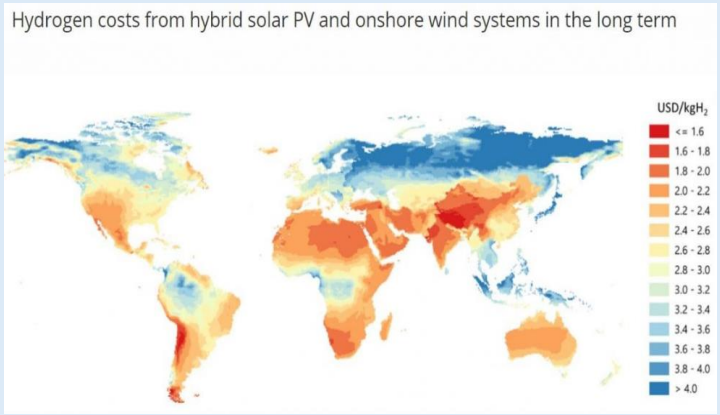
The Hydrogen Dilemma: Local Power or Global Supply?

Anesh Tahir | Dr. Eni Oko | School of Engineering

BACKGROUND

The United Kingdom aims to reach net zero emissions by 2050. Hydrogen plays a pivotal role in decarbonising heavy industry, transport, and energy systems. Hydrogen demand could reach up to 460 TWh by 2050 - nearly half of the UK's current energy use.

This study compares two key options for supplying hydrogen to the Humber industrial cluster: importing hydrogen (as ammonia, cracked at the Immingham Green Energy Terminal) and producing it locally through blue hydrogen (ATR + CCS).



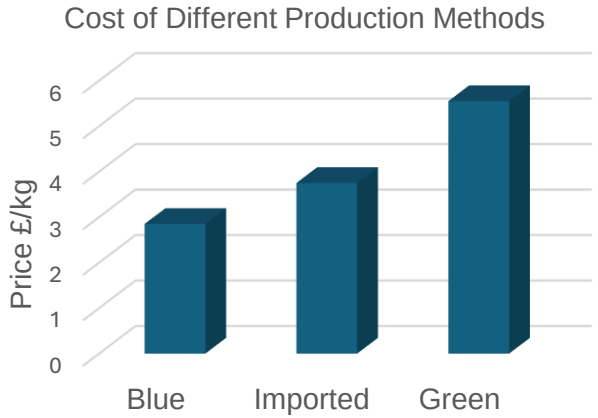
METHODOLOGY

Delivered hydrogen cost (£/kg) was estimated for both routes, accounting for feedstock, transport, conversion losses, and capital and operational costs.

Three supply pathways were analysed:

- **Imported hydrogen via ammonia** - renewable ammonia produced abroad and cracked to hydrogen at Immingham.
- **Blue hydrogen** - local production from natural gas using autothermal reforming (ATR) with carbon capture and storage (CCS).
- **Green hydrogen** - electrolysis powered by renewable electricity.

Industry data and published techno-economic studies informed cost projections. Costs were normalised to £/kg of delivered hydrogen for comparison, using mid-2025 UK energy prices and sensitivity tests for gas, electricity, and CO_2 costs.



COMPARISONS

Under current energy prices, blue hydrogen is the most cost-effective route, followed by imported ammonia-derived hydrogen. Green hydrogen remains more expensive but has strong future potential as renewable power prices fall.

Summary of hydrogen delivery costs:

- Blue H_2: £2.5-3.2 /kg
- Imported H_2: £3.5-4 /kg
- Green H_2: £4.9–6.2 /kg

CONCLUSIONS

Though Blue H_2 remains the most cost-effective route right now, it was projected that by 2050, Green H_2 could undercut it:

- Blue H_2 experiences a gradual cost improvement from efficiency but rises slightly post-2050 as carbon pricing tightens.
- Imported H_2 declines modestly as shipping and cracking improve, but fuel and handling keep it > £2.8/kg.
- Green H_2 experiences a major drop driven by cheaper renewables.

These cost projections are highly sensitive to several key market factors:

- natural gas price
- electricity price
- CO_2 cost assumptions

UK hydrogen strategy should combine blue H_2 in the near term, scale up green H_2 capacity, and retain import options for long-term.

FUTURE RESEARCH

- Integrate dynamic electricity pricing and CO_2 market factors into models.
- Quantify life-cycle emissions of imported vs local hydrogen.
- Assess hydrogen pipeline, storage, and port infrastructure resilience.
- Model regional deployment strategies across the UK (Humber, Teesside, Scotland).