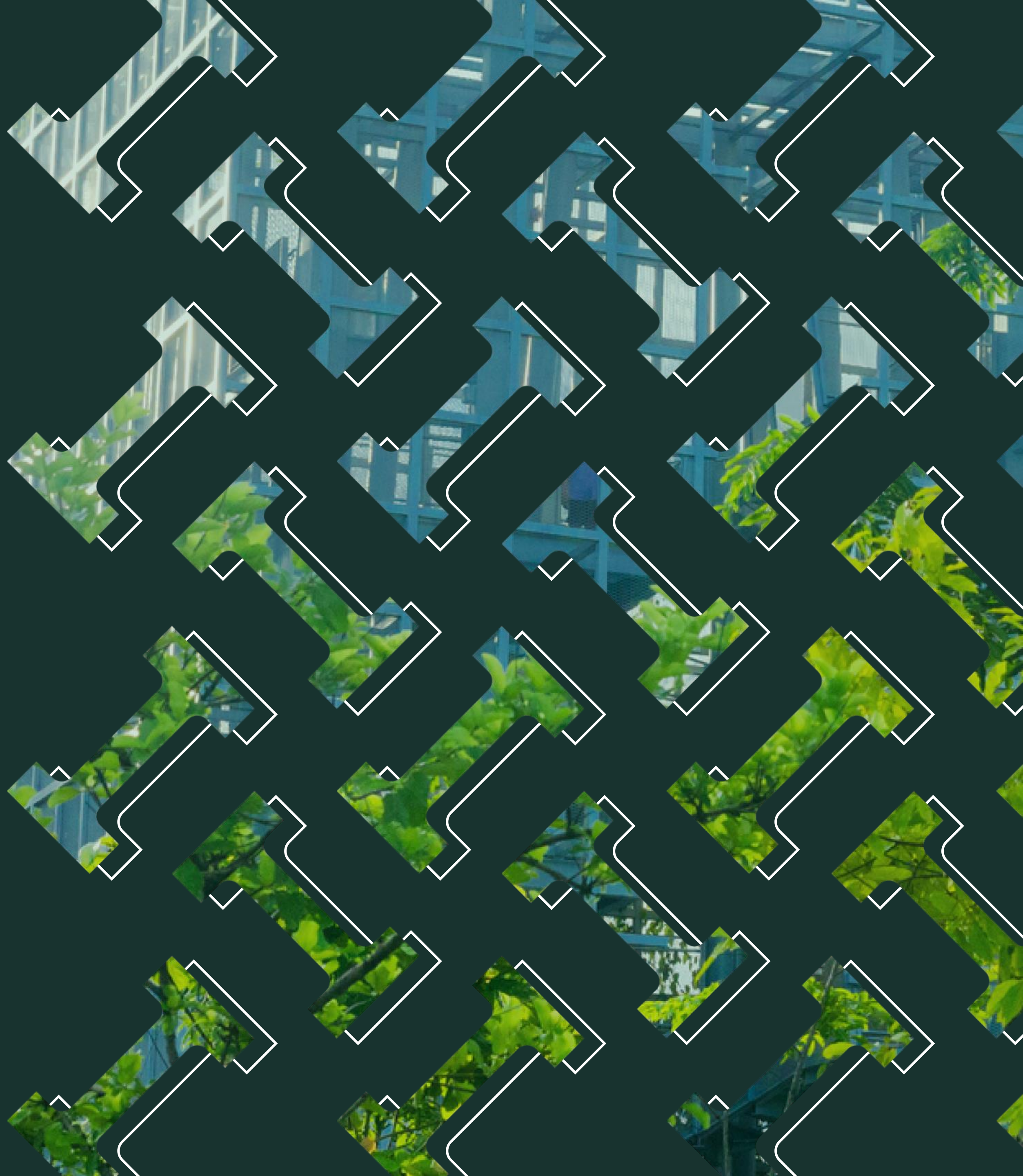
MISSION POSSIBLE PARTNERSHIP

Steel's transformation:

A new engine for **South Korea's** growth and competitiveness

Report | August 2026



Foreword

Faustine Delasalle
CEO, Mission Possible Partnership
Executive Director, ITA

"The Korean steel industry is at a crossroads. It has the industrial base, the technology and the levers to shape it.
— **Faustine Delasalle**

Korea's steel sector stands at an inflection point – the choices made now will determine whether Korea leads the clean industrial transition or adapts to new market realities shaped by others.

Korea built one of the world's most valuable steel industries, not by making the most steel, but by making the right kind. Ranked sixth globally by production volume but fifth by export value, Korea supplies the high-specification grades that cars, ships and electrical equipment depend on. Steel is a critical input for close to 40% of Korea's manufacturing output and underpins an industrial base employing around 1.8 million people.

At a time when global overcapacity and trade tensions are putting the Korean steel industry under strain, it can be difficult to look beyond short-term turmoil and anticipate the next transformation horizon. But two trends are converging which will reshape the global steel market in the next decade. Carbon-conditioned trade is arriving fast: the EU's CBAM will place around $7.7 bn of Korean exports under a carbon cost when it extends to vehicles and machinery from 2028. Meanwhile, China is undertaking the largest shift to hydrogen-based steel making of any country – more than 10 Mtpa under way – accumulating learnings and cost advantages with every tonne produced.

The transition to clean steel opens up a real opportunity for Korea, one larger than it appears. Clean steel creates value across three channels: it gives producers preferential access to a growing number of carbon-conditioned markets; it unlocks green premiums paid by first mover buyers – through voluntary purchase initially, policy-driven purchase later and it opens up an opportunity for upstream technology exports. Just today's pipeline of clean steel projects represents a $70bn market for equipment supply and services; an opportunity which will grow as global demand matures.

What is missing for Korea to seize this opportunity is not capability – it is committed early demand. Korea can build any clean steel route; but it needs revenue certainty to underpin investments. Public procurement, clean steel mandates in the automotive industry and emerging clean demand from trade partners could underwrite at least 6.5 Mt of production, creating the investment certainty on which new investments depend and providing an alternative to relining for coal-based production capacity approaching a relining date. The Korean steel industry is at a crossroads. Korea has the industrial base, the technology, and the levers to shape a clean and competitive future. Time is of the essence for this future not to slip away.

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Executive Summary

Korea’s steel sector is a high-value industry, increasingly exposed in a changing world

Korea built one of the world's most valuable steel industries by making the right things, not the largest amount of things. It ranks sixth in the world by volume but fifth by export value, supplying high-specification grades for cars, ships and electrical equipment, which scrap-based steel cannot reliably produce.

The sector sits at the heart of Korea's industrial economy. Steel is an input to almost **40% of manufacturing output** and, together with the automotive, shipbuilding and machinery sectors it supplies, it is part of an industrial base employing close to **1.8 million people**. Around three quarters of Korea's steel comes from blast-furnaces, the most carbon-intensive way to make it.

That carbon intensity matters because almost half of production is exported directly, and once the steel embedded in cars and ships is counted, close to two thirds is ultimately sold into foreign markets – markets that are beginning to price carbon and reward those whose products are less carbon-intensive.

Tightening Carbon Border Adjustment Mechanism (CBAM)-style policies and Chinese cost competition are forcing the need for new clean steel investments

The first pressure is carbon-conditioned trade. The EU's CBAM already reaches Korea's highest-value grades, placing around **$7.7bn of exports** under a carbon cost as it extends to vehicles and machinery from 2028. The greater risk is that as more markets follow, more Korean exports will face carbon-conditioned access, with high-carbon blast-furnace steel most exposed.

The second is China, with **more than 10 Mtpa of blast furnaces** shifting to hydrogen-based steelmaking – the most of any country. The threat is less its export volume than the cost advantage and learning it accumulates with every tonne.

The timing is acute: margins sit in single digits, and a wave of decisions on whether to retire or “reline” furnaces is fast approaching. To maintain cost leadership & competitiveness means expanding cleaner production. Korea has begun – POSCO's Gwangyang EAF, FBR (HyREX) and Hyundai Steel's EAF-BF combined process - and the K-Steel Act and K-GX Strategy now provide the framework to build on.

Clean steel could create more value for Korean industry than is currently recognised

Clean steel costs more to produce today, and that is usually where the conversation stops. But the value it could create has rarely been examined. It falls into three channels: technology and equipment exports upstream, green premiums as carbon costs boost the value of low-carbon steel, and preferential access to downstream markets that reward low embodied carbon.

Cleaner routes capture more of all three. Opportunity per plant rises around fourfold, from roughly **$230m for gas-based hot briquetted iron (HBI)** to as much as **$1.15bn for Fluidized Bed Reactor** (FBR) (e.g., HyREX). Premiums and market access come first as carbon pricing tightens; technology exports follow, and are the largest prize of all - **a $70bn global tech market** that grows with worldwide demand rather than Korea's own export volumes.

Much of this value is not recognised because it does not accrue to the steelmaker carrying the capital risk. Technology gains flow to equipment makers and EPC firms, market access gains to downstream manufacturers. Closing that gap between what the investor pays and what the country gains is an important policy issue.

Clean steel pathways offer very different competitiveness, resilience and employment outcomes

Multiple clean routes are emerging. Beyond cost, three dimensions matter: market upside, supply chain security, and employment.

On cost, gas and CCS are most competitive to 2030; scrap EAF is cheaper where domestic scrap allows. All sit above blast-furnace steel before carbon is priced.

The initial capital to reach 2.3 Mt of capacity by 2028 is c.$3.5bn – modest compared to the c.$70bn total opportunity. 300 ktpa FBR pilot (HyREX) and 2 Mtpa gas-HBI are the near-term pipeline; committing now positions you well for the larger prize.

On supply chain security, imported gas-HBI provides the best buffer against feedstock shocks; FBR (HyREX) most reduces fossil fuel dependence.

On employment, ironmaking is ~5% of the steel workforce, so direct jobs are stable across routes. The greater opportunity is upstream: only HyREX could cornerstone upstream manufacturing employment.

Steelmakers currently lack the revenue certainty to invest in new clean steel capacity

Korea's competitiveness depends on expanding into clean steel, which raises the question: what is holding the capital back? It is not capability or technology – Korea can build any of these routes. The missing condition is revenue certainty: the confidence in future cash flows that allows a large project to raise finance, which rests on committed offtake.

Korea has almost none. Just one transaction appears in the global green steel offtake tracker. Stegra alone, the first commercial-scale project to reach financial close, had locked offtake for around 60% of capacity beforehand.

The most direct fix is within Korea's control. As other markets have done, Korea could use public procurement, automotive mandates and trade-linked demand to underwrite around 6 Mt of production against a ~20 Mt wave of reline projects. Demand at that scale would support several projects, giving Korea the experience to drive down costs and capture the wider opportunity.

Korea still has time to compete and real options to lead the technology frontier

Korea has the foundations to compete in clean steel: Deep steelmaking expertise, world-class engineering and EPC capability, a manufacturing base spanning the equipment these new routes require – alongside a narrow but open window to act before locking in carbon-intensive relines.

No single pathway settles every trade-off. The task is less about picking 1 route than making bets that maximise flexibility and option value. The evidence points to 4 priorities:

1. **Activate demand** to create the investment certainty on which everything else depends
2. **Build a portfolio** that uses gas as a bridge while betting on FBR (HyREX) for the long-run prize for industrial competitiveness
3. **Build cost leadership** in scrap, cheaper hydrogen and capital intensity
4. **Design trade partnerships** that work across cost, demand and export at once

Steel is entering a new iron age. Korea has the industrial base, the technology and the levers to help shape it.

Korea is one of several countries across the East Asian region where the steel sector is facing a pivotal moment, this is the first in a series of reports where we examine the opportunities for countries to reinforce the foundations of their industrial strength.

Attribution

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Priority 1

Activate multiple sources of demand for investment certainty

POTENTIAL INTERVENTIONS

Establish green public procurement requirements for steel

Create lead markets in downstream sectors

Priority 2

Build a portfolio spanning near-term and long-run export prize

POTENTIAL INTERVENTIONS

Support gas and hybrid DRI projects to FID

Accelerate FBR (HyREX) toward commercial readiness

Build competitive supply chain capability

Priority 3

Build cost leadership across the portfolio

POTENTIAL INTERVENTIONS

Mobilise domestic scrap

Develop optimisation technologies to reduce H2 costs

Reduce the capital intensity of new production routes

Priority 4

Design trade partnerships across cost, demand and export

POTENTIAL INTERVENTIONS

Deploy financing and capital efficiency tools to drive down HBI costs

Use upstream investment leverage to secure reciprocal green demand

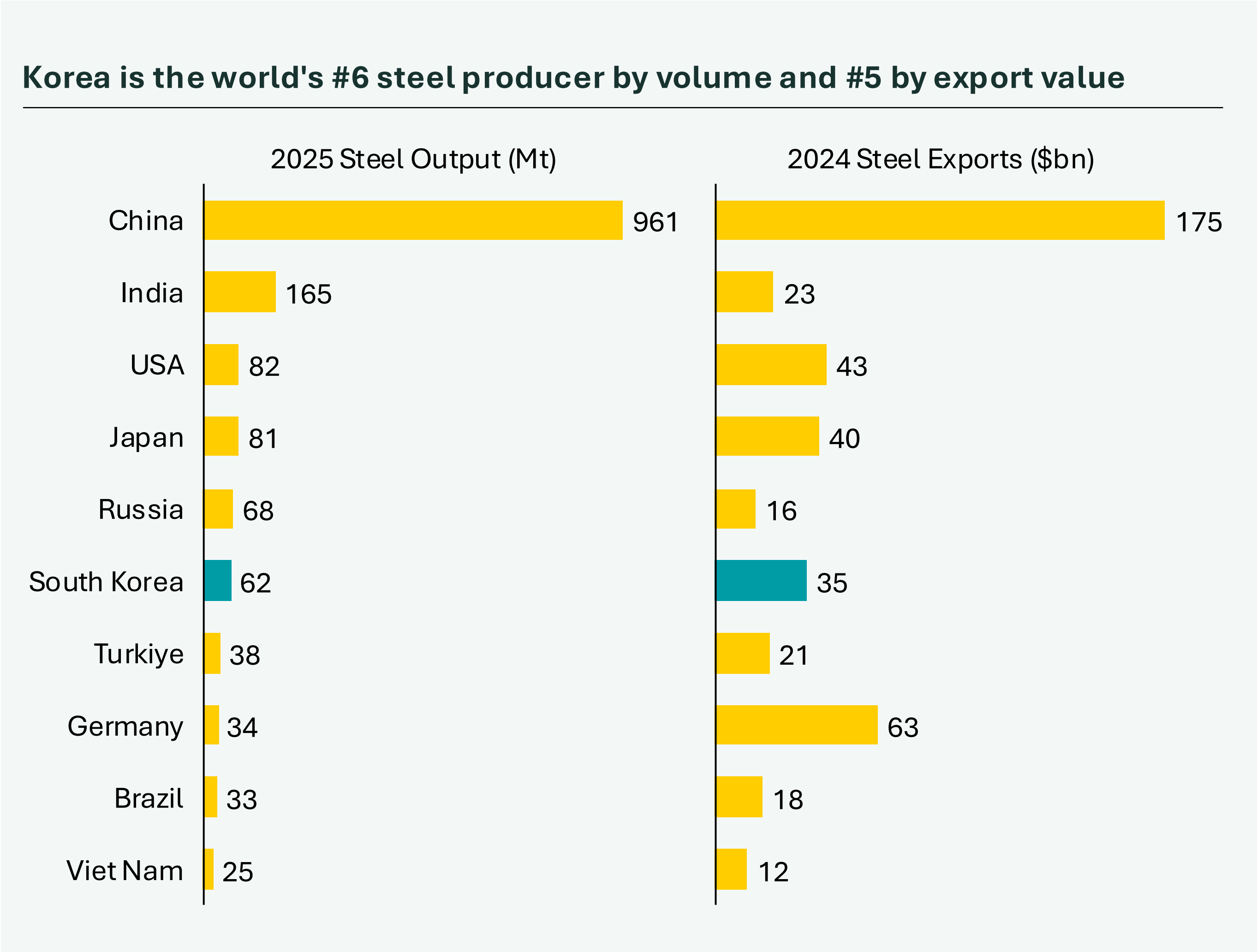
Use early overseas projects to test and scale Korean technology

Sector foundations

Korea’s steel industry is a foundation of national competitiveness; underpinning advanced manufacturing, trade and employment at a scale that make its future worth fighting for

| Cars for global export, Gwangyang, Korea

With 62 Mt in annual production and $35 bn in exports, Korea has built one of the world's most productive steel industries



Korea has built one of the world's most valuable steel industries: not by producing the most, but by producing the right things. At 62 Mt of output and $35 bn in export value, Korea ranks sixth globally by volume but fifth by value. Germany earns $63 bn from just 34 Mt, but Korea's achievement is strong value intensity at volume scale, not niche production.

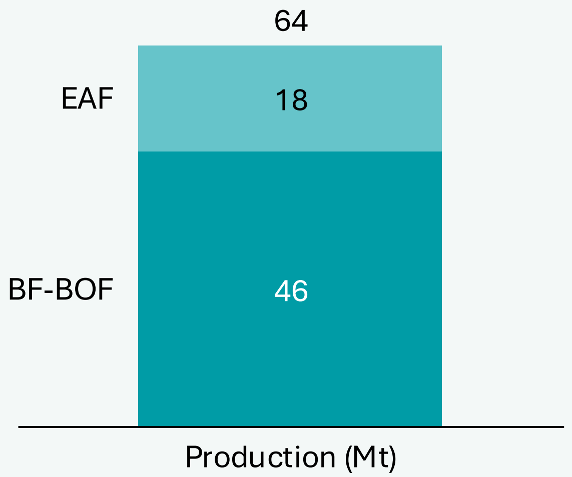
Flat steel, the highest-specification category, dominates Korea's export mix more than any other major Asian producer. At 59% of exports, Korea's flat-product share exceeds Japan (50%), China (30%) and India (19%). These are the steel grades used in automotive panels, ship hulls and appliances: sectors where the grade specification is locked in at the design stage and supplier relationships last decades.

This mix is the product of a deliberate industrial strategy and it is what makes Korea's position distinctive. Korean steelmakers built their capabilities around the demands of the country's most competitive manufacturers. POSCO's technical depth is inseparable from the industries it serves, and that alignment is the foundation of the sector's enduring strength.

Source: Steel output is taken from Worldsteel Data Viewer, steel exports are from BACI and cover all exports from HS72 and 73.

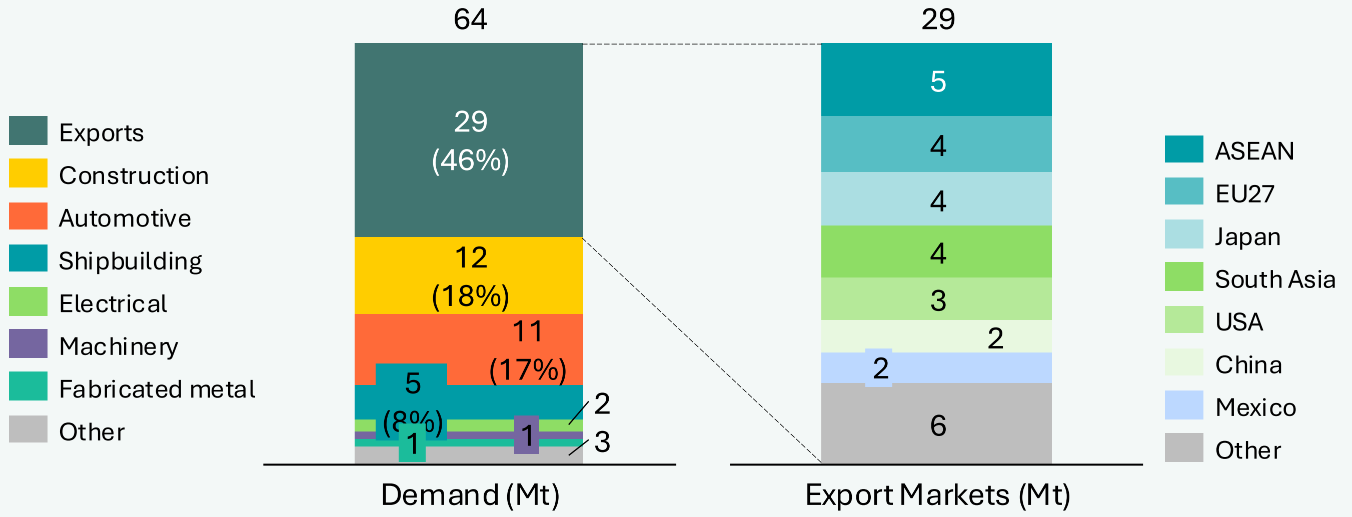
Korea's steel industry runs on blast furnaces and exports: 72% blast furnace output, anchored by advanced manufacturing at home

BF-BOF dominates production



Korea's output is overwhelmingly blast furnace-based: the route best suited to the flat, high-specification grades its downstream manufacturers need. About 72% of output comes from BF-BOF (blast furnace basic oxygen furnace) routes. The other 28% is EAF (electric arc furnace) focused on long products for construction, where scrap-based routes are viable.

c.45% of Korea's steel production is exported; advanced manufacturing covers ~50% of domestic steel demand



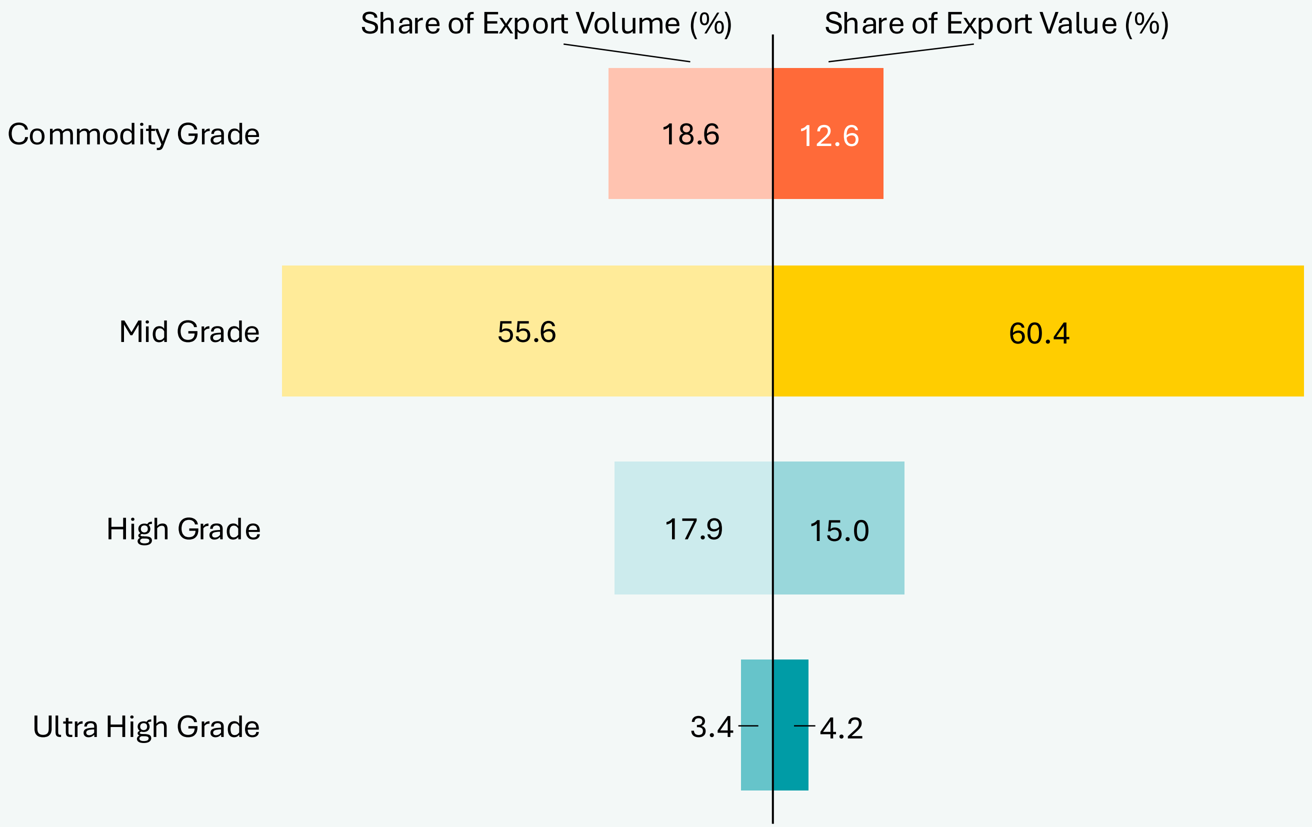
Domestic demand is anchored in advanced manufacturing: automotive, shipbuilding and electrical equipment. These sectors co-develop specification grades directly with the mill – where the steelmaker is embedded in the manufacturer's design process, not simply supplying a commodity input. That relationship is what makes domestic demand strategically significant beyond its volume.

Exporting 45% of output makes Korea's quality position visible across the world's most demanding markets. With no single destination representing more than 20% of export tonnage, Korean steel reaches ASEAN, EU27, Japan and South Asia simultaneously. That breadth of reach – across markets with some of the most technically exacting buyers anywhere – reflects decades of relationship-building that sits at the heart of Korea's competitive position.

Source: All data are for 2024. Production split is from KOSA (2026). For the demand breakdown, export data are calculated from BACI based on HS72 and 73 codes. Demand for domestic sector usage is calculated as production minus exports and allocated to end use sectors based on Yuanta Korea (2025). Export markets are drawn from trade flows within the BACI data aggregated to trade blocs.

Mid-grade products anchor 60% of Korea's export value - with another 19% in grades that scrap electric arc furnaces cannot reliably serve

Korea's steel export mix by technical grade, 2024 share of volume and value



Korea's export portfolio is mid-grade by design. The four largest product groups – galvanised sheet ($2.9 bn), heavy plate ($2.2 bn), pre-painted flat steel ($1.9 bn) and alloy steel ($1.4 bn) – serve automotive finishing, shipbuilding, infrastructure and precision machinery. That breadth within a single tier reflects a technically diverse customer base, not a commodity position.

High and ultra-high-grade products have held at $3.5 bn–$4 bn a year since 2017 – cold-rolled coil, electrical steel, electro-galvanised sheet and tinplate. Value tracks price cycles rather than volume growth, confirming these are mature positions in established relationships rather than expanding markets.

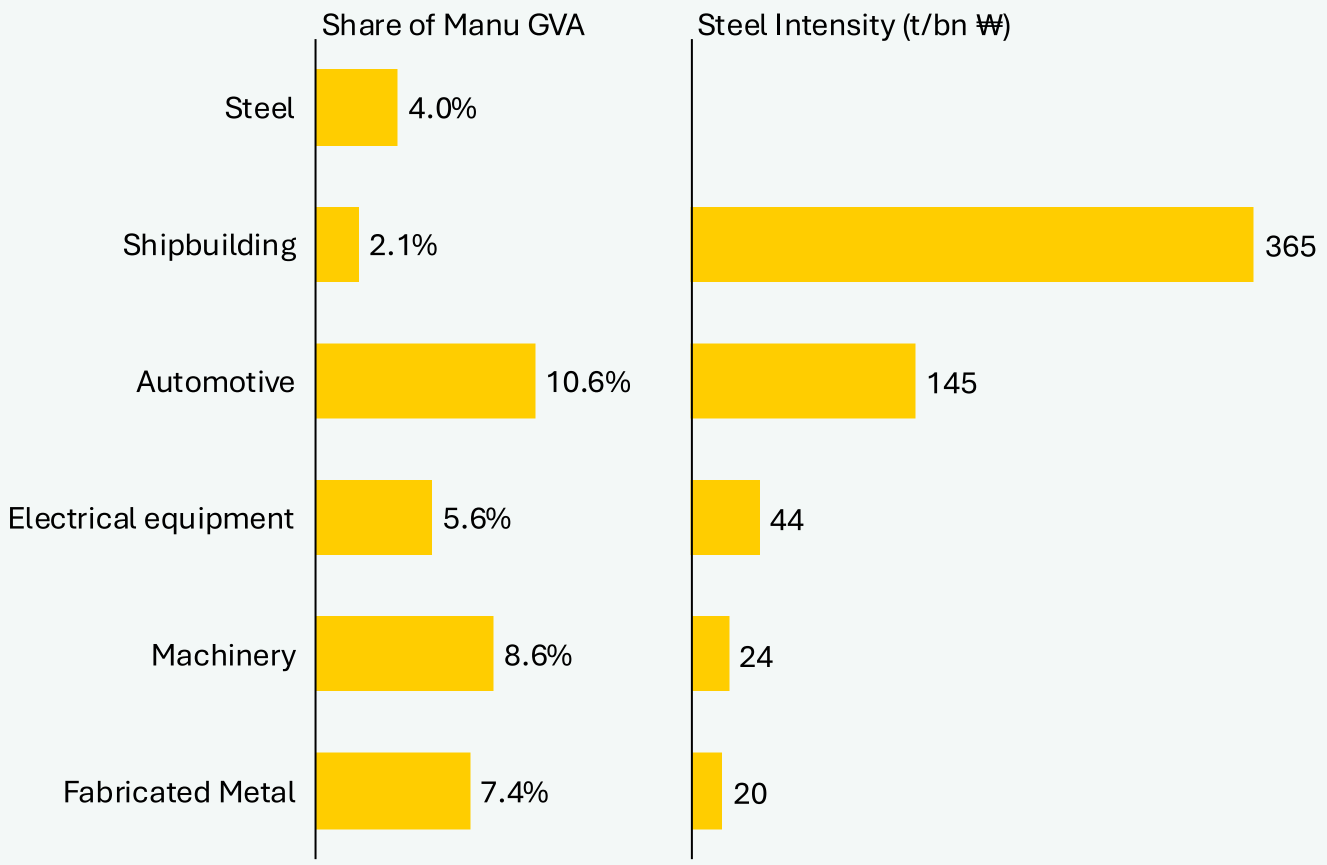
Scrap-based electric arc furnace (EAC) routes face two structural barriers. First, purity: residual elements accumulate in recycled scrap and degrade the surface quality of coated and galvanised products. Second, precision: UHSS and AHSS grades for automotive stamping, and grain-oriented electrical steel for transformers, require alloy tolerances achievable only with primary iron. Both are physics constraints, not cost gaps that can be closed by investment.

