

The geopolitics of hydrogen – a new world order

Key trends in global hydrogen geopolitics



The nascent hydrogen market will display low geopolitical risk due to localised demand being met by local supply.



As demand for volume increases, supply chains will elongate and the propensity for geopolitical risk will increase.



The degree of import dependence, means of supply, and the demand elasticity of the resource can inform the level and nature of geopolitical risk.



New hydrogen exporters and increased market fragmentation have the potential to reshape energy geopolitics and make the market less susceptible to coordinated supplier behaviour and oligopolies, relative to hydrocarbons.



Global hydrogen exporters may have lower economy-wide political leverage compared to gas due to lower final energy consumption from hydrogen. However, critical systems could still be affected.



The hydrogen supply chain requires technical know-how, critical material and manufacturing capacity, enabling some countries to exercise their geopolitical leverage upstream.

Will hydrogen be similar to today's energy commodity markets and geopolitics?



Can we use oil and gas as frameworks for hydrogen?

Countries with significant oil and gas resources available for exports can exercise significant political and economic leverage over their importers: the geopolitics of oil and gas see few countries with the

potential to influence prices and supply of critical resources. As the energy transition is set to reduce the role of hydrocarbons, conventional wisdom is that geopolitical risk is likely to reduce. However, the role of hydrogen as a tradeable commodity offers a notable challenge to this view. In many respects hydrogen could

have similar dynamics to current energy commodities, such as crude oil and natural gas. On the other hand, there are three key differences that impact the extent to which hydrogen dynamics affect a country's power and geopolitical leverage.

Similarities		Differences			
	 Market dynamics	 Geopolitical impact		 Market dynamics	 Geopolitical impact
01	Emphasis on price stability, demand and supply security in order to incentivise initial adoption, resulting in localised markets.	Localised markets display low geopolitical risk.	01	Global supply of hydrogen will see new producers and increased market fragmentation.	A new, larger set of hydrogen producers could reshape geopolitical relationships and make the market less susceptible to coordinated supplier behaviour and oligopolies, relative to hydrocarbons.
02	As the market evolves, supply chains become more elongated and less localised to serve higher volumes.	As supply chains elongate, the propensity for geopolitical risk increases.	02	Hydrogen is forecasted to have a lower share of final energy consumption compared to gas and different use cases in the economy, compared to gas.	Hydrogen exporters may have lower economy-wide leverage compared to gas. However, critical systems might still be affected.
03	Both natural gas and hydrogen can serve the market through fixed pipelines or maritime routes (e.g., LNG and ammonia).	Geopolitical complexity increases.	03	The hydrogen supply chain requires technical know-how and critical materials as inputs and advanced manufacturing capacity.	Countries will compete across the whole hydrogen supply chain.

Similarity

01

In the nascent market, local demand will be met by local supply, reducing geopolitical risk.



Market dynamics

Emphasis on price stability, demand and supply security in order to incentivise initial adoption, resulting in localised markets.



Geopolitical impact

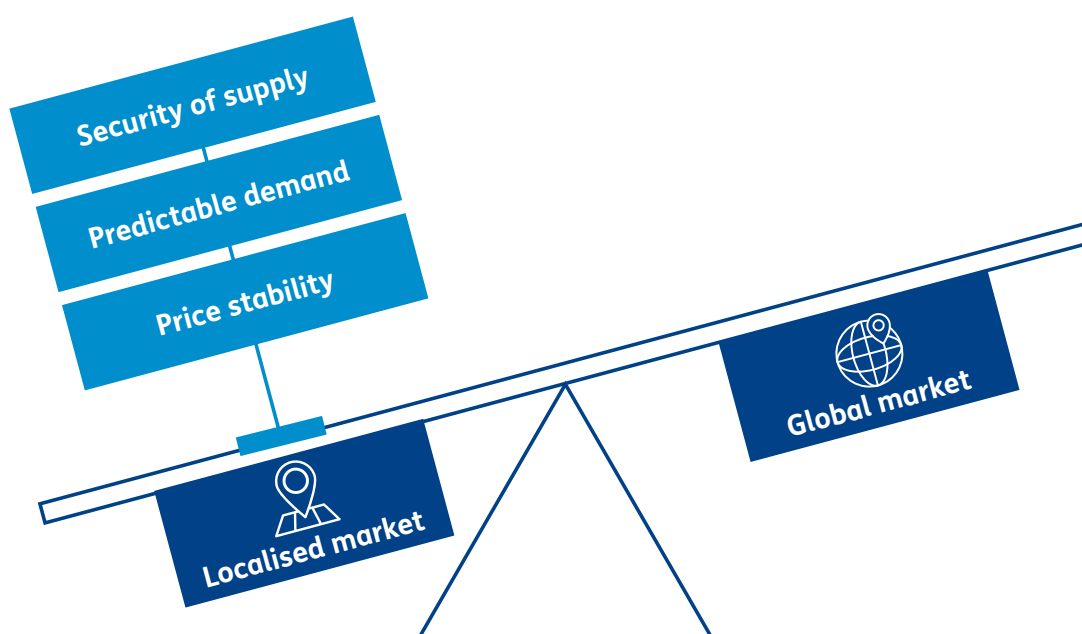
Localised markets display low geopolitical risk.

