Policy Paper

Leveraging Green Trade:
The MENA Region's Opportunity in the Global Green Iron and Steel Market

Carboun Institute

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Abbreviations

BF-BOF	Blast Furnace–Basic Oxygen Furnace
CAGR	Compound Annual Growth Rate
CBAM	Carbon Border Adjustment Mechanism
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation.
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace
ECA	Export Credit Agency
EPD	Environmental Product Declaration
ETS	Emissions Trading System
EU ETS	European Union Emissions Trading System
EUA	EU Allowance (unit in the EU ETS equal to one tonne CO_2-equivalent).
FOAK	First-of-a-Kind.
FOB	Free on Board
GCC	Gulf Cooperation Council.
HBI	Hot Briquetted Iron
HRC	Hot-Rolled Coil (steel).
HYBRIT	Hydrogen Breakthrough Ironmaking Technology
LCOE	Levelized Cost of Electricity
LCOH	Levelized Cost of Hydrogen
MENA	Middle East and North Africa
MDB	Multilateral Development Bank
MoU	Memorandum of Understanding.
MRV	Monitoring, Reporting, and Verification
NDC	Nationally Determined Contributions
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreement
SWF	Sovereign Wealth Fund
tCO_2	Ton of Carbon Dioxide
VCM	Voluntary Carbon Market.

Executive Summary

The steel industry must decarbonize and to do so fast. The sector contributes between 8 to 10% of global energy-related CO_2 emissions, and starting from 2026 the EU's Carbon Border Adjustment Mechanism (CBAM) will charge imports for embedded emissions, reshaping trade economics.

This policy paper argues the MENA region can convert this shift into advantage by leaning on three existing strengths: incumbent DRI capacity, low-cost renewables and green hydrogen, and central geography, becoming a competitive supplier of green iron.

Although the MENA region produces only 3.6% of global crude steel, it is the world's largest Direct Reduced Iron (DRI) producer, delivering 44% of global DRI in 2024 (62.5 Mt of 140.8 Mt). This is a springboard to lead green iron trade, with capacity build-out already signaled by announced regional projects, but it is only viable with clear hydrogen targets. Otherwise investments risk emissions lock-in and stranded capital.

The primary recommendation of this policy paper is that MENA region governments and investors decisively integrate upstream pelletizing with midstream HBI production, backed by sovereign support and international finance, and establish credible carbon certification while pursuing green trade corridors with Europe and Asia to secure market access. This integrated approach can convert its energy advantage into global leadership in green iron, securing long-term industrial growth while contributing to climate goals.

At stake is the region's value-creation opportunity: secure iron concentrate and high-grade pelletizing upstream; then scale midstream green iron exports to supply European and Asian steelmakers as in-region downstream capacity develops.

To realize it — while leaving room for additional opportunities — implementation follows four trade pathways shaped by key drivers, building green iron corridors linking MENA supply to demand in Europe.

Five conditions for success are essential to address hurdles and risks:

- Boost bankability
- Secure early market access
- Anticipate volatility
- Manage premium uncertainty
- Diversify markets and align standards

These conditions keep green-iron corridors investable, compliant, and resilient, turning the region's energy advantage into a long-term industrial edge.

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01 Introduction

The Iron and Steel industry is at the heart of our climate challenge, responsible for 2.8 gigatons (Gt) CO_2, and representing 8% of total energy-related emissions worldwide, or a staggering 10% if indirect emissions from electricity generation are included.[1]

Starting on 1 January 2026, the European Union's Carbon Border Adjustment Mechanism (CBAM) will phase in a border charge on imports of iron and steel and products from other hard to abate sectors, while free allowances, under its internal Emissions Trading System (ETS) are gradually phased out.[*, 2] Other markets, including the UK, are following suit with their own CBAM plans.

The Middle East and North Africa (MENA) region has a huge opportunity and the tools to be a leader in green iron and steel. Nowhere is the incentive and the ability to do so greater.

This policy paper makes the case that the Middle East and North Africa (MENA) region has a clear opportunity to shift from being a traditional energy exporter to a powerhouse of green and iron industry. It explains how new carbon-focused trade rules are turning MENA's strengths, such as low-cost renewable energy, existing Direct Reduced Iron (DRI) facilities, and its prime location as a global trade hub into valuable possibilities.

The paper proceeds in five steps. First, it outlines the decarbonization imperative reshaping the iron and steel industry. Second, it details the MENA region's competitive edge. It will then set out the opportunities for the MENA region to capitalize on its competitive advantages, and present four plausible trade pathways. Next, it outlines the conditions for success that enable these pathways. Finally, it provides policy recommendations for governments, investors, and buyers.

* In its definitive regime from 2026, CBAM will initially apply to imports of cement, iron and steel, aluminum, fertilizers, electricity and hydrogen with full enforcement in 2034

02

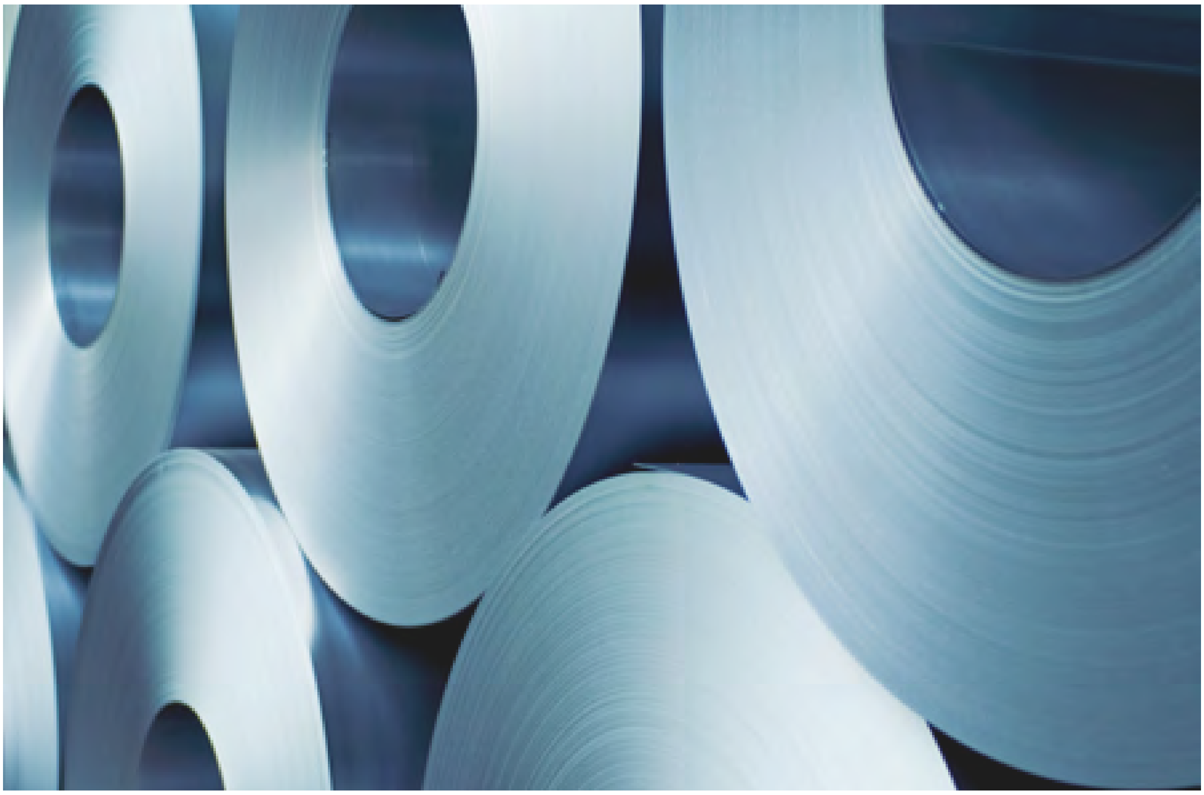
Steel in Flux: Inevitable Disruption of Global Value Chains

