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Global Hydrogen Trade to Meet the 1.5°C Climate Goal

Presenter: Herib Blanco, Analyst – Hydrogen Energy (Power to X)

TUESDAY, 20 September 2022 • 10:00-10:30 CEST

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SPEAKERS

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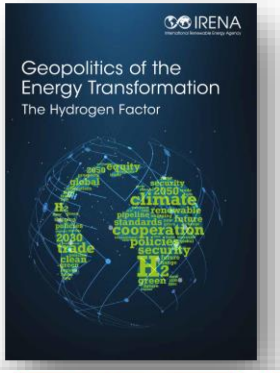
Trade within the broader hydrogen landscape

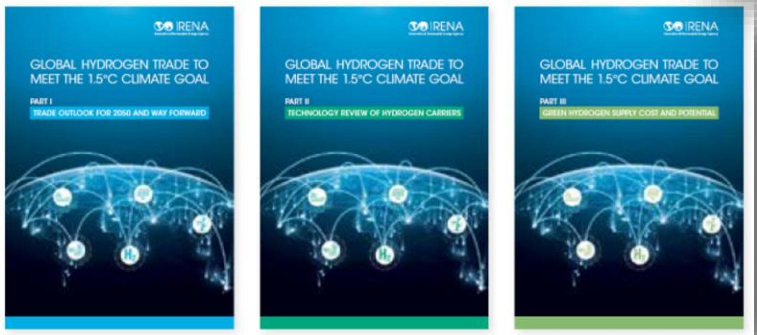
Supply

Electrolysis

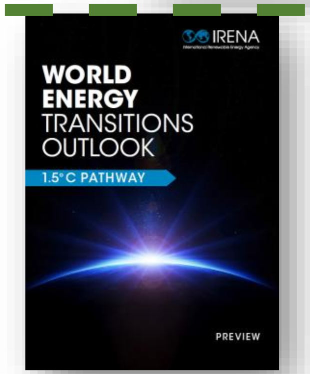
Sector coupling

Trade





Demand



Cross cutting

Policies

Outline

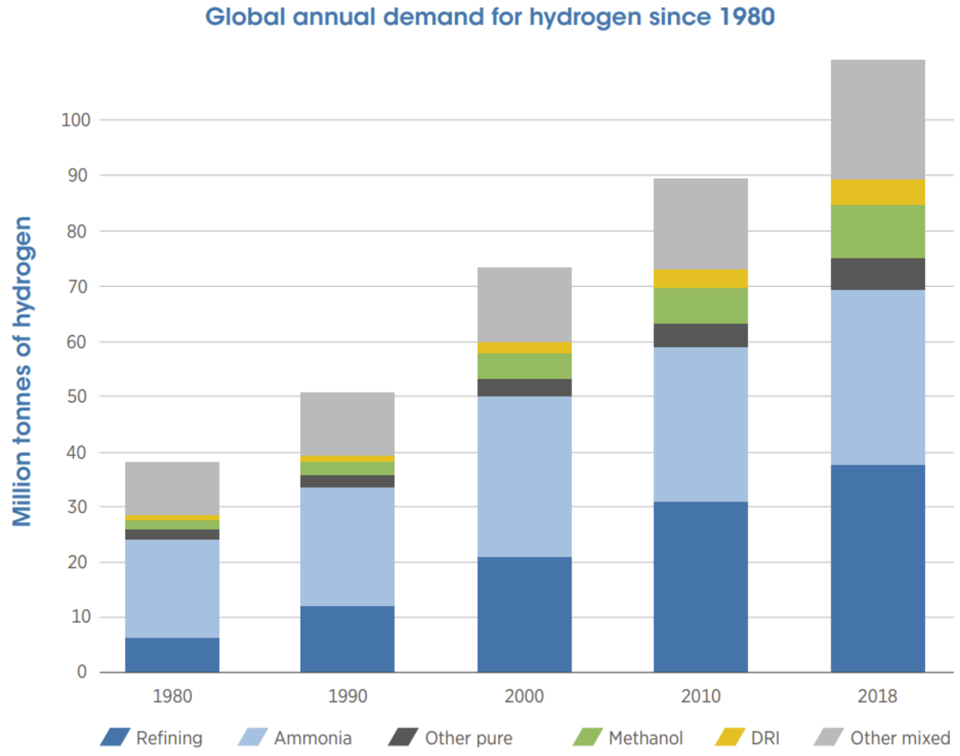
1. Technology options for long-distance transport