Security of supply, as well as stable demand and prices, are necessary conditions for most nascent energy markets to develop sustainably. An environment where those features are present encourages early adoption of the new commodity and the development of infrastructure needed to transport the resource in bulk over long distances.

As with early-stage oil and gas markets, this lends itself to localised markets to secure investment and adoption. These markets carry limited geopolitical

risk due to their localised nature, short supply chains and co-dependency. The hydrogen market is likely to develop starting from isolated, scattered clusters, with production and consumption in proximity to one another. Where political risk does exist, it is largely domestic as opposed to geopolitical, with national policy informing market evolution.

However, domestic political risk could be significant, with early demand likely needed to be incentivised by policy and government support.



As the market matures, the propensity for geopolitical risk increases.



Market dynamics

As the market evolves, supply chains become more elongated and less localised, providing higher volumes and cheaper equipment.

As demand for volume increases, localised markets will be unable to scale sufficiently, pushing supply chains to elongate, thereby increasing exposure to geopolitical risk.

The European gas market started with local North Sea gas projects and evolved to long range pipelines imports and global maritime LNG trade. The evolution of the hydrogen market is likely to follow an analogous path: isolated hydrogen clusters

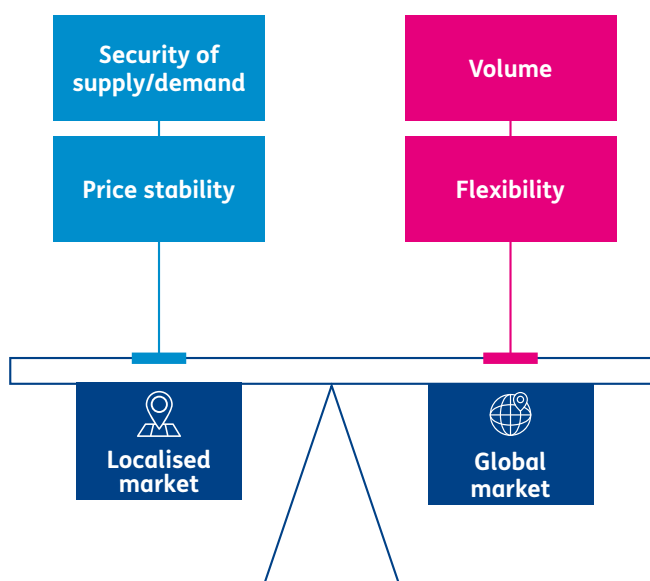


Geopolitical impact

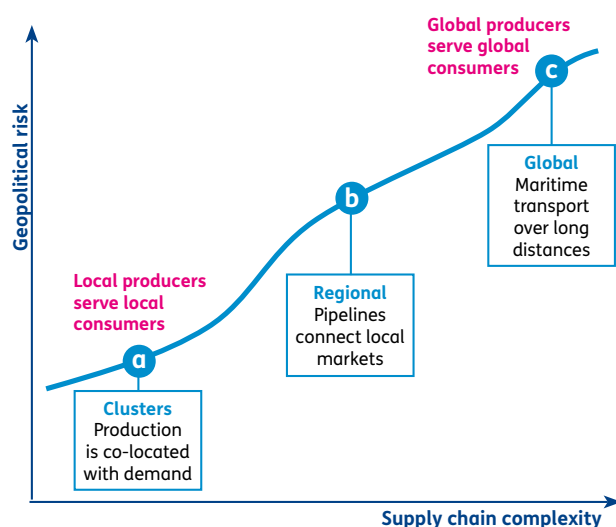
As supply chain elongate, the propensity for geopolitical risk increases.