The global steel industry is pivoting toward lower-carbon routes. Buyers are signaling demand for verified "green" iron and steel, while climate-trade rules make carbon intensity a price factor at the border. Supply chains are reorganizing around transportable green metallics, decoupling ironmaking from steelmaking and redirecting trade toward regions with abundant, low-cost renewables.

Why is Steel Decarbonizing?

The iron and steel sector ranks first among heavy industries for energy-related CO_2 emissions, contributing approximately 25% of global industrial emissions.[3] The sector's high carbon intensity stems not only from heavy energy use but also from the chemistry of steel production. Coal accounts for approximately 73-75% of the sector's total energy demand.[4] However, its function extends beyond providing thermal energy. Coal, in the form of coke, serves as the primary chemical reducing agent required to strip oxygen atoms from iron ore in a blast furnace, thereby producing metallic iron.

The sector's reliance on coal is the main driver for its emissions profile. The coal-based Blast Furnace-Basic Oxygen Furnace (BF-BOF) route remains the dominant steel production pathway, accounting for 70.4% of global steel production in 2024.[5] In this route, iron ore, coke, and limestone are fed into a blast furnace to produce molten iron, which is then refined into steel in a basic oxygen furnace. This route is emission–intensive, emitting roughly 2.32 tons of CO_2 (tCO_2) for every ton of crude steel* it produces.[6]



* Word Steel Association defines crude steel as steel in the first solid state after melting, suitable for further processing or for sale. The term is synonymous with raw steel.

25%

of global industrial emissions come from the steel sector

For the sector to align with climate goals such as the 1.5°C target of the Paris Agreement, it will need to drastically cut its emissions across its entire value chain. In the IEA Net-Zero by 2050 Scenario, iron and steel emissions must fall by 25% by 2030 and 91% by 2050[7] compared to 2022 levels. However, achieving these reductions is challenging due to the steel sector's current heavy reliance on fossil fuels and inherent process emissions. Recent data shows that emission intensity increased by 0.6% over the 2019-2023 period, while steel production grew only 0.1% from 2022 to 2023, underscoring the urgency for change.[8]

Scientific studies have calculated sector-specific carbon budgets representing the total cumulative volume of CO_2 that can be emitted while still meeting the 1.5°C goal. The University of Technology Sydney (UTS) estimates the steel industry's remaining energy-related carbon budget at only 19 Gt CO_2 until 2050.[9] To put that in perspective, at current annual emission levels of 2.8 Gt CO_2, this represents around 7 years of emissions. Thus, the window for meeting the sector's decarbonization targets in line with the Paris agreement is extremely narrow.

The global stock of blast furnaces could single-handedly exhaust this carbon budget. The IEA estimates that the global average age of blast furnaces is relatively young: approximately 24 years since the initial installation, or 13 years from the date of the most recent major refurbishment.[10] However, average age varies widely by region: EU furnaces aging, while China and India operate much younger fleets and may continue for 30–40 more years unless policy intervenes.[11] By 2035, however, many EU blast furnaces are due for reinvestment or retirement, reaching decision points: either locking in further coal-intensive production, or transitioning to cleaner alternatives.[12]

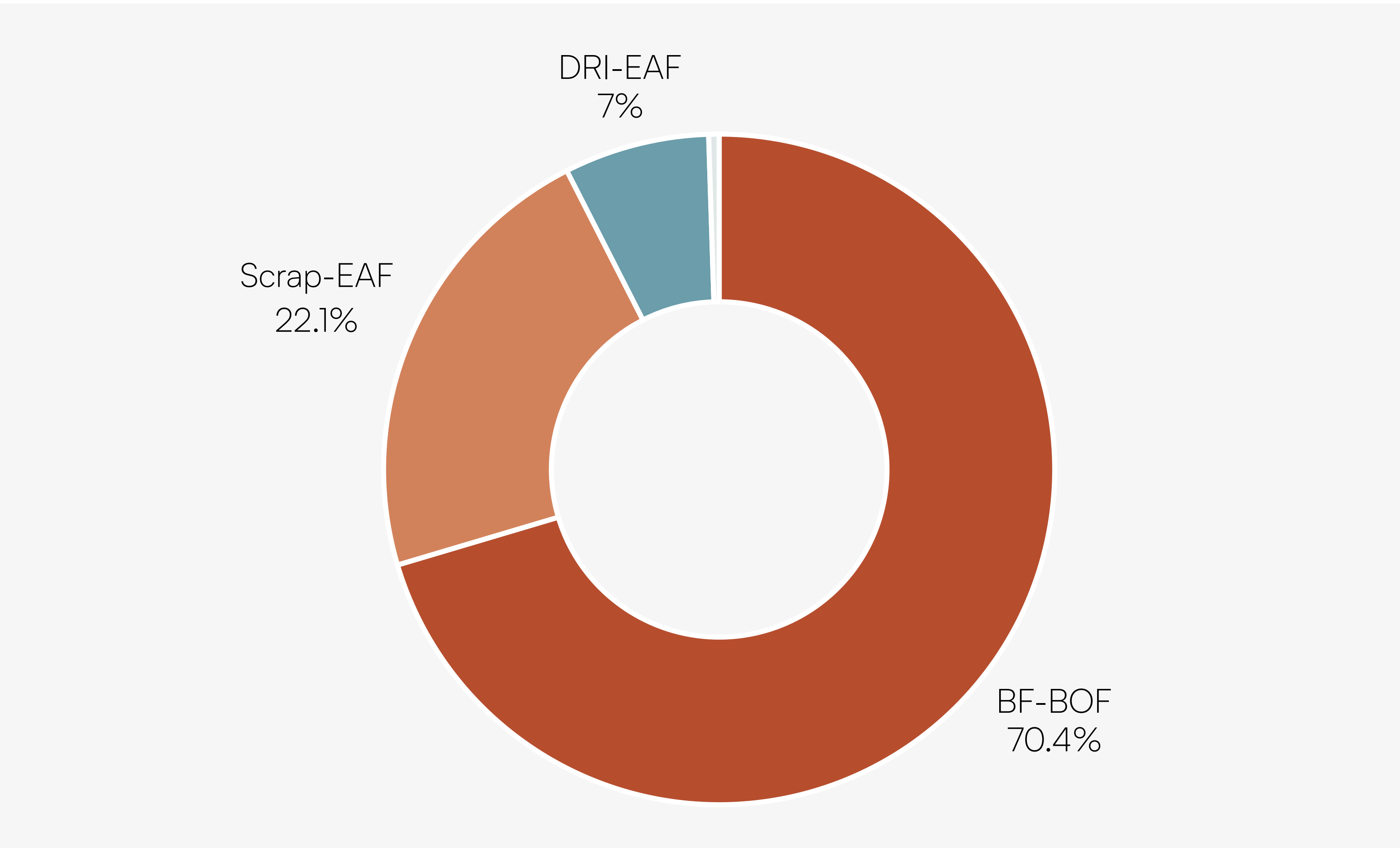
The Australasian Centre for Corporate Responsibility (ACCR) study suggests that relining* blast furnaces typically costs between $300 million and $1 billion.[13] With high and volatile electricity prices in Europe, this dynamic could create both a medium-term challenge for regional steelmakers and stronger incentives to import green iron feedstock from abroad.[14]

