Accelerating the Truly Low-Carbon Hydrogen Transition in South Korea: Policy Actions

Summary:

There is an unprecedented opportunity for South Korea to remain a key low-carbon market player and climate leader though policy measures like the Clean Hydrogen Power Generation Bidding Market and the Clean Hydrogen Portfolio Standard. Ensuring that these policies favour truly low carbon and green hydrogen will be critical to realise this potential. This may include considering measures like competitive non-cost factors, rigorous emissions thresholds, sub quotas or separate bidding markets for green hydrogen, incentives and price support mechanisms. In the longer term, it could include ambitious demand-side measures and incentive schemes for hard-to-abate sectors.

Possible policy options:

1. **Policy instruments that ensure diversified supply of truly low-carbon and green hydrogen through the Clean Hydrogen Power Generation Bidding Market.**
   - Competitive non-cost factors and emissions thresholds.
   - Subquota for green hydrogen within the current bidding market.
   - Separate bidding market for green hydrogen. Structured incentive scheme based on emissions.
2. **Demand-side measures for hard-to-abate sectors.**
   - Bidding market for priority hard to abate sectors (e.g. steel and chemicals)
   - Targets to complement R&D support for green shipping.
3. **Regional collaboration to trigger a green hydrogen market in APAC.**
   - Coordinated policy and financial incentives.
   - Regionally harmonised standards and certification.
   - Trade and infrastructure partnerships.

Issue at hand

The Asia Pacific region is well placed to produce green hydrogen competitively, to decarbonize industries which are hard to electrify and to ensure energy security and self-sufficiency. Japan and South Korea are market leaders which are sending strong demand signals through ambitious policies.

Australia is making progress with establishing green hydrogen and ammonia production to meet the demand, and there is great potential for economies like Indonesia, Malaysia, Thailand, and Vietnam to scale up renewable energy capacity and green hydrogen production to drive green industries.

South Korea is a front-runner in establishing clean hydrogen policy measures through the Clean Hydrogen Power Generation Bidding Market and the Clean Hydrogen Portfolio Standard. However, there is a risk that the current policy framework does not incentivize production and supply of truly low-carbon and green hydrogen. This can disadvantage South Korean companies in the hydrogen supply chain that are invested in the construction of renewable energy and hydrogen projects, provide or manufacture green hydrogen technology, or produce green hydrogen with the intention to export hydrogen or ammonia to Korea. There is also potential to consider longer-term measures to facilitate demand for green hydrogen to reduce emissions in hard to abate sector and ensure that products exported to markets like Europe remain competitive as carbon border taxation comes into force.

This paper proposes policy actions based on consultation with Korean industry and non-state actors interested in scaling up production and use of truly low-carbon and green hydrogen in South Korea and the Asia Pacific region. It seeks to support the Clean Hydrogen Power Generation Bidding Market and the Clean Hydrogen Portfolio Standard and draws on global and regional good practices to strengthen policy and financial incentives to bridge the 'green premium' gap and to create regulatory certainty and investor confidence.

What's in it for South Korea

- **Green hydrogen offers energy security and diversified supply.** Green hydrogen projects are being planned across a diverse range of markets with high renewable energy potential. It will offer a more secure and reliable supply than fossil fuel-based hydrogen production, which is dependent on a smaller set of fossil fuel producers with high exposure to geopolitical risks. Fossil fuel-based ammonia will spike when gas prices spike, while green ammonia can be procured at a long-term fixed price, thus avoiding the risk of future fuel price spikes.

  Cost-competitive green hydrogen and ammonia projects are not infinite. There are only a limited number of suitable locations for large amounts of green hydrogen and ammonia production that can procure abundant renewable power at low cost, have good access to deep water export ports, and have no environmental issues. Competition for sourcing competitive green hydrogen and ammonia from favorable sites may become more intense as demand for green hydrogen and ammonia increases. Early procurement for a small amount may ensure long-term stability of competitive green hydrogen and ammonia, while competition is still loose.

By investing in green hydrogen production in the Asia Pacific region, as Korean players like POSCO and Samsung in Malaysia, South Korea is already contributing to increasing securing energy and green hydrogen supply from markets in within the region.

