions and national strategies particularly for short- and medium-term market scenarios needed between EU and China.



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Hydrogen Background

- Hydrogen is not an energy vector today but a simple industrial gas, but it is called to play an important role in the energy system in the future to decarbonize large segments of the industry (the « hard-to-abate » industries such as cement, steel, and others)
- **Global Hydrogen** demand at historical high @ **95Mt in 2022**, w. industry and refining applications, sourced from fossil fuels, w. **900 Mt CO2** emitted, China representing 30% of global demand
- **China** is world largest hydrogen producer @ **35 Mt = 30% of world total**, sourced from fossil fuels, w. corresponding CO2 emissions of **360 Mt**
- For reference IEA scenarios call for **150Mt/yr hydrogen production** level by **2030** (Net Zero 2050)
- China was a slow starter but is now leader in electrolyser capacity deployed (1.2GW end 2023) and **50% of global electrolysers manufacturing capacity**
- Both **China and the EU have Hydrogen strategies** in place: “*China 2022 – Medium and Long-Term Plan for Development of the Hydrogen Industry 2022-35*”
- “*EU Hydrogen Strategy for a Climate-Neutral Europe*” (2020), upgraded w. “*RePower EU*” (2022).



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EU and China have Hydrogen Strategies in place

Green hydrogen in selected hydrogen strategies

Type of hydrogen production: Gray / brown hydrogen Blue hydrogen Green hydrogen

	CHINA	EUROPEAN UNION
National plan	Medium and Long-term Plan for Hydrogen Energy Industry Development (2021 - 2035)	A Hydrogen Strategy for a Climate-neutral Europe
H ₂ color supported		
Stated targets for green H ₂	100,000-200,000 tons green hydrogen by 2025	6 GW by 2024, producing 1 million tons; and 40 GW by 2030, producing 10 million tons
Investment volumes expected	No targets	Electrolyzer investments by 2030: EUR 24-42 billion. Total investments by 2050: EUR 180-470 billion

Sources: National Development and Reform Commission (China), Federal Ministry for Economic Affairs and Energy (Germany), European Commission

Gray/brown: prod from fossil fuel, nat gas or coal

Blue = Gray H₂ w. CCS

Green: H₂ prod from renewables



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China Green Hydrogen industry ramp-up: + and -

- +/- China regards Hydrogen as a « **frontier technology** » with « **development first** » and « **greening** « **second** », and is ramping up its industrial development
- + China **Policy Support**: over 500 Hydrogen related policies released in 2 years!
- + **New Project Development**: 120 green hydrogen projects under development
- + **Industrial build-up**: electrolyzers capacity aiming to reach **38 GW by 2030 (EU 40 GW)**
- + Our study shows industrial developments and **local policies** are moving beyond initial central conservative targets
- + **Private industry** is part of this rapid momentum simultaneously with State-Owned sector
- -----
- – However significant **uncertainty on future demand level** remains
- – **Increased** financial and equipment **costs** are adding risk to green hydrogen projects launched or under planning
- – **Green Hydrogen is not cheap!**
- – Green Hydrogen **production costs not yet competitive with grey hydrogen.**



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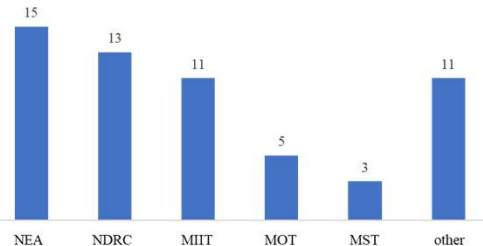
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Booming Hydrogen Energy policies released by Central Government in 2022-2023

Table 2.1. Representative Policies Relating to Hydrogen Energy Released by the National Development and Reform Commission

Release time	Institutions	Policy Name	Content
2022.3.23	NRDC	Medium and Long Term Plan for the Development of Hydrogen Energy Industry (2021-2035)	By 2025, a relatively complete supply chain and industrial system will be preliminary established. By 2030, a relatively complete technological innovation system for the hydrogen energy industry, as well as a clean energy hydrogen production and supply system, will be formed. By 2035, a hydrogen energy industry system will be formed.
2022.6.1	NRDC	The 14th Five Year Plan for the Development of Renewable Energy	Promote the large-scale demonstration of renewable energy hydrogen production, and promote the industrialization of renewable production in areas with low renewable energy generation costs and good conditions for the development of hydrogen energy storage and transmission industries, creating a large-scale green hydrogen production base.
2022.9.26	NRDC	Guiding Opinions on Accelerating the Green and Intelligent Development of Inland Ships	Strengthen the research and development of technical equipment such as marine hydrogen fuel cell power systems, hydrogen storage systems, and refueling systems, explore the application of hydrogen fuel cell power technology in passenger ships, and encourage the use of green hydrogen electrolyzed by renewable energy such as solar energy.