Commodity grades have retreated to 13% of export value against 19% of volume – and Korea is not competing here. That gap confirms a deliberate exit toward grades where specification and customer relationships create a durable position. It is also the portfolio most exposed to what comes next.

Notes: Products classified by what they require to manufacture, not what they sell for. Ultra-high-grade products – electrical steel and tinplate – require blast furnace iron and chemical control that scrap cannot achieve. High-grade products require cold-rolling and are sensitive to impurities in the steel charge. Mid-grade products need quality control but tolerate either steelmaking route. Commodity products are route-agnostic. Classification applied at the six-digit trade code level across 167 steel product categories. **Source:** BACI HS72 trade data; MPP analysis.

₩260tn in gross value added, ~40% of manufacturing output and around 10% of GDP – all underpinned by Korea's steel sector

Steel is an input for 38% of Korea's manufacturing output, with intensity concentrated in technically demanding sectors



Korea's most steel-intensive downstream sectors are also its most technically demanding: automotive, shipbuilding and electrical equipment all require specification grades that are co-developed with the mill. Automotive (10.6% of manufacturing GVA) requires high-specification flat steel. Shipbuilding is only 2.1% of GVA but the most steel-intensive sector, and its grades are the most technically restricted. Machinery (8.6% GVA) is the exception: large by value, structural rather than specification-grade.

In shipbuilding, the steel grade is part of the vessel certification and cannot be substituted. LNG carriers require 9% nickel cryogenic steel to withstand -163°C. Only a handful of mills globally can supply it; POSCO is one.

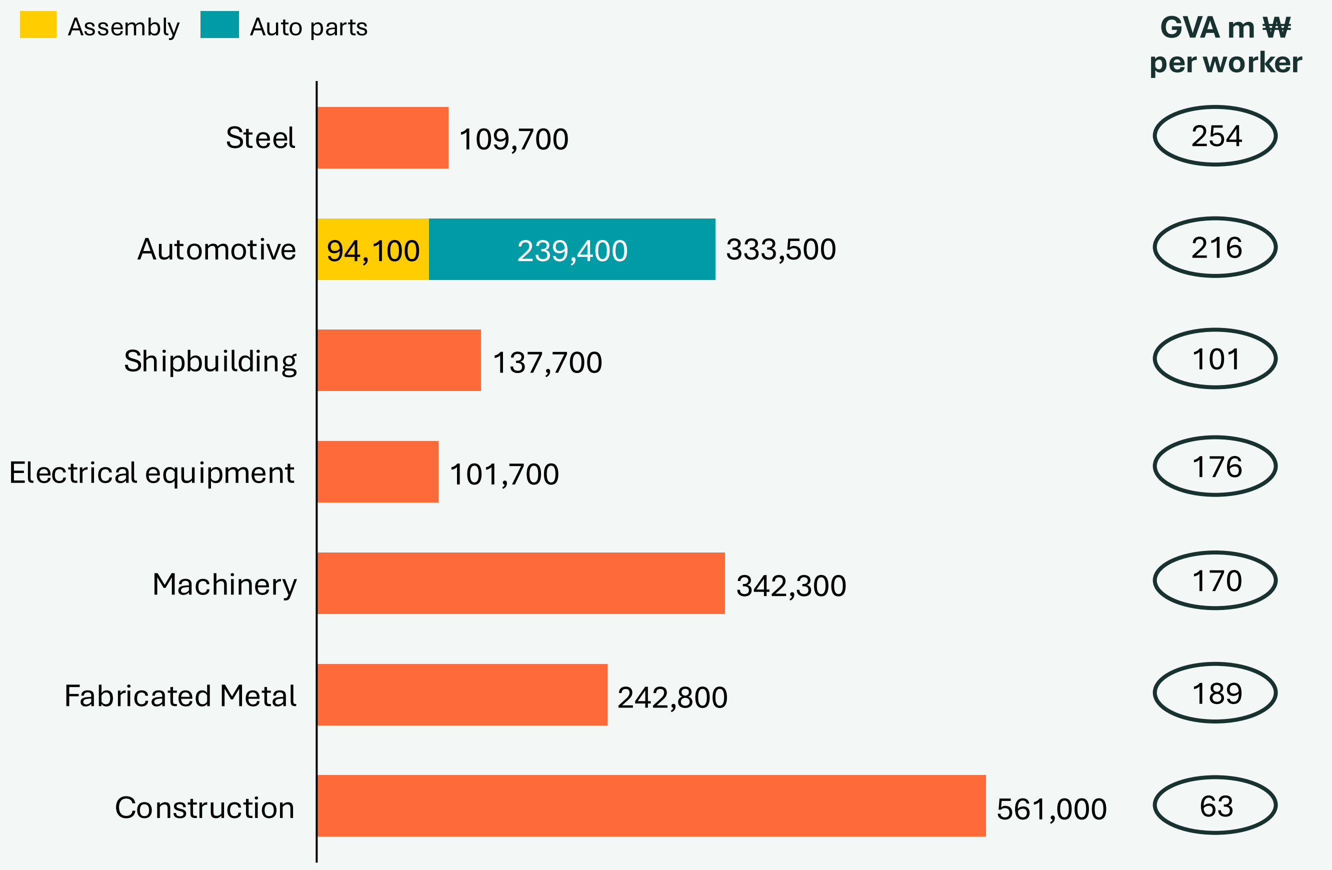
In automotive, specification rises as the focus on reducing weight deepens and the steelmaker is inside that process. AHSS and UHSS grades are developed jointly between steelmaker and OEM; POSCO and Hyundai Steel work directly with Hyundai-Kia.

In electrical equipment, the technical lock-in is absolute rather than relational. Grain-oriented silicon steel for transformers and non-oriented grades for EV motors sit in the ultra-high-grade tier where scrap-EAF steel cannot provide products because of physics, not cost. The grade requirements for electrical equipment mean manufacturers cannot substitute away from primary iron regardless of price.

Source: GVA: Bank of Korea national accounts 2024 (KOSIS DT_200Y103); subsector splits via Statistics Korea Mining and Manufacturing Survey 2024 (KOSIS DT_1FS1103). Steel intensity: KOSA/Yuanta Korea (2025) domestic end-use demand divided by sector GVA. Construction excluded from manufacturing GVA shares. "Other" steel demand category (2.7 Mt) excluded from intensity panel.

1.8 million jobs, equal to ~6% of total Korean employment are supported through Korea's steel industry and the associated manufacturing sectors

South Korea's steel sector employs ~100k workers directly but underpins at least 1.8m jobs across the economy



The steel sector itself employs around 110,000 workers directly. Downstream, automotive, shipbuilding, machinery, electrical equipment and fabricated metals employ a further 1.1 million. These are not peripheral industries; they are the productive core of the Korean economy.

Within the steel sector, rolling and forming is where the value is created. Processors converting raw steel into cold-rolled coil, galvanised sheet and specialty grades generate 369 m ₩per worker, more than double the 180 m ₩ of primary steelmaking. That is where Korea's industrial edge sits.

Automotive is the only major downstream employer that matches the steel sector's value intensity. Machinery employs 342,000 people at 170 m ₩ per worker; construction employs 561,000 at just 63 m ₩. Automotive assembly reaches 422 m ₩ per worker, the highest of any sector. Steel and automotive together form the twin anchors of Korea's high-value manufacturing base, and the future of one is inseparable from the future of the other.

Source: Employment and GVA: Statistics Korea Mining and Manufacturing Survey 2024 (KOSIS DT_1FS1103, establishments ≥10 workers) and Bank of Korea national accounts 2024 (KOSIS DT_200Y103). GVA for shipbuilding and motor vehicles allocated from national accounts Transportation Equipment aggregate using survey value-added shares. Electrical equipment and fabricated metal products adjusted to exclude non-steel-intensive sub-sectors (batteries, appliances, lighting, wires and cables; weapons and ammunition); adjusted figures use survey value-added basis. Iron and steel castings shown separately from basic iron and steel. Construction employment estimated from KOSIS employment statistics 2024; civil engineering shown as steel-intensive subset.

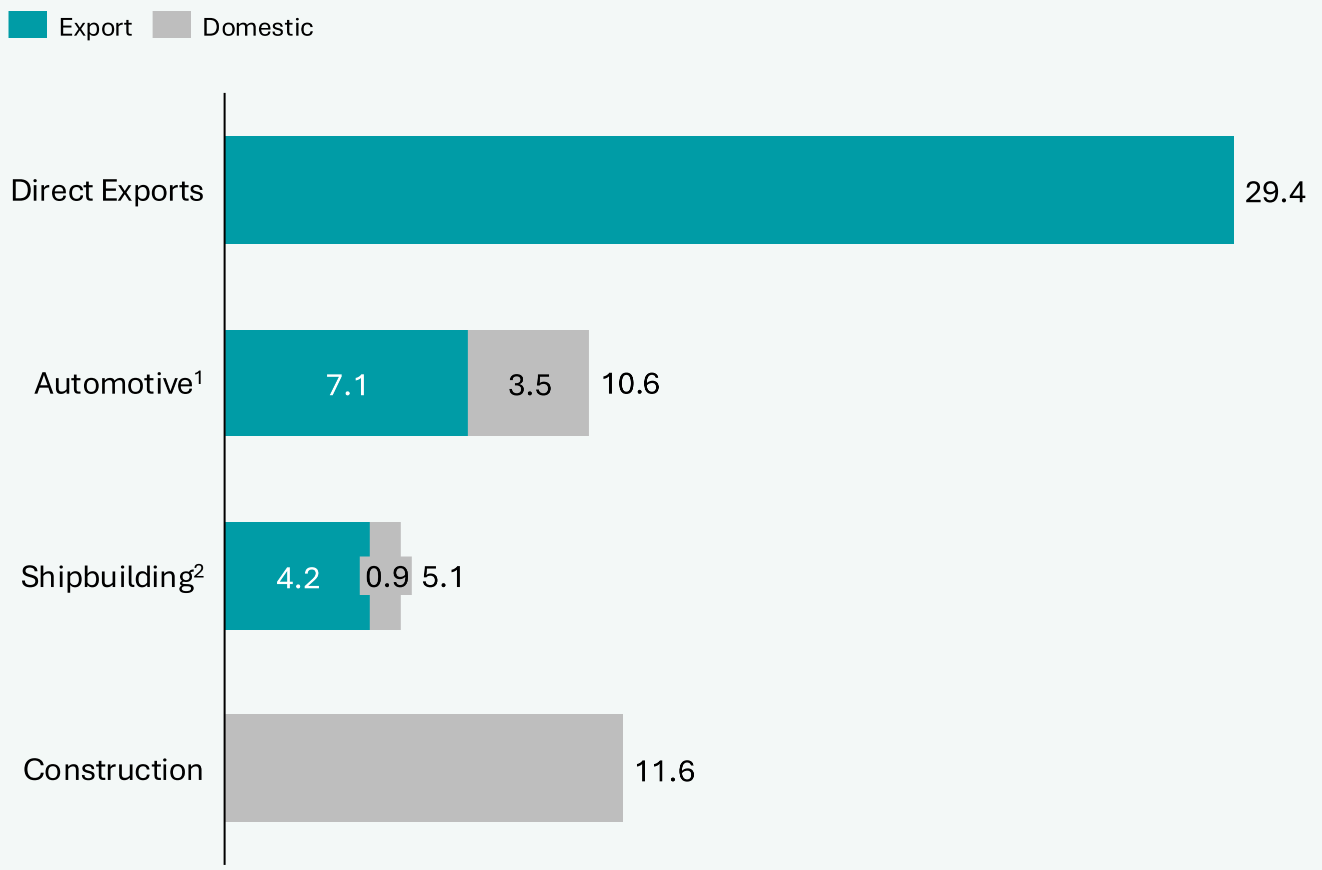
Korea's trade reach runs deeper than exports show and it is concentrated not spread evenly

Korea's steel trade exposure is substantially larger than direct export volumes imply. Direct steel exports account for 29.4 Mt, or 46% of production. But tracing steel through Korea's downstream sectors reveals a broader picture: close to two thirds of total production is ultimately subject to the purchasing decisions, policy frameworks and competitive conditions of foreign markets.

That exposure is asymmetric – concentrated in Korea's most export-intensive downstream sectors. Construction, at 11.6 Mt, is almost entirely domestic and insulated from shifts in trade conditions. Automotive[1] and shipbuilding carry[2] the bulk of the external exposure, embedding a further 11.3 Mt of Korean steel in products destined for international markets. Between them they account for 12.6% of Korea's manufacturing GVA and employ over 470,000 workers directly.

That concentration means shifts in market access conditions carry economy-wide consequences. Korea's trade exposure is not spread evenly across a diversified export base – it is loaded into two sectors that together anchor a significant share of manufacturing output and employment. When the conditions facing Korean automotive and shipbuilding change, the effects run through communities and supply chains, not just steel order books.

2024 estimated exported steel as a share of selected sectors, Mt



1. Automotive export share assumed as 66.8% based on KAMA (2026) sales data for domestic and export sales; 2 Shipbuilding export share assumed as 81.9% based on average domestic purchases 2020–2025 from OECD (2026) figure 2.3.
Source: Export data based on BACI using HS72 and HS73 trade codes. Reliable domestic/export consumption data for other sectors are not readily available.

Competitive threats

The steel sector's next capital cycle will be defined by two structural shifts: climate-aligned trade policy tightening market access, and China building a technology and cost lead in clean steel

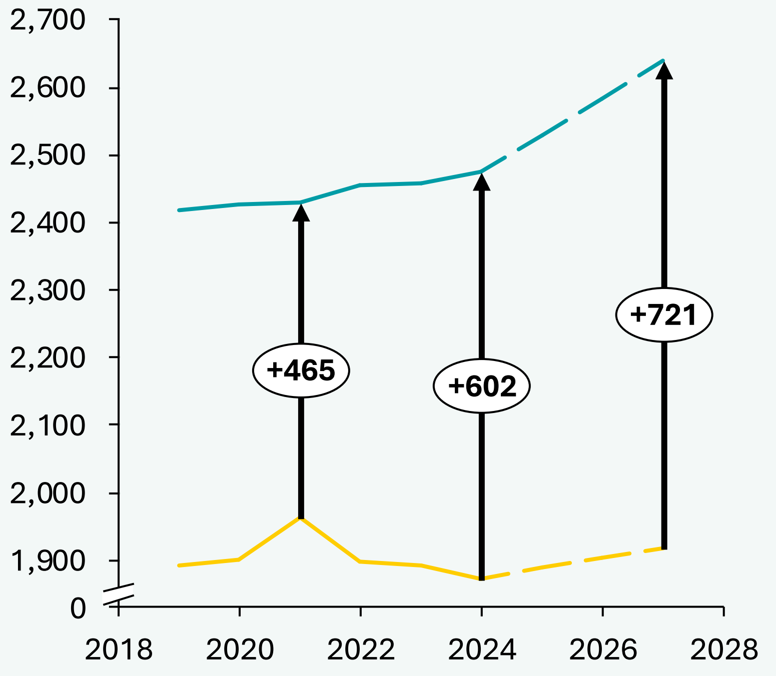
| Seoul, South Korea

Globally, the steel industry is under significant pressure, with margins under pressure because of overcapacity

c.720 Mt overcapacity by 2027

2019–27 global steel overcapacity, Mt

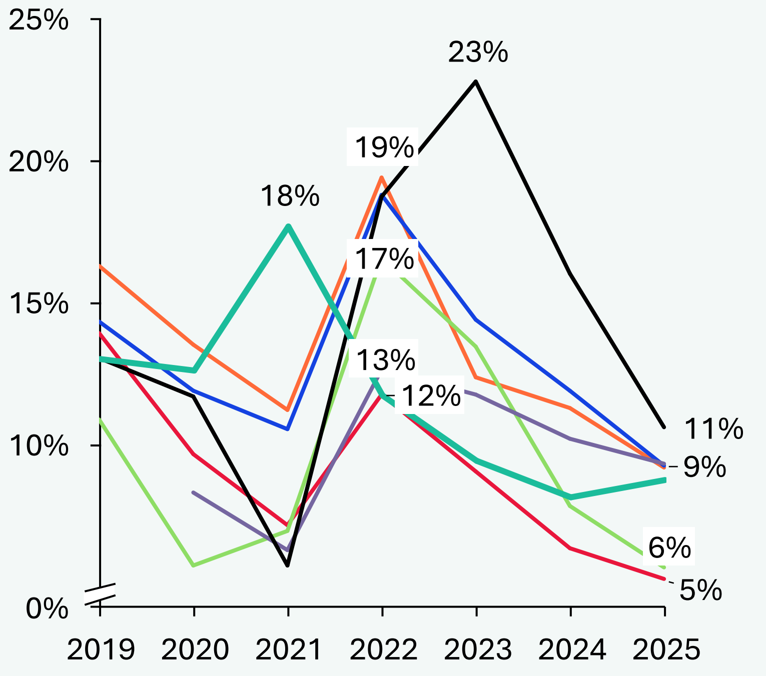
Demand (historical) | Capacity (historical) | Demand (forecast) | Capacity (forecast)



5–10% global margins compressed

2019–25 EBITDA margins by country[1], %

AU, NZ, Canada | Emerging | Global | US | China | Europe | Japan | South Korea



Overcapacity is widening. The capacity – demand gap could reach c.720 Mt by 2027 from c.470 Mt in 2021, with 165 Mt of new capacity additions amidst modest steel demand growth. Global utilisation of steel production is implied to be c.75%.

Asia is expected to drive new capacity additions – China, India, ASEAN. Cross-border investments are also directed to BF-BOF steelmaking. Chinese investment in particular has contributed to South-East Asia's growing excess capacity, adding fossil-route capacity to a market already struggling to absorb supply.

Meanwhile, margins have collapsed to single digits. Global steel EBITDA margins have fallen to c.10%, down from a 2022 peak of c.20%. European, Chinese and Japanese producers now sit at 5 – 9% – levels at which re-investing in new production capacity is challenging.

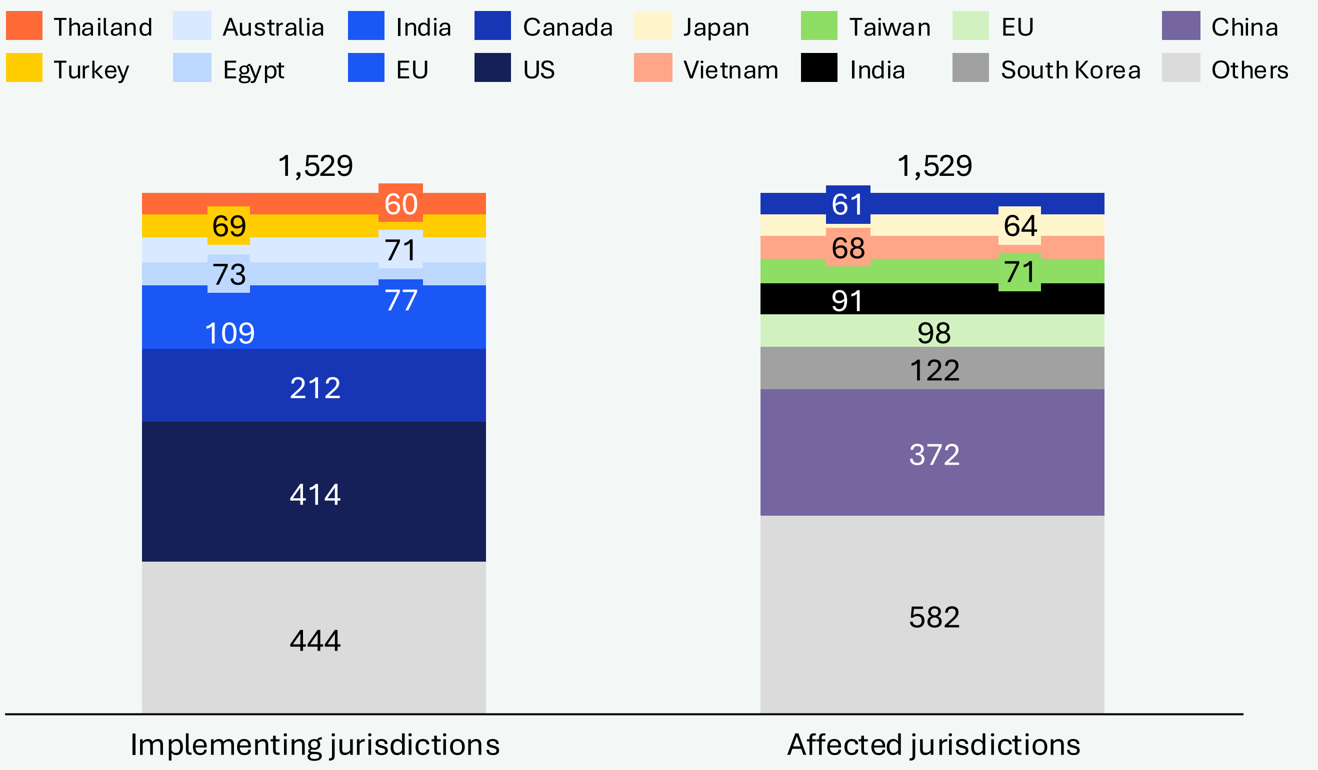
Korea is not insulated from this pressure. At 8.7% EBITDA in 2025, Korean producers sit at the lower end of the global range – comparable to Europe and China. That margin level leaves limited headroom to self-fund capital-intensive reinvestments in production or productivity.

1. Total EBITDA / total revenues across peers (global 719, emerging 555, China 101, EU 57, Japan 40, US 19), EU includes UK, Switzerland, Scandinavia, emerging includes Asia, LATAM, East Europe, ME, Africa, Russia. Source: Analysis, OECD Steel Outlook 2025, Damodaran Online Stern NYU 2025, Bloomberg, Morningstar, Capital IQ, Compustat, World Steel Association

Overcapacity has pushed markets globally to tighten market access requirements and reduce reliance on imports

>1,500 steel trade barriers are tightening market access

2009–26 number of active global steel safeguards by implementing and affected jurisdiction[1]



Trade barriers across Korea's key export markets have reached historic levels. More than 1,500 steel trade measures are now active globally, with the US (414), Canada (212) and the EU (109) accounting for the bulk of defences in force. These are the markets Korean steel relies on most – and the direction of travel is one way: only one intervention was removed in 2026.

Korea is the second most-targeted steel exporter globally, behind only China. China is named in 372 active measures; South Korea in 122 – well ahead of other affected jurisdictions. That exposure is not incidental. It reflects Korea's position as a high-volume, high-quality exporter into precisely the markets most active in defending domestic production.

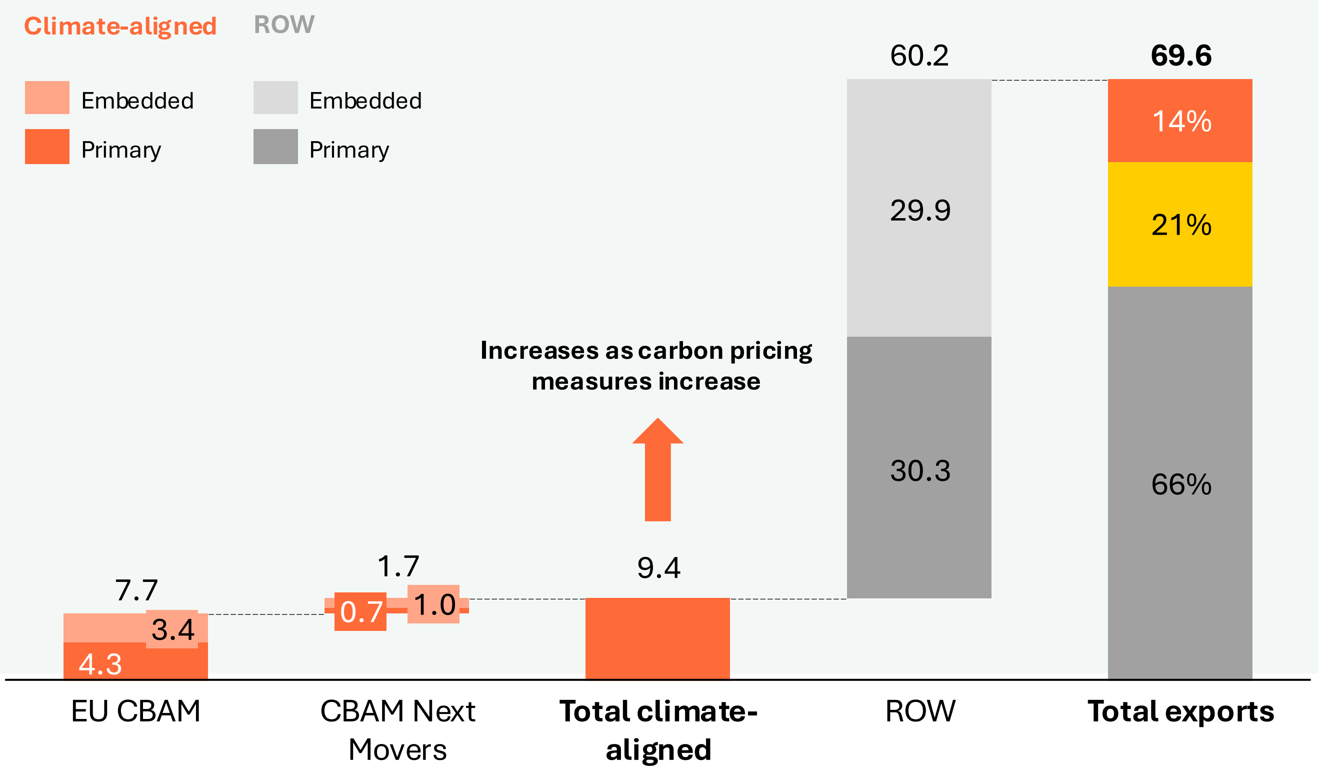
The policy toolkit is shifting from tariffs to structural barriers that are harder to navigate. The US raised Section 232 tariffs from 25% to 50% in 2025 – a blunt volume instrument. The EU is moving in a different direction: CBAM (Carbon Border Adjustment Mechanism) ties market access to embedded emissions, creating a permanent cost for high-carbon exporters that tariff exemptions cannot offset. India, Vietnam, Indonesia and Egypt are scaling domestic capacity to displace imports entirely. Together these measures represent a qualitative change in the nature of market access risk – not just higher costs, but conditions on access.*

1. Contingent trade-protective measures (anti-circumvention, anti-dumping, anti-subsidy, safeguard), only 1 intervention removed in 2026. Source: Global Trade Alert 2026

Market Access: explicit climate-aligned trade policies like CBAM impact a significant share of Korean steel exports

Exposure could rise to c.$9 bn as CBAM-style measures are extended to primary steel and manufactured products

2024 primary + embedded steel export value and country, $ bn



Korea's exposure to EU CBAM is immediate and concentrated in its highest-value export grades. Around $4 bn – roughly 15% of primary steel export value – is already within CBAM scope. Flat steel accounts for most of that exposure, reflecting precisely the grades Korea has built its competitive position around. As free allowances phase out through to 2034, the cost of that exposure will rise regardless of carbon price assumptions.