- **The cost of renewable hydrogen is predictable and will significantly fall over time.** The price of blue hydrogen depends on the price of natural gas and is exposed to price volatility. The costs of green hydrogen produced through renewable electricity are inherently more stable, based as they are on predictable inputs (i.e. upfront investment in renewable energy generation and electrolyser equipment). Through reduction of renewable energy costs and efficiencies in hydrogen production process, the cost of green hydrogen is estimated to reduce to by 50–60% by 2030, making it feasible to achieve USD 2/kg is feasible in some markets within the next five years.[1]

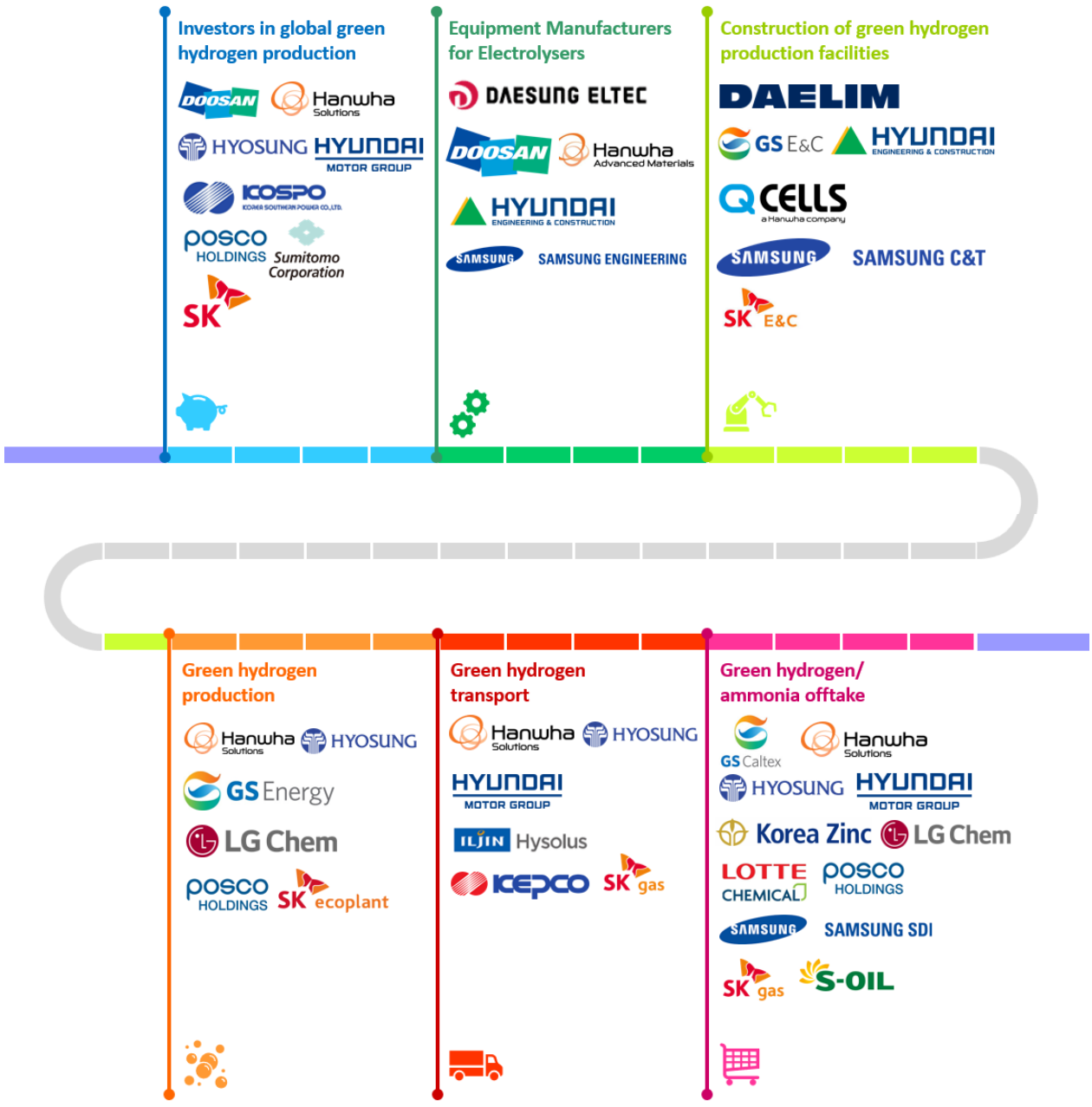
- **Korean companies can participate in the full value chain.** As the industry is being established, South Korea can promote active participation by its companies in throughout the green hydrogen supply chain. There is high demand for companies with experience in construction of renewable energy projects, manufacturing of technology and equipment, in particular from companies outside of China. Korea can be a leader in this industry and Korean investment and supply can help accelerate the growth of the industry in the APAC region and beyond.