2. 2050 outlook

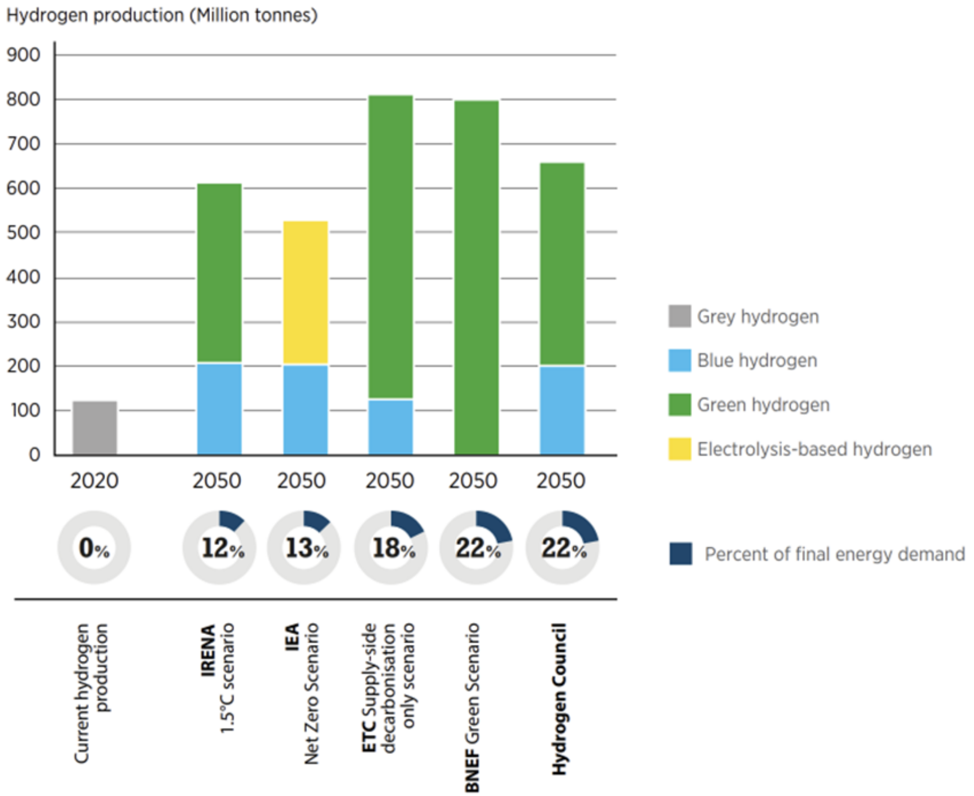
3. Short-term actions

Hydrogen demand could grow by a factor 5-6 by 2050

Past and today

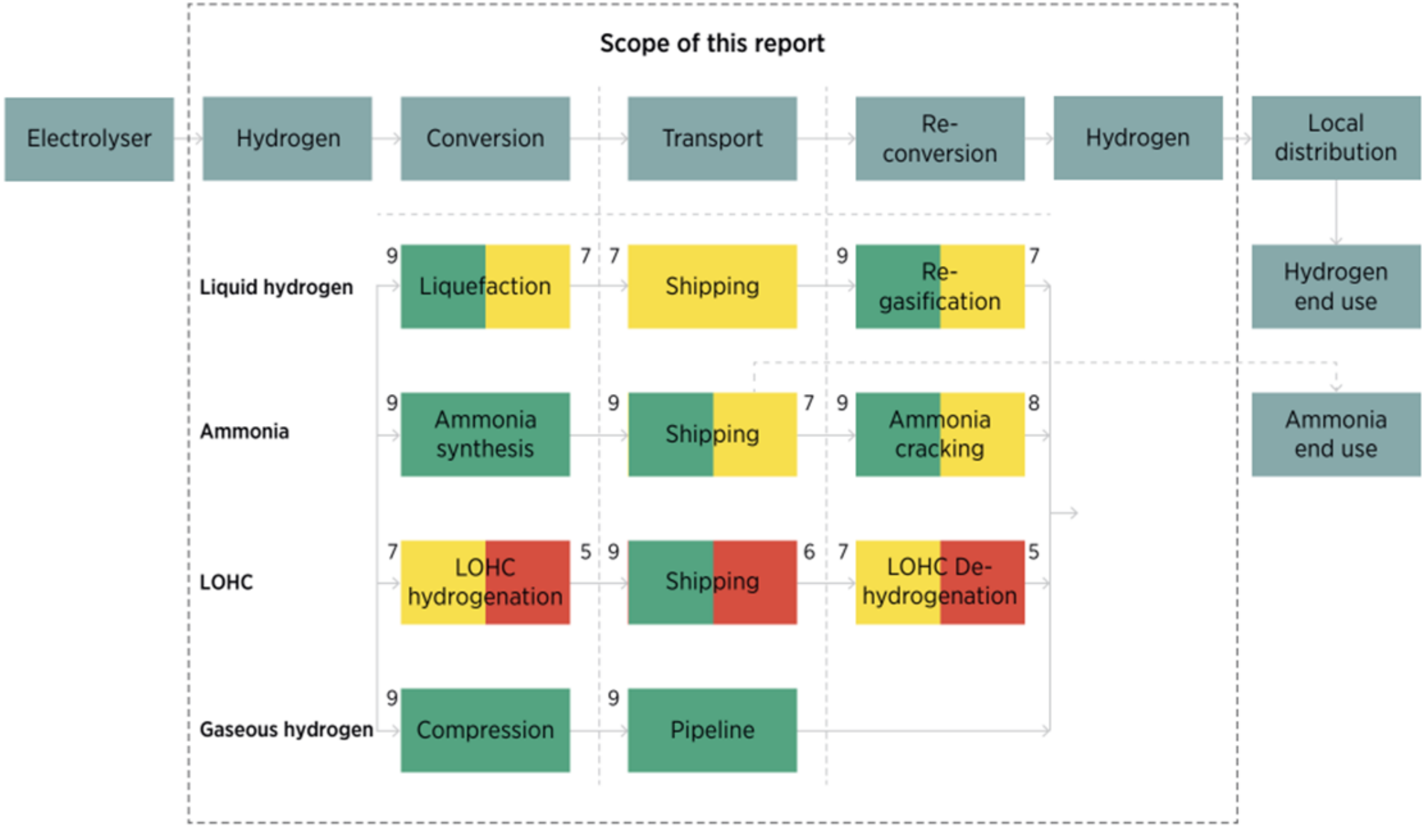


Future



Future hydrogen demand needs to unlock new applications in industry and long-haul transport