* BF relining is described as a major refurbishment or rebuild that extends the furnace life by approximately 20 years, with costs varying depending on size and scope.

A lower-carbon pathway for the steel industry exists. This route involves producing primary* iron through DRI technology, which typically uses natural gas as a reductant. This DRI is then melted in a furnace by means of an electric arc known as "Electric Arc Furnace" (EAF) to produce steel.

Although cleaner than the BF-BOF route, the natural gas-based DRI-EAF process still emits a significant 1.37 tCO_2 per ton of crude steel.[15] Its importance, however, lies in its ability to switch to green hydrogen as a reductant, offering a key decarbonization pathway. In 2024, DRI-EAF technology accounted for 7% of global steel production,[16] or 140.8 million tons.[17] Figure 1 shows the breakdown of global crude steel production by technology.

FIGURE 1. Global crude steel production by technology in 2024[18,19,20]



* In this context, "primary" means iron made from iron ore (virgin material), not recycled scrap.

Market Momentum

A. Corporate Demand and Offtake

Regions like Europe and China, along with major corporate buyers in automotive, renewable energy, and construction, are seeking steel with a low embedded carbon footprint because environmental regulations are becoming more stringent and corporate purchasing standards are creating market demand for cleaner steel.

Automakers — the world's second-largest steel consumers, accounting for ~12% of global demand[21] — have already made commitments to procure a share of their steel from green producers, given its relatively small cost impact — less than 1% increase in the final vehicle prices when green steel is used.[22]

Long-term off-take agreements in the automotive sector provide the revenue certainty needed to finance green steel projects, hence de-risking investments for producers. [23] Stegra, a Swedish startup, has secured funding of nearly €6.5 billion for the world's first large-scale green steel plant in Boden, Sweden.[24] Mercedes-Benz combined an equity stake with multi-year off-take agreements, creating a model that anchors bankability.*[25] Stegra's financing is built around a "co-invest + pre-pay off-take" structure. It has pre-sold over 1.5 million metric tons (mt) per year, about 60% of its planned 2.5 mt production, through multi-year agreements with creditworthy buyers.[26]

Table 1 summarizes recent multi-year automotive green steel off-take agreements from public disclosures. These contracts turn buyer pledges into predictable revenue and send a durable demand signal for new capacity.

12%

of global steel demand comes from the automotive sector

* Bankability means a project can raise debt (and attract investors) on acceptable terms — i.e., lenders see predictable cash flow and well-managed risks.

TABLE 1. Automotive green steel off-take and supply agreements

Automotive Company	Steel Partner	Contracted Quantity Tons	Notes
Mercedes-Benz[27]	Stegra	50,000	Starting in 2025 at an emissions intensity of 0.4 t CO_2/t steel
BMW[28]	Salzgitter	Undisclosed	Starting in 2026
Porsche[29]	Stegra	35,000	Starting in 2026 accounting for up to 15% of Porsche's steel demand[30]
Volkswagen[31]	Salzgitter AG	Undisclosed	Signed MOU starting at the end of 2025
Volkswagen[32]	Vulcan Green Steel	up to 300,000	Signed MOU starting in 2027
Scania[33]	Stegra	Undisclosed	Starting in 2027
Scania[34]	SSAB (HYBRIT)	Undisclosed	Starting from 2026-2030
ZF Group[35]	Stegra	Significant share of 2.5 M tonnes	7-year, 1.5 billion euros binding agreement
Volvo Group[36]	SSAB (HYBRIT)	Prototype volumes, ramping up	Deliveries anticipated from 2026
Ford Europe[37]	Tata Steel (Zeremis)	Undisclosed	First committed customer
Ford Europe[38]	Salzgitter Flach-stahl GmbH	Undisclosed	Starting the end of 2025

B. Price Signal

In green steel markets, the premium represents the additional cost buyers pay for lower-CO_2 steel compared to higher-emitting alternatives. In Europe, early-stage demand is concentrated and the premium is partly managed/offset because policy and procurement translate climate goals into purchasing: hard policy (the EU ETS and CBAM), and lead-markets tools (EU green public procurement criteria). Brand/consumer preferences also help in some end-products. These mechanisms vary by region, so the depth of early demand and the ability to absorb the premium differ across markets.

In their July 2025 assessment, cross-commodity price reporting agency Fastmarket estimated the "green-steel differential" in Northwest Europe at €130-180 per ton.[39, 40] This represents 24–33% above the Northern Europe HRC index of €547.50 per ton on 15 July 2025.[41]

This premium reflects the higher iron or steel production cost and the producer's internal cost delta driven mainly by higher input costs. The size of the premium is dynamic and varies regionally with factors such as energy prices, raw material availability, and policy incentives. An RMI study projects a 20–30% additional cost for full-scale hydrogen-based direct reduction compared to conventional steel production.[42] Other estimates go as high as 20–50%, according to Bloomberg NEF,[43] or as high as 70%[44] more than traditional methods made with natural gas, depending on the price of hydrogen. Moving from estimates to producer disclosures, Stegra quotes a 25–30% premium for its green steel and targets start of production in 2026.[45]

The premium signals buyers' willingness to pay; binding offtake agreements that include a premium confirm demand and secure revenue, as seen in Stegra's green steel project, transforming a climate goal into a bankable asset. It also aligns downstream buyer behavior: companies with science-based targets and buyer initiatives, such as First Movers Coalition and SteelZero, are willing to pay a strategic premium to decarbonize supply chains, with minimal impact on the final consumer price.

In first-mover industries like automotive, this makes it easier to absorb and commercially feasible to pass through to consumers.[46]

The premium also hedges against future carbon cost at the border, by switching to lower-carbon products at a premium, industries future proof their position through effectively pre-paying for carbon reduction.