Number of hydrogen-related policies released by national level entities



NEA: National Energy Administration;
NRDC: National Development and Reform Commission;
MIIT: Ministry of Industry and Information Technology;
MOT: Ministry of Transport; MST: Ministry of Science and Technology



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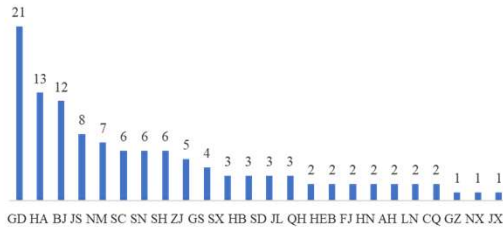
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Hydrogen: Provincial level policy making activity increasing rapidly in 2022-2023

Hydrogen Energy Provincial: policies release by province

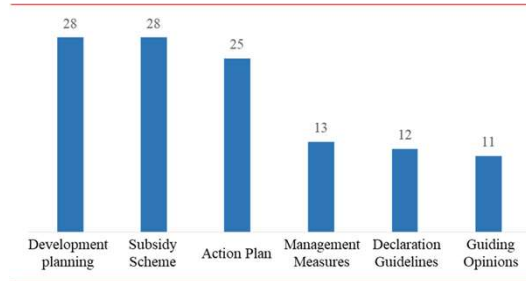


GD: Guangdong; HA: Henan; BJ: Beijing; JS: Jiangsu; NM: Inner Mongolia; SC: Sichuan; SN: Shaanxi; SH: Shanghai; ZJ: Zhejiang; GS: Gansu; SX: Shanxi; HB: Hubei; SD: Shandong; JL: Jilin; QH: Qinghai; HEB: Hebei; FJ: Fujian; HN: Hunan; AH: Anhui; LN: Liaoning; CQ: Chongqing; GZ: Guizhou; NX: Ningxia; JX: Jiangxi



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Hydrogen Energy Provincial policies: release 2022-2023 by type



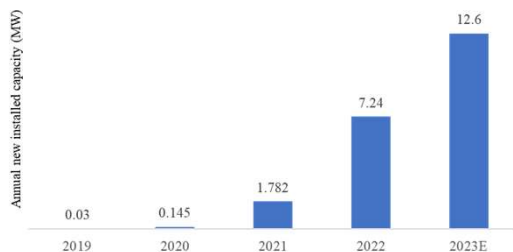
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China Hydrogen Industrial Chain Capacities: Electrolysers manufacturing

New installed capacity and players for fixed cell power generation 2019-23, +12.6MW in 2023



Enterprise	Electrolyser Type	Manufacturing Capacity in 2022	Ownership
PERIC Hydrogen Technologies	ALK - PEM	1.5 GW	state-owned
LONGI Hydrogen Energy Technology	ALK	1.5 GW	private
Cockerill JingLi Hydrogen	ALK	1 GW	private
Auyan New Energy Technology	ALK	1 GW	private
CPU Hydrogen Power	ALK	1 GW	private
Tianjin Mainland Hydrogen Equipment	ALK	1 GW	private
SUNGROW	ALK	1 GW	private