- **Market access and competitiveness of exports.** Markets like Europe and Japan have adopted or are considering carbon border taxation measures that (e.g. the EU's Carbon Border Adjustment Mechanism), to incentivize lower emissions from its products while ensuring the competitiveness of their domestic industries. This means that companies exporting to such markets will need to demonstrate low-carbon energy inputs throughout their business. Using truly low-carbon hydrogen with verifiable carbon and methane emissions will enable access to markets like the European Union.

- **Carbon reduction and climate leadership.** Green hydrogen is a zero-carbon product that enables full and rapid decarbonisation. Blue hydrogen meanwhile relies on CCUS technology that is unproven at scale. To get close to a genuinely low carbon product, blue hydrogen requires exceptionally high capture rates (above 95%) and virtually no upstream methane leakage. This is expected to be unachievable for many projects, which is why offtakers in Europe and Japan are increasingly focused on securing supply of genuinely low carbon and green hydrogen. Using green hydrogen for power generation may also help in facing criticism of co-firing in power generation, as it demonstrates real commitment to phase out fossil fuels in the power sector.

[1] RMI (2021), Fuelling the Transition: Accelerating Cost-Competitive Green Hydrogen.

Figure 1: South Korean participation in green hydrogen technology and supply chains



Policy options:

1. **Policy instruments that ensure diversified supply of truly low-carbon and green hydrogen through the Clean Hydrogen Power Generation Bidding Market.**

   In the Korean Clean Hydrogen Power Generation Bidding Market (based on the Clean Hydrogen Portfolio Standard), there is an urgent need to establish a favorable position for truly low carbon and green hydrogen and implement distinctive incentives for its adoption. This is particularly important due to the length of the contracts (15 years), which require a long-term perspective on fuel procurement.

   The current bidding criteria are structured with a 60:40 ratio between quantitative (price-based) and qualitative (including hydrogen-grade) criteria. There appears to be a consensus among market participants that the weighting on the price-based criteria will make it challenging for green hydrogen to outcompete blue hydrogen in the short term, in particular as emissions thresholds are higher than in other markets.

   This is likely to decrease demand for green hydrogen among market players intending to use low-carbon hydrogen in power generation, locking users into sourcing fossil fuel hydrogen with high emissions. This is particularly the case since the winning bidders will enter into 15-year supply agreements, causing inequality in the formation of a green hydrogen market over an extended period.

   ### *Possible actions include:*

   Competitive non-cost factors and emissions thresholds. A robust set of non-price factors in the Clean Hydrogen Power Generation Bidding Market that balances cost with consideration of energy security, carbon reduction and wider ESG requirements, can help create long term secure and scalable genuinely low-carbon hydrogen production.

   It will be critical to ensure that emissions accounting for all production pathways is rigorous. The Breakthrough Agenda, facilitated by the International Energy Agency, International Renewable Energy Agency and UN High Level Climate Champions have stated that low carbon “production routes will need to achieve verifiable low carbon intensities that trend towards near zero by 2030.” This will require a more rigorous threshold on acceptable emissions intensity for ‘low-carbon hydrogen’, recognising that 4kg CO2 per kg H2 on a well to gate basis is high compared to emerging global norms and will not help achieve Korea’s ambitious net-zero targets.

Table 1: Emissions thresholds in selected markets

Market	Policy	System Boundary	Emissions intensity level (kg CO2-eq/kg H2)
South Korea	Clean Hydrogen Portfolio Standard	Well-to-gate	4.0
Japan	Hydrogen Basic Strategy	Well-to-gate	3.4
European Union	Renewable Energy Directive II	Well-to-wheel	3.4
UK	UK Low Carbon Hydrogen Standard	Well-to-gate	2.4
USA	Clean Hydrogen Production Tax Credit	Well-to-gate	2.5 - 4 2.5 - 1.5 1.5 - 0.45 <0.45
Green Hydrogen Organisation	Green Hydrogen Standard	Well-to-gate	1.0
Climate Bonds Initiative	Climate Bonds Standard	Well-to-gate	2022: 3.0 2030: 1.5 2040: 0.6 2050: 0.0

Source: International Energy Agency (2023), Global Hydrogen Review 2023; Green Hydrogen Organisation (2023), Towards hydrogen definitions based on their emissions intensity.