In addition to this low-cost pass-through, this analysis finds that the green premium is currently driven by corporate buyers' need to reduce their Scope 3 (value chain) emissions to meet climate targets. It is also a differentiator when appealing to climate-conscious customers, thereby enhancing brand image. It represents a forward-looking positioning in anticipation of regulatory risk as carbon pricing becomes more aggressive and prices increase significantly.

C. Path to Clarity

While first-mover sectors demonstrate willingness and ability to pay green premiums, they remain a hurdle for more cost-sensitive sectors like construction. Current green premiums concentrate in specific industries and markets rather than reflecting broader market willingness to pay. The long-term business case assumes falling green hydrogen costs and rising carbon prices will make green steel cost-competitive with conventional methods. At that point, premiums will become unnecessary. Premiums are therefore viewed as transitional mechanisms bridging short to medium-term cost gaps and financing high initial costs of first-of-a-kind (FOAK) projects until technological learning, economies of scale, and policy measures create level playing field.[47]

Trade Rules Reshaping Supply Chains

The European Union's CBAM takes effect in 2026.[48] CBAM applies a carbon price on carbon-intensive imports like steel, cement, aluminum, fertilizers, electricity, and hydrogen. Importers must buy CBAM certificates (pegged to the EU ETS price[49]) to cover the embedded CO_2 in their imports; any carbon price already paid in the country of origin is deducted, and obligations ramp up as free EU ETS allowances are phased out. From 1 January 2026, CBAM obligations phase in proportionally with free allocation phase-out, reaching full implementation by 2034. Until then, CBAM applies only to the share of embedded emissions not covered by free allocation, ensuring even treatment of EU producers and importers.

For iron and steel, CBAM covers the embedded emissions in imported products, making higher-emission products less competitive because they require more CBAM certificates (and thus a higher cost). By contrast, lower-CO2 steel produced with renewable power and green hydrogen is likely to gain a competitive advantage, as the carbon costs of both EU-produced and imported steel (under CBAM) increase during the gradual phase-out of free allowances through 2034.

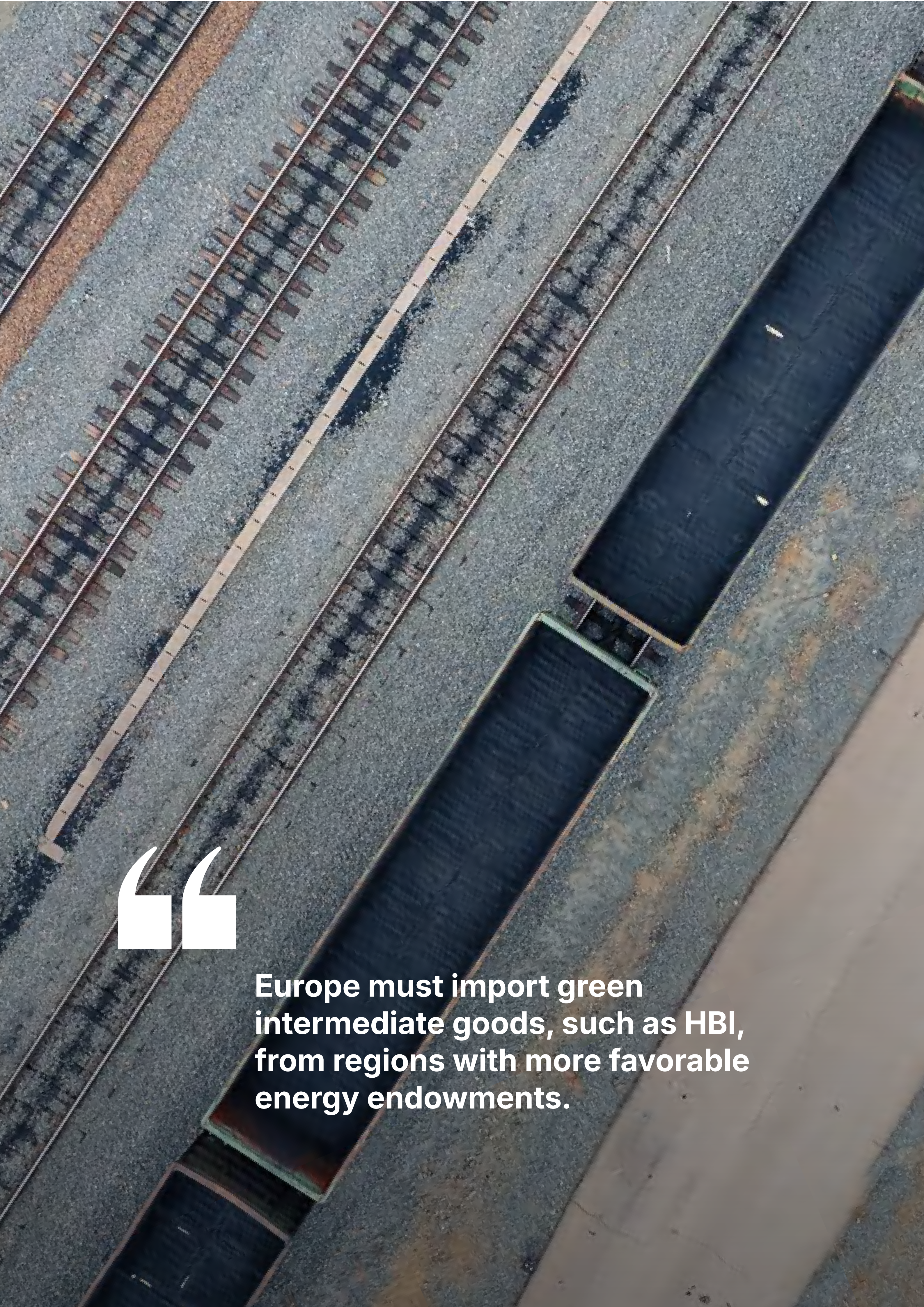
This means that foreign steel exporters to the EU will be exposed to carbon price volatility and no longer insulated from Europe's internal carbon market and its long-term upward price trend. Bloomberg projects carbon prices to start rising in 2027 and reach as high as €149 per ton by 2030,[50] compared to €73.50 per ton in July 2025.[51] Analysts estimate that the import charge, as a percentage of steel price under a medium carbon price scenario, will range between 20–30% for most countries exporting to the EU.[52] By 2034, when CBAM is fully implemented, steel from India and China could cost about 50% more than in 2026.[53]

In 2024, the EU imported 48.86 million tons of iron and steel,[54] valued at €73.1 billion,[55] up 4% from 2023, making CBAM levies critical to the commercial viability of conventional steel imports.

CBAM will impact coal-based BF-BOF exporters most severely, as this route carries much higher embedded CO_2 than EAF/DRI alternatives, resulting in higher border costs. Competitiveness will hinge on the product's verified carbon intensity, EU ETS price to which CBAM certificates are pegged, steel cost share and pricing power in the final product (for example, brand-differentiated goods or commodity long products), and any carbon price already paid in the country of origin (credited under CBAM).