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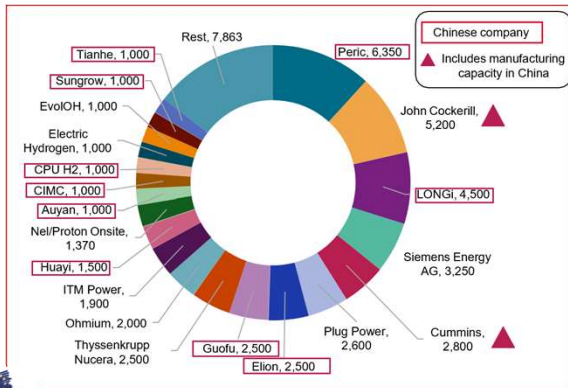
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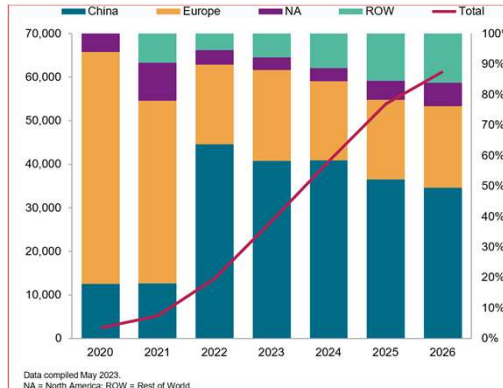
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China's electrolysis manufacturing capacity grew rapidly in 2022 - by 2025, China could account for over half of global capacity

Annual Electrolysis Capacity installed by 2025 by companies



Evolution of Electrolysers manufacturing capacity per regions



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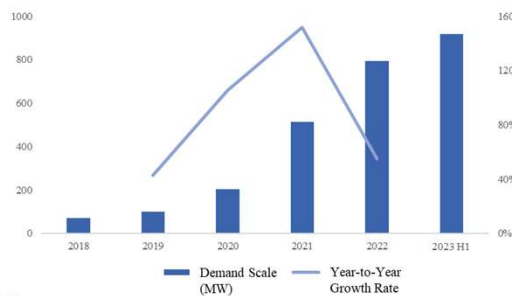
Source: SP Global

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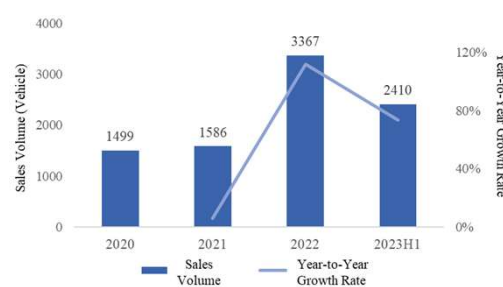
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Business scale: Hydrogen utilisation still limited, capacity building growing faster than market demand

China Electrolytic Cells demand 2018-2023



Fuel Cell Electric Vehicles sales 2020-2023: a few 1000's/y only (CAAM)



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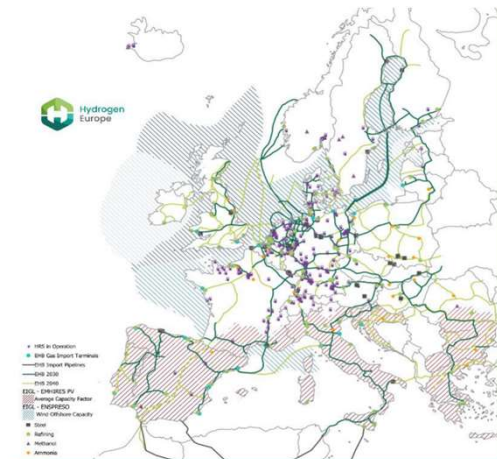
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Hydrogen Europe: taking off in a context of emissions and climate commitments

- EU's goals: produce and import 20 Mt of clean hydrogen by 2030, green hydrogen is part of EU energy mix target of 45% renewable by 2030
- Clustering concept: Hydrogen Valleys and Backbone (EHB)
- Financing: revenues from ETS to fund H2 production
- European Hydrogen Bank launched
- Int'l Hydrogen Initiative
- Challenge: synchronise new hydrogen production with new demand creation



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Green H2 Recommendations for a better Business Environment

- Hydrogen demand needs to be stimulated without favouring grey/brown hydrogen
- To calibrate policy making in parallel with expansion of market demand in various sectors
- To be contained: overcapacities (for inst. electrolyzers) to avoid capital destruction, market fragmentation, int'l frictions
- To urgently design and implement cooperation initiatives to progress together on Regulations, Standardisation (safety) and Certification (EU's certifiHy) priorities to align market conditions, and ensure low-carbon or zero-carbon footprint of newly produced hydrogen; ensure mutual recognition of policies
- To jointly define market priority objectives: sustainable usage types like power generation, heating and decarbonising highly emitting industries
- Which space for European companies in this context? To engage with Chinese ones as suppliers and R&D and JV partners as chinese technological and research capabilities still lagging behind Europe, in exchange for fair and open market access in China and ther markets.