Steps in the hydrogen value chain



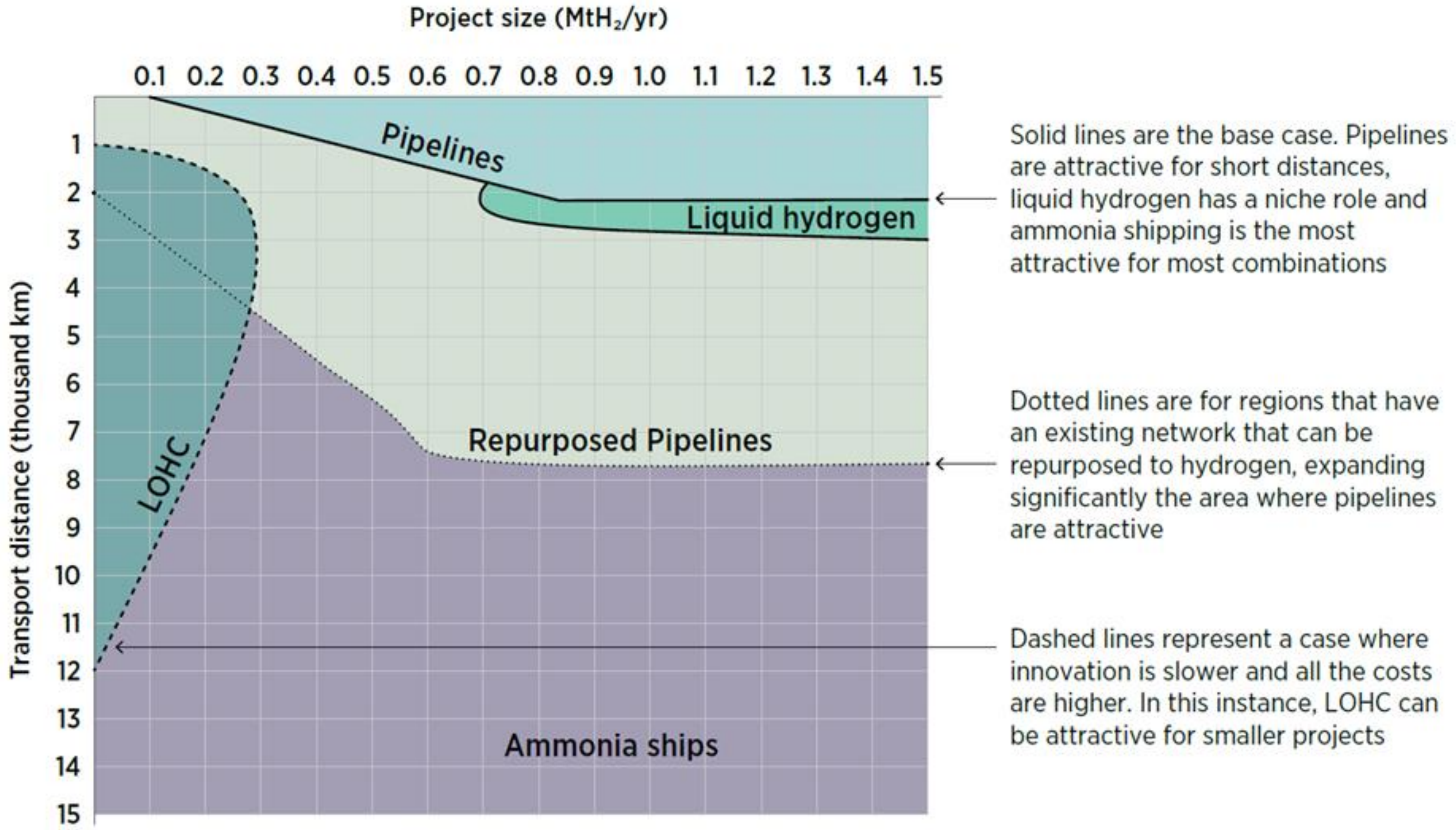
Additional processing steps are needed to transport hydrogen which increase the efficiency losses and costs

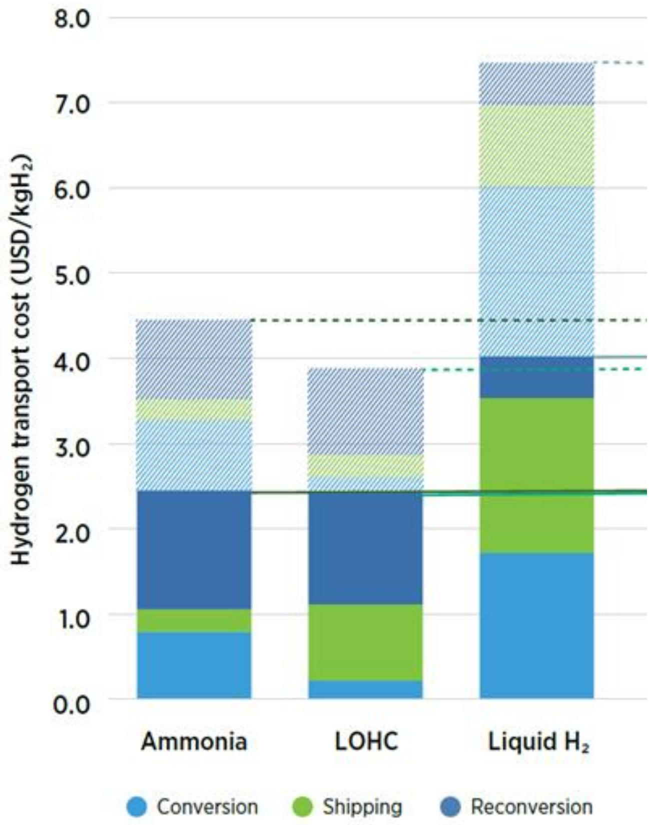
Qualitative comparison of pathways

	Advantages	Disadvantages
Ammonia	• Commercial (production/shipping) • Existing infrastructure • High energy density + direct use	• 13-34% losses for reconversion • Low flexibility of synthesis • Toxic and corrosive
Liquid Organic Hydrogen Carriers (LOHC)	• Low capital costs • Could use existing infrastructure	• 25-35% losses for dehydrogenation • 4-7% wt of hydrogen content • Need for compression and purification
Liquid hydrogen	• Largest energy consumption at exporting country • Commercial technology	• Boil-off losses / high CAPEX • Need for scaling up technology • 30-36% losses in liquefaction

Ammonia seems to be the most attractive carrier to start trade by coupling with a certification scheme and using it directly (i.e. without reconversion to hydrogen)