Despite targeting imports, CBAM also disrupts Europe's domestic steel industry. With over half of the EU's blast furnaces set for retirement or major reinvestment before 2030,[56] Europe faces the major task of replacing them with cleaner production routes. Europe has indeed announced plans to build 40 to 50 million tons per year of new green steelmaking capacity using stand-alone EAF plants and EAFs integrated with DRI units.[57] However, this faces hurdles: high costs of green hydrogen, limited renewable energy availability, and shortages both in the quality and quantity of scrap required for high-specification steel.

This creates a structural European deficit in virgin, low-carbon iron,[58] which can only be met with transportable, intermediate goods, namely DRI and its transportable form, Hot Briquetted Iron (HBI). As a result, Europe must import green intermediate goods, such as HBI from regions with more favorable energy endowments.[59, 60, 61]



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How the Green Iron and Steel Value Chain Works

Most global steel production still uses the traditional BF-BOF method (Figure 2), industrial steelmaking's backbone for decades. In this process, iron ore is turned into molten iron, or "hot metal," through a chemical reaction called reduction that relies heavily on coking coal, a carbon-rich fuel made from coal. Iron ore, usually small particles called "fines," is mixed with other materials and heated to form larger clumps called "sinter" before entering the blast furnace.[62] Fines are the dominant traded form of iron ore,* making up about 70% of global seaborne iron ore exports.[63] The iron ore trade is concentrated in a few countries. In 2024, Australia and Brazil dominated exports, supplying about 74% by value and up to 80% by volume, as illustrated in Table 2.[64, 65, 66]

TABLE 2. Global iron ore export in country in 2024

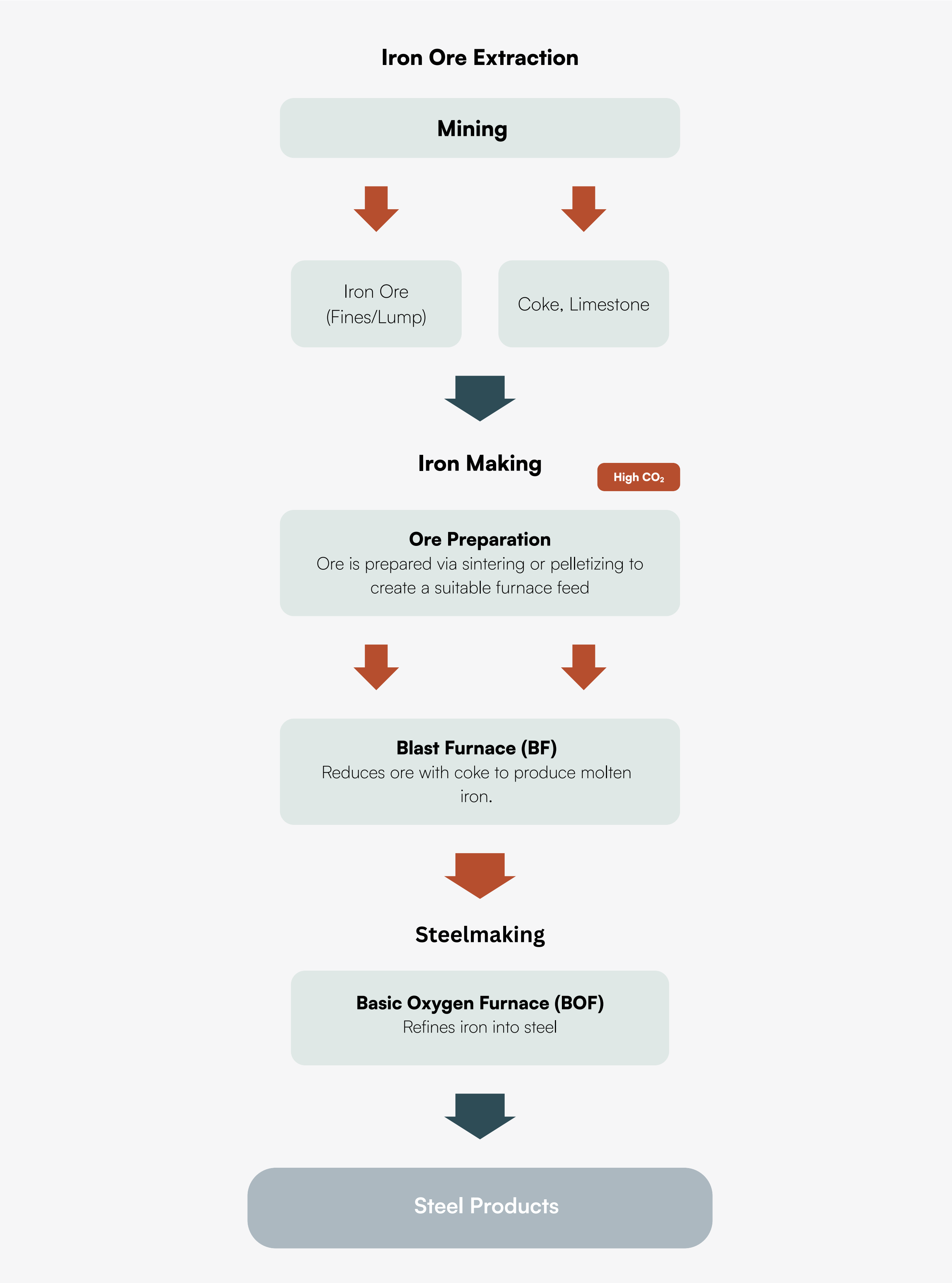
Exporter	Exports (Mt)[67,68]	Volume Share	Export Value (US$ B)[69]	Value Share
Australia	902	56%	83	54.3% of $152.7 B
Brazil	390	24%	29.9	19.5%
Canada	61	3.8%	6.4	4.2%
South Africa	61	3.8%	6.3	4.1%
Others	186	12.4%	27.1	17.8%
Total	1,600	100%	152.7	100%

12%

Australia and Brazil's share of global iron ore exports by volume

* There are other traded forms: lump, concentrate and pellet.

FIGURE 2. Traditional BF–BOF process, the dominant global route, but highly emission-intensive



Advances in furnace technology drove demand for more uniform and higher-quality iron ore feedstock, leading to the development of "pelletizing." This process transforms low-grade iron ore fines, or their upgraded, higher-purity, finer form known as "concentrates," into uniform, spherical pellets that serve as an ideal feedstock for modern furnaces.[70] Unlike sinter, which is produced and used on-site, pellets are a stable, globally traded commodity, durable in handling, storage, and ocean shipping. They command significant premiums over fines as they bypass the sintering process. Today pellets represent about 9% of global iron ore exports, as shown in Figure 3.[71]

In the DRI-EAF process (Figure 4), a shaft furnace converts iron ore pellets to metallic iron, typically using natural gas. This produces DRI, known as 'sponge iron' due to its porous texture. The sponge iron is then melted in an EAF, which runs on electricity, to make liquid steel. By removing coal from the process, and especially when paired with renewable electricity and green hydrogen, this pathway enables far cleaner steelmaking. Key differences between the two routes are summarized in Table 3.