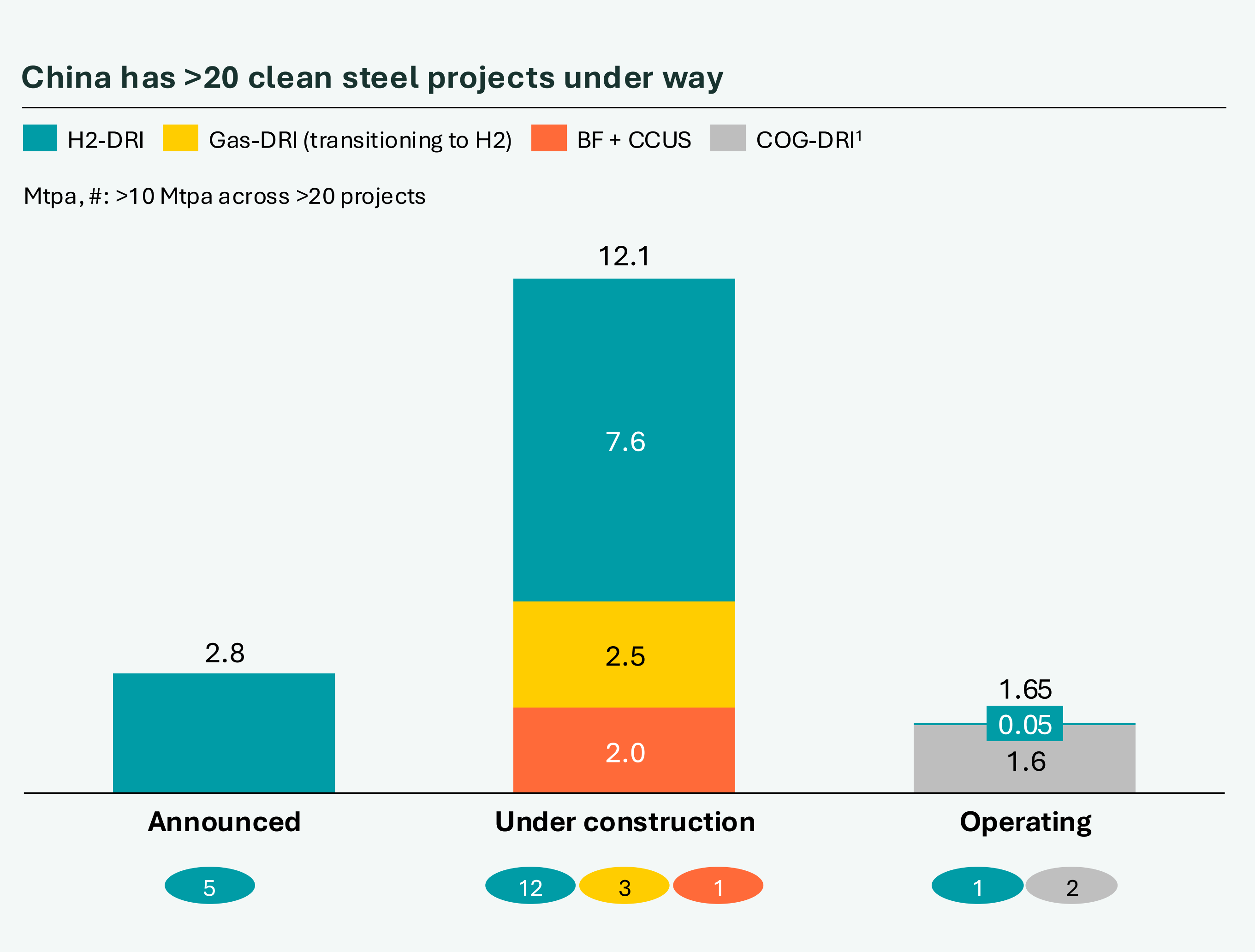
CBAM is extending beyond primary steel to steel embedded in manufactured goods. From 2028, the EU will widen coverage to include steel embedded in vehicles, machinery and electrical equipment. That will lift total Korean steel exposure to around $7.7 bn – nearly double the current primary steel figure – with automotive carrying over a third of the new exposure alone.

Other major markets are moving in the same direction. The UK and Australia are each at various stages of developing carbon border measures broadly consistent with CBAM in design. Together they represent a further $0.7 bn of Korean steel exports currently outside carbon-pricing scope.

The cumulative effect is an accelerating share of Korean exports subject to carbon conditionality through the 2030s. What is today a defined EU compliance obligation is becoming a structural feature of Korea's export relationships. Producers without a credible low-carbon position will face not just cost penalties but conditional access – and the window to build low-carbon capacity ahead of the measures tightening is narrowing.

Source: MPP analysis of HS6 codes for steel exports (chapters 72/73) covered by CBAM and the additional c.130 HS codes for steel proposed to be covered by the downstream CBAM extension. Trade data are for 2024 and taken from BACI. Proposed CBAM 100% phase-in could be extended to 2038 – currently legislative proposal and not yet final law

China has sensed this trend and made the most progress on low-carbon steel production with >10 Mt of iron making using green hydrogen



China is rebuilding its steel base, not retrofitting it. More than 10 Mtpa of H2-HBI capacity is being built at more than 20 projects – the largest BF-BOF to DRI-EAF pivot anywhere, with capital committed faster than in any other jurisdiction. The scale and pace together represent a structural shift, not an incremental one.

The build is aimed at export markets, principally in Europe. Crude fossil steel capacity is capped under MIIT's capacity replacement policy and the 2030 carbon peak commitment – domestic demand has peaked, so new clean tonnes are aimed abroad. HBIS Zhangjiakou and Baowu Zhanjiang are already positioning to supply BMW, Mercedes-Benz and Volkswagen via tier-1 suppliers as CBAM tightens. China is not waiting for cost parity to pursue market share in premium segments.

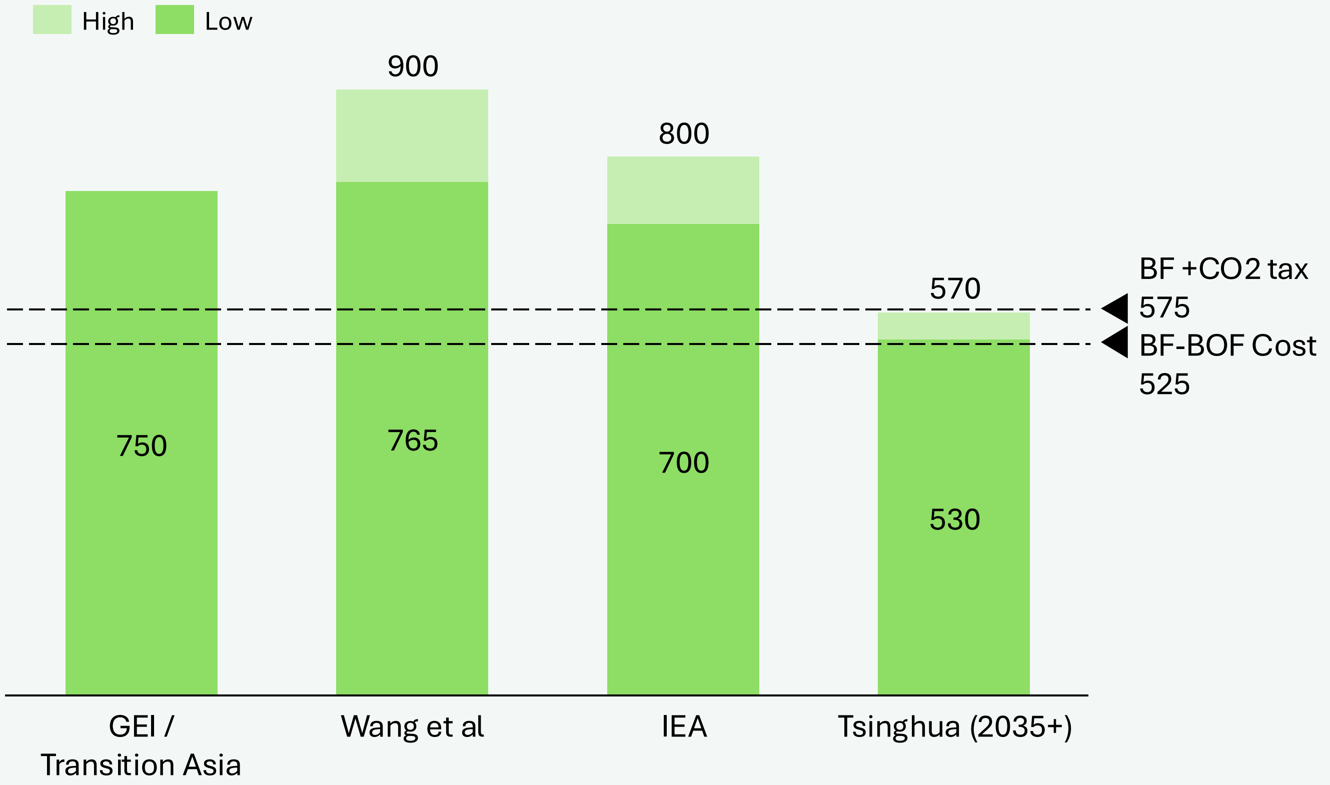
Policy is designed to manufacture that cost parity, not wait for it. Hydrogen Pilot Projects offer up to RMB 1.6bn per city cluster over four years, with steel-specific production incentives layered on top. The 15th Five-Year Plan locks capacity control to decarbonisation targets, embedding the transition in the planning architecture rather than treating it as voluntary. The 2026 hydrogen strategy targets end-user prices below RMB 25/kg by 2030 – from RMB 35–50/kg today – a trajectory that, if achieved, closes the cost gap with BF-BOF within the decade.

1. Coke Oven Gas. Sources: CISRI interview, MPP Global Project Tracker Oct 2025

China's transformation could rapidly change the economics of low carbon steel and unlock demand at scale

Green steel in China remains more expensive today, but some estimates show it approaching cost parity after 2035

2030 LCOS estimates for China, by analyst USD/t HRC



Low-carbon steel production is much more costly today. Analysts estimate H2-HBI sits at \$750–900/t against c.\$520/t for BF-BOF – a 50–70% gap. At current hydrogen costs and capital intensity, the economics do not close without policy support, long-term offtake, or carbon pricing.

China is building through that premium anyway – and accumulating something more valuable than capacity. Every project is a test case for cutting costs, operational learning and frontier technology development. Producers running H2-HBI-EAF at commercial scale build knowledge and first-hand experience in process control and optimising flexibility that compounds over time.

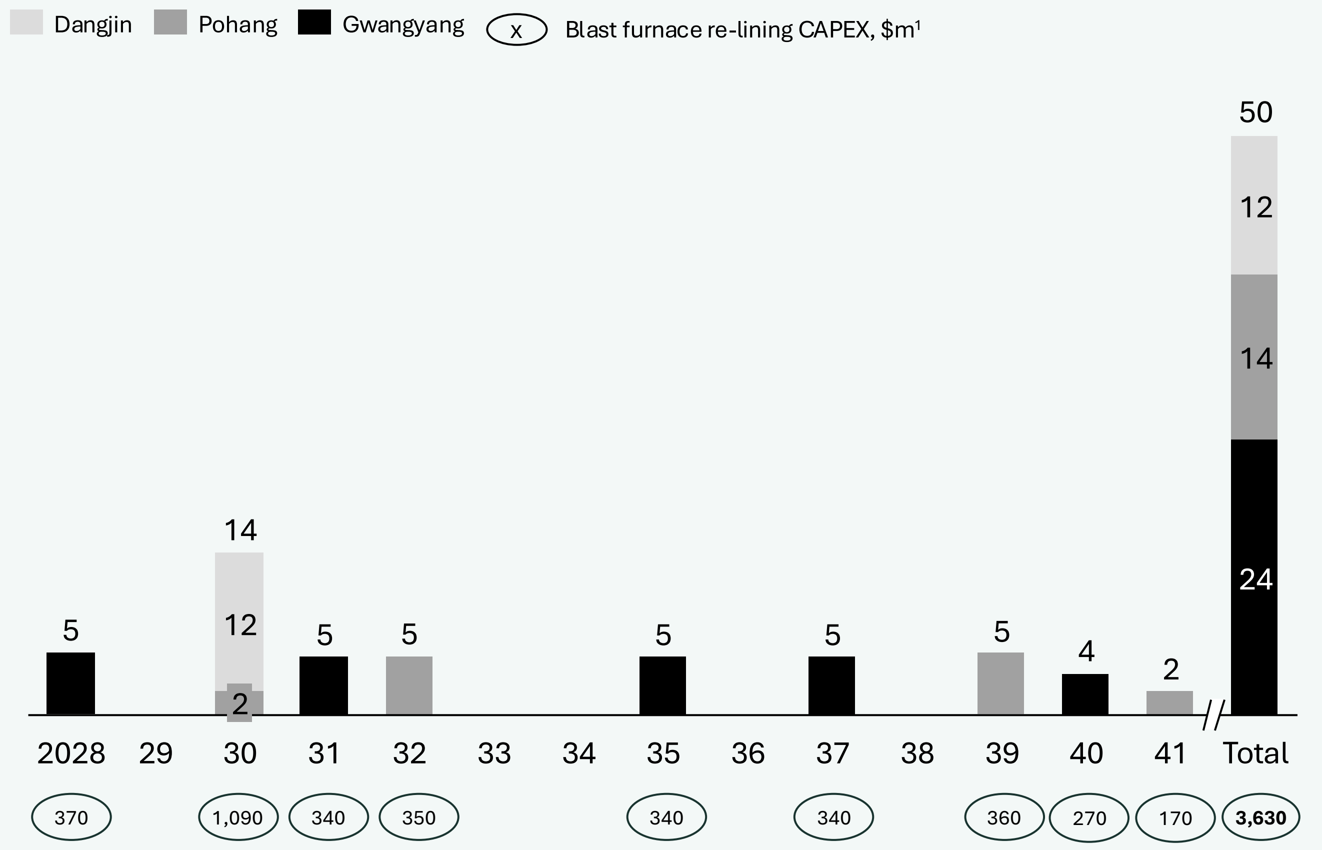
Recent research points to a credible path to cut costs through operational flexibility rather than hydrogen price alone. Tsinghua shows that H2-HBI-EAF systems can operate as an integrated flexibility stack – scheduling electrolysis, direct reduction and steelmaking around renewable availability rather than buffering variability with batteries and hydrogen storage. That cuts CAPEX from \$2.4 bn – \$3.1 bn to \$2.0 bn – \$2.4 bn and LCOS drops 6–10%, bringing Chinese H2-HBI within striking distance of BF-BOF cost parity by 2035. Latent demand is waiting: c.50% of companies surveyed would pay a premium for steel with 25% lower emissions, and c.80% expect lower-emission steel to be standard by 2035.

The risk for Korea is not Chinese export volumes but cost leadership and technological capability. The learning curve from operating at scale determines who sets the cost frontier when the market inflects. Korea's window to match that learning and stay competitive is measured in blast furnace relines, not years.

Sources: Tsinghua He et al. (2026) Unlocking Multi-Stage Flexibility Enables Cost-Competitive Hydrogen-Based Steelmaking in China, Energy & Env. Science (S5: Electrolyzer standby + flexible DRI + batch EAF), GEI / Transition Asia, Wang et al, IEA, press search, Climate Group / Ramboll

Korea faces an acute decision point: >$3.5 bn commitment to legacy furnace relining is due, decisions that lock in emissions and costs for decades to come

2028–41 blast furnace re-lining capacity, Mt



The next major reline decisions are Gwangyang BF1 and Dangjin BF1 and BF2, expected in 2028. Gwangyang BF1 – the world's largest at 5 Mt – was last revamped in 2013, with Dangjin BF1 and BF2 at 4 Mt each. Each reline locks in technology and emissions for 15–20 years, with a further $3.5 bn of decisions through to 2040.

Timing is less forced than the wave implies. With a c.60-year design life and Korea's fleet aged c.15–50 years, many furnaces remain short of end-of-life.

There are three options:

1. Re-line in coal-based capacity – as POSCO did with Gwangyang BF2 at 4.5 Mt in 2024
2. Defer or retire the BF and reduce output
3. Rebuild as DRI-EAF – gas-based now, FBR (HyREX)-ready by the 2030s

The DRI-EAF rebuild is Korea's path to keep its place in the low-carbon export market. Re-lining locks in high-carbon tonnes facing rising CBAM and Scope 3 pressure, and stepping output down cedes premium tonnes to China's H2-HBI build. The rebuild is the investment worth making – provided credible energy and hydrogen infrastructure is in place to underpin it. With POSCO's earliest HyREX timeline c.2037, the near-term priority is to build that infrastructure so low-carbon FIDs proceed with confidence. ArcelorMittal's June 2025 cancellation of its Bremen and Eisenhüttenstadt DRI-EAF projects – citing weak policy, energy and demand conditions – shows what happens when that infrastructure is absent.

1. Large-scale BFs >500 kt $340–370 m / re-lining, mid-sized units $270–300 m, assumed 15 years of operation after last re-lining. Source: Analysis, NEXT Group steel mill database

Two factors will define South Korea’s steel capital cycle: how it responds to climate-aligned trade policy and China’s cost competitiveness

Three forces are converging on the same decision point. Climate-aligned trade policy, Chinese competition and the wave of furnace relines are arriving simultaneously. The capital decisions made in the next five years will define Korea's competitive position for the next 20–25 years, and those decisions cannot be deferred until the picture is clearer.

CBAM exposure sets a transformation floor, not a ceiling. The scale of Korea’s exposure to carbon-conditioned demand defines the minimum conversion Korea cannot avoid – some relines will need to be rebuilds regardless of strategic preference. But compliance with CBAM is the floor. Producers who treat it as a ceiling will lose ground to those who use the transition to cut costs and build capabilities that outlast the compliance regime.

China is not just building capacity – it is building the learning curve. Operational knowledge in hydrogen metallurgy, flexibility optimisation and process control compounds with every tonne produced. Korea's window to match that learning and stay at the frontier is measured in reline cycles. Producers who wait for cost certainty before committing to low-carbon production will find the gap harder to close with each passing year.

Trend	What it means	Implications for competitiveness
Increasing carbon-aligned markets: Up to $8–10 bn annual exposure	Around 12% of Korean steel exports flow into the EU27 today. That share is not yet dominant, but it is not immaterial, and it is growing as more markets adopt similar measures. The more significant point is directional: climate-aligned trade policy is expanding, and a rising share of Korean exports will face carbon costs over time.	Blast-furnace steel will be at a disadvantage in export markets to lower-carbon routes because it will face higher carbon costs. Producers who do not invest in those routes risk losing market share in carbon-aligned markets, even before CBAM spreads further.
Competition from China: at least 10 Mtpa H2-HBI capacity	China is leading the race to develop, deploy and commercialise hydrogen metallurgy at scale. With more than 10 Mtpa of H2-HBI capacity in build, Chinese producers are accumulating operational experience, driving down costs, and demonstrating the ability to produce higher-grade steels from new production routes.	China's ambition is not limited to commodity markets. As hydrogen metallurgy matures, Chinese producers could challenge Korea in premium segments where lower carbon content and product quality both count. The competitive threat is as much about capability and learning as it is about cost.
Capital cycle: ~20 Mt of reline decisions in the next 5–6 years	Around 20 Mt of Korean blast-furnace capacity is due for reline in the next 5 years, a meaningful share of total production. Each reline is a 15-year investment decision. The technology and emissions profile chosen now will be locked in through the late 2030s and beyond.	The reline schedule is the binding constraint. Decisions taken in the next five years will determine Korea's production profile through to the late 2030s. The window to embed lower-carbon routes into the capital cycle is open now, and it will not reopen for a generation.

Source: MPP Global Project Tracker Oct 2025

Embracing new production routes to supply into CBAM markets is inevitable and Korean steelmakers have already made early bets

Both POSCO and Hyundai Steel have made early commitments across multiple routes. POSCO is commissioning a 2.5 Mt scrap EAF at Gwangyang in 2026 and advancing FBR (HyREX) at demo scale in Pohang, targeting commercial scale by 2037. Hyundai Steel holds an 80% equity stake in the Louisiana DRI project, co-owned with POSCO, targeting first production in 2029. POSCO is also developing a 2 Mt hybrid DRI project at Port Hedland in Australia.

The near-term pipeline is defined by Gwangyang, HyECO and Louisiana – but the mid-decade picture is unresolved. FBR (HyREX) may not reach commercial scale before 2037 and no further FIDs appear imminent. That leaves a gap between current clean capacity and the next wave of capacity decisions.

Korea's bets are real but concentrated – and the reline pipeline requires a broader and faster capital response than the current pipeline delivers. The K-GX Strategy and K-Steel Act provide the legislative foundation to accelerate. But legislation will not move capital without bankable project economics, demand certainty and financing structures. The gap between Korea's policy framework and the investment pipeline it needs remains the central challenge of this decade.

Technology family	How it works	Key limitations	Korean steelmaker bets
CCS on BF-BOF	Captures CO_2 from blast furnace flue gas and stores it underground. Retains existing iron-making process.	No proven commercial reference plant globally. Korean geology presents additional CO_2 storage constraints.	No committed commercial deployment by POSCO or Hyundai Steel.
Scrap EAF	Melts recycled scrap in an electric arc furnace, bypassing iron-making entirely. Emissions track grid carbon intensity.	Domestic scrap supply insufficient to displace primary steel at scale. Contaminants in scrap limit ability to produce flat steel grades.	Hyundai Steel already operates scrap EAF commercially.
DRI-based routes: *Gas-DRI/HBI** *Hybrid-DRI/HBI* *H_2-DRI/HBI*	Reduces iron ore with a hydrogen-rich gas in a shaft furnace; blends range from natural gas through to pure green hydrogen.	Requires DR-grade pellet ore – a globally limited supply distinct from blast furnace fines.	Hyundai Steel and POSCO have a 2.5 Mt gas-based DRI plant under construction in Louisiana. POSCO also has a 2 Mt hybrid HBI project under development at Port Hedland, Australia.
FBR (HyREX) *POSCO proprietary*	Fluidised-bed hydrogen reduction using iron ore fines directly – designed to overcome the DR-grade ore requirement of shaft-furnace DRI.	No commercial reference plant. Requires green hydrogen at scale.	POSCO demo plant under construction at Pohang, expected complete 2028. Commercial scale not expected before 2035.

Source: Press search, MPP Global Project Tracker Oct 2025, Hyundai Steel, POSCO websites. *note that DRI connoted direct reduced iron. Imported products are likely to be hot briquetted iron (HBI) which is more stable to transport.

CORE choices dictate which bets to double down on: Competitiveness, Opportunity, Resilience and Employment

Every low-carbon pathway creates four CORE choices for Korean steelmakers: Competitiveness, Opportunity, Resilience and Employment. Competitiveness asks which pathways cost least to produce and hold up once carbon costs are fully priced in. Opportunity captures the commercial value available to Korean firms across the value chain – not just for steelmakers. Resilience measures dependence on energy imports and exposure to commodity prices. Employment captures both the direct workforce each pathway sustains and the upstream manufacturing jobs its capital investment catalyses.

The four dimensions together reveal trade-offs that no single pathway resolves. The right balance of CORE choices will depend on the strategic priorities each steelmaker and the government bring to the transition – and those priorities are not identical.

	Metric	Description	Why it matters
C Competitiveness	**Levelised cost of steel (2030)** $/ t steel	All-in production cost per tonne including capex, energy, and feedstock.	Lowest cost before carbon is priced
	Delivered cost into Europe (2035) $/ t steel	LCOS plus full CBAM carbon cost per tonne exported to the EU at 2035 phase-in.	Lowest cost into Europe once carbon is priced
O Opportunity	**Annual revenue per plant (2030)** $m / year	Revenue from a 2.5 Mt plant spanning upstream tech, midstream equipment, and downstream green-premium steel.	Most commercial value for Korean firms in 2030
	Tech export opportunity $m / Capex	Share of plant value addressable by Korean tech firms and exportable to other markets.	Largest exportable technology opportunity
R Resilience	**Imported energy per tonne** GJ / t steel	Total imported energy required to produce one tonne of steel across all energy inputs.	Reduces Korea's energy import exposure
	Energy price shock on LCOS $/ t steel	LCOS increase from a 90th-percentile adverse move in input commodity prices.	Holds up best when commodity prices spike
E Employment	**Direct workers per plant** workers / 2.5 Mt plant	Steelmaking and ironmaking workforce directly employed at a 2.5 Mt plant.	Largest direct workforce at the plant gate
	Korean equipment jobs supported workers / 2.5 Mt plant order	Upstream Korean manufacturing jobs catalysed by capex in one plant – power and grid, H2, BESS, ironmaking, CCS.	Most upstream Korean manufacturing jobs

Emerging opportunities

Korea does not need to play defence in the low-carbon transition: cleaner pathways generate more value across every channel, and technology exports are the largest and most scalable prize on the table

| Steel working

Steel decarbonisation creates three distinct value channels for Korean industry; each channel has unique drivers and beneficiaries

	Upstream: Tech exports	**Midstream:** Green premiums	**Downstream:** Carbon-enabled market access
Value description	Korea captures value by supplying the equipment, components, and EPC services that build green steel plants globally – wherever they are sited.	Lower-carbon Korean steel commands a price advantage where carbon costs apply. The value is the avoided cost of CBAM charges that higher-emission steel would bear.	Low-carbon credentials open regulated downstream product markets where embodied carbon thresholds are tightening – covering not just steel, but goods that contain it.
Value drivers	• The share of plant CAPEX that Korean firms can supply – electrolysers, ESF, fluidised bed, BESS, EPC • Global DRI capacity additions and Korea's position as technology provider of choice • The production pathway: Korean IP share varies substantially by route	• EU ETS price and CBAM coverage, both increasing as the compliance regime matures • The emissions gap between Korean production and the BF-BOF benchmark • Export volumes to CBAM-eligible markets: EU, and potentially AUS and UK	• Frameworks like the IAA[1] and EU CO2 emission performance standard for cars with EU steel credits[2] reserve preferential market access for FTA partners with verified low-carbon credentials • Korea leverages established presence and carbon credentials to grow market share on a preferential basis
Beneficiaries	Equipment OEMs, EPCs, technology providers – not steel producers e.g. POSCO E&C, Samsung Engineering, LS Electric, Hyosung Heavy Industries	Korean steel producers, on their existing export volumes e.g. POSCO, Hyundai Steel	Korean downstream manufacturers, and the steel producers supplying them e.g. Hyundai Motor, Kia, HD Hyundai Heavy Industries, Hyundai E&C

The payoff from transition flows through three distinct channels, each with a different economic logic. Technology exports capture plant CAPEX; clean premiums capture the avoided carbon cost spread against the BF-BOF benchmark; and market access leverages trade policy to grow downstream export volumes as embodied carbon thresholds tighten.

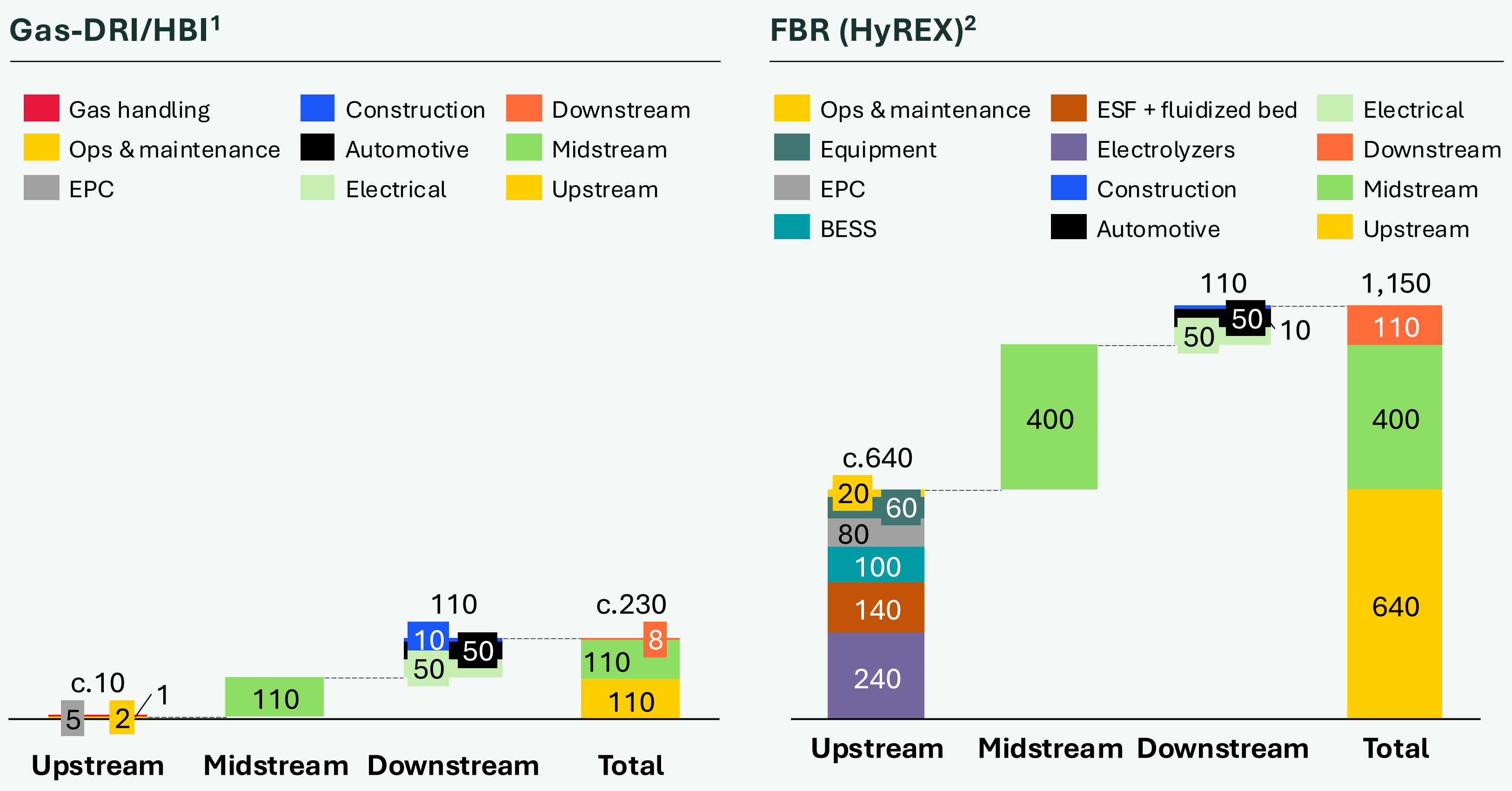
Each pathway has a different payoff function across all three channels. Technology choice not only determines Korean IP share in plant equipment, but also how far emissions intensity falls below BF-BOF, and if carbon credentials meet tightening import requirements.

