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The Hydrogen Complex

Hydrogen's applications & competitiveness

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This is the final part of our series looking at hydrogen as an energy vector in a net-zero future. The viability of a low-carbon hydrogen ecosystem is highly context specific with geography, end use-case demand and coordination being key factors.

Whether or not hydrogen (green or blue) is economically competitive against either fossil fuels (with carbon pricing) or against alternative decarbonisation routes such as electrification, is clearly important to know.

But it is not sufficient to determine its likely success or failure. Hydrogen's unique characteristics as an energy carrier makes its viability highly context-specific and dependent upon a confluence of factors.

While global trade may neutralise the geographic asymmetries in low carbon hydrogen production, the viability of the hydrogen value-chain remains very much dependent on circumstantial factors, including location, infrastructure, use-case and industry coordination.

Local context

Large scale green hydrogen production locations (with abundant renewable resources) will rarely coincide with major hydrogen demand centres such as industrial clusters. Therefore access to low cost infrastructure, in order to transport hydrogen from “source to sink”, will be critical. Blue hydrogen production is a significant opportunity for hydrocarbon-rich countries such as the US, Canada, the UAE, Russia and North West Europe (with its strong oil and gas heritage). Many industrial clusters are already well integrated with the upstream sectors in these regions and are better-positioned as recipients of blue hydrogen in the future.

Industry context

When projecting the uptake of low carbon hydrogen, it is a mistake to assume a simple substitution of grey hydrogen for green or blue. No two manufacturing plants are the same, be they petrochemical complexes, refineries or fertiliser producers, with varying site-configurations and access to raw materials depending on supply - and demand. Often the grey hydrogen production units are integrated into the plants and the heat from the process is used elsewhere. These plants have long investment cycles and swapping grey hydrogen inputs for green will likely require significant capital to reconfigure or upgrade the facilities.

These are realities that need to be factored in to the timelines and as a result, we expect to see staged commitments to green hydrogen transitions by incumbent users. They will do so in relatively small increments that can be absorbed with minimum investment in the short term and larger volumes in line with capital spending plans longer term.

We expect to see staged commitments to green hydrogen transitions, by incumbent consumers, in relatively small increments.

Coordination

A workable hydrogen value chain is entirely conceivable for numerous use-cases, but it won’t come ready-made, and it is unlikely to evolve organically. This is because the developers of renewable energy, as well as producers of hydrogen, will require certainty and long-term contracts (typically 15–20 years), while end-users who may be tied in to long-term grey hydrogen contracts or accustomed to shorter term suppy arrangements (five years or less), will be reluctant to invest or commit to projects especially if lower cost hydrogen is potentially around the corner.

Scientists and journalists tend to delight in technological challenges but it could well be the more mundane co-ordination problems faced by those on-the-ground, trying to make long-term business decisions in good faith, that prove to be the real sticking points for the adoption of hydrogen. For all the carrier’s merits, we could end up with no real advancement in the use-case application of hydrogen if this challenge isn’t addressed in a smart and focused way.

For one thing, ecosystems will require ‘anchor customers’ – organisations willing to take on the risk and provide their suppliers with long-term guarantees that will enable an ecosystem to get moving. But the market can only do so much. For clean hydrogen to be viable, government support will be indispensable.

Bread as an early green hydrogen adopter: ammonium nitrate fertilizer for growing wheat contributes to 40% of a loaf of bread’s carbon footprint, but only 1% of its price.

Competitiveness

Government support is essential for the adoption of green hydrogen, although some major industries could become early adopters simply by virtue of their cost-base.

While there is much conjecture around the 'learning rates' for green and blue hydrogen, we expect only modest reductions in green hydrogen costs over the next decade, driven mainly by a fall in the manufacturing cost of those electrolysers that can optimise multiple low-cost renewable energy sources.

Today green hydrogen struggles to compete with grey without a carbon price significantly higher than the €60 per tonne highs we have witnessed recently. There are some promising regions such as Australia and Saudi Arabia where green hydrogen could be produced for less than $2/kg. In these locations, use cases such as green (H_2) steel would be competitive with today's steel prices but in the EU carbon prices would need to be closer to €100/te for the same green steel to be priced competitively against the incumbent.

As a result, for green hydrogen's widespread adoption, government fiscal intervention, including carbon border adjustments, is unavoidable.

Use cases

From an industry perspective, the use-cases that are most likely adopters of green hydrogen are those that are the toughest to decarbonise. We believe there are numerous customer segments that should find clean-hydrogen value-chains attractive in the near-term, given the trajectory of ESG investment and decarbonisation agendas in the corporate world.

Which Hydrogen value chains will be most attractive in the short?