FIGURE 3. Global iron ore exports by product share[72]

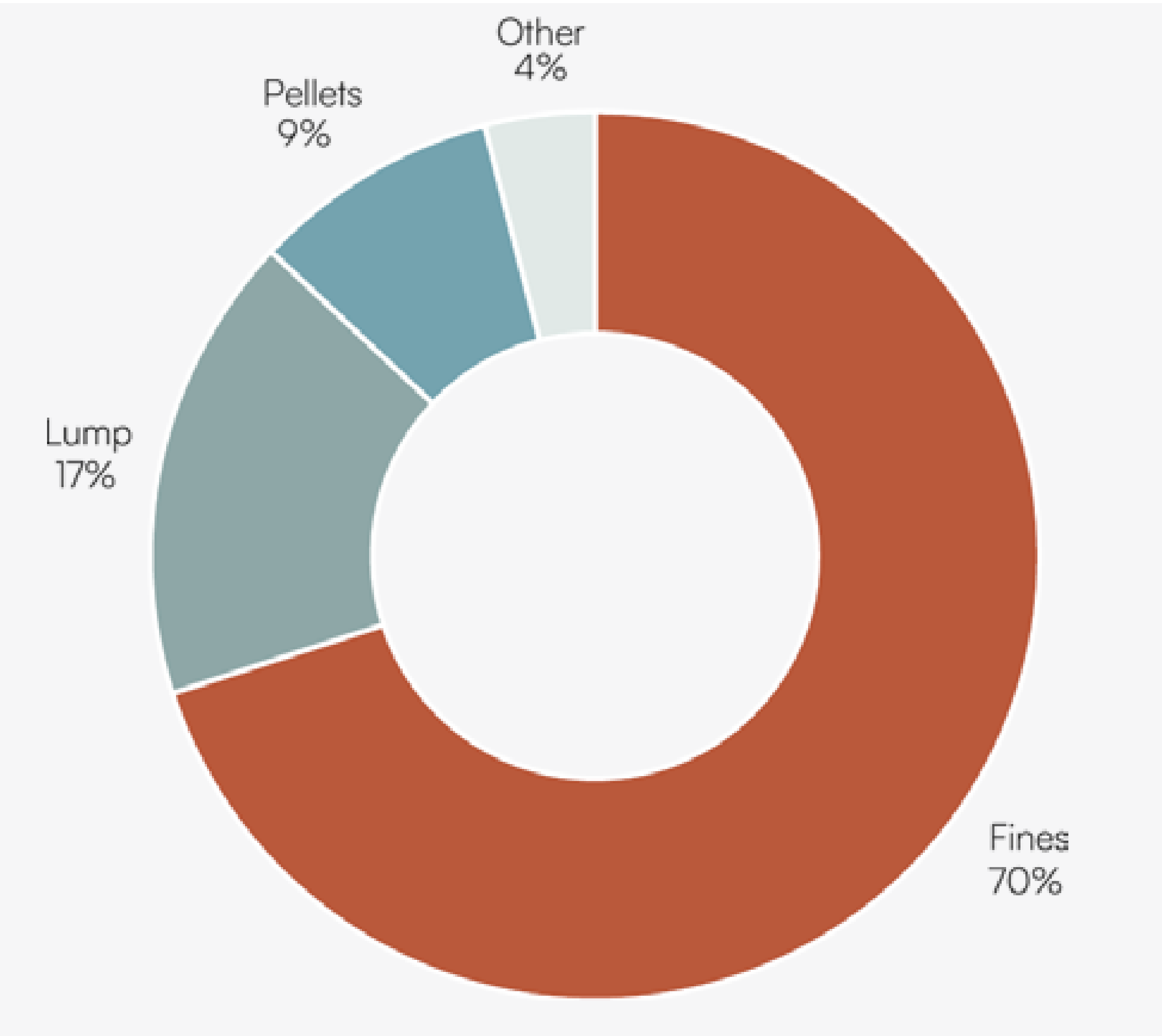


FIGURE 4. The DRI–EAF steelmaking pathway

TABLE 3. Comparison of legacy BF–BOF and DRI–EAF steelmaking routes

Metric	Conventional BF-BOF Route	DRI-EAF Route
Primary Feedstock	Standard Iron Ore Fines	DR-Grade Iron Ore Pellets
Primary Reductant/ Energy	Coking Coal	Natural Gas / Green Hydrogen
Key Intermediate Commodity	Hot Metal (molten iron)	Direct Reduced Iron (DRI) / Hot Briquetted Iron (HBI)
Emissions Intensity (tCO_2 / ton of steel)	2.32	1.37 (with natural gas) 0.1-0.3[73, 74] (with green Hydrogen)*
Value Chain Structure	Geographically co-located (integrated model)	Geographically decoupled (enabled by HBI)

85%

Potential reduction in direct emissions from switching from BF-BOF to DRI-EAF

* Hydrogen-based DRI is critically dependent on the carbon intensity of electricity used to produce hydrogen.

Process-vendor engineering studies (Midrex and ENERGIRON) indicate that existing natural gas DRI shaft furnaces can be adapted for hydrogen via targeted changes to the gas supply, cleaning, and heating systems.[75, 76] Additionally, new-build DRI furnaces are offered as "hydrogen-ready," capable of running on any NG/H_2 mix up to 100% H_2 as hydrogen availability improves. Switching the DR shaft from natural gas fully to green hydrogen can abate on the order of 85–95% of direct CO_2 emitted during the reduction step, with near-zero CO_2 emissions steelmaking possible when paired with renewable-powered EAFs.[77, 78]

The DRI-EAF pathway requires a premium class of feedstock as the shaft furnace cannot eliminate impurities as effectively as a blast furnace, and therefore requires exceptionally pure Direct Reduction Grade Iron Ore Pellets, or 'DR-grade pellets,' with iron content of 67% or higher.[79] While alternatives to DR-grade pellets are being developed and showing potential, they remain at pilot/demonstration stages and are not yet deployed at a commercial scale.[80]

The strict quality standards for these pellets create a critical supply bottleneck in the growing green steel industry. They currently account for approximately 4% of seaborne iron ore.[81] Despite varying estimates, market forecasts consistently point to sustained growth and future supply gaps. The International Iron Metallics Association (IIMA) forecasts that demand for merchant DR-grade pellets will surge from approximately 47 million tons in 2022 to over 118 million tons by 2033.[82] Macquarie's analysis projects that, by 2027, the global traded pellet market will face a supply deficit of about 43 million tons as demand grows, with Europe accounting for most of the growth.[83] McKinsey projects DR-grade pellets demand will face a deficit of more than 100 million tons per annum by 2031, sustaining high premiums and confirming tight supply conditions amid growing demand.[84]

A precise breakdown of DR-grade versus BF-grade pellets is not consistently available for all countries or producers. However, the landscape for DR-grade iron ore pellets is highly concentrated, dominated by only a handful of countries.