Steelmakers bear the capital risk of transition but do not capture all the value they create. Tech export gains flow to equipment OEMs and EPCs; market access gains accrue to downstream manufacturers. The party investing in the reline is not the same as the party capturing the upside – that misalignment is the policy design problem this chapter addresses.

1. Industrial Accelerator Act; 2. European Commission – 10% of emissions reduction could be from low-carbon steel made in EU from 2035. Source: Press search

The size of low-carbon pathway benefits depends on control of the technology stack and the ability to access green premiums

2030 annualized opportunity per 2.5 Mt plant[3], $m



Pathways differ on two of the three value channels – upstream technology and midstream carbon savings – while downstream market access is the same regardless of route. Together those two differences produce a roughly 4x gap in total opportunity per plant.

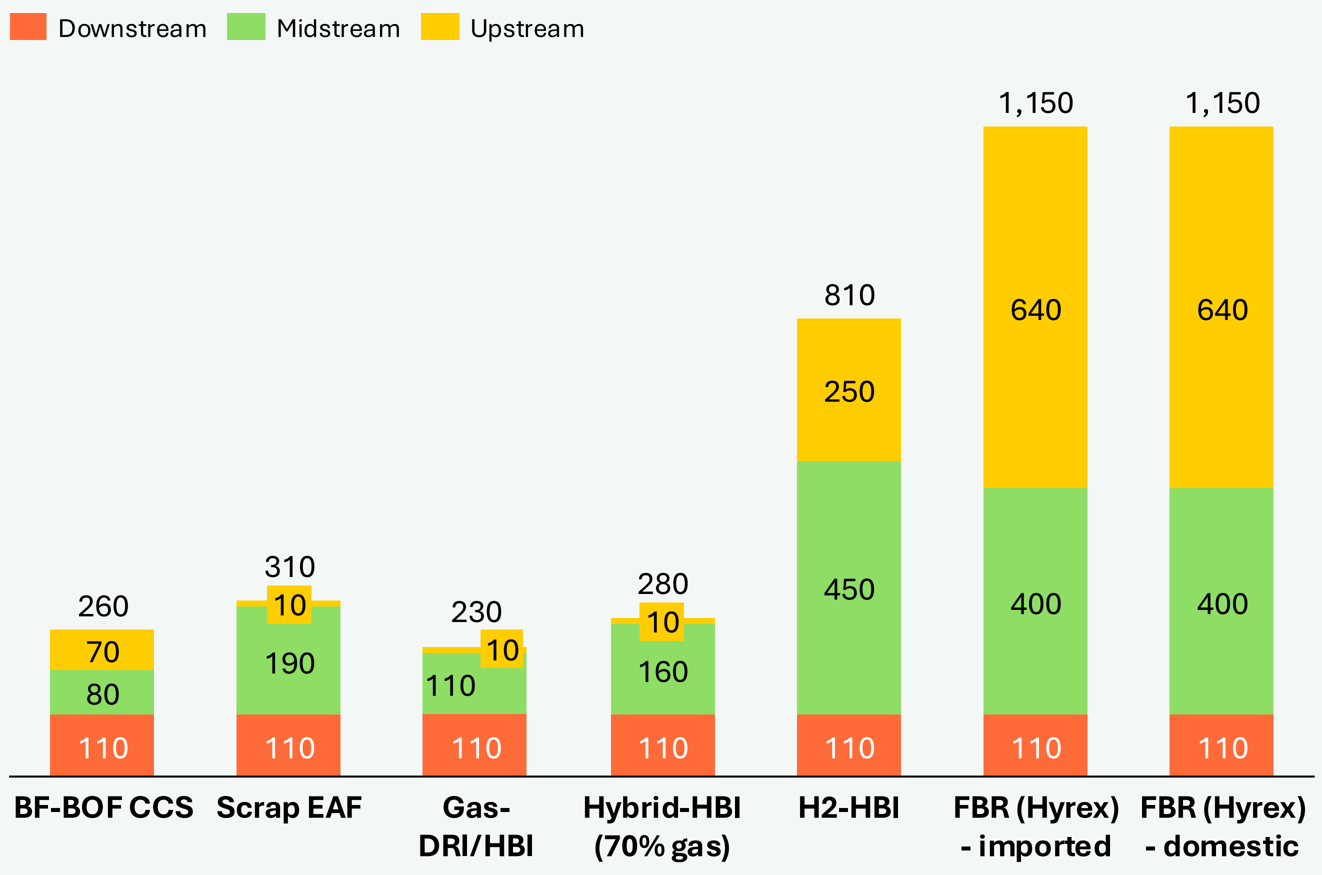
The upstream gap is driven by technology ownership. Gas-DRI/HBI relies on international capital equipment; Korea competes mainly in EPC and O&M. FBR (HyREX) directs the bulk of upstream plant CAPEX to domestic industry, with Korean-owned process equipment in areas such as electrolysers, ESF + fluidised bed and BESS.

The midstream gap is driven by emissions intensity. As EU free allowances unwind from 2026 – 34, FBR (HyREX)'s lower carbon intensity translates directly into larger avoided CBAM charges on Korean steel exports – a gap that widens each year compliance tightens.

1. c.USD440 / t steel capex, gas handling 1% of CAPEX, EPC 4%, 1 tCO2 / t steel; 2. HyREX with imported H2-HBI from Australia, c.USD2,700 / t steel CAPEX, equipment (power & grid, H2 handling) 9% of CAPEX. ESF + fluidized bed 20%, 10 – 13% EPC, 34% electrolyzers, 4 hr BESS c.USD1,700 / kW, 0.3 tCO2 / t steel; 3. Annual sales revenue with upstream annualised over 10 year payback assuming refinancing, O&M 2 – 4% of CAPEX, 1.4 tCO2 / t HRC CBAM benchmark, 51.5% 2030 CBAM coverage, BF-BOF 1.98 tCO2 / t steel, 2030 EUR145 / tCO2, 2040 EUR180 / tCO2, upstream annualised over 10 year payback assuming refinancing

Cleaner steelmaking routes offer greater value to Korean businesses

Short-run 2030 opportunity value per 2.5 Mt plant per year[1], $m



The cleanest routes deliver the most opportunity: gas, scrap, hybrid and CCS cluster at the low end, with a step-change at H2-HBI and above. Below that threshold, total opportunity per 2.5 Mt plant ranges from $230m to $540m. At H2-HBI it jumps to $810m, and FBR (HyREX) reaches $1,150m.

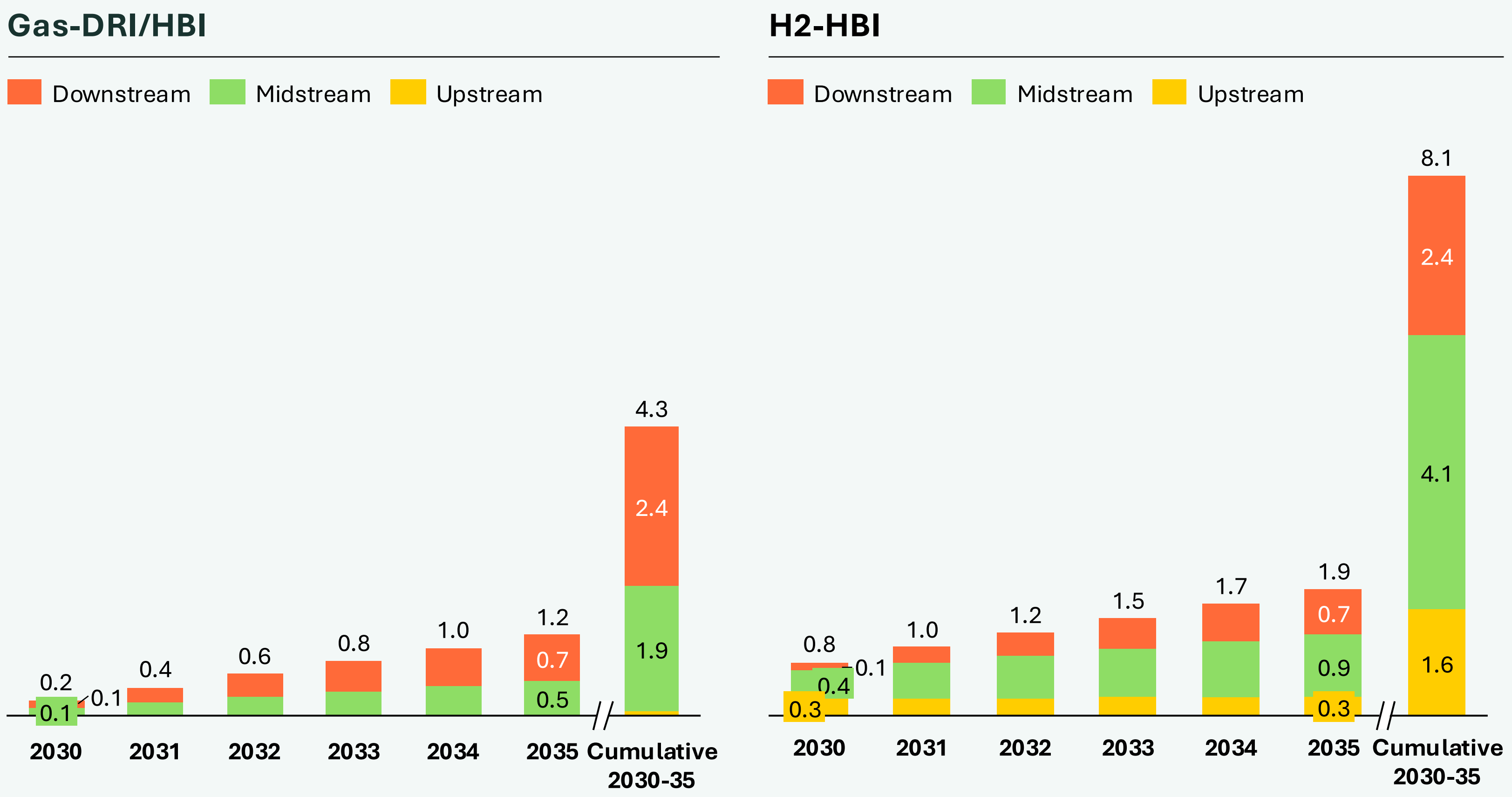
Upstream technology exports account for most of that difference, and the opportunity is concentrated in hydrogen metallurgy routes. Upstream value is negligible across gas, scrap and hybrid pathways – below $80m – because core capital equipment is internationally owned. For H2-HBI and FBR (HyREX), where electrolysers, ESF and fluidised bed reactors become the dominant equipment, upstream value reaches $250m – $640m per plant. Korean industry is best placed to capture this layer of value.

Korea can capture the HyREX opportunity regardless of how the plant is supplied. FBR (HyREX) delivers the same ~$1,150m opportunity per 2.5 Mt plant whether it runs on imported HBI or on domestically produced iron using nuclear hydrogen. Because the opportunity does not depend on that choice, Korea captures the full upstream value in either configuration – making HyREX a robust value-capture route rather than one contingent on a single supply-chain decision.

1. Upstream based on South Korea opportunity capture of CAPEX / t Steel: BF-BOF CCS c.$970 / tpa, H2-HBI c.USD2 k / tpa, scrap EAF & gas-DRI & hybrid-DRI c.$400 / tpa, FBR (HyREX) c.$2.7k / tpa, annualised by a 10 year payback period where assumed refinancing takes place, Midstream based on 1.4 tCO2 / t HRC CBAM benchmark, 51.5% 2030 CBAM coverage, BF-BOF 1.98 tCO2 / t steel, EUR145 / tCO2 in 2030, EUR180 / tCO2 in 2040, emissions intensity: BF-BOF CCS 1.1 tCO2 / t Steel, scrap EAF 0.2, gas-DRI/HBI 1.0, hybrid-DRI 0.9, H2-HBI 0.2, FBR (HyREX) 0.3 (nuclear H2). Source: Analysis, NEXT Group LCOS model 2026

Green premiums and access to carbon-conditioned markets dominate the 2030–35 opportunity, with clean-tech exports contributing only a little

2030–35 opportunity value by technology per 2.5 Mt plant[1], $B



In the near term, midstream and downstream – not technology exports – are where Korean industry captures value. With commercial FBR (HyREX) not expected before 2035, upstream contributes a small share of cumulative opportunity on both pathways. The near-term case for transition is about establishing a low-carbon position now – being in the market when the larger prizes open.

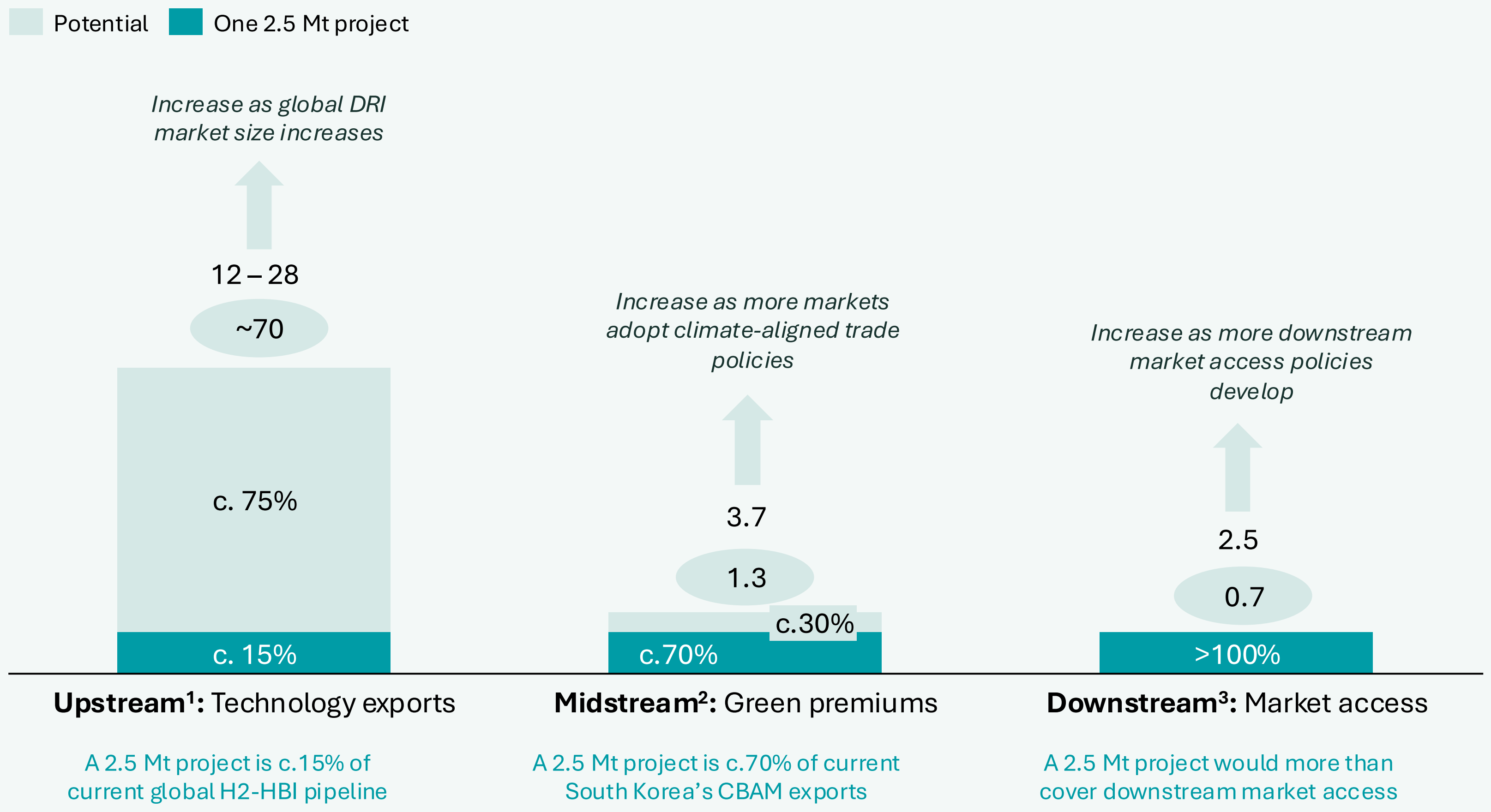
CBAM free allowances determine the speed at which midstream value accrues – on H2-HBI, midstream becomes the dominant channel as allowances phase out. As allowances unwind from 2026 – 34, the avoided carbon cost per tonne grows year by year. On gas-DRI/HBI, midstream avoided carbon cost reaches $1.9bn cumulatively by 2035; on H2-HBI it reaches $4.1bn – nearly double downstream on that pathway.

Downstream is a significant prize on both pathways, but it does not open automatically. At $2.4bn cumulative by 2035, unlocking it requires Korea to actively build reciprocal alignment with Europe – structured trade partnerships where low-carbon credentials create preferential access for Korean steel and steel-intensive manufactured goods.

1. H2-HBI CAPEX c.$2k / tpa, c.10% of CAPEX for equipment power & grid and H2 handling, 10 – 13% EPC, BESS c.$400 / tpa, gas-DRI c.$400 / tpa, 1% equipment oxygen handling, 10% EPC margin with c.40% from EAF, 2 – 4% O&M, 1.4 tCO2 / t HRC CBAM benchmark, 51.5% 2030 CBAM coverage, BF-BOF 1.98 tCO2 / t steel, 2030 EUR145 / tCO2, 2040 EUR180 / tCO2 in 2040, emissions intensity: BF-BOF CCS 1.1 tCO2 / t Steel, gas-DRI/HBI 1.0, H2-HBI 0.2, upstream 10 year payback period assuming refinancing.
Source: Analysis, NEXT Group LCOS model 2026

But in the long run, clean-tech exports have the most scalable ceiling: green premiums and market access have hard limits

One 2.5 Mt FBR (HyREX) project as % of potential market size[1], Mt, $B, %



Technology exports are the only value channel with a ceiling that rises with the global DRI market rather than with Korean export volumes. At ~**$70bn**, the addressable upstream prize is an order of magnitude larger than midstream or downstream. 1-2 plants cover Korea's entire CBAM-scope steel export base, but Korean OEMs and EPCs can compete for every DRI plant built.

Korea's technology positions are strong in energy, BESS and finishing – but absent where today's DRI market is concentrated. Shaft furnace ironmaking is dominated by Midrex and Tenova/HYL; EAF equipment by European and Japanese firms. These incumbents hold the reference plants, engineering depth and customer relationships that new entrants cannot quickly replicate.

That gap defines Korea's strategic choice more sharply than any cost comparison. Competing in shaft furnace DRI means entering markets where established players have decades of lead. FBR (HyREX) involves proprietary Korean IP, no established competitor, and a technology designed to bypass shaft furnace ore constraints entirely.

1. Current H2-HBI project pipeline South Korea (low), global (high), value low based on total bottom-up project CAPEX, high based on equipment CAPEX for FBR (HyREX) with electrolyzer on 28 Mt global project pipeline; 2. Exports to EU, Australia, UK 3.7 Mt; 3. 0.9 Mt of steel exported in automotive, construction, electrical to EU and UK, value only linked to 0.9 Mt and no estimate from 2.5 Mt project. Source: Analysis, Mission Possible Partnership Global Project Tracker Nov 2025

The cleanest pathways offer Korea the greatest upside: hydrogen routes outperform gas and CCS-based options across every value channel

The highest-value pathways are the lowest-carbon ones. Opportunity value scales from c.$230m per 2.5 Mt plant for Gas-DRI/HBI to $810m for H2-HBI and $900m–$1,150m for FBR (HyREX). All three value channels – technology exports, clean premium, carbon-conditioned market access – favour the same end of the spectrum. Value and decarbonisation point the same way.

Korea captures relatively little from gas-based routes, but CCS offers a partial exception. Gas-based iron's technology export share sits at 7–9%; Korea competes mainly on EPC and operations, not core process equipment. BF-BOF CCS is a partial counter at 66% technology export share – a transition option that can be exploited through Korea's existing asset base. Gas-based pathways are a near-term bridge, not a strategic position.

The near-term prize comes from carbon trade policy; the long-run prize comes from technology. Clean premiums and carbon-conditioned market access are accessible now – before H2-HBI commercialises – by moving early on verified emissions data. Beyond 2035, as premium and market access channels saturate, technology exports are the only channel with a scalable ceiling. Korea's pathway choice today determines whether it holds that position when the larger prize opens.

But the steelmaker investing in the highest-value pathway does not capture all the value it creates. Technology export gains accrue to OEMs, EPCs, and equipment suppliers – not to the steelmaker bearing the capital risk. The private return understates the national return, and that gap is the policy design problem this report addresses.

Tech		1 Opportunity: a 2030 revenue opportunity[1], $m	1 Opportunity: b Tech export potential[2], $b Capex
BF-BOF		-	-
BF-BOF CCS		260	1
Scrap EAF		310	2
Gas-based iron	Domestic (DRI)	230	-
Gas-based iron	Imported (HBI)	230	5
Imported Hybrid HBI (70% gas)		280	1
Imported H2-HBI		810	70[4]
FBR (HyREX)	Domestic (Nuclear)	1,150	3
FBR (HyREX)	Imported (as HBI)	1,150	6

High upside / low cost | Medium upside / cost | Low upside / high cost

1. Annualized value of revenue from upstream, midstream and downstream $m per 2.5 Mt plant per annum; 2. One-off tech sales based on CAPEX multiplied by announced project pipeline BF-BOF CCS USD700 / t 2 Mt, scrap EAF USD145 / t 14 Mt, Gas-HBI USD90 / t 55 Mt, Hybrid-DRI USD140 / t 7 Mt, FBR (HyREX) USD2,900 / t 1 Mt domestic, 2 Mt imported; 3. Nuclear; 4. H2-HBI bottom-up equipment CAPEX including RE USD27 B

Source: Analysis, MPP Global Project Tracker June 2026, MPP Procurement Book 2026

Navigating trade-offs

Gas and CCS are the most cost-competitive routes to 2030, but FBR (HyREX) leads on resilience and employment – the right balance depends on Korea's strategic priorities

| POSCO Pohang, South Korea

Competitiveness: newer production pathways will likely displace traditional blast furnace production by 2035 in CBAM markets

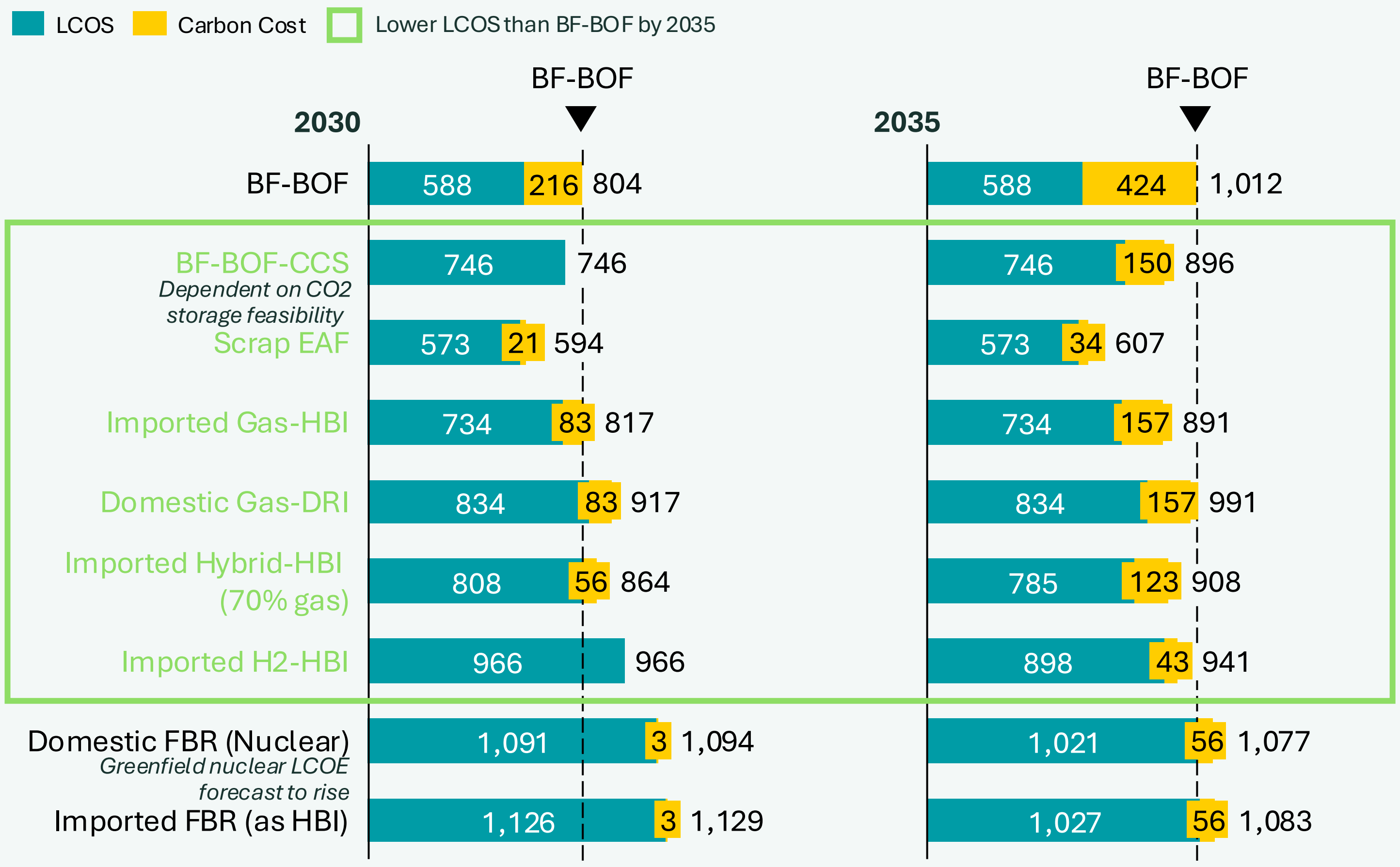
Blast furnace-basic oxygen furnace (BF-BOF) remains the lowest-cost route in markets insulated from carbon pricing. At $588/t, blast furnace steel is much cheaper for Korean steel going to markets without carbon conditions.

As free allowances phase out, clean technologies become more competitive very quickly for Korea's most important export markets. Carbon costs on BF-BOF rise steeply between 2030 and 2035, making them more costly to deliver into Europe than imported gas-HBI, scrap EAF, and, by 2035, even imported H2-HBI. The inversion is not gradual: it is defined by the allowance schedule, and the competitive order flips decisively as the free allocation rate reaches zero.

Scrap EAF is the lowest-cost clean pathway, but it cannot serve the volumes most exposed to CBAM. Korea's CBAM-exposed exports are concentrated in flat steel grades, coated sheet, heavy plate, cold-rolled coil, where the accumulation of tramp elements in recycled scrap creates a quality ceiling that is a physics constraint, not a cost gap. Scrap EAF addresses the cost problem for some output; but not for the grades that matter most.

Imported routes are cheaper for gas, but FBR (HyREX) is the exception. Imported gas-HBI lands around $100/t below domestic production, driven by access to cheaper producer-market gas. FBR (HyREX) domestic and overseas costs are broadly similar; however, over time imported production is expected to outcompete domestic nuclear on energy costs.[2]

Cost of Steel by pathway into Europe[1], $/ t Steel



Source: NEXT Group LCOS Model was used for LCOS and route-specific carbon intensities. By 2035 some small falls in hydrogen prices drive a decline in H2-linked route LCOS. CBAM benchmarks for BF-BOF, DRI-EAF, and scrap-EAF under Colum B are used. A CBAM certificate cost of $170/t in 2030 and $215/t in 2035 as per BNEF's 2025 H2 ETS price forecast. CCS based on literature dependent on feasibility (e.g., CO2 storage sites, storage safety, transportation including long distance maritime and cross-border storage coordination). FBR (HyREX) based on MPP analysis. Proposed CBAM 100% phase-in could be extended to 2038 – currently legislative proposal and not yet final law. 2. For example Moon et al (2025) forecast South Korean nuclear LCOE increasing by 15% by 2035, and up to 44% by 2050.