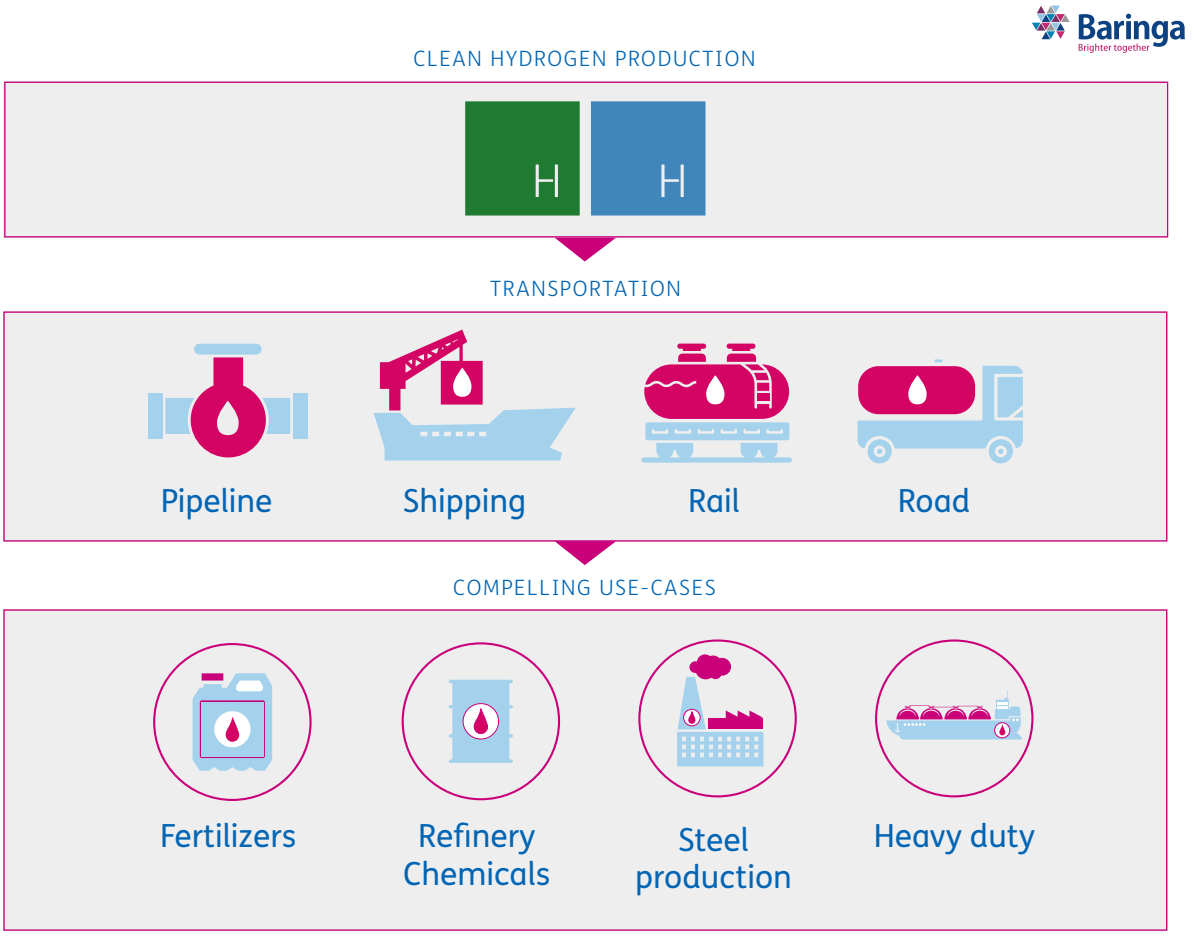
Governments aside, we hypothesise that the earliest corporate adopters will be those users for whom the additional cost of using green hydrogen represents the smallest proportion of their overall cost base. These players will be able to advertise legitimate 'green' credentials, without having to absorb significant additional costs, and yet, such action taken in aggregate could have a large environmental impact.

For instance ammonium nitrate fertilizer used in wheat production accounts for 40% of a loaf of bread's total carbon footprint, but just 1% of its price.

In other words, the cost of going green is often vanishingly small to the end-consumer – despite green ammonia currently costing two to three times as much as grey. A similar dynamic is plausible across a range of diverse businesses, from data centre power supplies to green steel in passenger vehicles.

Hydrogen has the potential to be a major energy vector in our journey towards net-zero. To get there, we face technological, logistical and policy challenges, which create a complex, multi-faceted development challenge. Somehow, all the players in those ecosystems must be encouraged to move forward in lock-step.

Whilst green hydrogen is the holy grail it would be a mistake to allow 'the perfect to be the enemy of the good', and so a rapid scaling of blue hydrogen would also be a pragmatic and welcome addition to the developing hydrogen ecosystem.



We expect long-term oriented players to become anchor buyers of green hydrogen, and industry to make incremental moves away from more polluting forms of hydrogen production in response.

While plenty of technological challenges remain (notably around the cost of production & transportation, the ramping up of renewable energy sources, emissions and safety), hydrogen also faces the uphill struggle of having to create its own use-case specific ecosystems and infrastructure – something that cannot be driven from the top alone.

The prevailing wind is with electrification, but hydrogen has a huge potential and contribution to make to a net-zero world. The challenge is real, and so is the prize.

Baringa Partners

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