will eventually be connected by regional pipeline projects, such as the European Hydrogen Backbone initiative. Moreover, long-range tankers carrying hydrogen derivatives, such as ammonia, will re-shape global trade flows.

Note: The actualisation of geopolitical risk may be balanced by increased supplier co-dependency on import markets, given the need to underpin investment and maintain export revenue.



Moving towards a global hydrogen market



Similarity
03a

Pipelines, ships, import dependency and inelastic demand have the potential to shape political relationships.



Market dynamics

Both natural gas and hydrogen can serve the market through fixed pipelines or maritime routes (e.g., LNG and ammonia).



Geopolitical impact

The degree of import dependence, means of supply and the demand elasticity of the resource can inform the level and nature of geopolitical risk.

a. The Cost/Flexibility Trade-off of Transport links

There is a tradeoff between cost of the resource and supply flexibility (i.e., the ability to change supplier). LNG and ammonia transported via ship are usually more expensive than the equivalent resource transported via pipeline but enable access to a larger number of market participants (although the nascent LNG market was inflexible and governed by long-term contracts to secure uptake). In a mature market, the high flexibility may reduce geopolitical risk (for

those who can afford it) but also exposes actors to global macroeconomic conditions such as booming demand in other geographies. On the other hand, hydrogen pipelines are expected to carry hydrogen at a significantly lower cost but are inflexible and regionalise supplier-consumer relationships. Whilst this is likely to significantly increase the supplier's geopolitical power, the ability to exercise their leverage may be limited by co-dependency.

	Volume	Flexibility	Cost	Geopolitical risk	
 Cluster	LOW	LOW	LOW	NONE	The nascent hydrogen market is likely to develop clusters with hydrogen production and demand in close proximity.
 Pipeline	HIGH	LOW	LOW	HIGH	As access to greater volumes is needed, pipelines are likely to develop. They concentrate supplier-consumer relationships and provide low cost access to the resource. The lack of alternative supply sources could be exploited for political and economic leverage, however, in most instances, co-dependency ensures stability.
 Maritime	HIGH	HIGH	HIGH	LOW	An established global market will see consumers trading in a many-buyers/many-sellers environment, but usually with higher transport costs compared to pipeline. Exposure to broader macroeconomic risk may arise.

Similarity
03b

Pipelines, ships and inelastic demand have the potential to shape political relationships.



Market dynamics

Both gas and hydrogen can serve the market through fixed pipelines or maritime routes (e.g., LNG and ammonia).



Geopolitical impact

The degree of import dependence, means of supply and the demand elasticity of the resource can inform the level and nature of geopolitical risk.

b. Inelastic demand for hydrogen, selected use cases

As with commodity markets, the extent of geopolitical risk is underpinned not by supply flexibility alone, but also by demand elasticity. Energy commodities are often difficult to replace, due to high CAPEX, switching costs and limited alternatives, meaning their demand elasticity is low.

Once the hydrogen market has been established and processes have switched to the resource, we are likely to see an inelastic demand broadly similar to other fuel sources. Similarly, certain use cases have particularly limited viable green alternatives and display inelastic demand.



Steel production

Steel is hard to decarbonise due to the high temperatures required in the production process. Hydrogen is one of few available alternatives.



Long duration energy storage

Hydrogen brings a strong case for long duration energy storage with its potential to serve as a powerful inter-seasonal storage. For example, to leverage high solar PV production in the summer.



HGVs

Hydrogen offers a powerful decarbonisation option for heavy goods vehicles. This is thanks to higher range and lower weight compared to traditional lithium batteries.