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Carbon Capture, Utilisation and Sequestration (CCUS) Background context

- CCUS = A set of proven technologies to decarbonise the industry experiencing a reborn in recent years
 - An essential (unique?) instrument to climate change mitigation addressing greenhouse gas emissions from fossil fuelled industries
 - IEA’s “Net zero emissions by 2050” scenario suggests **5.9 Gt CO2** captured and stored annually by **2050**
 - Around **20% of China’s energy consumption yet from fossils by 2060**, with corresponding issue of potentially economically stranded assets
 - **EU**: CCUS is embedded in EU Green Deal and Climate Law, “Fit for 55” policy (reduce GHG emissions by 55% by 2030)
 - **EU** is witnessing **80 new CCUS projects** (13 involving low-carbon hydrogen) = **50 Mt CO2/yr** sequestration capacity
 - **China** has **100 small-size demo projects as of 2023** altogether targeting only a few Mt/yr
 - CCUS is not yet at industrial stage but rather at “**large demonstrators**” stage
 - Rapid industrialisation (upscaling, resolution of pending unresolved technical issues) is needed to reach a meaningful impact on emissions reduction
- CCUS deployment costs must be lowered significantly and must be challenged/supported by consistent carbon pricing policies.



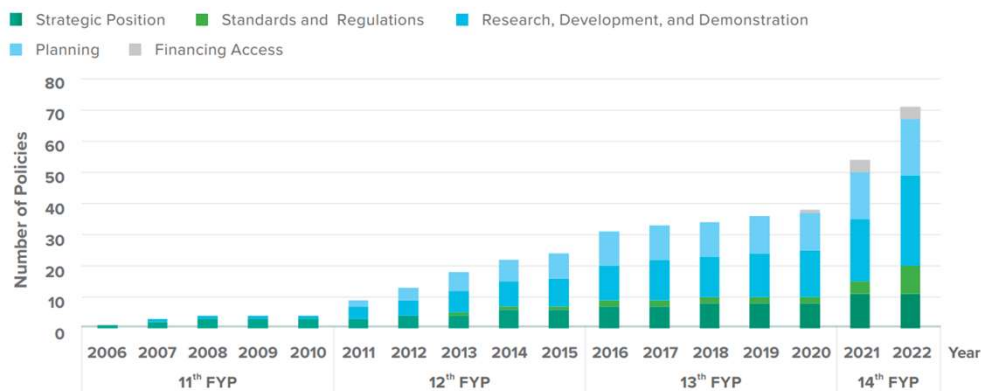
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Number of CCUS-related policies issued in China 2006-2022



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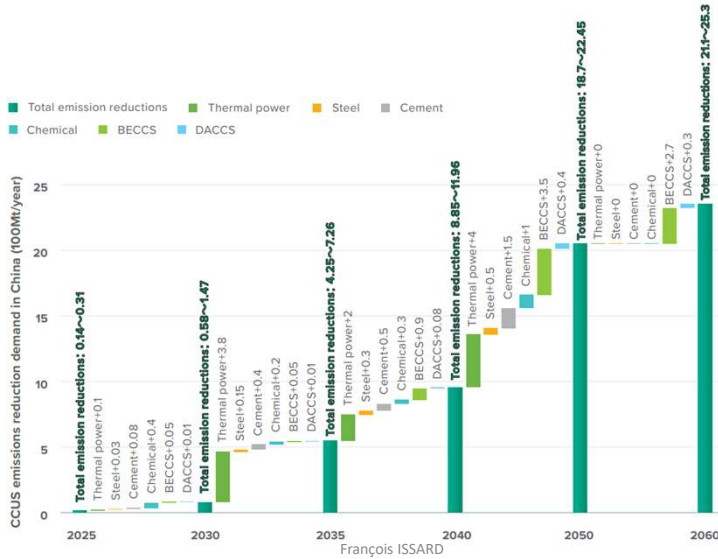
*FYP: Five-Year Plan

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China's CCUS emissions reduction demand simulation 2025-2060