The analysis carried out for this paper reveals market division between export-oriented merchant producers and regionally focused, captive-oriented suppliers.* In some regions, domestic DRI plants consume most of the pellets output, limiting exports.[85] Table 4 provides a summary of the leading corporate players in the global DR-grade pellet market and their focus.

* "Captive" supply means that iron ore pellets are produced mainly for the company's own use (or for closely affiliated plants) rather than being sold freely on the open market.

TABLE 4. Global DR-grade pellet suppliers: Export vs. captive [86, 87]

Company	Country	Remark
Vale	Brazil	Merchant exporter
Samarco	Brazil	Merchant exporter
LKAB	Sweden	Merchant exporter
Rio Tinto IOC	Canada	Merchant exporter
ArcelorMittal Mines Canada	Canada	Mixed/captive-leaning
Bahrain Steel (Foulath)	Bahrain	Merchant exporter
Vale	Oman	Merchant exporter
Ferrexpo	Ukraine	Merchant exporter
Iranian producers	Iran	Primarily captive
Metalloinvest/ Severstal	Russia	Mostly captive
Cleveland-Cliffs	USA	Captive-leaning

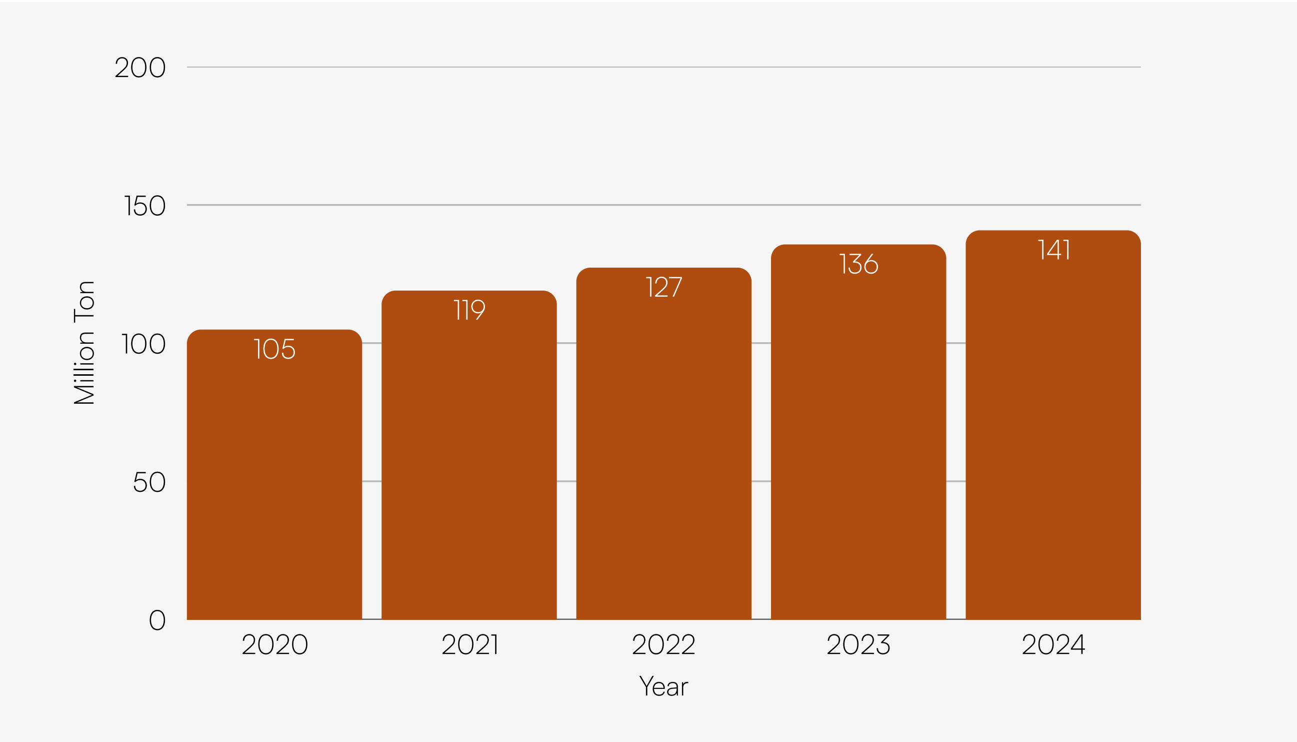
The next stage in the value chain is the transformation of these DR-grade pellets into metallic iron, or DRI. Every 1.4 tons of DR-grade pellets yields 1 ton of DRI.[88] However, DRI's porous structure makes it difficult to transport. The solution is Hot Briquetted Iron (HBI), made by compressing DRI at high temperatures into dense blocks, stabilizing it for transportation over long distances and outdoor storage.

HBI enables a profound shift: the spatial decoupling of iron and steel production. For over a century, ironmaking in blast furnaces and steelmaking in basic oxygen furnaces were co-located and tightly linked. Sites were typically chosen for proximity to coal, iron ore, or major industrial markets. HBI breaks this long-standing model.

Being stable and transportable, HBI allows the energy-intensive iron reduction step to occur far from traditional steelmaking hubs. This enables HBI production in global 'sweet spots,' with cheap renewable energy and access to high-grade iron ore. The produced metallic iron can then be shipped to steelmakers worldwide.

Global DRI production has been on a steady growth trajectory from 2020 to 2024, increasing from 104.84 million tons in 2020 to 140.8 million tons in 2024, an increase of about 34.3% over five years (Figure 5).[89] This represents the total global DRI output, including the merchant plants and captive facilities. The vast majority of DRI is consumed captively, meaning it is produced and used within integrated steel complexes rather than traded as a merchant commodity. International trade in DRI was reported at 11.7 Mt, but including unreported flows from sanctioned countries, the actual 2024 volume was likely closer to 13.3 Mt.[90] Looking ahead, CRU estimates that global trade could increase 13-fold between 2025 and 2050.[91]

FIGURE 5. World DRI production by year 2020-2024 (million tons)[92]