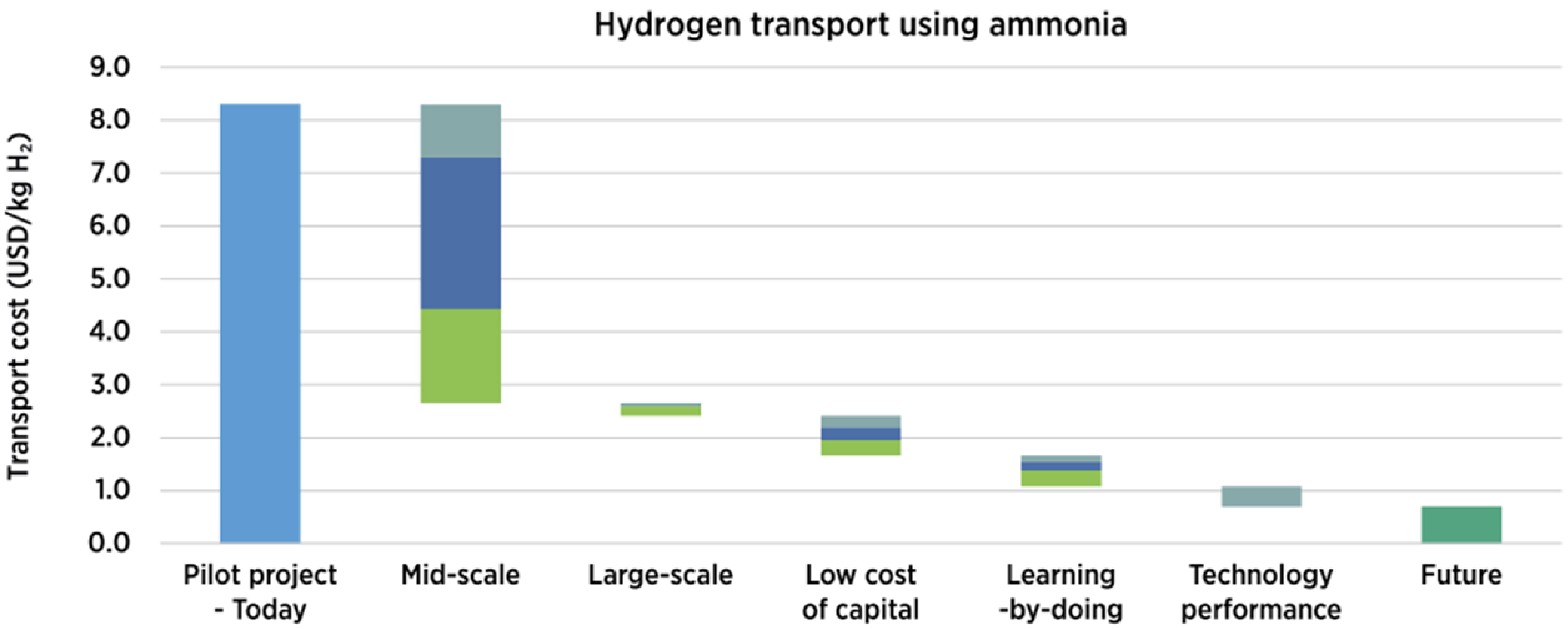
Quantitative comparison of transport pathways





Ammonia ships and hydrogen pipelines (especially in places with an existing network) are the most attractive options. Ammonia can be used directly as chemical feedstock and bunker fuel for shipping

Levers for reduction of transport cost



Economies of scale is the largest lever for cost reduction but innovation, learning from deployment and global supply chains are needed to achieve the lowest costs

Global hydrogen and ammonia trade

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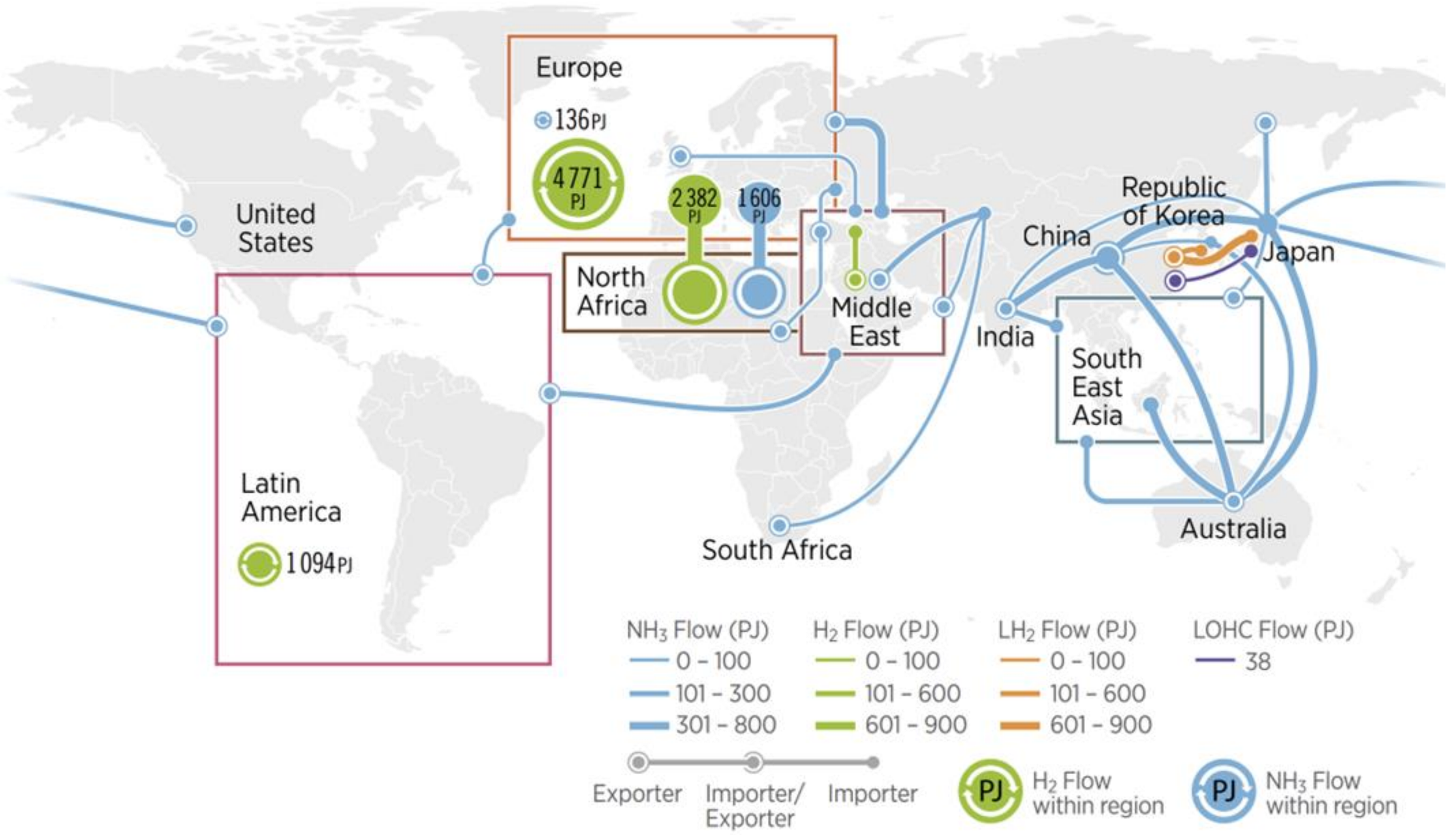

Note: Trade flows for 2050 using optimistic assumptions

About a quarter of the global hydrogen and ammonia supply is traded, roughly with a 50/50 split between ammonia ships and pipelines, 70% of ammonia used directly