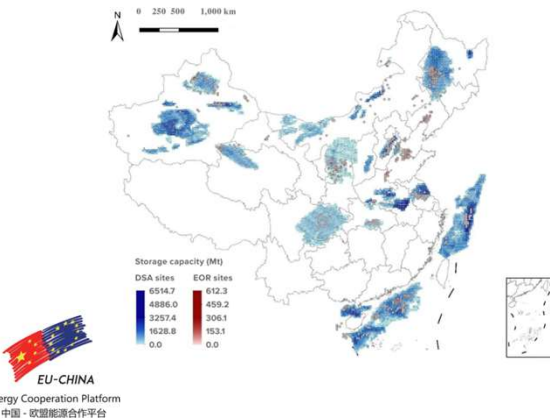


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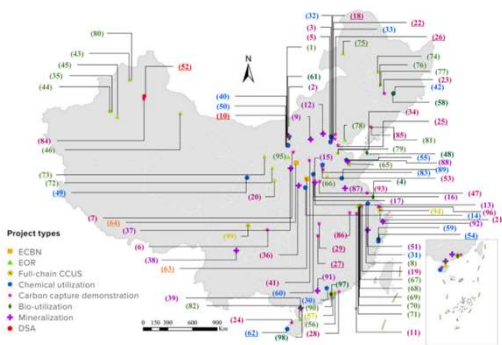
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CCUS in China: CO2 Storage and Demo Projects Location

Theoretical geological storage capacities



100 Demonstration Projects: passing the Mt/yr overall capacity



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CCUS Projects Progress by Industry and Sectors: Electricity and Chemicals are main targets

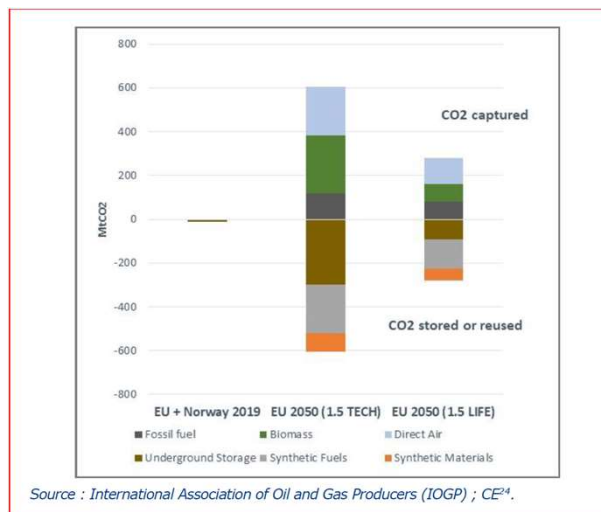


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CCUS balancing role in EU Commission's 1.5° scenario



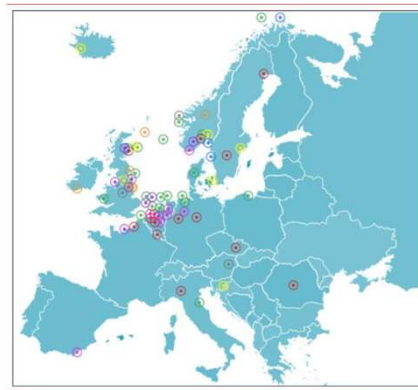
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CCUS Projects in Europe: more and bigger

European CCUS projects location



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Northern Lights industrial project



Source : Global CCS Institute

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- During last years Projects have increased in number / size
- 76 projects in 16 countries
- 50 Mt/y CO₂ to be stored by 2030



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CCUS Recommendations for a better Business Environment (1)

- CCUS is part of a portfolio of technologies historically in the hands of the Oil & Gas industry
- The first trial projects or pilots were carried out within this industry several decades ago
- CC and injection in geological reservoirs has been performed at industrial scale to improve recovery of certain oilfields (EOR) in particular in China (CNPC, Sinopec)
- Both the EU (IOCs) and China (NOCs) could join (industry associations?) in re-defining the toolkit required to accelerate the development of this industry which is the best solution to decarbonise first their own business and develop the supply chain required to bring this technology to industrial stage with acceptable costs for all
- Institutional support should be given by local and central jurisdictions to provide an economically healthy and supportive decision-making environment.