Subquota for green hydrogen within the current bidding market. A specific sub-quota for green hydrogen and ammonia (e.g. 25%) in the 2024 or future bidding rounds would allow Korea to secure supply of green hydrogen and diversity supply. A separate quota for green ammonia, for insurance for 100 ktpa or 200 ktpa, would support Korean power generation companies in building a fuel procurement portfolio from a long-term perspective. This will also help support early mover projects with Korean participation.

Separate bidding market for green hydrogen. In the absence of changes to the current bidding market for green hydrogen, a separate bidding market to ensure supply of green hydrogen can be an option to ensure diversified supply of truly low-carbon and green hydrogen.

Structured incentive scheme based on emissions. Offering subsidies, tax credits or a price support mechanism will be key to help cover the green premium between green and fossil-based hydrogen. The subsidies could be tied to a sliding scale, with more incentives being offered to the hydrogen produced with lowest emissions, as set out in the Clean Hydrogen Portfolio Standard. This would align with incentive schemes in markets like the United States and Japan, which offer production tax credits and contract for difference incentives to reduce the cost of production and facilitate offtake agreements.

Table 2: Public funding towards low-carbon towards low-carbon hydrogen in selected markets

Country	Policy	Total amount of funding towards low-carbon hydrogen (USD)
European Union	European Hydrogen Bank, REPowerEU Innovation Fund	~167 billion
Japan	Contracts for Difference Scheme	~53 billion
Spain	Strategic Project for Recovery and Economic Transformation on Renewable Energy, Hydrogen and Storage	~10.6 billion
Germany	H2Global, Carbon CfD Scheme	~9.7 billion
USA	Hydrogen Production Tax Credit (IRA), Regional Clean Hydrogen Hubs	~8 billion
South Korea	Clean Hydrogen Certification System, Clean Hydrogen Power Generation Bidding Market	~3 billion

Source: International Energy Agency (2023), Global Hydrogen Review 2023; Wood Mackenzie (2023), Hydrogen policy summary.

2. Demand-side measures for hard-to-abate sectors.

Currently, the incentive system introduced in Korea is limited to clean hydrogen used for power generation, and not to clean hydrogen used for hard to abate sectors that are not possible to electrify without hydrogen. The chemical, steelmaking and shipping industries for instance will have significant demand for clean hydrogen and derivatives to achieve their net zero and decarbonisation goals. This is especially the case for chemical or steel products that are exported to the EU, given the introduction of the Carbon Border Adjustment Mechanism. Facilitating the uptake of green hydrogen technologies in these industries will allow for continued market access on a competitive basis.

Possible policy actions include:

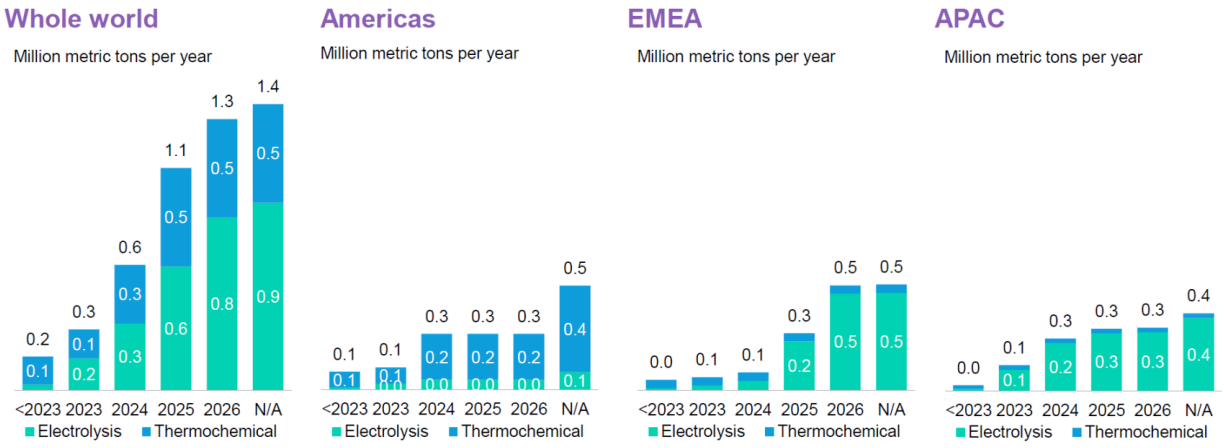
Bidding market for priority hard to abate sectors (e.g. steel and chemicals). To create the entire clean hydrogen value chain, not limited to the power market, the government could design an incentive scheme with industry demand targets and bidding markets similar to the current Clean Hydrogen Power Generation Bidding Market. This will be crucial to stimulate demand for clean hydrogen from diverse sectors and promote its use beyond power generation.