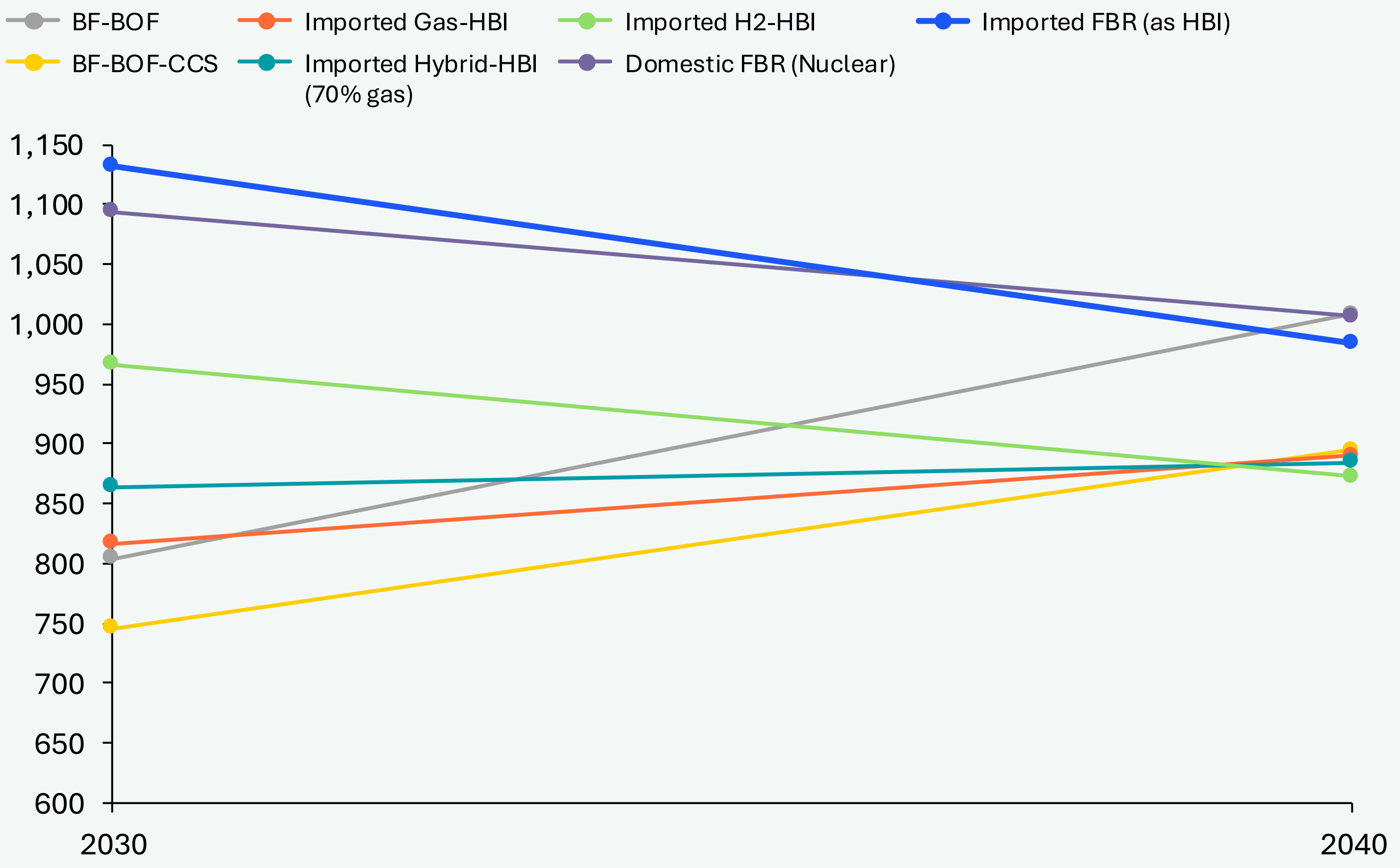
Competitiveness: By 2040, all major low carbon production pathways could be cheaper than traditional blast furnace production

BF-BOF's cost advantage erodes as CBAM costs rise and clean route costs fall. The dynamic visible in 2035 continues and deepens: blast furnace steel production costs are static while carbon charges keep increasing on top of them. Clean routes move in the opposite direction. The convergence is asymmetric, BF-BOF is not getting cheaper, everything else is.

By 2040, the clean routes have clustered tightly, but it is far from clear which will be the most cost-effective. H2-HBI, imported hybrid-HBI, and gas-HBI arrive within 2% of each other, at $873/t, $885/t, and $890/t respectively, a margin well within the uncertainty range of any long-run cost model. BF-BOF-CCS, which held the lowest-cost clean position in 2030, has slipped to fourth at $894/t as rising carbon costs erode the value of its capture advantage. It is clear that BF-BOF, at $1,009/t, sits well clear of the pack. What is not clear is which clean route leads it.

The technology order matters, but Korea's own decisions determine where it lands within it. No single route has separated so cleanly from the others that the choice is predetermined. Korea's decisions on hydrogen procurement, capital intensity, and domestic scrap mobilisation can actively shift the outcome between the H2-HBI lead and the hybrid middle ground.

Cost of Steel by pathway into Europe[1]**,** $/ t Steel



Source: NEXT Group LCOS Model was used for LCOS and route-specific carbon intensities. 2040 assumes a CBAM certificate cost of $214/t consistent with S&P (2023) forecast of ETS prices. FBR (HyREX) based on MPP analysis

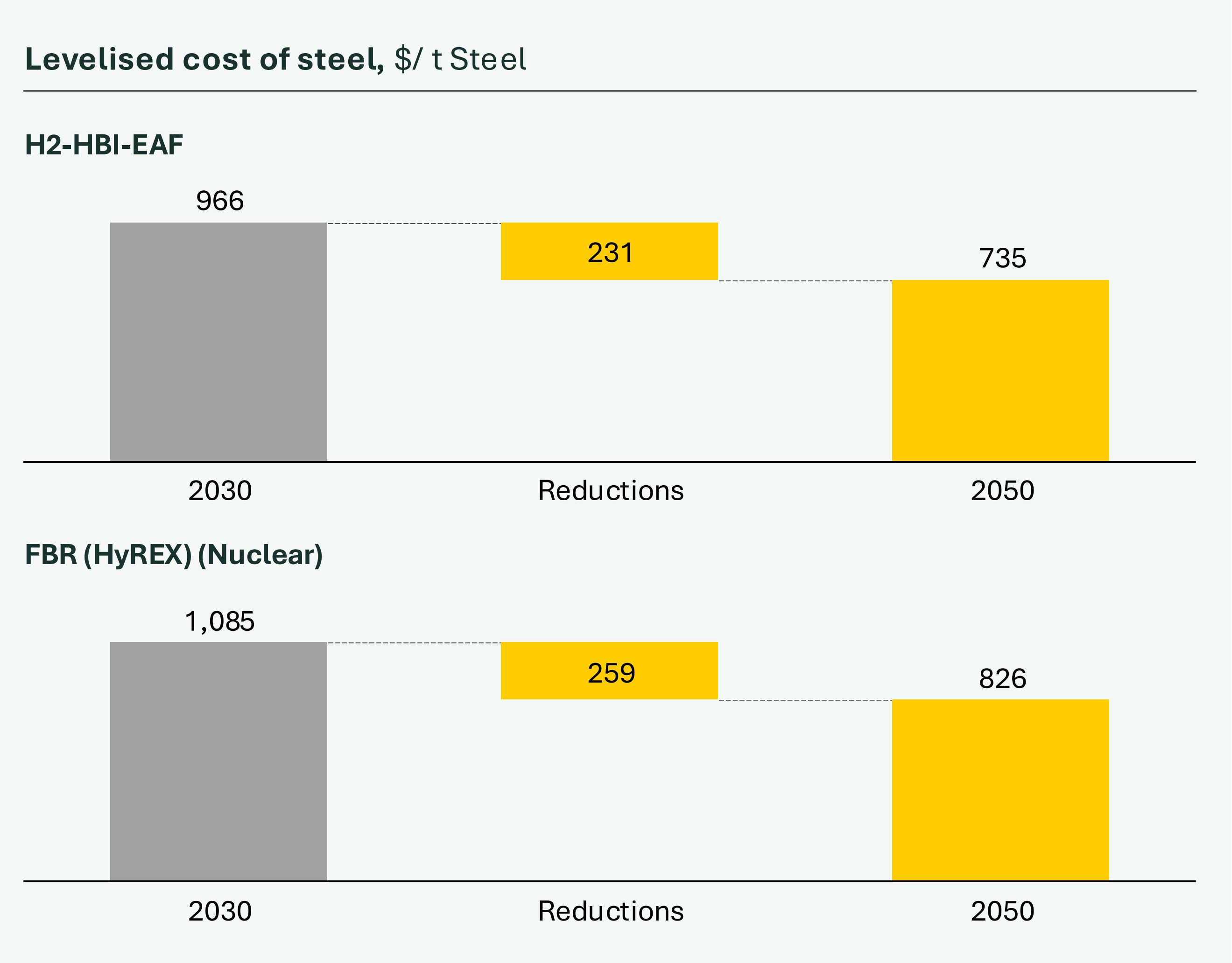
Competitiveness: three cost levers are needed to enhance the competitiveness of clean pathways

Cost reductions for the cleanest routes are achievable but not inevitable. Each depends on Korea making deliberate choices over the next decade – on financing structure, infrastructure, and technology deployment. Three levers do most of the work.

Scrap cost and blending rates offer the most immediate cost reduction. Reducing scrap costs through collection infrastructure, processing capacity and grading frameworks lowers input costs across any pathway that uses it. Increasing blending rates is a separate and harder challenge – tramp element accumulation sets a metallurgical ceiling that can only be raised through precision processing and significant R&D, likely AI-enabled. Both matter; neither is automatic.

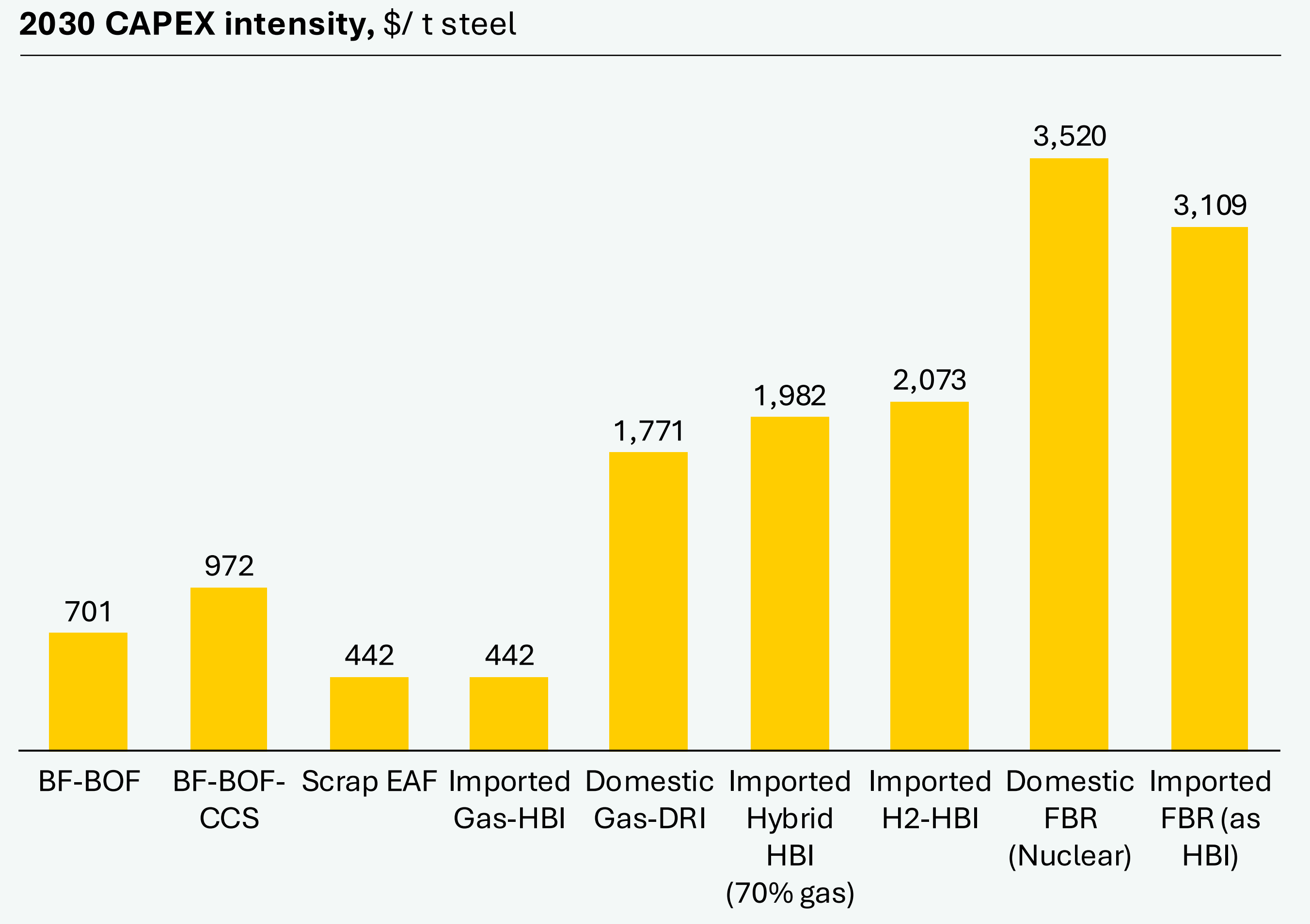
Cutting hydrogen costs depends equally on financing structure and project design. Renewable electricity dominates the H2 cost stack, and financing charges are a significant share of that – reducing capital costs through concessional finance or upstream equity positions will have the biggest impact. Project design works in parallel: partial grid connection, integrated scheduling across electrolyser, BESS and DRI furnace, and avoiding overbuild can each materially reduce delivered cost without the need to wait for electrolyser technology to improve.

FBR (HyREX) is the only pathway that bypasses the DR-grade ore constraint entirely – and known levers could reduce its capital premium substantially by 2050. That reduction depends on deployment proving the technology works at scale; the optimised case is not a passive forecast. The critical near-term decision is standardising plant design across planned builds before pilot parameters are fixed: it converts first-of-kind engineering costs into replicable ones and cannot be made retrospectively.



Source: NEXT Group LCOS Model, FBR (HyREX) based on MPP analysis

Competitiveness: clean routes require substantially more capital than blast furnaces – and capital support alone may not be enough



The initial capital to reach 2.3 Mt of clean steel capacity by 2028 is c.$3.5 bn[1] – modest relative to the total opportunity. The HyREX demonstration plant at Pohang and gas-HBI at Port Hedland are the near-term pipeline. At c.$3.5 bn combined, this is small vs. the $70 bn total opportunity; committing now builds credibility for the larger prize.

Clean routes cost substantially more than BF-BOF, raising the investment threshold. Scrap EAF and imported gas-HBI are relatively modest; FBR (HyREX) with imported H2-HBI a step-change driven by electrolyser CAPEX. A flat subsidy rate will support the highest-value routes.

Imported routes let Korea defray domestic capital burden through trade partnerships. Sourcing HBI keeps domestic CAPEX near scrap EAF levels. Australia's $1 bn green iron fund illustrates the type of upstream capital support available to partner projects.

Variable operating costs are also higher across clean routes – capital support alone is insufficient. Hydrogen and electricity dominate the cost of DRI and FBR (HyREX), well above fuel costs for blast furnaces in 2030. Without complementary operating support, projects risk being built but uneconomic to run.

1. Based on 300 ktpa FBR (HyREX) demonstration plant at Pohang and 2 Mt gas-HBI facility at Port Hedland (Australia). CAPEX estimates from NEXT Group LCOS model 2026. Source: Analysis, NEXT Group LCOS model 2026, FBR (HyREX) based on MPP analysis

Competitiveness: Imported gas-HBI and CCS balance 2030 levelised cost of steel and delivered costs below blast furnace steel into the EU27

Imported gas-DRI and hybrid-DRI offer the strongest near-term cost benefit into CBAM markets. Both sit below the 2035 BF-BOF delivered cost benchmark, combining manageable production costs with lower carbon exposure than blast furnaces. For Korean producers facing reline decisions in the next five years, these are the pathways where the cost case is clearest today.

CCS on BF-BOF is competitive in 2030 but weakens as carbon prices rise. It sits below the BF-BOF benchmark on a delivered basis and requires less capital disruption than a full route change. The constraint is not cost but credibility: Korea has yet to resolve the issue of geological storage, and a pathway that depends on unproven domestic storage capacity carries execution risk that goes beyond the issue of cost alone.

Hydrogen routes remain cost-challenged until the 2040s – closing that gap will require active cost innovation, not just time. At current cost trajectories, H2-HBI and FBR (HyREX) sit well above the CBAM-adjusted BF-BOF benchmark through 2035. Carbon pricing continues to erode that gap from one direction; falling hydrogen and capital costs from the other. But the pace of that convergence is not fixed – China is actively compressing it through scaled deployment and technology development. Korea's participation in hydrogen steelmaking before cost parity arrives is a competitive necessity, not a premature bet.

Tech		2 Competitiveness: a 2030 LCOS, $/ t steel	b 2035 CBAM cost, $/ t steel
BF-BOF		588	903
BF-BOF CCS		746	857
Scrap EAF		573	599
Gas-based iron	Domestic (DRI)	834	951
	Imported (HBI)	734	851
Imported Hybrid HBI (70% gas)		808	877
Imported H2-HBI		966	930
FBR (HyREX)	Domestic (Nuclear)	1,091	1,063
	Imported (as HBI)	1,126	1,069

High upside / low cost | Medium upside / cost | Low upside / high cost

Source: Analysis, FBR (HyREX) based on MPP analysis

Resilience: Different steel production routes require different feedstocks, trade partners and each faces unique constraints

Supply inputs, partners and structural constraints by steelmaking route

Pathway	Key inputs	Trade partners	Constraints	Energy and price exposure
BF-BOF (CCS)	Met coal; standard BF-grade iron ore	Coal: Australia, Indonesia, Russia, Canada Iron ore: Australia, Brazil	BF-grade ore widely available; no grade ceiling constraint	High fossil import dependency
Scrap-EAF	Grid electricity; steel scrap	Mostly domestically sourced, but c.75% of scrap imports from Japan[1]	Limits on domestic scrap supply High-grade flat-product scrap scarce due to tramp element accumulation	Electricity and scrap prices are the key drivers of margin compression
DRI-based routes (gas, H2)	Natural gas or hydrogen; DR-grade pellets (>67% Fe)	HBI: US, Oman, Australia, Brazil, Canada	DR-grade ore is a separate, globally limited supply from standard BF ore; shaft furnace DRI capacity constrained globally by high-grade ore ceiling[2]	DR grade ore premium may widen as supply tightens. Imported HBI price embeds producer-country gas costs and underlying volatility
FBR (HyREX)	Nuclear electricity; standard BF-grade iron ore	Iron ore: Australia, Brazil, Canada	No grade constraint – fluidised bed bypasses shaft furnace and DR-grade requirement entirely	Large domestic electricity requirement may create competition with other energy users

Routes differ fundamentally in their primary inputs. BF-BOF uses coke derived from metallurgical coal to reduce iron ore, with LNG for process energy. Scrap-EAF recycles steel using electricity, bypassing ironmaking entirely. DRI routes use gas or hydrogen but need DR-grade pellets above 67% Fe – distinct from standard BF ore and non-substitutable in shaft furnaces. FBR (HyREX) uses nuclear power and standard iron ore fines, with no grade requirement.

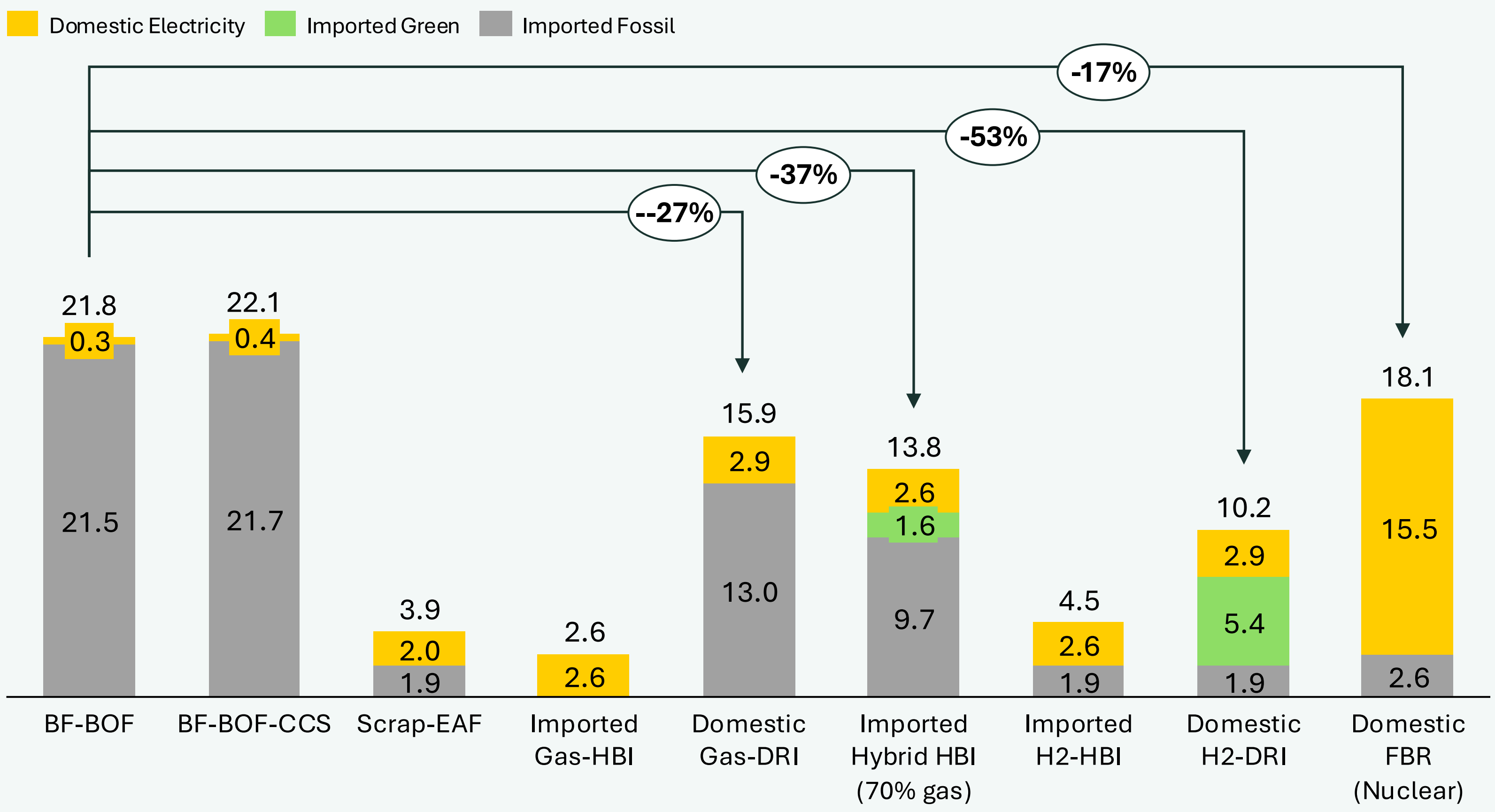
Korea's supply relationships are concentrated across multiple routes simultaneously. Australia anchors met coal, LNG and iron ore for blast furnace routes. Japan supplies approximately 75% of imported scrap. DRI routes would rely on a small group of HBI exporters – the US, Oman and Australia are the primary candidates – in a market that remains nascent and thinly traded.

Each route faces a distinct structural limit that price metrics alone do not capture. BF-BOF carries high fossil import dependency and volatile input costs. Scrap-EAF faces a quality ceiling for flat products from tramp element accumulation, and acute Japan dependency as other sources contract. DRI faces HBI market thinness and upstream DR-grade ore constraints. FBR (HyREX) places substantial demand on Korea's domestic clean electricity supply.

1. BACI data based on HS code 7204; 2. Systemiq ( ). Source: Analysis, FBR (HyREX) based on MPP analysis

Resilience: clean pathways can reduce energy demand by 17–53%; some pathways more than halve exposure to fossil imports

Energy consumption and source per steel production pathway, GJ/t steel



Blast furnace routes are energy-intensive and fossil-import dependent. BF-BOF and BF-BOF-CCS each consume c.22 GJ/t, with over 98% from imported fossil fuels. CCS captures carbon but leaves the energy bill and import dependency unchanged.

Gas-based routes cut total energy demand by 29–37%, though fossil import exposure remains high. Gas-HBI and hybrid gas/H2 improve energy intensity materially, but imported fossil energy (in the form of HBI) still accounts for 70–83% of energy input.

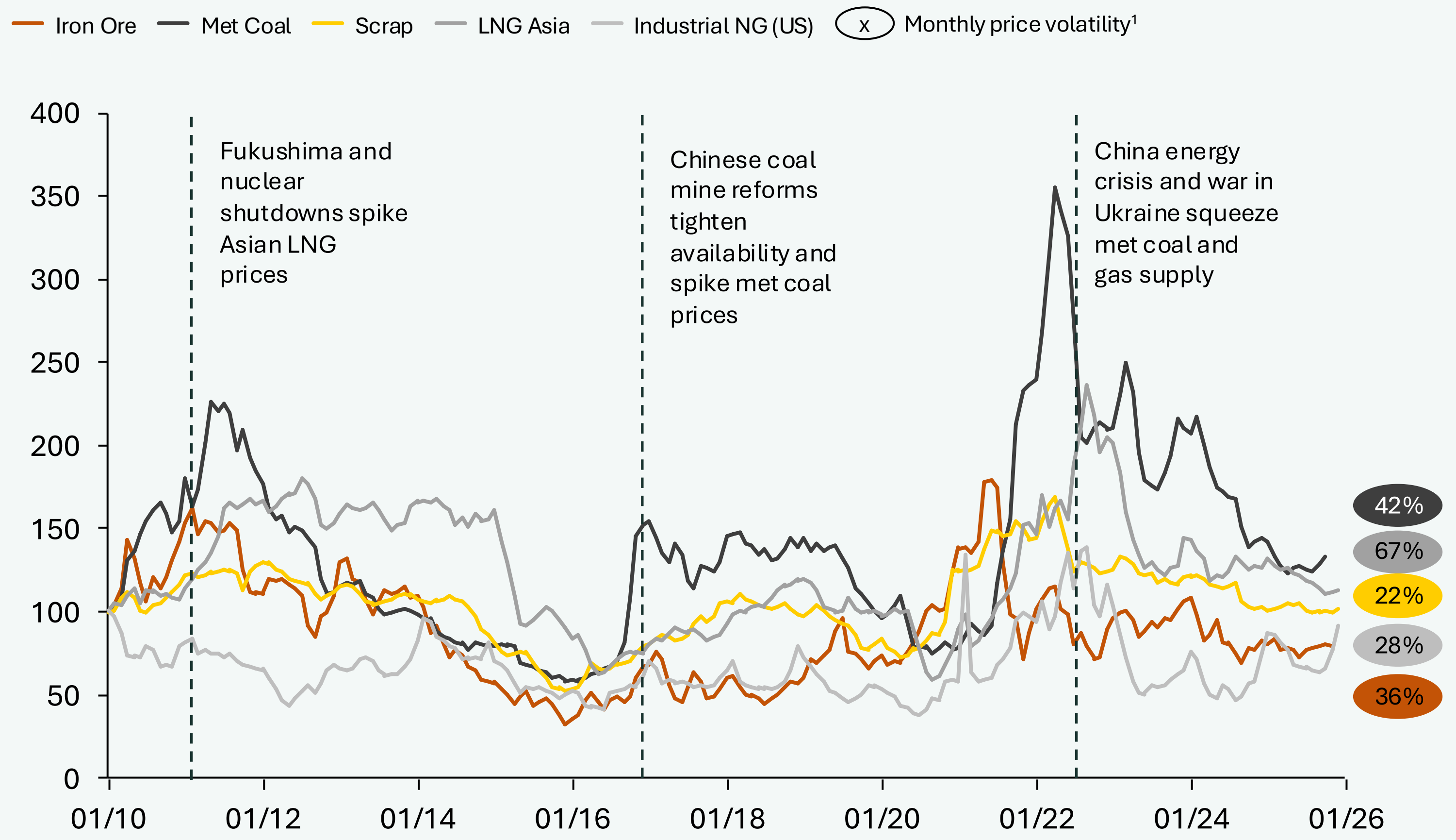
H2-HBI delivers the deepest transformation: −53% on total energy and −90% on fossil imports. At 10.2 GJ/t with just 1.9 GJ/t of residual imported fossil, H2-HBI-EAF is the most complete supply chain transformation of any primary steelmaking route.

Scrap-EAF and FBR (Hyrex) both minimise fossil imports – but by fundamentally different mechanisms. Scrap-EAF achieves near-zero fossil inputs through process efficiency (3.9 GJ/t total). FBR substitutes fossil with domestic electricity, but its 15.5 GJ/t power draw places substantial demand on Korea's clean grid.

Source: NEXT Group LCOS model. Coal and gas are assumed to be 100% imported. Energy imports for electricity are not considered. Imported HBI is not assumed as an energy import, although energy consumption to produce HBI is material. FBR (HyREX) based on MPP analysis

Resilience: key steelmaking inputs have exhibited significant price volatility over the past 15 years

Monthly feedstock costs for steel, rebased to 100 = January 2010



Metallurgical coal has experienced three sustained price spikes over the past 15 years. Long-term supply agreements provide steelmakers with a degree of control over volume and grade, but do not provide price stability: quarterly indexation to spot benchmarks means buyers absorb price changes.