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CCUS Recommendations for a better Business Environment (2)

- Carbon neutrality cannot be achieved without CCUS due to the stubbornness of some fossil fuel supported industries until the second half of the century
- Cooperation opportunities between European and Chinese companies are many, from collaboration in large-scale demo projects to be set in China to JV and industry partnerships potentially internationally driven
- Cooperation needed in developing/accelerating the nascent China's Carbon market
- Cooperation in R&D to reduce lead time in technology development (capture and storage)
- Cooperation to work out internationally recognised methods to measure CO2 emissions and assess abatement costs of CCUS technologies
- Take advantage of existing joint projects in China and abroad to test/validate concepts at scale.



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Joint Conclusions: opportunities and challenges (1)

- Europe a first runner in H2 and CCUS new technology solutions, China rapidly catching up, driven by its climate engagements to the world and its traditional strengths in cost, manufacturing and up-scaling
- EU and China have complementary skills and development stages in both CCUS and Hydrogen, EU has advantage in conceptualisation and regulatory framework building to enable viable business cases while China is successful at reducing costs, materialising value chains and offering economy of scale
- Both emerging technologies, CCUS and Hydrogen will have first to satisfy their local markets with local conditions and constraints, while national-scale demand has not yet jump-started in neither, cooperation should be a « no-brainer » at this moment of their development
- Numerous cooperation opportunities exist in regulations, standardisation and certification processes to harmonise and organise long-term global markets as well as launching/testing demonstration projects at scale and faster.



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Joint Conclusions: opportunities and challenges (2)

- Cooperation is also needed in several sectors in R&D to develop usage of CO2 and accelerate resolution of remaining outstanding technical issues (capture, storage)
- Ensure reciprocal access to necessary data (incl. GIS) within approved protocols to allow open cooperation in non-competitive business segments
- Facilitate access to reciprocal tendering processes for an open and fair access to new projects
- Funding: ensure transparency in the definition and the application of investment opportunities and conditions, subsidies
- Boost cooperation for the rapid development of China's Carbon Trading system to avoid so-called « carbon leakage ».

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Hydrogen/ Medium and Long-term Development Plan for China Hydrogen Energy Industry

Background of Industrial Development:

The global hydrogen energy industry is experiencing

- rapid development. Over 30 countries, which account for 75% of global GDP, have released hydrogen energy roadmaps.

China's hydrogen energy industry is in its early stages but has started to take shape

- The world's largest hydrogen-producing country
- Preliminary mastery of the entire technological process
- Small-scale demonstration applications
- Over 300 companies

China's hydrogen industry still faces a series of issues

- Weak technological foundation
- Lagging basic system
- Unclear development path or trajectory
- Blindly following trends at the local level, homogeneous competition, and low-level construction

Industrial positioning:

Important components of the energy system: leveraging energy storage to build a multi-energy complementary system.

An important carrier for achieving green and low-carbon transformation in the energy consumption sector; cross-sectoral applications tailored to local conditions.

Key development directions for strategic emerging industries and future industries; new growth points for industrial transformation and upgrading, and new drivers for high-quality economic development.

General requirements Seize the opportunity for development, coordinate industrial layout, enhance innovation capabilities, improve management systems, promote standardized and orderly development, increase the proportion of hydrogen energy in the energy consumption structure, and provide strong support for building a clean, low-carbon, safe, and efficient energy system.

Basic principles Innovation leading, self-reliance and self-improvement. Safety first, clean and low-carbon. Market-oriented approach with government guidance. Stable and cautious application, leading by demonstration.

Development goals 2025: Policy improvement, basic mastery of technology, preliminary improvement in the supply chain. 2030: Technologically comprehensive, low-carbon hydrogen production, rational and orderly industrial layout. 2035: Diverse hydrogen energy application ecosystem, significant increase in the proportion of green hydrogen.

The four major tasks. Building a system to support the high-quality development and innovation of the hydrogen energy industry. Coordinating the promotion of hydrogen energy infrastructure construction. Steadily promoting diversified demonstration and application of hydrogen energy. Accelerate the improvement of hydrogen energy development policy and institutional guarantee system.

Organisation and implementation

Overall coordination	Building a "1+N" policy system.	Pilot demonstration
Financial support	Promotion and guidance	Supervision and evaluation



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