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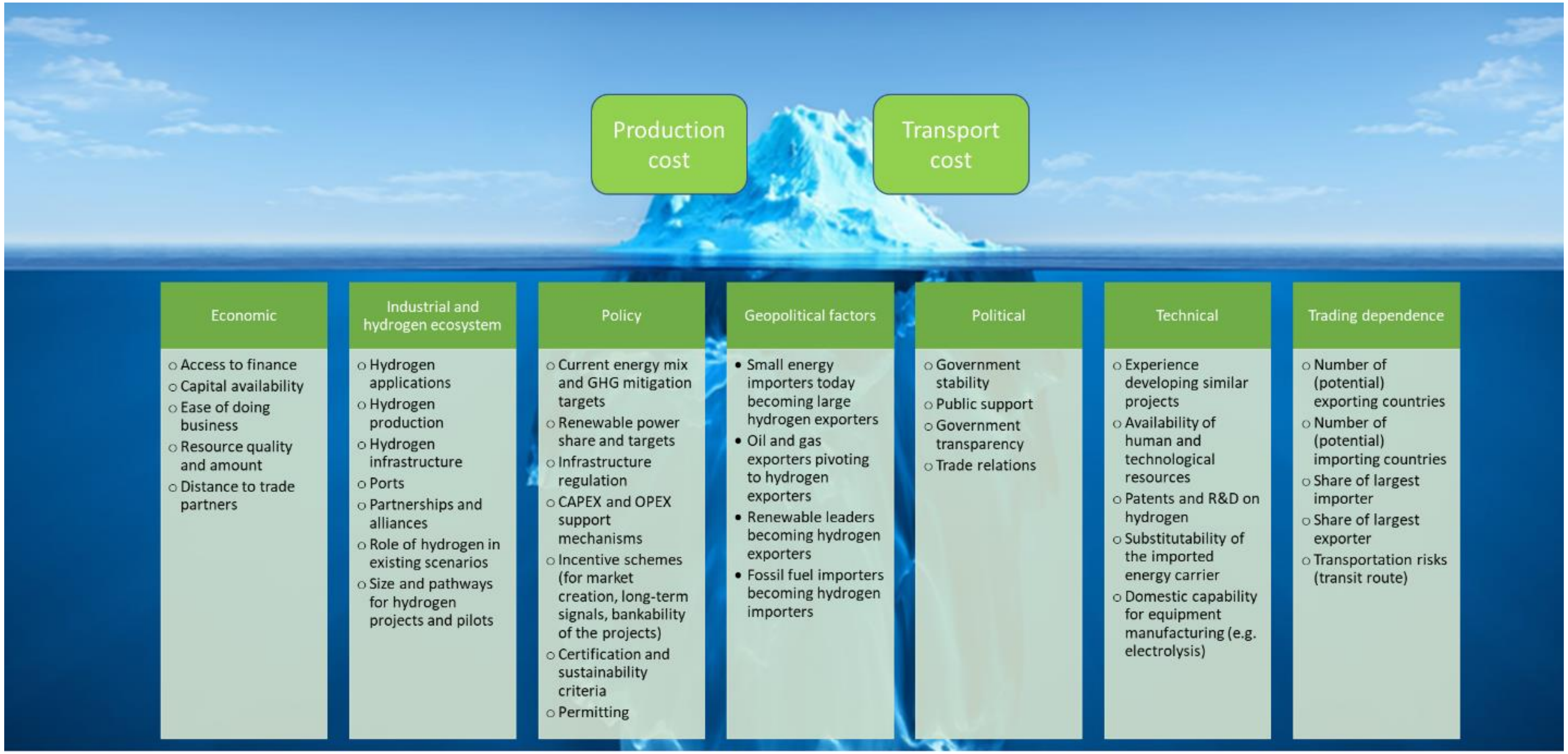
Geopolitical factors to consider for trade



Trade will most likely be defined by factors beyond the cost differential so a cost optimization approach might not provide an accurate outlook

Certification is essential for sustainability, market creation, economic incentives and global trade

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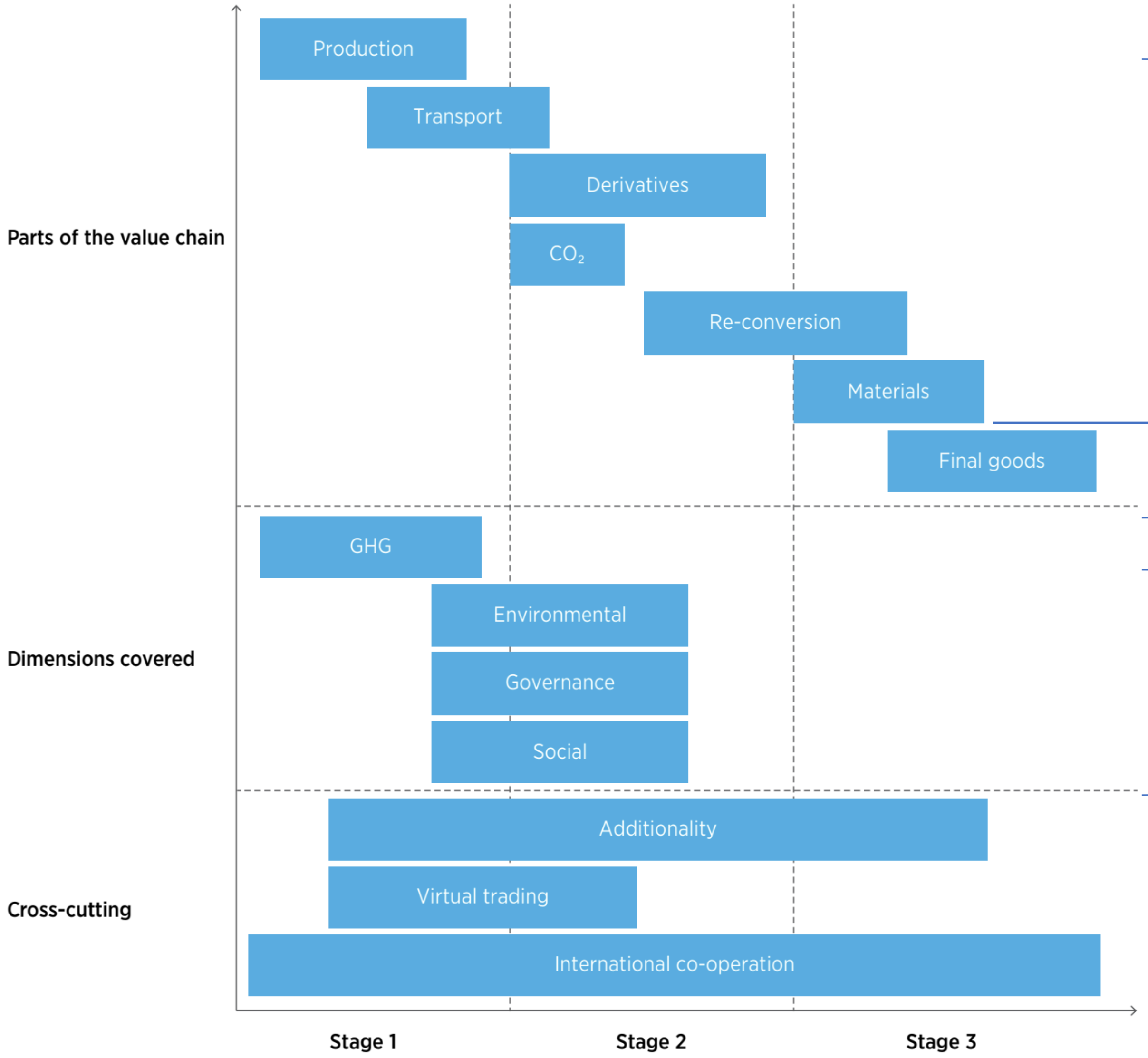