Low carbon feedstock

Low carbon hydrogen can replace existing grey hydrogen as a feedstock in industrial processes.

Difference
01a

A new geopolitical map: new exporters and increased market fragmentation



Market dynamics

Global supply of hydrogen will see new producers and increased fragmentation.



Geopolitical impact

A new and larger set of hydrogen producers could reshape geopolitical flows and reduce risk of oligopolist or cartel-like behavior, relative to hydrocarbons.

a. New exporters enter the race

Demand hubs are likely to remain virtually unchanged, while, in the long-term, the main suppliers of green hydrogen are forecasted to change and favour countries with cheap and abundant renewables, redrawing the global geopolitical map of energy.

However, large hydrogen off-takers will hold significant power to shape the global market: the off-taker's requirements and reception facilities will drive the form in which hydrogen is exported and transported, especially in the early years before a large-scale market develops.

High potential hydrogen players do not necessarily match the old world energy exporters

Country	Leading fossil fuel exporter	Hydrogen export potential	
US	Oil & Gas	Significant	Existing energy exporter
Saudi Arabia	Oil	Significant	Existing energy exporter
Qatar	Gas	Significant	Existing energy exporter
Australia	Oil & Gas	Significant	Existing energy exporter
Russia	Oil & Gas	Lower	Downsized role
Morocco	NO	Significant	New entrant
Chile	NO	Significant	New entrant
South Africa	NO	Significant	New entrant

Note: the table accounts for relative differences between countries and does not necessarily imply that the same volume is likely to be exported or produced.

Difference

01b

A new geopolitical map: new exporters and increased market fragmentation



Market dynamics

Global supply of hydrogen will see new producers and increased fragmentation.



Geopolitical impact

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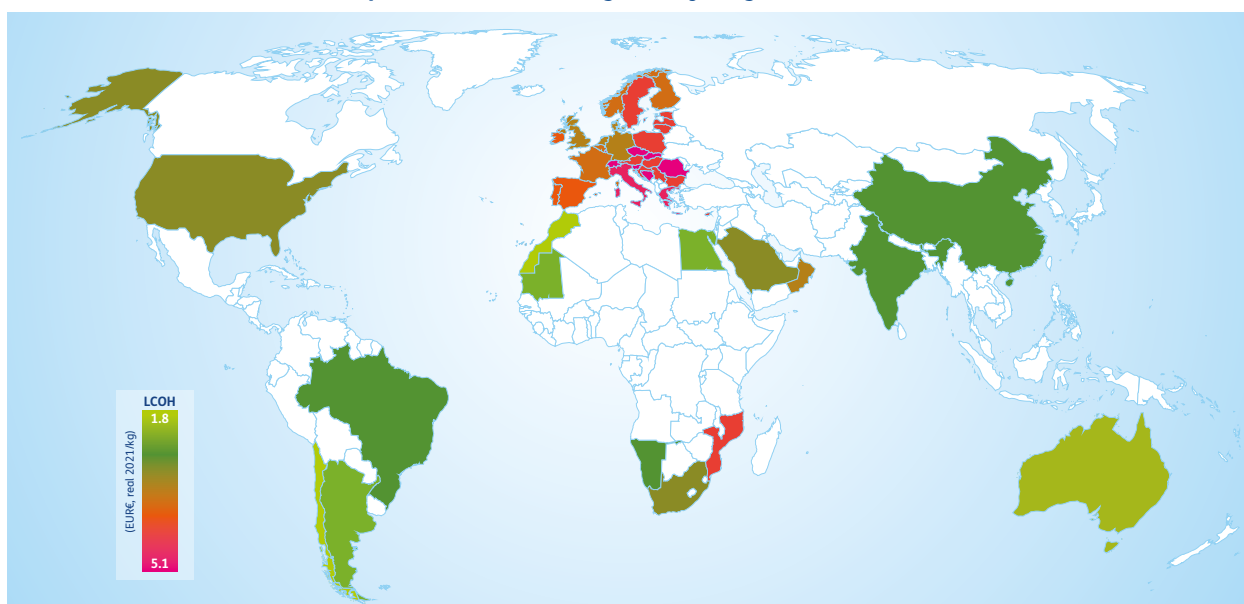
b. Market fragmentation – supply side

In traditional energy commodities markets, major production and export is concentrated in few countries. This is particularly evident in the oil market, where many countries are net importers supplied by a small number of net exporters. This concentrates political leverage in the hands of a few countries, often in an oligopolist structure (e.g., OPEC) and concentrates the sources of geopolitical risk.