Targets complementing R&D support for green shipping.
To both create demand for hydrogen fuels and contribute to decarbonizing the maritime sector, the government could direct subsidies or set targets for green ammonia use as fuel on ammonia carriers delivering imports to Korea, especially where these are Korean built or flagged vessels. This would combine well with Korea's shipbuilding ambitions and research and development (R&D) investments, where there is potential to accelerate existing efforts by including sub-targets for hydrogen and derivative-powered ships within the shipbuilding support package, expand R&D spending, and implement schemes similar to Norway's capex support for hydrogen-and ammonia-powered vessels.

3. Regional collaboration to trigger a green hydrogen market in APAC.

The APAC region is assumed to be a key market for low-carbon hydrogen consumption rather than a producer of green hydrogen, given the growing energy needs of Asian economies and dependency on fossil fuels for power generation. The exceptions are China and India, which are moving fast ahead of the rest of the world in developing renewable energy and electrolyser technology and production capacity. Australia is also making progress in becoming a global producer and supplier of green hydrogen and ammonia.

Figure 2: Operational and financed low-carbon hydrogen production volumes (as of February 2024)



Source: BloombergNEF (2024).

South Korea could play a leading role in initiating the APAC Green Hydrogen Alliance to increase regional collaboration and identify "trigger actions" that will accelerate a regional green hydrogen market.

Possible areas of collaboration include:

1. ***Coordinated policy and financial incentives.***
   Policy measures, incentives, and subsidies are essential to attract private capital and bridge the price gap between conventional and low-carbon hydrogen. Japan is finalising the design of its contracts for difference (CfD) scheme and is collaborating with South Korea to raise funds for joint investments in hydrogen and ammonia production abroad. The alliance aims to share best practices in designing cost-effective financial incentives and CfD schemes, and identify and accelerate investment-ready, frontrunning projects in the region.

2. ***Regionally harmonised standards and certification.***
   Various countries worldwide are establishing their own regulations and standards for certifying clean hydrogen, but each country uses different methods to authenticate it and assess carbon emissions. To facilitate international trade and market growth, there's a need for a uniform cross-validation system ensuring transparent trading between countries. Without this, there's a risk of destabilizing the global market's fairness. It is therefore crucial for APAC countries to establish standardised clean hydrogen certification systems with harmonized emissions thresholds, recognised globally from the outset of developing the market building on ongoing efforts by ISO and IPHE.

3. ***Trade and infrastructure partnerships.***
   The APAC region's demand for low-carbon hydrogen and ammonia exceeds production capacities, necessitating infrastructure development for trade and transportation. Global progress on this front is slow, posing concerns due to lengthy project lead times. Urgent action is needed to address challenges in planning, permitting, and financing, with collaboration among stakeholders crucial for achieving economies of scale and sharing infrastructure costs.

The alliance has been established in partnership with **Breakthrough Energy**.

Industry leaders and Asia Green Hydrogen Alliance supporters consulted on this paper:

These policy options reflect feedback from a broad range of industry and non-state stakeholders and emerging global good practices. The options do not necessarily reflect individual company positions, however they seek to bring together a representative summary of the inputs received. Consulted stakeholders include:

- *Avaada*
- *Adani*
- *ACME*
- *Baker Hughes*
- *Breakthrough Energy*
- *Fortescue*
- *CWP Global*
- *Doosan*
- *H2Korea*
- *Hanwa*
- *Hyundai Motors*
- *KEPCO*
- *Kim & Chang*
- *KoreaZinc*
- *Mizuho*
- *Samsung Engineering*
- *SK Global*
- *SK Ecoplant*
- *SK Ventures*
- *Solutions for Our Climate*
- *Plan 15*
- *LG Sciencepark*
- *Plug Power*
- *POSCO Holdings*

The Green Hydrogen Organisation (GH2) is a global non-profit foundation working to accelerate the production and use of green hydrogen. GH2 works closely with industry, government and civil society in its efforts to fight climate change through the accelerated production and use of green hydrogen.

The APAC Green Hydrogen Alliance aims to support policy measures and financing incentives, accelerate sustainable production, use and trade and catalyse financing for green hydrogen projects. It focuses initially on Japan, Singapore, South Korea, Australia and Indonesia as frontrunners in the region.