Certification should go beyond production

There are already separate efforts to certify some of the hydrogen derivatives

Certification should go beyond CO_2 emissions

Clear distinction between methodologies (objective) and labels (subjective)

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Key takeaways

1. **Ammonia and pipelines** might provide a good **starting point** for trade of hydrogen (derivatives) and are also attractive in the long term
2. The **most influential parameters** in hydrogen trade are also the most uncertain which are **CAPEX and WACC** differential between countries
3. The trade of **hydrogen derivatives might be more relevant** than pure hydrogen trade
4. **Factors beyond cost could have a larger effect on trade** pairs since most countries have multiple options within a narrow cost range

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Q & A

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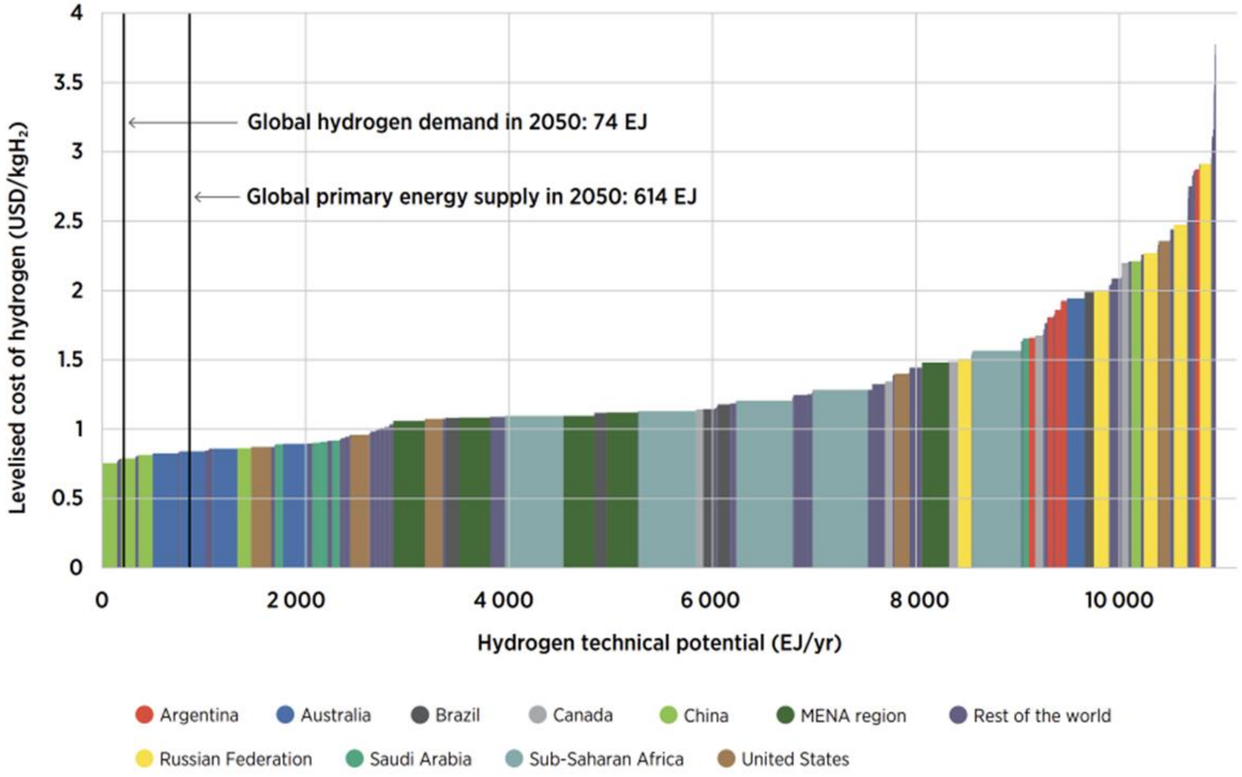
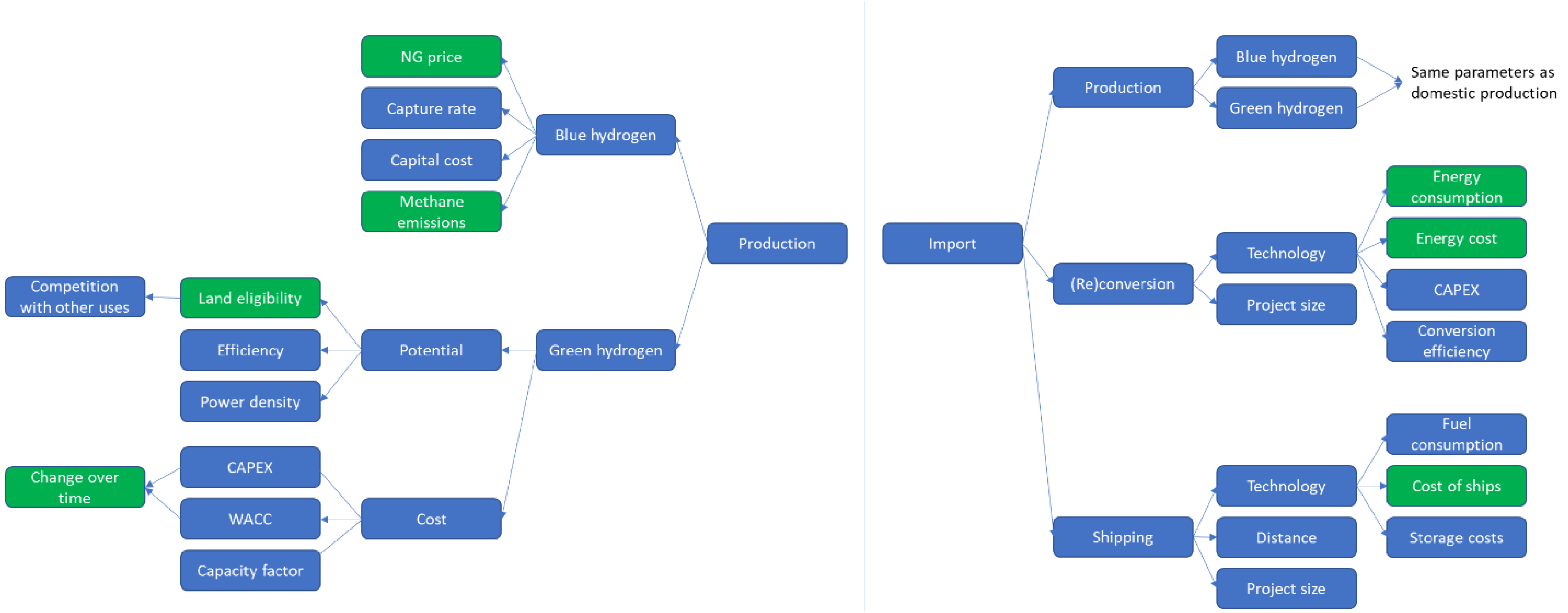
Technical potential for renewable hydrogen