On the other hand, hydrogen is a conversion process (not an extraction one) with the potential to be competitive in a larger set of countries. Many

countries with cheap and abundant renewable energy sources are well placed to produce hydrogen (e.g., Morocco, Chile, Brazil, US, China are among those displaying particularly low LCOH, according to Baringa modelling). Hence, indigenous production is likely to increase and a market with few major export centres similar to oil is less likely to materialize. This dilutes the intensity of global geopolitical dynamics. Whilst this is likely to decrease supply availability risks, geopolitical leverage is still present as some exporters may still be able to influence or set prices due to lower cost curves than their competitors.

Levelised production costs of green hydrogen worldwide in 2030



Source: Baringa analysis

Difference

02

Hydrogen will serve less of the global final energy consumption compared to fossil fuels, reducing the direct geopolitical leverage.



Market dynamics

Hydrogen is forecasted to serve a lower share of world total final energy consumption.

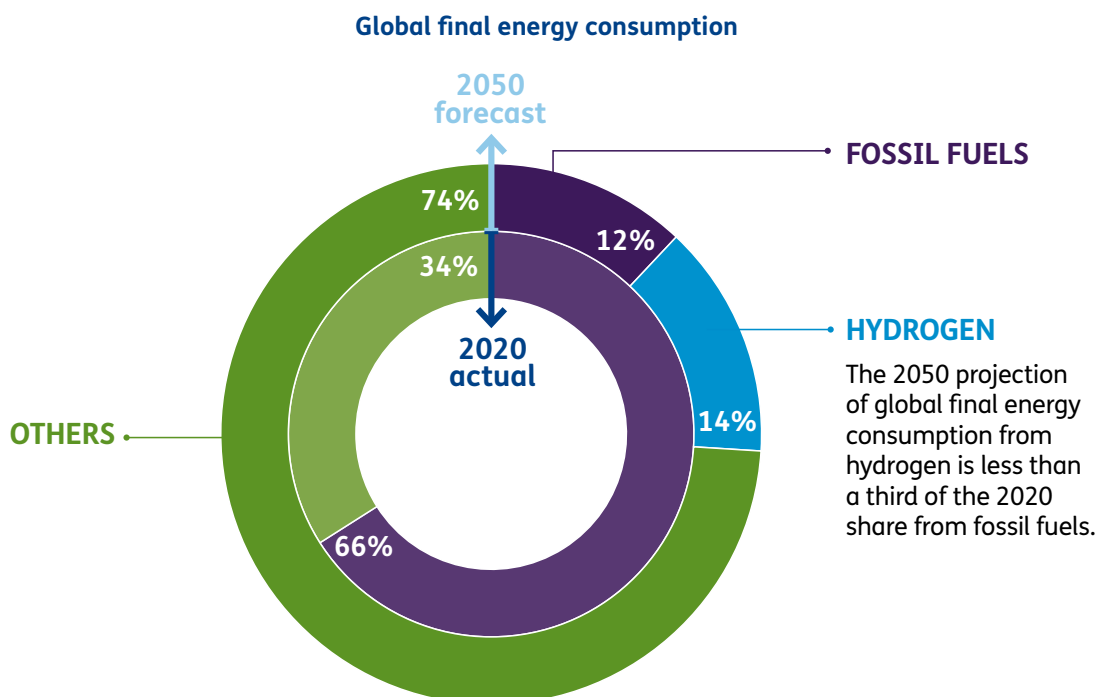


Geopolitical impact

Hydrogen exporters may have lower economy-wide leverage compared to gas. However, critical systems may still be affected.