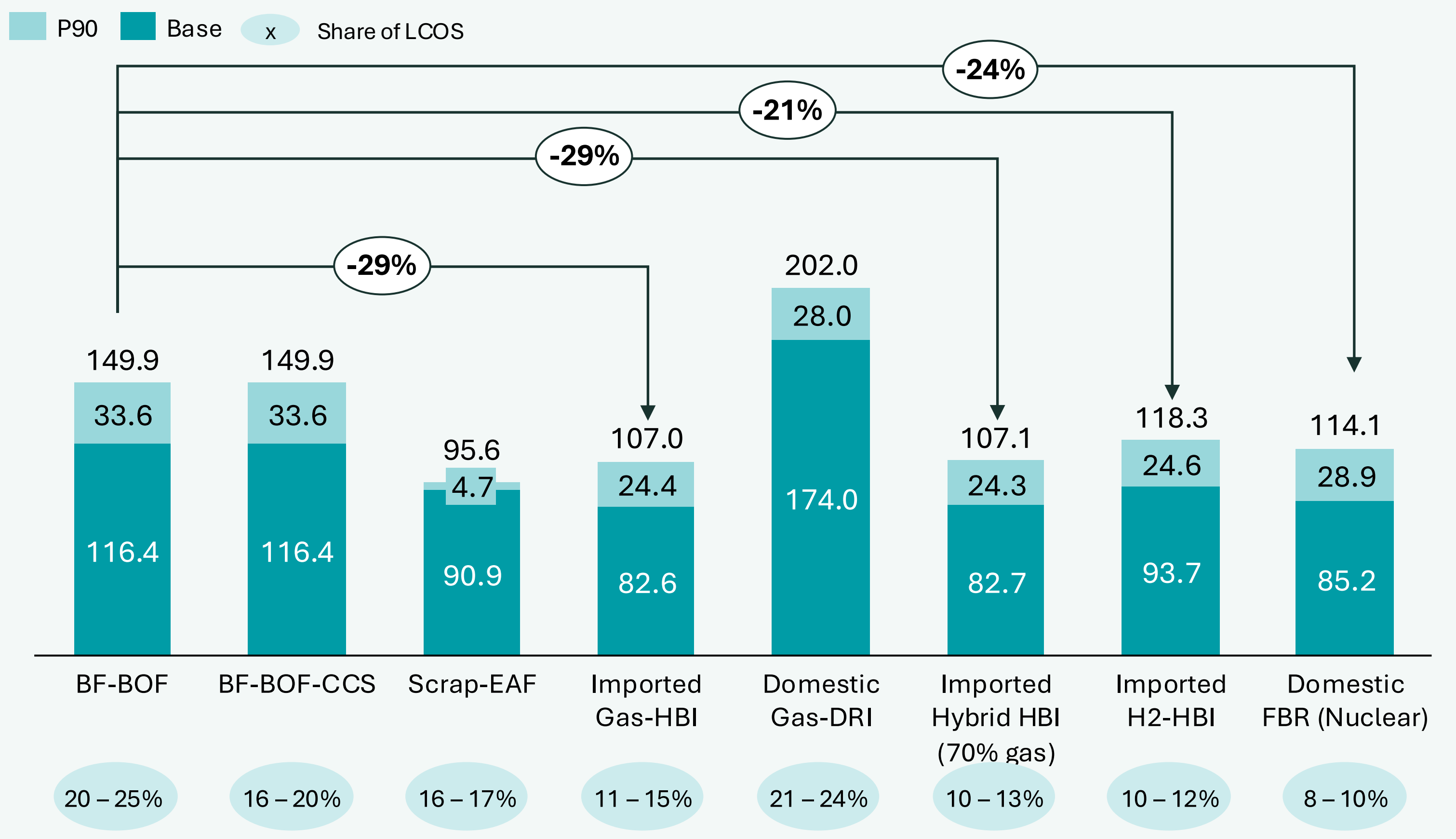
Asian LNG spot markets are significantly more costly and more volatile than gas in major producing regions. Asia's LNG prices have averaged \$12.65/MMBTU over the past 15 years; prices in the US and Saudi Arabia have been around a third of this. Perhaps more tellingly, Asian LNG prices exhibit roughly x2.4 the volatility of major LNG exporters. Korea imports all gas at Asia-linked prices – but sells at lower regulated tariffs to domestic manufacturers which drives operating losses and debt constraints.

Scrap has been the most price-stable feedstock – but structural scarcity could introduce new volatility. Scrap has stayed in a relatively tight band with prices fluctuating by a maximum of c.50%. As global scrap demand grows and export bans are implemented, availability – particularly in Asia – will tighten, which could materially increase scrap prices and price volatility.

Source: Iron Ore and Met Coal are from Resources and Energy Quarterly (2025) and converted into USD/t using monthly historical AUD/\$exchange rates from RBA (2026); LNG Asia is from World Bank (2026), Industrial natural gas is from EIA (2026) where industrial gas prices are assumed a proxy for price volatility decoupled from global spot markets (e.g. US, Saudi Arabia), Scrap is from Bank of Korea (2026). Monthly price volatility is expressed as the coefficient of variation: the standard deviation as a share of the long-term mean. It represents the typical monthly dispersion of prices around the long run average commodity price.

Resilience: Feedstock price volatility weighs significantly on blast furnace routes; cleaner routes are less structurally exposed

Feedstock volatility impact on pricing, $/t steel



BF-BOF faces significant recurring feedstock cost exposure. At $116/t in a typical year, feedstock risk represents c.20% of BF-BOF's total cost stack. Without steel prices rising in parallel, recurring spikes translate directly into lower margins.

Clean routes are structurally less exposed. Gas HBI routes sidestep Asian LNG spot volatility via structurally cheaper and less volatile producer-market gas. Hydrogen routes achieve stability differently – through long-term cost-plus contracts and fixed-price PPAs. However, these routes still have variable costs higher than BF-BOF routes.[1]

The blast furnace risk premium widens further at P90. BF-BOF adds $150/t at P90; clean routes add $96–$128/t. The absolute gap versus best-in-class widens from $33/t in the low case to $92/t at P90, compounding the margin penalty compounds.

Domestic Gas-DRI is the transition route with the most unhedged feedstock exposure. On an unhedged basis, exposure to Asian LNG spot pricing would exceed even blast furnace risk, with feedstock impacts between $174–202/t. Regulated tariffs only delay and dampen this impact.

1. See for example Exhibit 4 in Systemiq (2026). Source: Analysis. The Low case takes a 1 standard deviation in historical feedstock price and adds this to the LCOS from the NEXT cost model. This weights feedstock price volatility by each feedstock's share of the cost stack. Hydrogen does not have a historical comparator. Green hydrogen production cost CV of 0.091 is derived by scaling a blended electricity cost CV by electricity's 70% share of production cost (IRENA, 2020). The electricity CV combines a CPI-escalation linked PPA (80% of consumption, CV = 0.061) and a grid-linked leg (20% of consumption, CV = 0.606, AEMO SA1 quarterly VWAP 2020–2025), yielding a combined electricity CV of 0.131. The 80/20 split reflects the upper bound of modelled grid exposure for Australian green hydrogen projects (Superpower Institute, 2025). FBR (HyREX) based on MPP analysis

Resilience: Gas-HBI and Hybrid-HBI offer the best near-term resilience; with a HyREX-style FBR best to manage long-run fossil import independence

BF-BOF is red on both dimensions; CCS changes neither number. At 21.5 GJ/t of imported fossil energy and $116/t feedstock shock exposure, BF-BOF carries the highest burden on both supply chain metrics. Adding CCS addresses carbon risk, not the feedstock risks.

Imported Gas and Hybrid HBI achieve the best feedstock shock scores, but shaft furnace routes carry a structural ore vulnerability. Both routes benefit from sourcing gas at export market prices, avoiding Asian LNG spot volatility. However, shaft furnace DRI processes require high-grade DR-grade ore, and supply of DR-grade ore is projected to face structural constraints as global DRI capacity expands. This introduces a feedstock availability risk that the $/t volatility metric does not fully capture.

FBR (HyREX) is the long-run supply chain resilience leader, with near-zero import energy and no DR-ore dependency. At 2.6 GJ/t imported energy and $85/t feedstock shock, FBR (HyREX) scores green on both metrics. Critically, it uses standard iron ore fines rather than DR-grade ore, sidestepping the supply constraint that limits shaft furnace routes at scale. The constraint is domestic electricity availability, not feedstock supply.

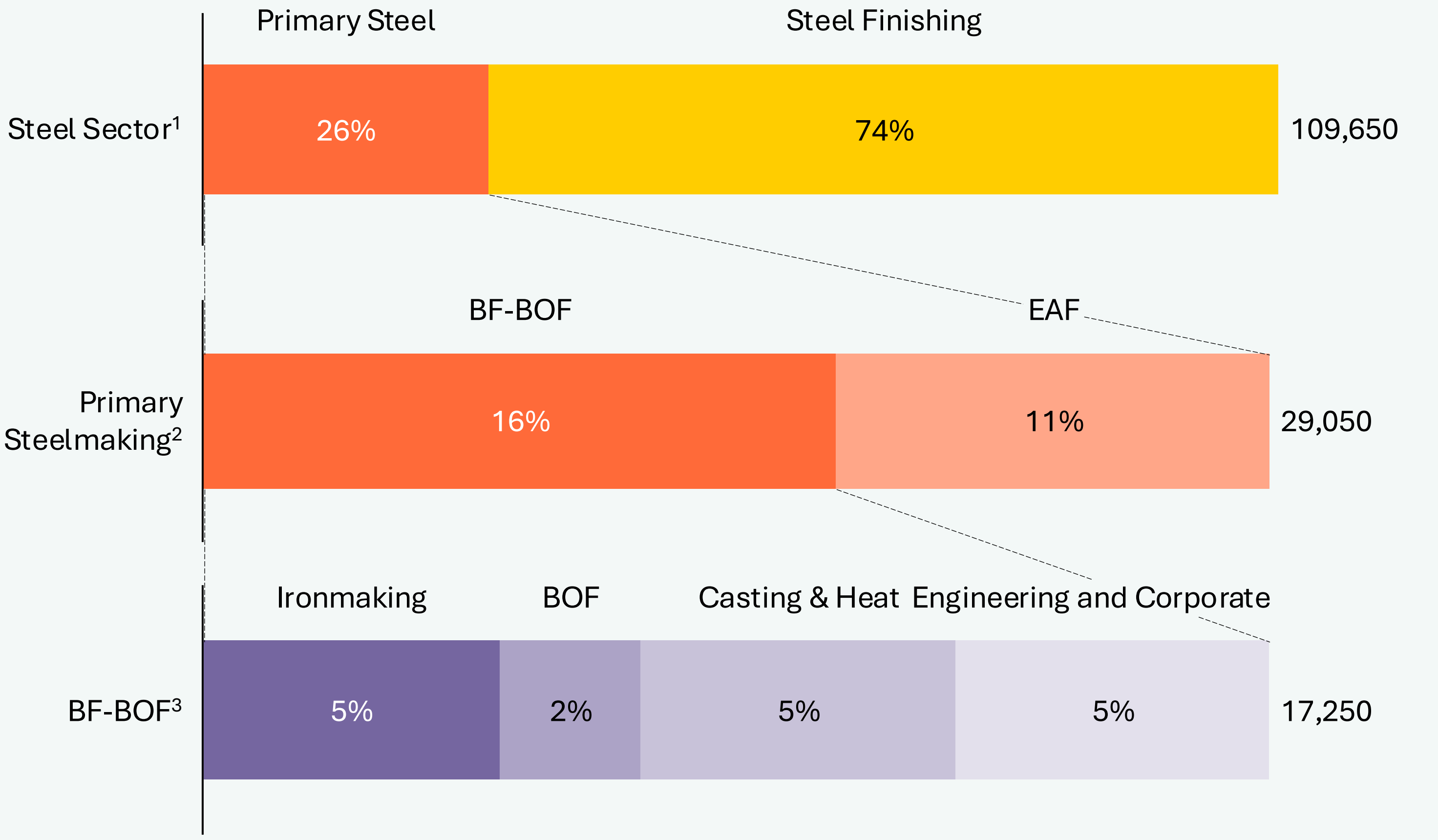
Tech		3 Supply chain resilience: a Imported energy / t steel, GJ/t steel	3 Supply chain resilience: b Feedstock shock impact, $/t steel
BF-BOF		21.5	116
BF-BOF CCS		21.7	116
Scrap EAF		1.9	91
Gas-based iron	Domestic (DRI)	13	174
Gas-based iron	Imported (HBI)	13	83
Imported Hybrid HBI (70% gas)		11.3	82
Imported H2-HBI		7.3	92
FBR (HyREX)	Domestic (Nuclear)	2.6	83
FBR (HyREX)	Imported (as HBI)	7.3	83

High upside / low cost — Medium upside / cost — Low upside / high cost

Source: Analysis, FBR (HyREX) based on MPP analysis

Employment: Primary steelmaking represents c.26% of the steel workforce, with ironmaking just c.5%

Decomposition of Korea's steel workforce



74% of the steel sector's 110,000 workers are in finishing, not primary production. Rolling, drawing, and pipe-making are where most steel jobs sit. Primary steelmaking accounts for 29,000 of the 110,000.

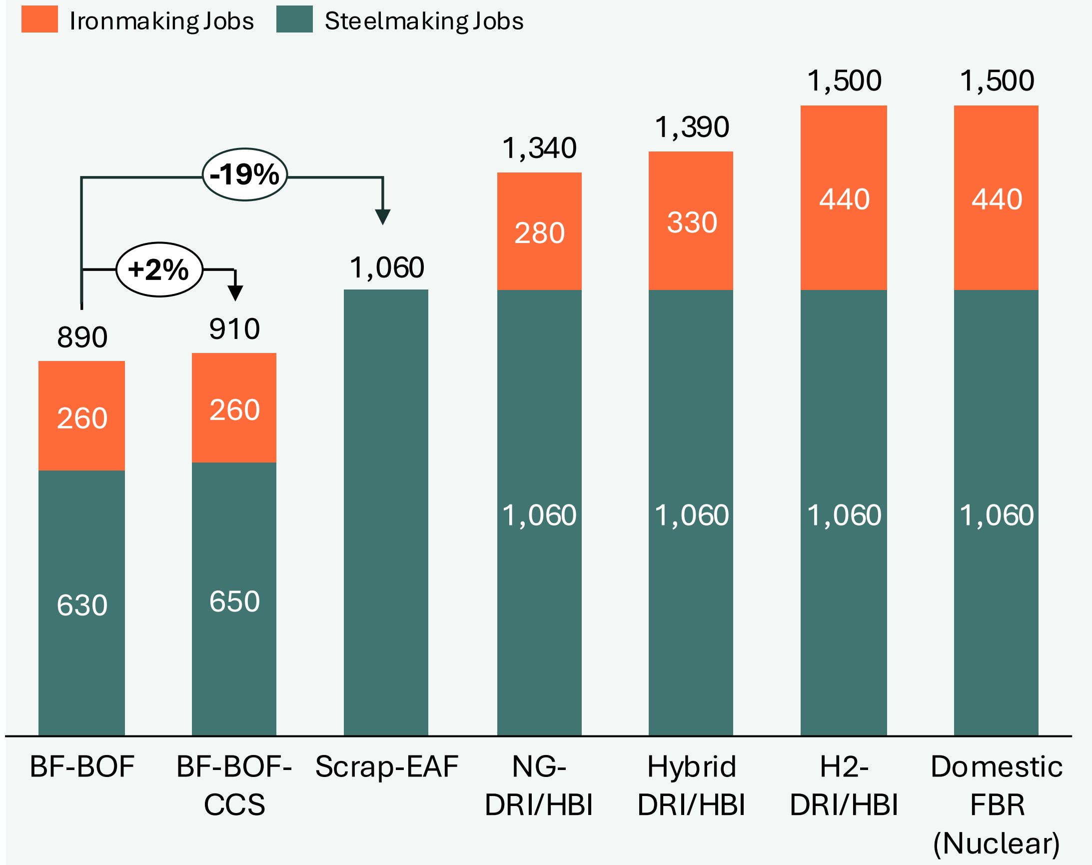
Of primary steelmaking's 29,000 workers, 59% are on BF-BOF routes and 41% in EAF. The BF-BOF workforce is concentrated in three integrated mills: POSCO Pohang, POSCO Gwangyang, and Hyundai Steel Dangjin. The EAF workforce is more dispersed, spread across a dozen smaller specialty and flat-product producers.

Within BF-BOF's 17,250 workers, ironmaking is one of four roughly equal functions. At 28%, it is comparable in headcount to casting and heat treatment (29%) and engineering and corporate (29%). Blast furnace operations along with coke ovens and sinter plants accounts for roughly 5,000 workers across the sector, 5% of the 110,000.

1. Steel sector employment is taken from KOSIS Mining and Manufacturing Survey. Statistics by industry, employment. Primary steel is 'manufacture of basic iron and steel. Finishing includes 'rolling, extusion and drawing', 'pipes, tubes, and hollow profiles' and 'other basic iron and steel products'. Note the KOSIS statistics likely exclude contracted workers and so may underestimate total employment. 2.The split of primary steelmaking into BF-BOF and EAF is based on Global Energy Monitor (2026) estimates for each steelmaking plant in Korea. 3.BF-BOF workforce distribution is based on IEAGHG (2013) Table D-6 which sets out direct labour estimates by process stage for a study of a 4Mt BF-BOF with c.3000 workers. Source: Analysis, FBR (HyREX) based on MPP analysis

Employment: Employment variation across clean steel pathways is modest

Potential employment per clean steel pathway, workers per 2.5Mt plant



Net impact of offshoring 5Mt ironmaking

Korean steel is among the world's highest-productivity operations. At 357 workers/Mt, Korean BF-BOF plants run with fewer workers than the US (491/Mt) and far fewer than China's average (1,337/Mt), reflecting significant investment in automation and AI.

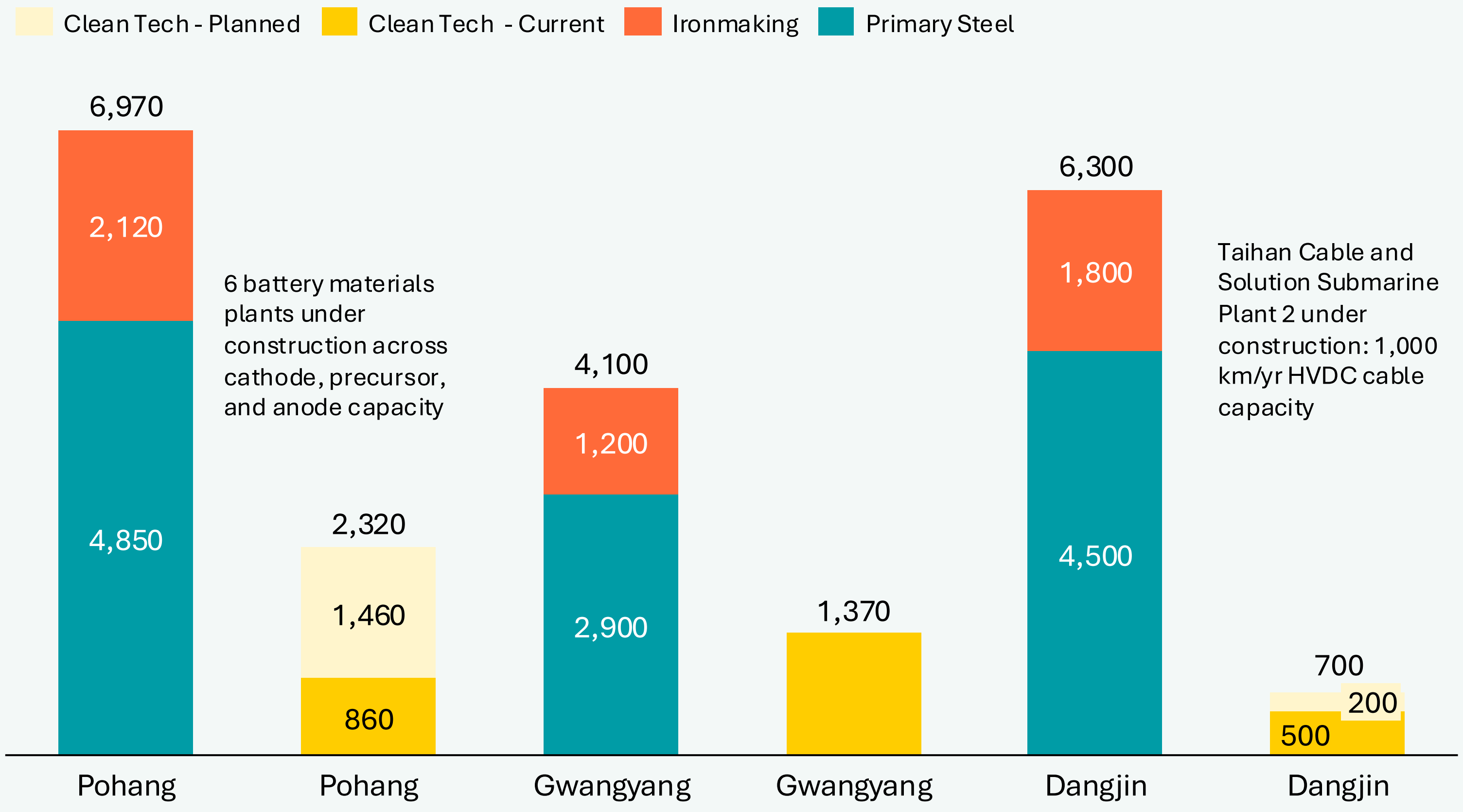
Employment variation across clean steel pathways is modest – and what variation exists is driven almost entirely by the ironmaking step. Total headcount ranges from 890 workers per 2.5Mt plant for BF-BOF to 1,500 for H2-DRI/HBI and FBR (HyREX), with the steelmaking base of 1,060 workers essentially constant across all DRI routes. The variation sits entirely in the ironmaking component: gas-DRI/HBI adds c.280 workers in the reduction shaft, H2-DRI/HBI c.440, with the premium largely attributable to electrolyser operations at scale.

Offshoring ironmaking has a negligible impact on total sector employment. Offshoring 5Mt of ironmaking to MENA or Australia displaces roughly 520 ironmaking roles while retaining all downstream steelmaking employment in Korea – a net impact of just -0.5% on Korea's total steel workforce. The choice between onshore and offshore ironmaking is about competitiveness and supply chain, not jobs.

Source: Analysis. All figures are for a 2.5Mt/year reference plant. The base (1,060 workers) uses Korean EAF plant-level data (Global Energy Monitor) and is applied across all DRI routes. BF-BOF and Scrap-EAF use route-specific intensity factors from the same source. CCS and the BF-linked worker breakdown both draw on IEAGHG (2013) which shows c.24 workers required for the CCS unit and c.29% of BF-BOF workers sit in ironmaking (coke, sinter, blast furnace), implying c.260 workers at Korean reference scale. Gas-DRI (280 workers) averages two disclosed US plant workforces: Cleveland-Cliffs Toledo and ArcelorMittal Corpus Christi. Hybrid-DRI is a 70/30 blend of gas and hydrogen figures. H2-HBI (440 workers) is derived from Stegra's 1,500-worker headcount for its integrated 2.5Mt plant in Boden, with the EAF base netted off. No public disclosure exists for commercial-scale FBR (HyREX); the H2-HBI figure is used as a proxy. FBR (HyREX) based on MPP analysis

Employment: Clean technology employment is growing rapidly in Korea’s BF-BOF heartland

Estimated workforce breakdown in three major steelmaking centres[1,2]



Steelmaking is a major employer in all three cities, with ironmaking workers representing a significant share of each site's workforce. These are the workers most exposed to transition risk as Korea's steel sector transforms.

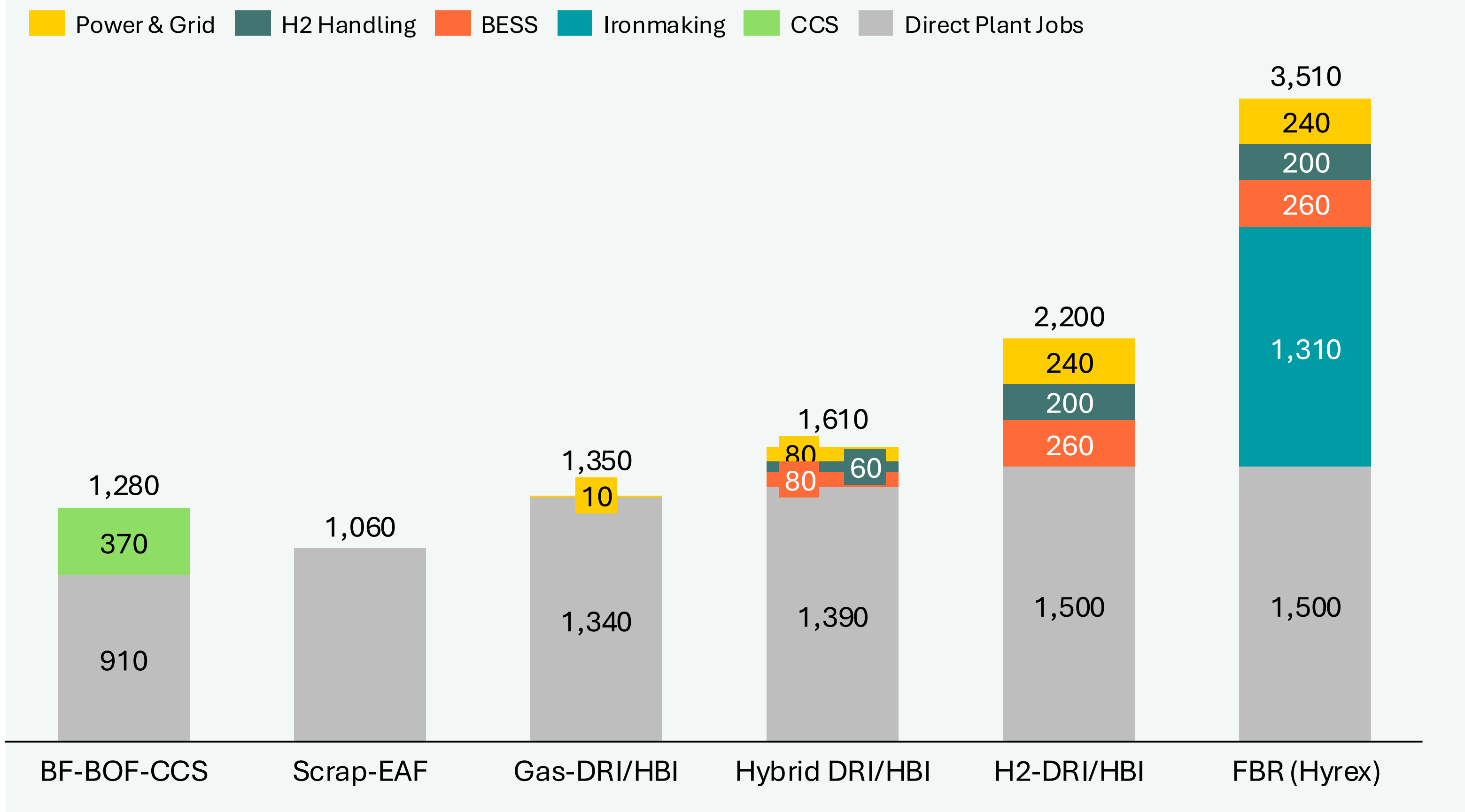
Clean technology manufacturing is generating substantial new employment in the same regions. Pohang hosts 8 active battery materials facilities across cathode, precursor, anode and lithium processing, with six more under construction. Gwangyang's facilities are predominantly POSCO Future M, with anode feedstock from PMC Tech's needle coke plant. Dangjin sits on a different pathway, anchored by Taihan's transmission cable cluster.

Co-location of steel and clean tech manufacturing creates real options for diversification. Ironmaking workers carry transferable skills in precision operations and process management, directly relevant to battery materials and cable production. A credible just transition framework needs to operate at the city level, matching support to the specific opportunities each location already has.

1. Primary steel workforce numbers are taken from Global Energy Monitor ( ). Ironmaking estimates assume 28% of the workforce are dedicated to these activities as per IEAGHG ( ). Pohang includes an additional 120 workers for the Hyrex pilot based on it’s 300ktpa capacity relative to the 1500 workers at Stegra’s 2.5Mt Boden plant. 2. Clean tech employment estimated from a facility-level database of Korean OEM manufacturers (battery materials, solar, wind, transmission cable, and grid equipment). Employment is derived by applying sector-specific labour intensity benchmarks to facility production capacity and may not reflect facility-level employment outcomes Employment multipliers for battery cathode, precursor and anode facilities revised to 0.004 jobs per tonne of annual capacity, benchmarked against disclosed direct headcount at POSCO Future M's Gwangyang battery materials facilities.. 'Current' reflects operational facilities; 'Planned' reflects facilities under construction orwith committed investment. Estimates do not include construction-phase employment or downstream service roles. Source: Analysis, FBR (HyREX) based on MPP analysis

Employment: Tapping into clean steel investment could drive demand for clean tech manufacturing and underpin employment growth

Estimated Korean equipment manufacturing jobs supported by one 2.5 Mtpa plant order, workers per 2.5Mt plant



Each clean steel plant represents a substantial potential order for Korean manufacturers. A single 2.5 Mt plant purchases large volumes of electrical systems, process machinery and storage equipment. Individual component orders can represent a meaningful share of a Korean supplier's annual production.

Hydrogen metallurgy pathways generate by far the largest Korean equipment manufacturing employment. H2-DRI/HBI supports around 700 Korean manufacturing jobs per plant; FBR (HyREX) approximately 2,000 – both drawing on Korean strengths in BESS, grid equipment and process machinery.

CCS retrofits offer a more limited opportunity, and Gas-DRI/HBI and Scrap-EAF very little. A BF-BOF CCS retrofit generates roughly 370 jobs per plant, concentrated in compressors and capture equipment. Gas-DRI/HBI and Scrap-EAF generate fewer than 10, reflecting the near-total absence of Korean-owned technology in shaft furnaces and reformers.

Technology ownership creates a durable link between pathway selection and Korea's clean tech manufacturing base. A global FBR (HyREX) build-out generates sustained order flow for Korean manufacturers across each project cycle; a Gas-DRI/HBI or H2-DRI/HBI - dominant transition could send the same investment largely offshore.