Note: CAPEX, PV: USD 225-455/kW; onshore wind: USD 700-1070/kW; offshore wind: USD 1275-1745/kW. WACC per 2020 values without technology risks across regions. Potential based on land availability considering protected areas, forests, permanent wetlands, croplands, urban areas, slope of 5% [PV] and 20% [wind], population density and water stress)

The green hydrogen technical potential considering land availability constraints is still almost 20 times the global primary energy demand in 2050

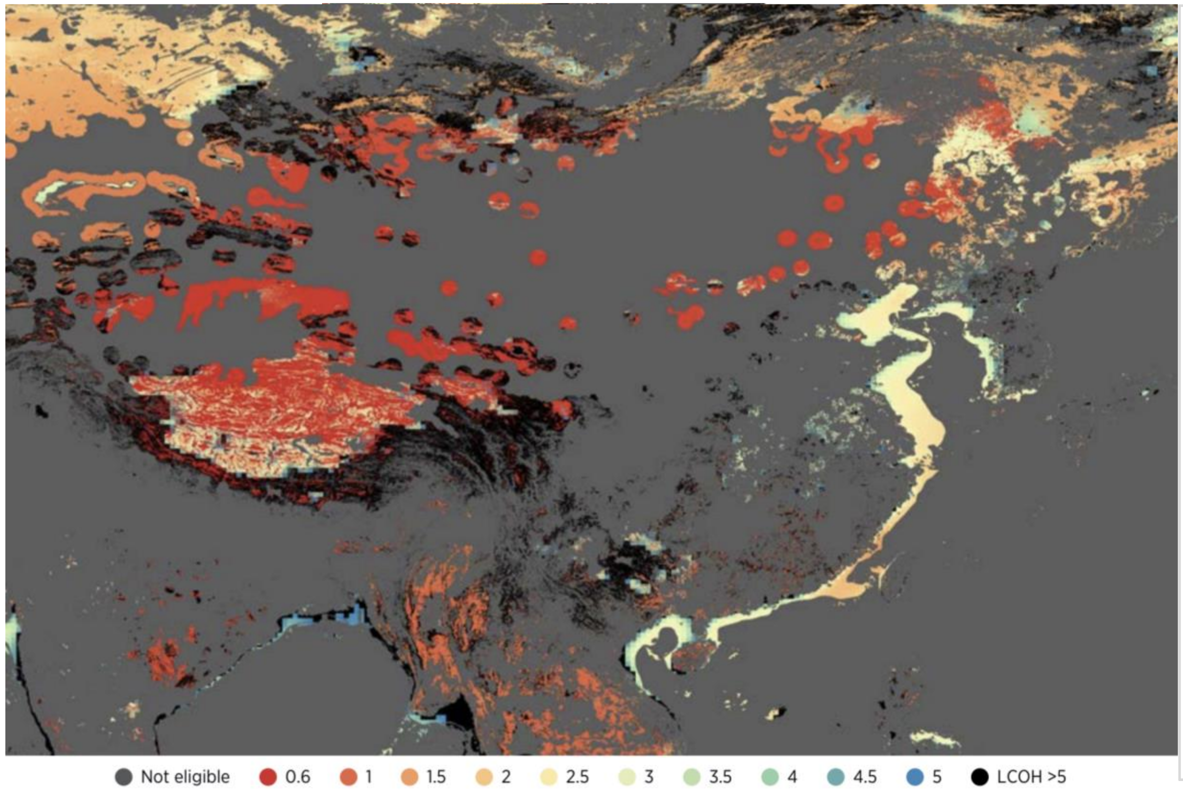
Drivers and trade-offs of hydrogen trade