The share of world total final energy consumption served by hydrogen is set to be significantly smaller compared to today's fossil fuels. Hydrogen is likely to have more specific use cases in the economy compared to natural oil and gas. Whilst this may concentrate geopolitical risk to certain parts of the economy, spillover effects will still propagate in the economy, possibly with a lag (e.g., shocks to hydrogen

used in fertilizer production may affect agriculture output, raising food prices and inflation). However, as hydrogen remains one of the leading options for inter-seasonal long duration energy storage and power system flexibility, its role in power systems is still set to be significant and with limited alternatives, increasing geopolitical leverage.



Notes: 'Others' includes electricity (direct), biogas (both modern and traditional uses) & other energy sources. | Source: IRENA

Difference

03

Value chain competition



Market dynamics

Hydrogen requires more technical know-how and critical materials as inputs.



Geopolitical impact

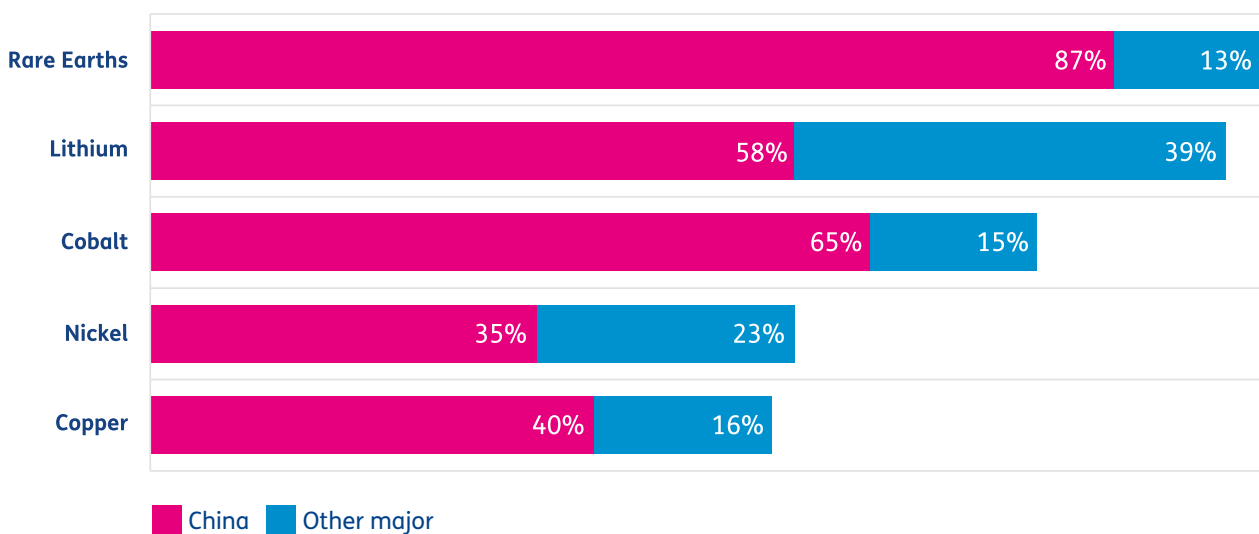
Geopolitical leverage can be exercised upstream (e.g., at critical materials, production equipment).

As demand for hydrogen increases, the manufacturing capacity for hydrogen production technologies, such as electrolyzers, will need to rapidly increase from current levels. For example, China is rapidly scaling up its electrolyzers domestic manufacturing base, aiming to produce the technology at less than half the cost of overseas manufacturers at large volumes.

Inputs into hydrogen technologies resources are unevenly distributed and competing with other

transition and non-transition technologies. This may lead to supply chokeholds or monopolistic positions in the future. For example, in 2019 China was processing nearly 90% of rare earth minerals and 65% of cobalt, globally. Should geopolitical leverage be exercised, consequences can inflict significant economic damage: in 2010, China implemented an export restriction of critical materials to Japan, with severe consequences for the Japanese electronics sector.

Where clean energy metals are processed

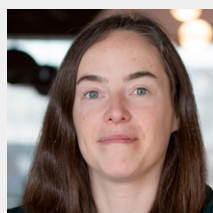


Note: major players only. Does not necessarily sum to 100. | Source: IEA (2019 data)

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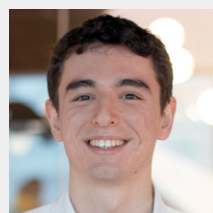


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