Source: Analysis. Estimated using Bank of Korea 2022 direct employment coefficients (직접 고용계수, small-sized classification) applied to Korean-captured equipment CAPEX by pathway. Direct coefficient measures employment at the manufacturer only – total economy-wide stimulus could be higher. BESS assumed 100% Korean-captured (Samsung SDI, LG Energy Solution, SK On); ESF + fluidised bed assumed 100% Korean-captured (POSCO-proprietary FBR (HyREX) technology). Peak annual figure spreads total manufacturing demand over a four-year delivery period. EPC and O&M excluded. FBR (HyREX) based on MPP analysis. Component-level labour intensities (jobs per $1M CAPEX): power and grid interface – BOK sector 372, 0.66 jobs/$1M; H2 handling – BOK sector 382, 0.79 jobs/$1M; BESS – BOK sector 373, 0.27 jobs/$1M; ESF + fluidised bed – BOK sector 392, 0.98 jobs/$1M; electrolyzer – BOK sector 399, 1.11 jobs/$1M; CCS equipment – BOK sectors 382/399, 0.66–1.11 jobs/$1M.

Employment: direct employment variation is limited across pathways, but cleaner routes could accelerate upstream workforce development

BF-BOF carries the highest permanent workforce but generates limited Korean manufacturing demand during construction. At 890 workers per plant, employment is concentrated across ironmaking, casting and engineering. A CCS retrofit adds roughly 370 Korean equipment manufacturing jobs during the build period but leaves permanent headcount unchanged.

Shaft furnace routes deliver broadly similar ongoing employment but almost no Korean manufacturing stimulus. Gas-DRI/HBI, Imported Hybrid-HBI and Scrap-EAF all sustain 1,060–1,390 permanent workers per plant. The construction-phase opportunity is negligible across all three, as shaft furnace and reformer technology is owned almost entirely by foreign firms.

Hydrogen metallurgy routes match BF-BOF on permanent employment and lead on construction-phase Korean manufacturing demand. H2-HBI sustains around 1,500 ongoing workers and generates approximately 700 Korean equipment manufacturing jobs during construction; FBR (HyREX) matches on headcount and nearly triples the manufacturing stimulus to approximately 2,000, anchored by POSCO's proprietary ESF and fluidised bed technology.

The displacement of ironmaking workers remains the central transition risk – but clean tech co-location creates a credible redeployment pathway. Battery materials, grid equipment and cable manufacturing are growing in Pohang, Gwangyang and Dangjin – the same communities most exposed to transition risk.

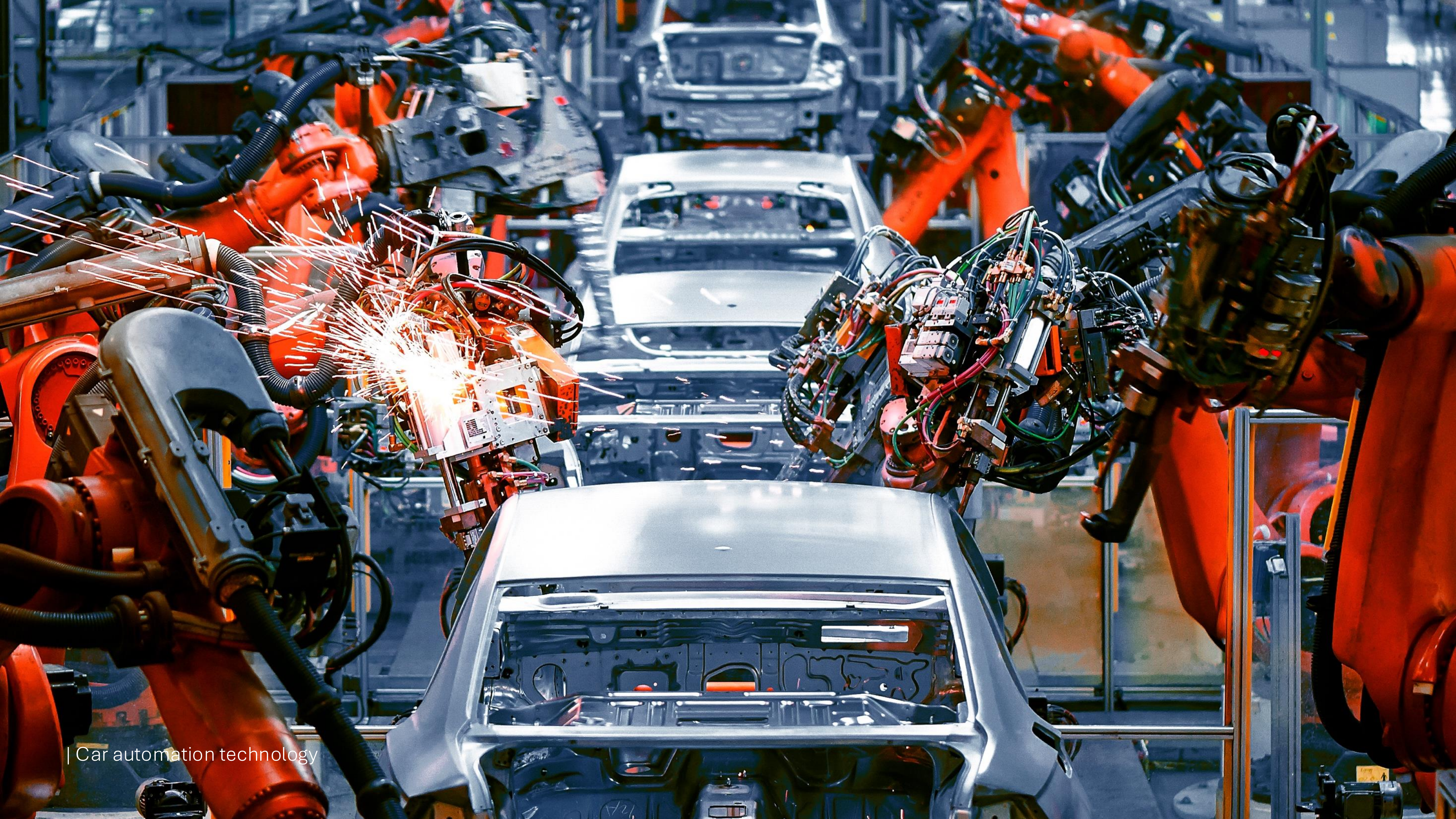
Tech		4 Employment	
		a Workers per plant	b Korean manu jobs per plant
BF-BOF		890	-
BF-BOF CCS		910	370
Scrap EAF		1,060	0
Gas-based iron	Domestic (DRI)	1,390	10
	Imported (HBI)	1,060	10
Imported Hybrid HBI (70% gas)		1,060	150
Imported H2-HBI		1,060	700
FBR (HyREX)	Domestic (Nuclear)	1,500	2,000
	Imported (as HBI)	1,060	2,000

High upside / low cost · Medium upside / cost · Low upside / high cost

Source: Analysis, FBR (HyREX) based on MPP analysis

Creating certainty

Korea's low-carbon steel pipeline faces a structural gap: the demand certainty and revenue conditions that have brought projects to FID in other markets do not yet exist



| Car automation technology

Korea has the capabilities to deliver clean steel projects, but it does not yet have the revenue conditions to justify investment

Revenue certainty conditions compared

	Stegra at FID	FBR (HyREX) pilot
Track record and sales pipeline	Greenfield	Decades of relationships with premium buyers
Carbon value	EU ETS c.€60–80/t	K-ETS 100% free allocation to steel
Green premiums	Yes, driven by voluntary demand	Limited evidence
Long term offtake	60% of capacity under long term offtake	Limited evidence
Public derisking	€265m EU grant, Swedish state support	Possible under K-Steel and K-GX

Positive Neutral Negative

Korea has the operational expertise, EPC depth and technology ecosystem to execute any clean steel production pathway. POSCO and Hyundai Steel operate blast furnace and electric arc routes at commercial scale, have demonstrated EPC capability through POSCO E&C and affiliate engineering firms, and have committed jointly capital to projects in Louisiana while POSCO has also invested in Port Hedland and Pohang. The capability is clear. The investment is not.

What separates projects that reach financial close from those that remain in development is not technology readiness, it is revenue certainty. Large-scale green industrial projects are non-recourse by design: project debt is secured against project cash flows, which means lenders require confidence in those cash flows before committing capital. That confidence turns on long-term offtake. Stegra, the first commercial-scale green steel project to reach financial close, secured binding agreements covering approximately 60% of production capacity across 20 contracts with customers including Mercedes-Benz, Porsche, BMW, Volvo and IKEA before a financing decision was made.[1] The contracts ran five to seven years with material green premiums. The offtake stack was the foundation everything else was built on.

Korean offtakers have not yet taken equivalent steps. Korea appears once in BloombergNEF's January 2026 green steel offtake tracker – a 200-tonne trial delivery from POSCO to LG Electronics.[2] That is the entirety of Korea's offtake footprint against a multi-million tonne reline wave over the next decade.

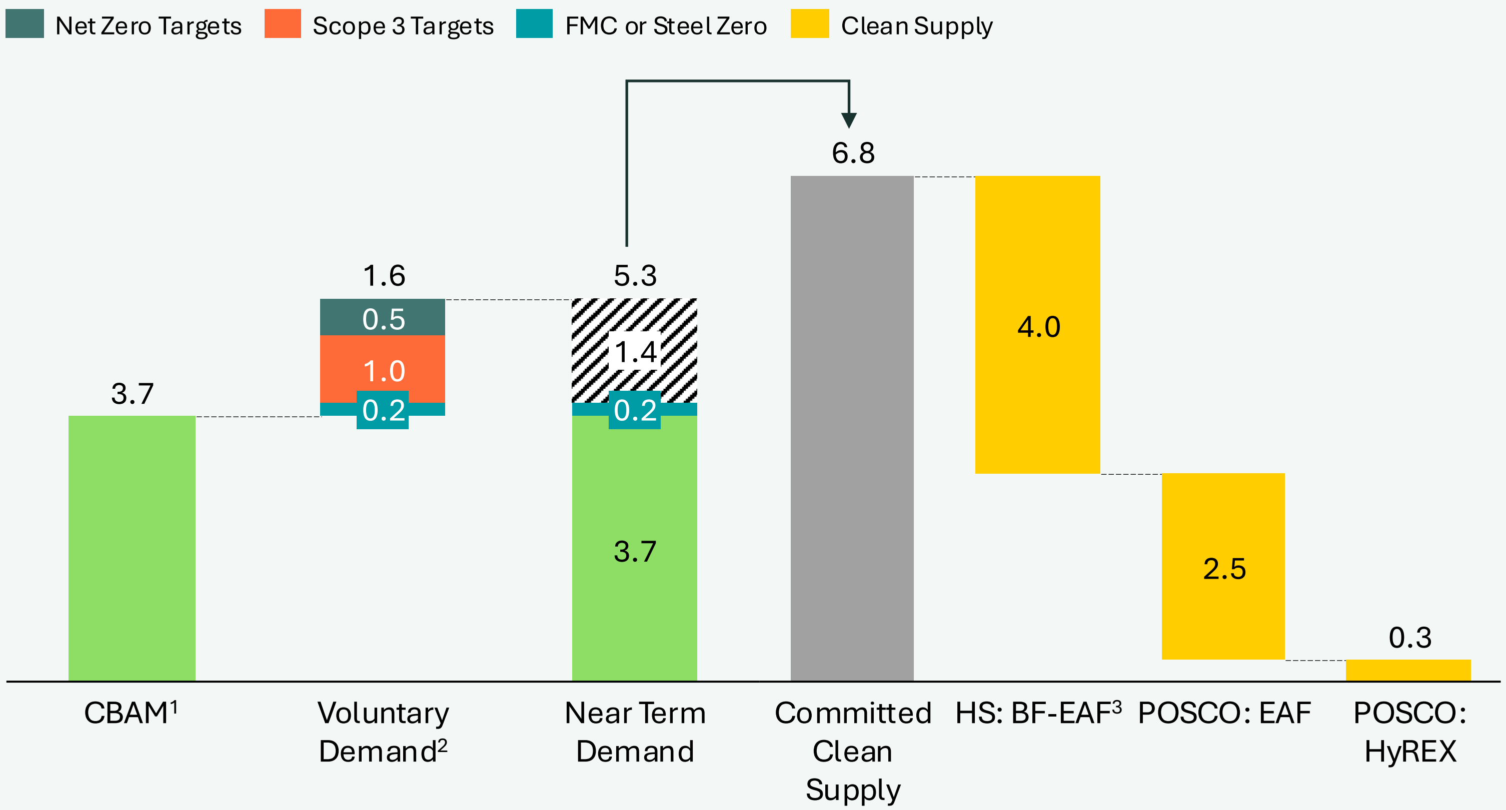
Without bankable demand, Korea cannot close the gap with China or get ahead of CBAM. Korea may be able to manage near-term CBAM exposure through the Gwangyang EAF and Hyundai Steel's EAF-BF combined process, but those positions do not scale to the reline wave, and carbon-conditioned market access will extend and tighten through the 2030s. The more fundamental risk is China. Chinese producers are building process knowledge and technology leadership in hydrogen metallurgy at commercial scale, and that learning compounds with every tonne produced. Korea's window to match that capability, and to hold its position in the premium segments where that capability will matter, closes with each reline cycle that passes without a green FID.

Refer to Green Demand Policy Playbook for further examples of demand-stimulation policies in clean industry.

Notes: 1. Mission Possible Partnership (2025). 2. BNEF Green Steel Offtake Database v1.1.1. Source: Green Demand Policy Playbook (2025)

Early clean steel demand is emerging but leaves no headroom for the next wave of projects

Estimated accessible clean steel demand by source and committed clean supply, Mt steel



CBAM and voluntary demand together represent a real but insufficient signal. CBAM covers 3.7Mt of Korean steel exports but creates compliance pressure, not contracts. Voluntary commitments add 1.6Mt, of which just 0.2Mt reflects explicit purchase pledges. The remainder is Scope 3 and net zero intent: directional, but not bankable.

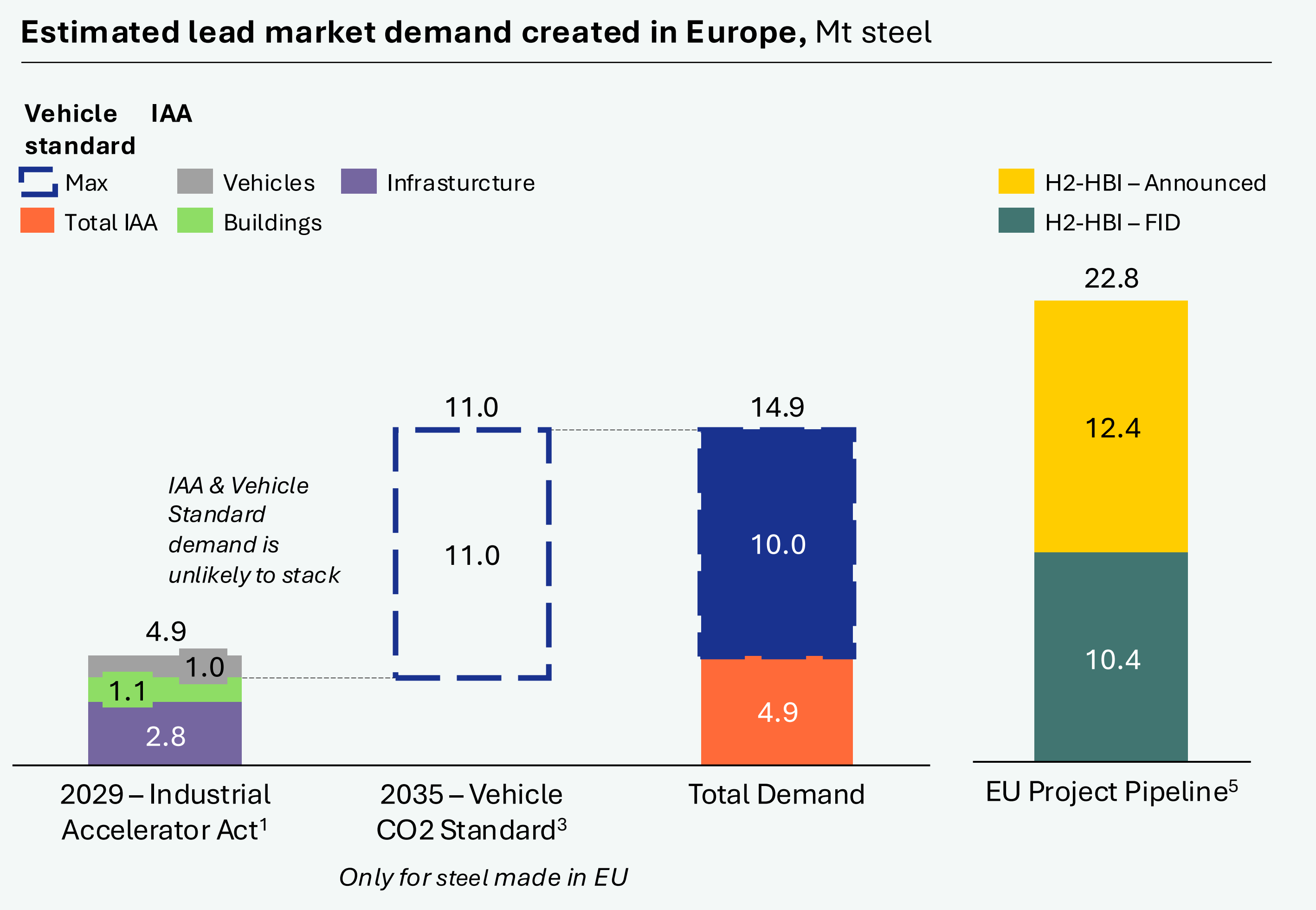
The demand total is almost entirely absorbed by already-committed supply. Against 5.3Mt of demand signals, Korea has up to 6.8Mt of committed clean supply across the Hyundai Steel's EAF-BF combined process, POSCO EAF and FBR (HyREX) pilot. With no meaningful headroom, today's demand landscape cannot pull forward a single additional project.

Without new demand, Korea cannot build the project pipeline it needs to stay competitive. The reline wave requires FID decisions on capacity beyond what is already committed. China is building process and technology leadership in hydrogen metallurgy at commercial scale. Every reline cycle without a new green FID widens the gap. Converting demand signals into contracts is not an incremental improvement, it is the precondition for Korea remaining in the race.

1.Based on RMI (2026) assessment of Korean voluntary steel demand in Asia Pacific. Demand confidence varies by category: FMC/SteelZero volumes reflect explicit purchase pledges; Scope 3 volumes are inferred from upstream emissions targets; Net Zero volumes are derived from broad carbon neutrality goals and are indicative only. 2. MPP analysis of HS6 codes for steel exports (chapters 72/73) covered by CBAM. Trade data are for 2024 and taken from BACI. 3. Hyundai Steel has not disclosed a rated capacity for its Phase 1 hybrid process but the existing EAF has a 1.2Mt capacity (but likely operates at a utilisation below 100%) and is assumed to blend at a 25% ratio with blast furnace hot metal to deliver the 20% CI reduction Hyundai Steel claim. Source: Analysis. Notes: 1. Mission Possible Partnership (2025). 2. BNEF Green Steel Offtake Database v1.1.1.

Source: Analysis

The markets making fast progress have deliberately constructed demand certainty, not just supply-side support



Lead markets are being built deliberately across the EU's highest-volume steel-consuming sectors. The IAA would introduce a 25% low-carbon steel requirement across public procurement and publicly supported construction and infrastructure from 2029, creating an estimated 2.4Mt of demand.[1] The EU Vehicle CO2 Standard extends that signal into automotive, where embedded steel requirements could unlock up to 11 Mt by 2035. However, actual demand is likely to undershoot this as faster vehicle electrification (as looks likely given current fuel disruptions) reduces required volumes.[5]

Supply-side support complements lead markets by reducing delivered cost and co-ordinating infrastructure no single project can internalise. Sweden anchored its green steel transition through state co-ordination of renewable power access, grid infrastructure and green public procurement, creating conditions the market could not produce alone. Germany committed €2.2bn to Thyssenkrupp's 2.5Mt DRI plant at Duisburg, with gas-based operations expected by end 2026.[4] Korea's K-GX and K-Steel Act provide an equivalent legislative foundation.

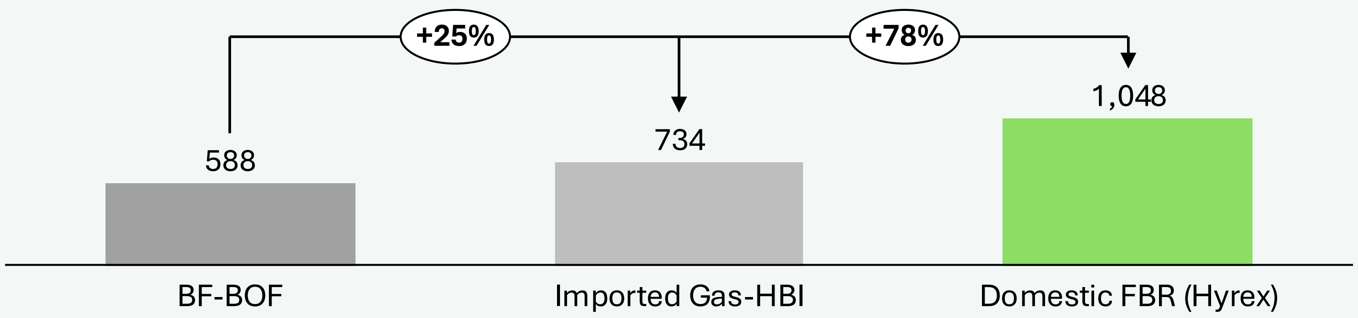
The European evidence is clear: supply-side frameworks accelerate projects, but demand creation is what gets them to FID. Across Europe, projects with substantial grant support but incomplete revenue stacks have stalled or been delayed, while those with binding offtake alongside public support have progressed. Korea's policy architecture is taking shape on the supply side. The priority now is building the demand side to match it.

1. Based on MPP analysis of measures set out in IAA proposal and accompanying impact assessment (2026), drawing assumptions from Brussels School (2024), JRC (2025), assuming low carbon requirement levels set out in IAA, and that 45% of funded schemes in the private sector corresponds to a pro-rata share of sectoral demand, includes both primary and secondary steel and public support schemes in automotive; 2. Assumes maximum tailpipe emission savings from green steel of 7.7 gCO2e/km, average steel content in cars of 1.1 t/car, total lifecycle mileage per car of 240,000 km; 3. Lower bound assumes 10M car sales per year in 2030, upper bound assumes 13M; 4. IEA (2025); 5. Based on MPP Global Project Tracker (2026)

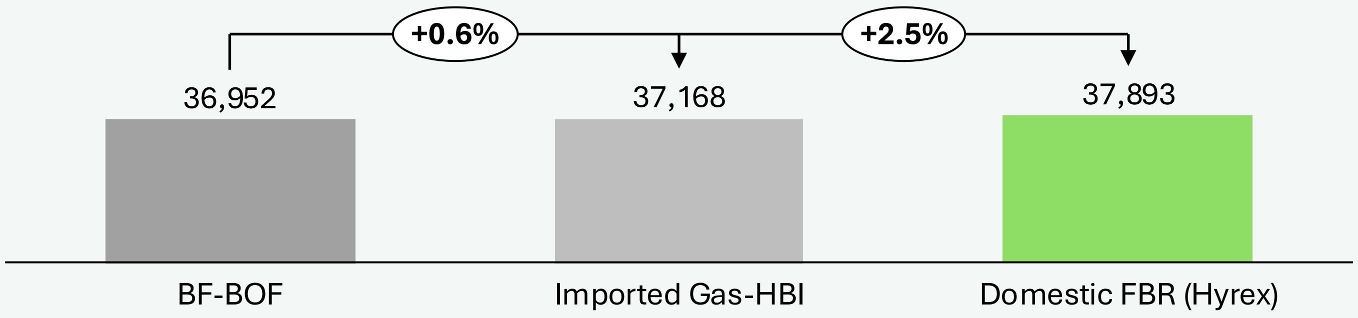
Source: Analysis, MPP Global Project Tracker June 2026, press search

The cost premium for clean steel is small for end consumers but concentrated in supply chains: targeted incentives can bridge the gap

Cost impact of switching to clean steel for steelmakers[1], USD/t, %



Cost impact of switching to clean steel for automakers[2], USD/car, %



The green premium is manageable for end consumers, limiting the competitiveness risk of demand policy. Switching to imported gas-HBI adds around 0.9% to the retail price of a mid-size SUV; H2-HBI and FBR (HyREX) around 2.5%.[1] The impact on a residential unit is comparable. These numbers do not move consumer purchasing decisions or erode Korea's downstream manufacturers' market position. The affordability argument against green steel demand policy does not hold at the product level.

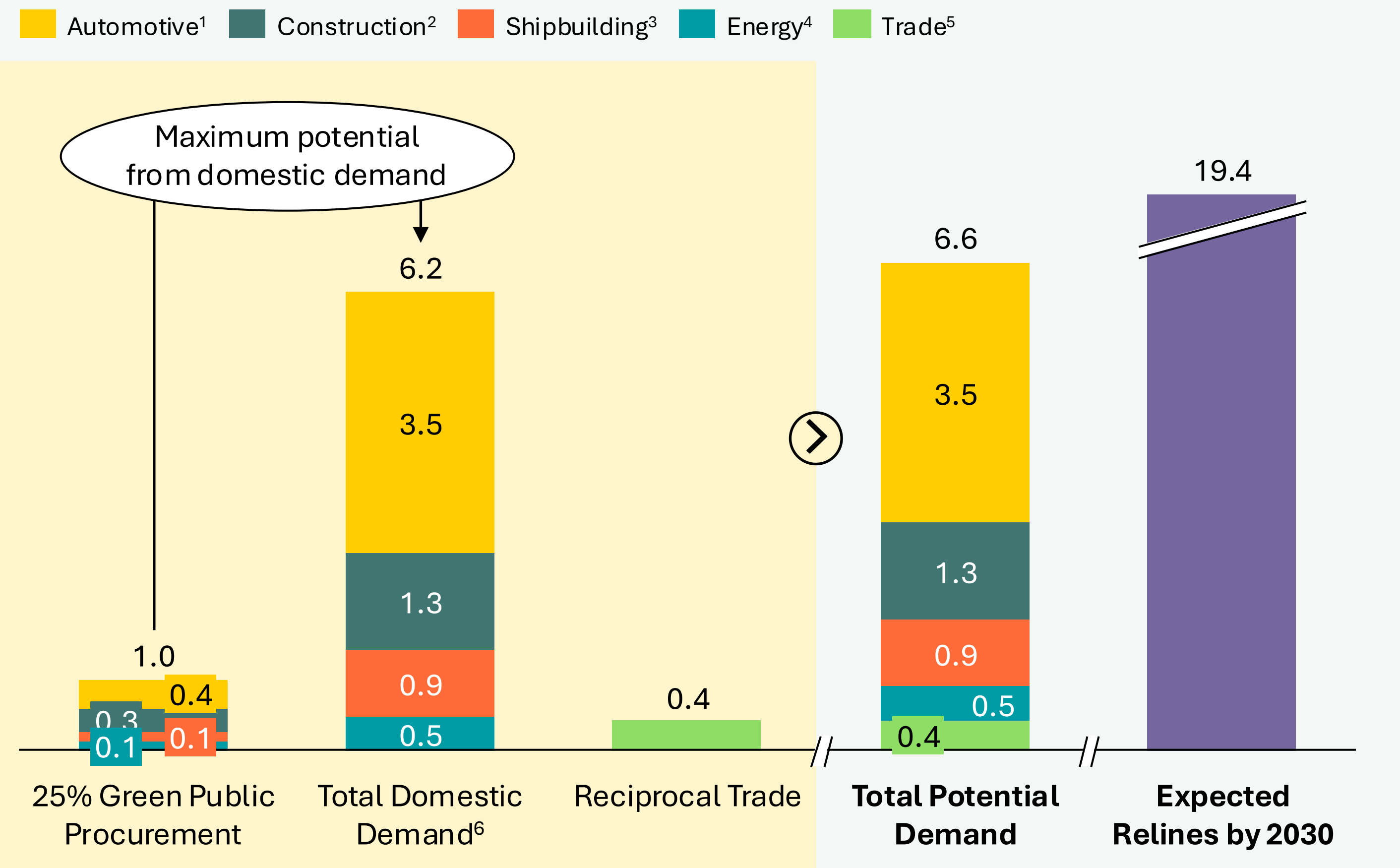
The more material impact falls in supply chains, where passing through costs is harder. For component manufacturers, green steel adds 13–17% to chassis and body-in-white costs for 100% hydrogen routes. Automotive suppliers cannot dilute that impact across a complex bill of materials the way a finished product can. This is where demand policy design becomes more consequential than headline affordability numbers suggest.

Japan's GX steel mechanism illustrates how other markets have addressed this. METI channels support through manufacturers of end products rather than the supply chain: JPY 50,000 per clean energy vehicle assessed on GX steel content share, sized to cover the full green steel premium at the OEM level.[3] This activates downstream demand without compressing supply chain margins. Korea has analogous policy levers and an analogous industrial structure.