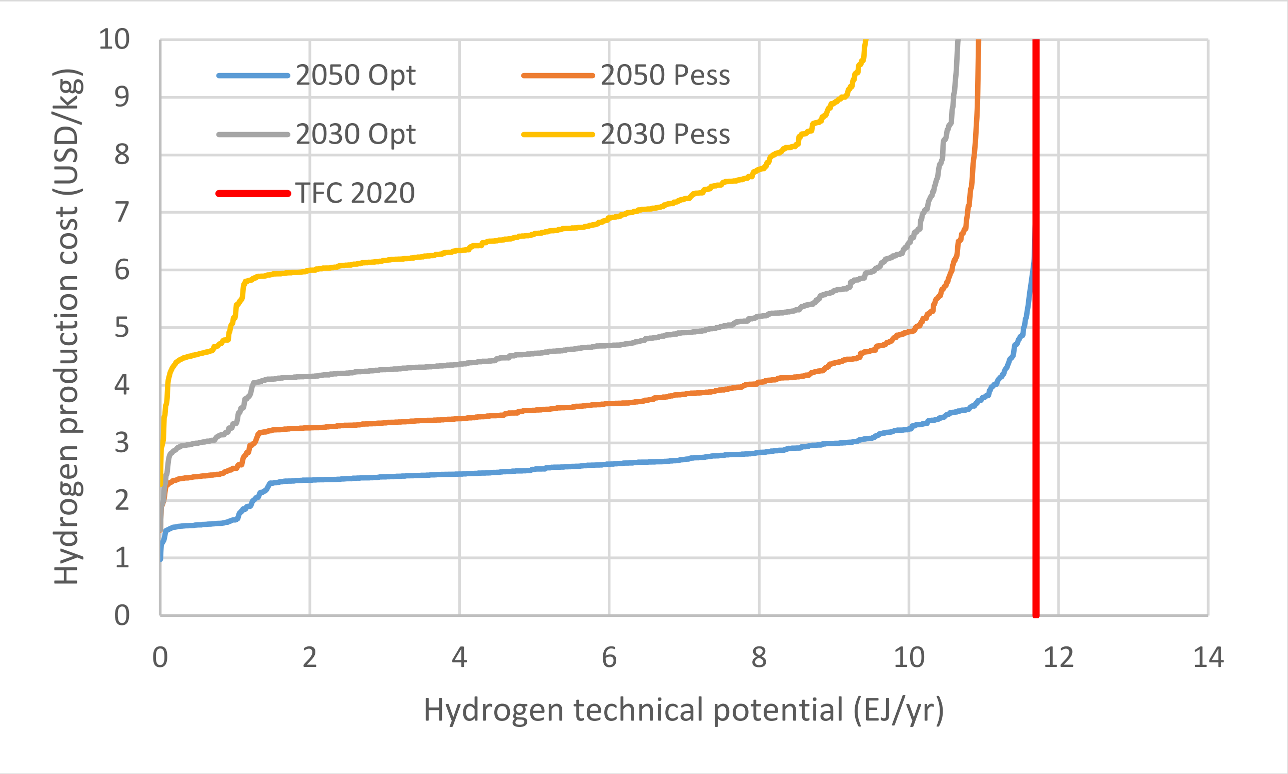


Note: Boxes in green are the ones with the largest influence over the results

The most influential assumptions are the CAPEX and WACC for the renewable input and the key choice for imports is the technology pathway

Supply cost curves for renewable hydrogen





Most countries can reach a production cost level of USD 1-1.5/kgH_2 by 2050 but there are a handful of countries that do not have enough potential

Landed cost in Japan

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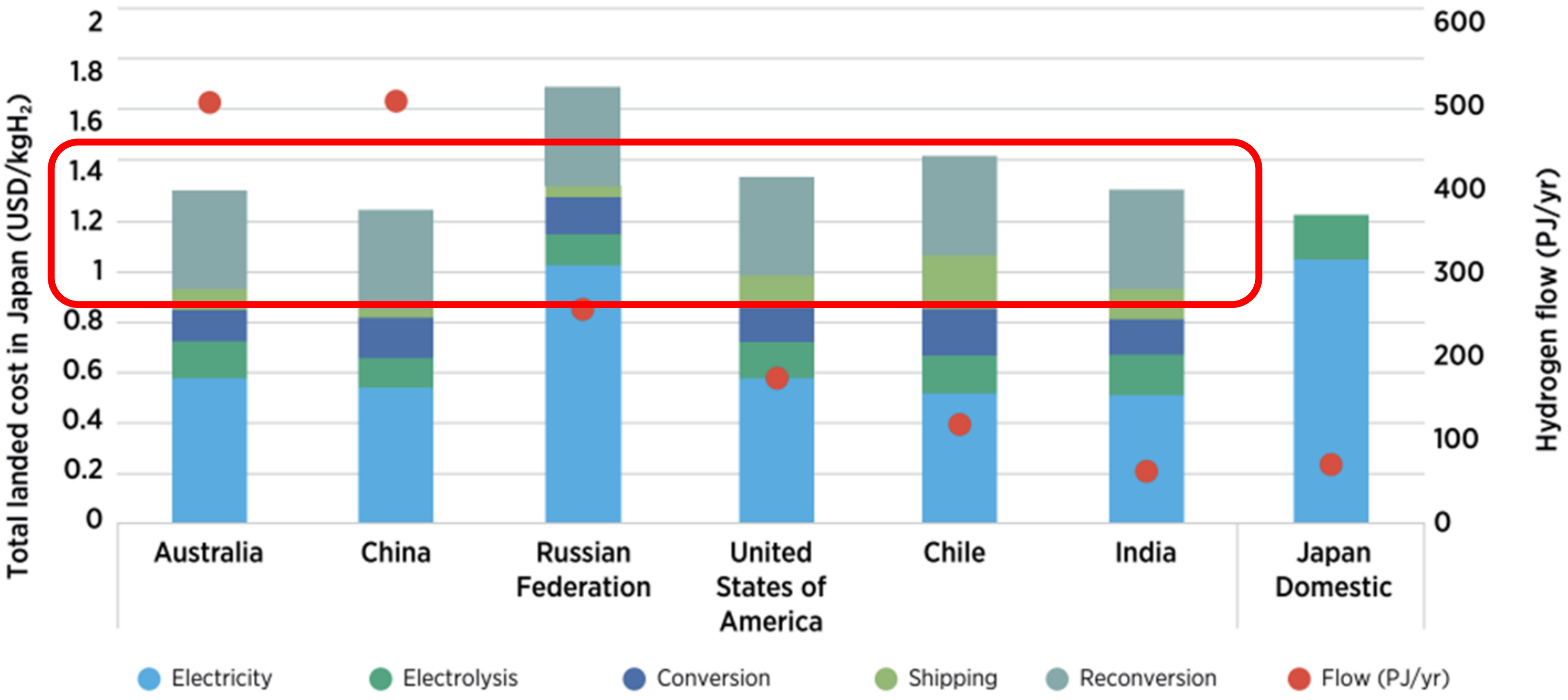

In a future where innovation and deployment have brought (production and transport) costs down, most countries have a small switching cost penalty