1. Based on Next Group LCOS Model. 2. Based on MPP Cost Passthrough Model based on J.C. Kelly et al. (2020), S. Xiong et al. (2019), BMIS (2025), R&D GREET 2 Series Vehicle-Cycle, ADEME (2024), BCG (2023), ICCT (2025), IEAGHG (2013), TradeMap, Steelonthenet (2025), N. Müller et al. (2021), K. Benavides et al. (2024), X. Fang et al. (2024), P. Cavaliere et al. (2022), A. Bhaskar et al. (2020), J. Hooey et al. (2014), W. Hall et al. (2021), P. Duarte and J. Martinez (2021), BNEF (2025), Eurostat (2025). 3. WWF (2025).

Demand activation could underpin c.6–7 Mt of low-carbon steel production capacity across the next capital cycle

Estimated impact of domestic lead markets policy by sector, Mt



Domestic lead markets across four sectors could activate over 6Mt of demand, scaled well with Korea's reline pipeline for 2030. Korea can generate demand unilaterally through green public procurement in construction and shipbuilding, automotive mandates and renewable energy sector requirements. Long-term offtake contracts flowing from these commitments would provide the revenue certainty needed to bring the first wave of FIDs forward.

Trade-linked demand could help align interests to accelerate projects and remains largely unexplored. Korea exports about $14bn of vehicles a year to the same economies it buys iron ore, LNG and HBI from. Embedding green procurement deals for Korean manufactured exports within upstream supply agreements could create a mutual interest: partner countries seeking Korean capital and technology have a clear incentive to offer demand in return.

Investment certainty would allow Korea to develop new export capabilities. Enough bankable demand to support FIDs on gas and hydrogen DRI routes would build the operational learning and commercial track record that could position Korean technology for export as the global DRI market scales. The demand pools exist. The instruments are proven. The reline schedule will not wait.

1. 2025 steel production 62 Mt, c.55% domestic market, automotive c.30% of domestic, 53 – 61% 2035 EV target, 7% green steel credits EU Industrial Accelerator Act Automotive; 2. c.35% of domestic, c.30% public procurement, c.60% rebar in construction; 3. 15% domestic, 25% public procurement; 4. 2024 wind tenders 1.9 GW, average 10 MW wind turbine, 1.9 kt steel per 10 MW turbine in monopile, 0.6 kt in tower, 25% public procurement; 5. 2024 South Korea c.800kt exported steel in vehicles to energy & iron suppliers (Australia, Brazil, Canada, MENA), 25 – 50% green procurement; 6. Construction and energy 100% public procurement. Automotive and shipbuilding 100% of domestic demand (not just public procurement)
Source: Asia-Pacific's Green Steel Demand Opportunity 2026, Yuanta Korea 2025, Influence Map 2025, EU IAA Automotive, Global Wind Energy Council 2025, press search, analysis.

Forging ahead

Korea has genuine options to navigate steel sector transformation – four strategic priorities define where to place deliberate bets and in what sequence


| Clean steel transformation

Korea's steel sector faces structural pressure, real opportunity and a single missing condition for action

Meet the moment by doubling down on clean steel

CBAM has already reached Korea's most valuable export grades, and the pressure is building. Around 3.7Mt of Korean steel exports are in scope today; as the impacts move downstream to automotive and machinery from 2028 total exposure could rise to $9bn annually. Carbon conditionality is becoming a structural feature of Korea's most important markets.

China is the more acute competitive threat. It is building more than 10Mtpa of H2-HBI capacity across over 20 projects. Chinese producers are not waiting for cost parity: they are building operational knowledge and cost leadership in hydrogen metallurgy that deepens with every plant that enters operation.

Korea still has a window to be at the forefront of technology. Delay forfeits it. The ~20Mt of reline decisions due in the next five years would lock in Korea's production profile through the late 2030s. Producers who defer will be behind a learning curve they cannot close within a single capital cycle.

Make the right bets at the right time

Clean production pathways carry a substantial cost premium today, but the economics are shifting. H2-HBI above $950/t against $588/t for BF-BOF at current hydrogen costs. But in markets with carbon pricing that gap is narrowing fast: once CBAM certificates are fully priced, BF-BOF steel exported to Europe will be uncompetitive against scrap EAF and imported gas-HBI before 2035.

The cleanest pathways also offer Korea the most economic value. FBR (HyREX) and H2-HBI generate up to $1.15bn a year per 2.5Mt plant across green premiums, market access and technology exports. They also cut fossil energy imports by up to 55%, directly reducing exposure to the LNG and met coal price volatility that has repeatedly compressed Korean steel margins.

The practical response is a two-horizon portfolio. Gas and hybrid DRI lead the way in selling low-carbon steel into Europe. FBR (HyREX) is the long-run prize, a proprietary technology stack able to compete in a global market worth $70bn. No single technology spans both horizons.

Create the demand certainty to unlock investment

Korea's policy architecture for clean steel is taking shape. The K-Steel Act and K-GX Strategy provide the legislative foundation. POSCO and Hyundai Steel have committed capital across Louisiana, Port Hedland and Pohang. Capability and policy intent are not in question.

What is missing is the revenue certainty that converts pipeline into investment decisions. Green industrial projects reach financial close on the strength of their offtake agreements, not their technology readiness. Stegra secured binding agreements for 60% of capacity before FID. Korea appears once in the global green steel offtake tracker against a multi-million tonne reline wave.

Korea has the demand levers to close this gap. Green public procurement, automotive mandates and trade-linked demand embedded in upstream supply agreements with iron ore and LNG exporters could together activate over 6Mt of bankable offtake. These are instruments proven in other markets, applied to demand pools Korea controls.

No pathway performs well across all four dimensions: Korea's choice is which trade-offs to carry, and in what sequence

		Competitiveness		Opportunity		Resilience		Employment	
		2030 LCOS $/ t steel	**2035 CBAM cost** $/ t steel	**2030 revenue opportunity** $m[1]	**Tech export potential** $b Capex[2]	**Imported energy** GJ / t steel	**Feedstock shock impact** $ / t steel	**Direct jobs** workers / 2.5 Mt plant	**Upstream jobs** workers / 2.5 Mt plant order
BF-BOF		588	903	-	-	21.5	116	890	-
BF-BOF CCS		746	857	260	1	21.7	116	910	370
Scrap EAF		573	599	310	2	1.9	91	1,060	0
Gas-based iron	Domestic (DRI)	834	951	230	-	13	174	1,390	10
Gas-based iron	Imported (HBI)	734	851	230	5	13	83	1,060	10
Imported Hybrid HBI (70% gas)		808	877	280	1	11.3	82	1,060	150
Imported H2-HBI		966	930	810	70[4]	7.3	92	1,060	700
FBR (HyREX)	Domestic (Nuclear)	1,091	1,063	1,150	3	2.6	83	1,500	2,000
FBR (HyREX)	Imported (as HBI)	1,126	1,069	1,150	70	7.3	83	1,060	2,000

High upside / low cost — Medium upside / cost — Low upside / high cost

No pathway performs well across all four dimensions. Scrap EAF comes closest, leading on cost and resilience, but generates the least opportunity of any clean route, is unsuitable for many steel specifications, and Korea's scrap position is import-dependent. The question is not which technology wins, but which trade-offs Korea carries, and when.

FBR (HyREX) leads on opportunity and employment and is among the strongest on resilience, but costs the most and arrives last. It captures the most value per plant and the largest upstream manufacturing demand of any route, but is also the most expensive by a wide margin, and commercial scale is not expected before 2035. Hyrex-style technologies begin to deliver real value for Korea when they compete with other technology options to supply global DRI projects and drive exports.

Imported gas and hybrid-HBI is the near-term route into carbon-conditioned markets, at a premium to blast furnace steel but without a hydrogen supply chain. Once carbon is priced it outperforms BF-BOF and every other DRI/HBI configuration on delivered cost, while materially reducing feedstock shock exposure and imported energy.

Remaining competitive through this disruption requires a portfolio, not a pathway. No single route resolves the trade-offs, and none spans the horizons over which they resolve. The discipline is sequencing: which trade-offs are acceptable now, which become unacceptable later, and what must be underway today to keep the later options open.

1. Annualized value of revenue from upstream, midstream and downstream $m per 2.5 Mt plant per annum; 2. One-off tech sales based on CAPEX multiplied by announced project pipeline BF-BOF CCS USD700 / t 2 Mt, scrap EAF USD145 / t 14 Mt, Gas-DRI USD90 / t 55 Mt, Hybrid-DRI USD140 / t 7 Mt, FBR (HyREX) USD2,900 / t 1 Mt domestic, 2 Mt imported; 3. Nuclear; 4. H2-HBI bottom-up equipment CAPEX including RE USD27 B

Source: MPP analysis, MPP Global Project Tracker June 2026, MPP Procurement Book 2026

Korea has the industrial base to capture the opportunities of steel's next act: four priorities define where to place deliberate bets

Korea has genuine options to transform its steel sector, and the moment to act on them is now. The four priorities that follow define where to place deliberate bets. They are not prescriptive: the right combination will depend on the choices steelmakers and government bring to the transition. Korea's buyers and competitors will not wait.

Demand certainty is the precondition for everything else. Without bankable offtake, no portfolio decision reaches FID.

A deliberate portfolio is the only way to capture the full range of prizes on the table. FBR (HyREX) is the long-run technology export bet, but it needs gas and hybrid HBI to bridge the gap.

Korea has a track record of cost leadership in steel, and real levers to build cost leadership on new routes. Scrap mobilisation, hydrogen cost reduction and capital intensity improvements require time and focused mobilisation of Korea's engineering base.

Korea's cost position turns substantially on how it structures its upstream relationships. Trade partnerships leveraging Korean capital, EPC capability and technology can cut import costs, create reciprocal demand and establish Korea as a preferred technology supplier.

Priority 1

Activate multiple sources of demand for investment certainty

POTENTIAL INTERVENTIONS

- Establish green public procurement requirements for steel
- Create lead markets in downstream sectors

Priority 2

Build a portfolio spanning near-term and long-run export prize

POTENTIAL INTERVENTIONS

- Support gas and hybrid DRI projects to FID
- Accelerate FBR (HyREX) toward commercial readiness
- Build competitive supply chain capability

Priority 3

Build cost leadership across the portfolio

POTENTIAL INTERVENTIONS

- Mobilise domestic scrap
- Develop optimisation technologies to reduce H_2 costs
- Reduce the capital intensity of new production routes

Priority 4

Design trade partnerships across cost, demand and export

POTENTIAL INTERVENTIONS

- Deploy financing and capital efficiency tools to drive down HBI costs
- Use upstream investment leverage to secure reciprocal green demand
- Use early overseas projects to test and scale Korean technology

Priority 1: Activate multiple sources of low-carbon demand to create investment certainty

Intervention	Description	Key Considerations
1 **Establish green public procurement requirements for steel**	Green public procurement is Korea's most direct and controllable way to create demand. Embodied carbon requirements across public construction, shipbuilding and energy procurement could activate up to 1Mt of low-carbon demand. Drawing on the EU Industrial Accelerator Act's 25% clean materials target as a benchmark, standards and procedures for low-carbon steel certification are under development by the government.	• **Managing downstream impacts**: Construction output is not internationally traded, limiting competitive distortion risk. Standards applied equally to domestic and imported materials could avoid trade friction. • **Standards alignment**: Procurement thresholds calibrated to higher-ambition technology tiers direct public demand toward the routes with greatest strategic value for Korea. • **Product category:** Public procurement could be effective for long products (e.g., construction, infrastructure) though demand-side incentives may need to be used for flat steel (e.g., automotive, appliances) which the government does not directly purchase.
2 **Create lead markets in downstream sectors, beginning with automotive**	Public procurement alone cannot generate the volume of demand needed to drive technological change. Lead markets across downstream sectors close the gap, with automotive the largest single source of demand. Korea's automotive sector is the most directly exposed to CBAM's extension to vehicles from 2028 and represents the clearest opportunity to activate demand at the scale the transition requires.	• **Managing costs over time**: The green premium on a typical vehicle using low-carbon steel is around 1% of retail price. Requirements should start at an achievable level and tighten as the low-carbon supply pipeline grows. • **Managing competitive exposure**: Korean OEMs export a significant share of production. Japan's mechanism – ¥50,000 per vehicle built with low-emission steel – activates demand without compromising competitiveness. Examples include splitting the existing EV subsidy into a base component and a low-carbon steel premium, targeting demand without new budget – plus support for low-carbon steel products and CCfDs to give producers revenue certainty. • **Consider the full range of demand sectors**: lead-market demand can extend well beyond passenger vehicles.

Priority 2: Build a portfolio that spans near-term and long-run opportunities

Intervention	Description	Key Considerations
1 **Support gas and hybrid DRI projects to FID**	In the near term, Korea's value opportunity sits in midstream low-carbon premiums and downstream market access, both of which require a lower-carbon production base than Korea currently has. This hedges the technological uncertainty of FBR (HyREX) while maximizing industrial competitive advantage (e.g., CBAM markets). This intervention requires investment support and policy frameworks, covering both configurations that source HBI from lower-cost locations and those that blend gas with increasing proportions of hydrogen.	• **Project eligibility shapes the cost outcome.** Imported HBI/DRI is more cost-competitive than domestic ironmaking for most configurations; K-Steel eligibility criteria that exclude them risk directing capital toward higher-cost pathways without a corresponding strategic return. **Conditions need to be met:** (1) H2 supply; (2) Trade partnerships for DRI imports; (3) Financing; (4) Offtake agreements (e.g., cost sharing). • **Standards determines value.** Higher carbon-reduction pathways generate greater value across premiums and technology exports; standards that do not differentiate by carbon reduction level disadvantage the highest long-run returns. • **Synergies with FBR (HyREX).** Operational experience from running EAFs with DRI provides a metallurgical and operational baseline to scale FBR (HyREX).
2 **Accelerate FBR (HyREX) toward commercial readiness**	FBR (HyREX) carries the largest long-run opportunity because its technology stack – ESF, fluidised bed reactors, and electrolyser integration – is proprietary and exportable. A pilot is planned for 2028, but a commercial-scale plant is unlikely before 2035 on the current trajectory. This intervention supports accelerating that timeline by securing conditions for a credible demonstration and speeding up the engineering and commercial work to bridge from pilot to full-scale FID.	• **Commercial scale depends on a successful demonstration.** Securing low-carbon hydrogen supply and offtake or licensing commitments before the pilot is operational is critical. **Conditions need to be met** – (1) Clean H2 cost and volumes; (2) Clean power; (3) H2 transport infrastructure; (4) Policies and permitting; (5) FBR (HyREX) technology. • **Infrastructure conditions matter as much as steel technology.** HyREX depends on competitively priced renewables and hydrogen at scale. China's state support for RE and H2 is already narrowing the green steel premium; Taiwan secured RE access for TSMC. Korea lacks an equivalent mechanism for priority zero-carbon allocation to strategic industries. • **Breakthrough technologies could still emerge.** There are a range of direct electrification technologies which could still disrupt FBR (HyREX) and require active monitoring or even inclusion in a Korean portfolio.
3 **Build competitive supply chain capability**	Korea's upstream value from the transition is captured only if Korean firms win equipment, technology, and project delivery work as the global DRI pipeline develops. This focuses on 3 areas: electrolyser manufacturing; EPC specialisation in hydrogen steelmaking; and manufacturing capability for FBR (HyREX)-specific process equipment – the ESF and fluidised bed reactors that carry the proprietary IP differentiating Korean technology in global markets.	• **Domestic capability carries a cost premium today, but not permanently.** K-Steel and K-GX procurement can provide the demand signal that makes supply chain investment viable; The premium narrows with scale. • **Domestic demand alone will not produce export-competitive suppliers.** Korea's own DRI tech demand is unlikely to drive supply chain firms to international competitiveness without a clear export ambition backed by trade partnerships and export financing.

Priority 3: Build cost leadership across the portfolio

Intervention	Description	Key Considerations
1 **Mobilise domestic scrap**	Scrap EAF is the lowest-cost production route available to Korean steelmakers, but Korea is a net importer of scrap with significant dependence on Japan. This intervention builds domestic scrap supply through collection infrastructure investment, grading frameworks, and processing capacity.	• **Managing supply security**: Korea's net importer position and reliance on Japanese supply creates structural vulnerability to regional disruptions and price movements. Building domestic collection and processing capacity reduces that exposure. • **Managing costs over time**: Raw materials account for approximately 50% of scrap processing costs. Investment in collection efficiency and processing automation converts higher domestic volumes into cost-competitive material.
2 **Develop optimisation technologies to reduce H2 costs**	Lower hydrogen costs translate to lower steel costs only for producers that have the operational and technological capabilities to capture them. For Korean steelmakers importing HBI, the lever is co-ordinating electrolyser and DRI/FBR (HyREX) scheduling around renewable availability rather than buffering variability with storage. This requires optimisation software, grid interface systems and balance of plant integration across electrolyser, BESS and EAF. These are capabilities Korean equipment firms and engineers are well placed to develop and, ultimately, to export.	• **Offshore site access is the primary cost lever:** Where Korea owns the electrolyser and DRI furnace, scheduling around renewable availability drives down HBI cost. • **Operational data cannot be substituted:** Algorithms built on live H2-HBI operations outperform those built on simulation. Early deployment in projects is how Korea builds IP worth exporting. • **Optimise the stack, not the component:** The latest research from China shows full-chain flexibility reduces LCOS materially versus electrolyser scheduling alone. The development target should be the integrated co-ordination layer.
3 **Reduce the capital intensity of new production routes**	New DRI-EAF and FBR (HyREX) routes carry capital costs five to seven times higher than scrap EAF. This intervention reduces those costs through scaled deployment and design standardisation.	• **Managing costs over time**: Electrolyser and plant CAPEX fall as cumulative production grows, but only for producers actively building. Technology forecasts without deployment commitments do not move the cost curve. • **Managing design and standardisation**: FBR (HyREX)'s first-of-kind status means early builds carry engineering cost premiums from bespoke design. Standardising plant design across multiple planned builds, while pilot parameters are still being established, converts first-of-kind costs into replicable ones – a decision that cannot be made retrospectively.

Priority 4: Design trade partnerships to work across cost, demand and export objectives simultaneously

Intervention	Description	Key Considerations
1 **Deploy financing and capital efficiency tools to drive down HBI costs**	Korea's HBI cost is primarily a capital cost problem, not an operating one. KEXIM and KDB instruments reduce WACC on upstream projects in ways commodity procurement cannot. Prefabrication and automation technologies can reduce construction costs in remote Pilbara and MENA locations. Deploying these levers requires equity and EPC rights, not just offtake.	• **Concessional finance targeted at the power stack delivers the largest LCOH reduction:** Renewable electricity dominates H2 production cost. Reducing WACC on that component reduces delivered HBI cost more than any other single lever. • **Prefabrication is the price of entry to the best sites:** Remote, low-cost renewable locations are unviable without modular construction capability. It also reduces project cost for the host country, strengthening Korea's position as preferred development partner.
2 **Use upstream investment leverage to secure reciprocal green demand**	Korea's HBI offtake underpins a major capital project delivering jobs and growth in the host country. That leverage should be used to negotiate reciprocal commitments: partner country buyers absorb part of the green steel premium through purchase agreements for Korean vehicles, ships and machinery. The green premium is distributed across the trade relationship rather than borne entirely by the Korea's manufacturing base.	• **Partner selection is the first design step:** This works where Korea has upstream leverage and established downstream trade flows. Australia is a strong candidate; the Middle East has the leverage but thinner demand relationships. • **EACs offer a route around fragmented end consumer demand:** Bulk certificate purchases at the country level distribute the green premium through the trade relationship rather than product by product. • **Reciprocal arrangements create mutual benefit:** Structuring commitments around mutual market access – partner-country demand for Korean goods in exchange for Korean upstream investment – distributes value across both economies and makes the green-demand commitments more durable.
3 **Use early overseas projects to test and scale Korean technology**	First overseas DRI projects are the reference plants that determine Korea's position as the global pipeline builds. Deploying Korean equipment on these projects builds the operational track record FBR (HyREX) needs before commercial FID. ASEAN and the Middle East are the priority markets.	• **Korean investment in overseas projects grows the market FBR (HyREX) needs:** The global clean steel pipeline is still nascent. Korean capital and offtake accelerates project development, building the market scale that makes FBR (HyREX) exports viable in the 2030s.

South Korea's steel sector: act now

The technology choice, the trade relationships, the demand signals – none of these can wait for certainty. The window is open now.

Korea built its steel industry not by making the most, but by making the right things for the right customers. That capability – deep specification expertise, long-term manufacturing relationships and proven ability to move up the value chain – is exactly what the clean steel transition rewards.

The pressure is real, and it is structural. Carbon-conditioned trade policy is coming to Korea's most important export markets. China is not waiting: it is building hydrogen steelmaking capacity at a pace that accumulates cost advantages and operational knowledge that compound over time. Both trends favour producers who move early and punish those who defer.

The choice of production route is not just a technical decision. It is a strategic one that shapes Korea's energy security, its position in global technology markets, and the quality of jobs its industrial base sustains. Different pathways deliver very different outcomes across all four of these dimensions – and those differences widen over time.

Clean steel is not a cost to be minimised. It is an opportunity to be captured. The value flowing from cleaner production – through green premiums, preferential market access and technology exports – grows as carbon pricing tightens and global demand shifts. The producers who build capability first set the cost frontier. Those who follow inherit it.

What is missing is not capability. Korea can build any clean steel route. The missing ingredient is committed demand – the revenue certainty that turns a viable technology into a financeable project. Government has direct levers: procurement standards, automotive mandates, and trade-linked demand signals that can create the offtake foundation on which private capital moves.

The time to act is before the capital decision is forced. Steelmakers, government, finance and downstream buyers each hold a piece of what is needed. The question is not whether Korea will make this transition – it will. The question is whether Korea shapes it or adapts to one shaped by others.

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Appendix

Key assumptions: 2030–35 opportunity sizing

Global inputs: Reference plant capacity **2.5 Mt** | **10-year payback period** with assumed refinancing | EUR-**$1.18** | EPC margin **10–13%** | O&M **2–4% of CAPEX**

Upstream - technology export economics

Technology components by route

Technology	Components included
BF-BOF CCS	CCS · EPC · Ops & maintenance
Scrap EAF	EPC · Ops & maintenance
Gas-DRI/HBI	Gas handling · EPC · Ops & maintenance
Hybrid-HBI	Equipment · Gas handling · EPC · Ops & maintenance
H2-HBI	Equipment · BESS · EPC · Ops & maintenance
FBR (HyREX) – imported	Equipment · ESF + fluidised bed · BESS · EPC · Electrolysers · Ops & maintenance
FBR (HyREX) – domestic	Equipment · ESF + fluidised bed · BESS · EPC · Electrolysers · Ops & maintenance

Global pipeline

Global H2-HBI pipeline	28 Mt

Midstream - CBAM-linked green premium

CBAM & free-allowance schedule

HRC CBAM benchmark	1.37 tCO_2/t
2030 CBAM coverage	51.5% → 100% by 2034
2030 free allowance	0.71 tCO_2/t
BF-BOF net emissions (w/ allow.)	1.27 → 1.98 tCO_2/t

Carbon price & green premium

EU ETS price, 2030	$170/t
EU ETS price, 2035	$212/t
HRC green premium, 2030	$134–170/t
Long-term floor, 2050	$85/t

Emissions intensity, tCO_2/t steel

BF-BOF / with CCS	1.98 / 1.08
Gas-DRI / Hybrid	1.01 / 0.89
H2-HBI	0.23
FBR (HyREX) (nuclear H_2)	0.34
Scrap EAF	0.16

Downstream - steel-intensive goods

EU market share gain & modelled value (2030)

Segment	Share gain	2024 base, $M	Value, $M
Automotive	+25% (1–6%)	$4,709	$47–320
Construction	+40% (1–6%)	$1,052	$11–63
Electrical	+40% (1–6%)	$5,013	$50–301
UK automotive base	-	$624	-

Flat steel export base, 2024 (CBAM-eligible)

EU only	3.2 Mt
EU + AU + UK	4.4 Mt

Voluntary & public demand pull (2030)

SteelZero	5.0 Mt
First Movers Coalition (top 3 of 25)	1.65 Mt
Public procurement	0.5 Mt (~$85 M)
McKinsey DRI demand 2030 → 2040	200 → 500 Mt

LCOS sensitivity analysis to input assumptions by technology

LCOS sensitivity by cost and technology pathway[1], USD / t steel

Costs	Scrap EAF Baseline LCOS: $573/tSteel	Imported Gas-HBI Baseline LCOS: $734/tSteel	Imported H2-HBI Baseline LCOS: $966/tSteel	Imported FBR (as HBI) Baseline LCOS: $1,269/tSteel
Gas ±USD1 / GJ	*N/A*	-9 / 9	*N/A*	*N/A*
H2 ±USD1 / kg H2	*N/A*	*N/A*	-54 / 54	-70 / 70
Power ±USD20 / MWh	-11 / 11	-2 / 2	-2 / 2	-15 / 15
Scrap ±USD50 / t scrap	-52 / 52	-15 / 15	-15 / 15	-10 / 10

1. Baselines: South Korea grid power cost ~USD100 / MWh for scrap EAF and HyREX, Imported power price from DRI ~USD60 / MWh for gas-DRI and H2-HBI, Australia gas for DRI ~USD7 / GJ , H2 cost ~USD5 / kg for H2-HBI, ~USD7 / kg for HyREX, scrap cost ~USD330 / t for all pathways

Source: MPP analysis

Glossary

Terms & Acronyms

AHSS / UHSS	Advanced / Ultra-High-Strength Steel
ASEAN	Association of Southeast Asian Nations
ATB	Annual Technology Baseline (NREL)
BESS	Battery Energy Storage System
BF	Blast Furnace
BF-BOF	Blast Furnace–Basic Oxygen Furnace route
BF-EAF	Blast Furnace–Electric Arc Furnace hybrid route
BOF	Basic Oxygen Furnace
CAPEX	Capital Expenditure
CBAM	Carbon Border Adjustment Mechanism (EU)
CCS / CCUS	Carbon Capture, (Utilisation) & Storage
CfD	Contract for Difference
CI	Carbon Intensity
CO2	Carbon Dioxide
CV	Calorific Value
DR-grade / DR-ore	Direct-Reduction-grade iron ore
DRI	Direct Reduced Iron
DRI-EAF	Direct Reduced Iron–Electric Arc Furnace route
EAF	Electric Arc Furnace
EBITDA	Earnings Before Interest, Tax, Dep'n & Amortisation
EPC	Engineering, Procurement & Construction
ESF	Electric Smelting Furnace
EV	Electric Vehicle
FID	Final Investment Decision
FINEX	POSCO fluidised-bed ironmaking process
FBR	Fluidised Bed Reactor
FMC	First Movers Coalition (demand platform)
GEI	Green Emissions Intensity
GJ / GJ/t	Gigajoule (per tonne) — energy unit
GPP	Green Public Procurement
GVA	Gross Value Added
GX / K-GX	Green Transformation (Japan: GX; Korea: K-GX)
H2	Hydrogen
H2-HBI	Hydrogen-based Direct Reduced Iron
HBI	Hot Briquetted Iron
HRC	Hot-Rolled Coil
HS6 / HS72–73	Product codes; Ch.72: iron & steel; Ch.73: steel articles
HVDC	High-Voltage Direct Current
HYBRIT	Swedish hydrogen-steel initiative
HyREX	POSCO hydrogen-reduction steelmaking process
IAA	EU Industrial Accelerator Act
JPY	Japanese Yen
₩	Korean Won
LCOS	Levelised Cost of Steel
LNG	Liquefied Natural Gas
MENA	Middle East & North Africa
MW / GW	Megawatt / Gigawatt
NG-DRI	Natural Gas–based DRI
NH3	Ammonia
O&M	Operations & Maintenance
OEM	Original Equipment Manufacturer
OPEX	Operating Expenditure
P90	90th-percentile estimate
PPA	Power Purchase Agreement
RMB	Chinese Renminbi
Scope 1–3	GHG emission scope categories
VWAP	Volume-Weighted Average Price
WACC	Weighted Avg Cost of Capital

Organizations & Sources

ADEME	French Agency for Ecological Transition
AEMO	Australian Energy Market Operator
BACI	CEPII International Trade Database
BCG	Boston Consulting Group
BHP	BHP Group (mining major)
BNEF	BloombergNEF
BOK	Bank of Korea
CISRI	China Iron & Steel Research Institute
DESNZ	UK Dept. for Energy Security & Net Zero
EIA	US Energy Information Administration
HBIS	Hebei Iron & Steel Group (China)
ICCT	International Council on Clean Transportation
IEA	International Energy Agency
IEAGHG	IEA Greenhouse Gas R&D Programme
IRENA	International Renewable Energy Agency
JFE / Nippon	JFE Steel / Nippon Steel (Japan)
JRC	EU Joint Research Centre
KAMA	Korea Automobile Manufacturers Association
KCCI	Korea Chamber of Commerce & Industry
KOGAS	Korea Gas Corporation
KOSA	Korea Iron & Steel Association
KOSIS	Korean Statistical Information Service
METI	Japan Ministry of Economy, Trade & Industry
MIIT	China Ministry of Industry & Information Technology
MOTIE	Korea Ministry of Trade, Industry & Energy
MPP	Mission Possible Partnership
NEXT	NEXT Group (energy transition analytics)
NREL	National Renewable Energy Laboratory (US)
OECD	Org. for Economic Co-operation & Development
POSCO	Pohang Iron & Steel Company (Korea)
RBA	Reserve Bank of Australia
RMI	RMI (Rocky Mountain Institute)
WWF	World Wide Fund for Nature