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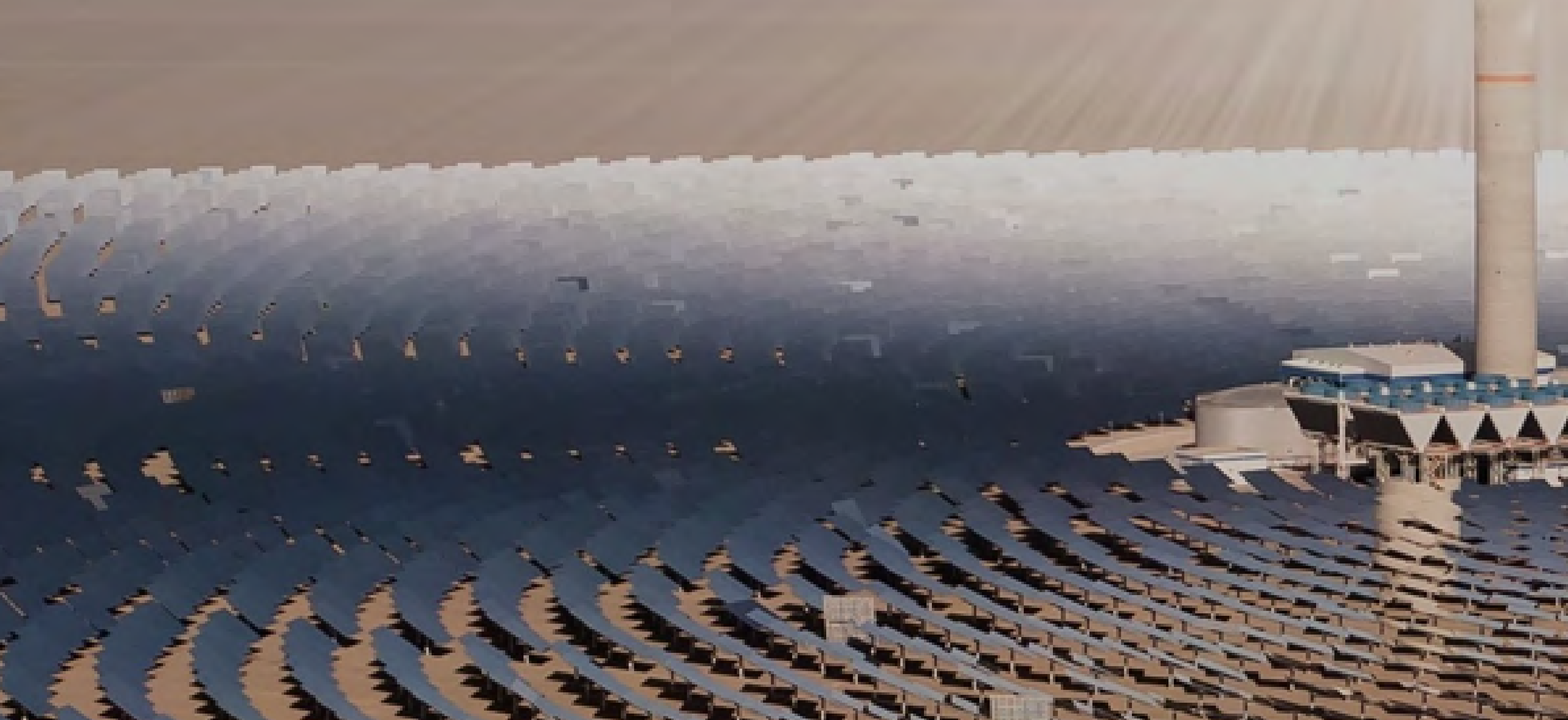
03

The MENA Region's Competitive Edge

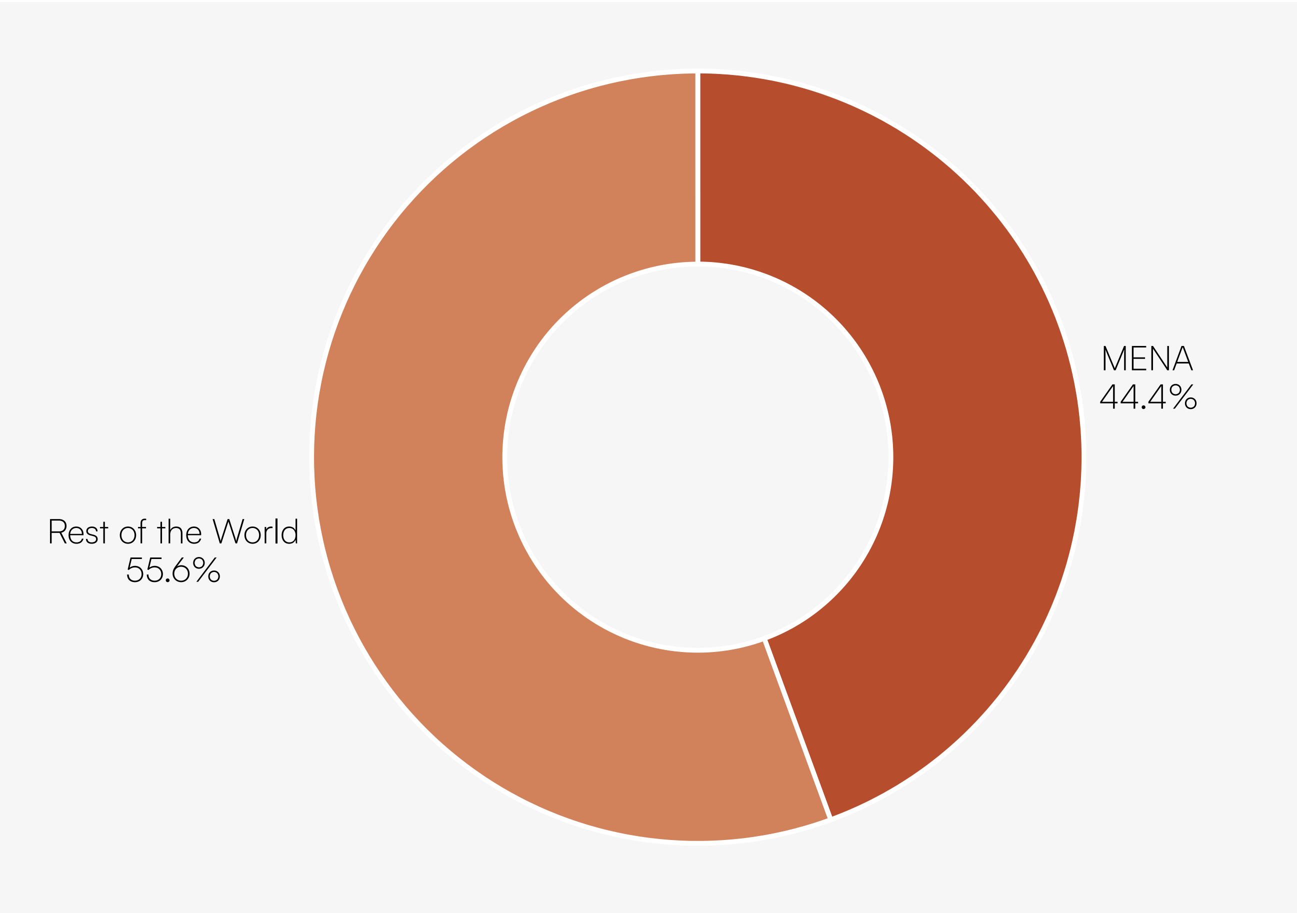
The MENA's edge stems from three factors that are difficult to replicate: a long head-start in DRI, world's cheapest clean power and hydrogen, and a strategic location.



A. Incumbent DRI leadership

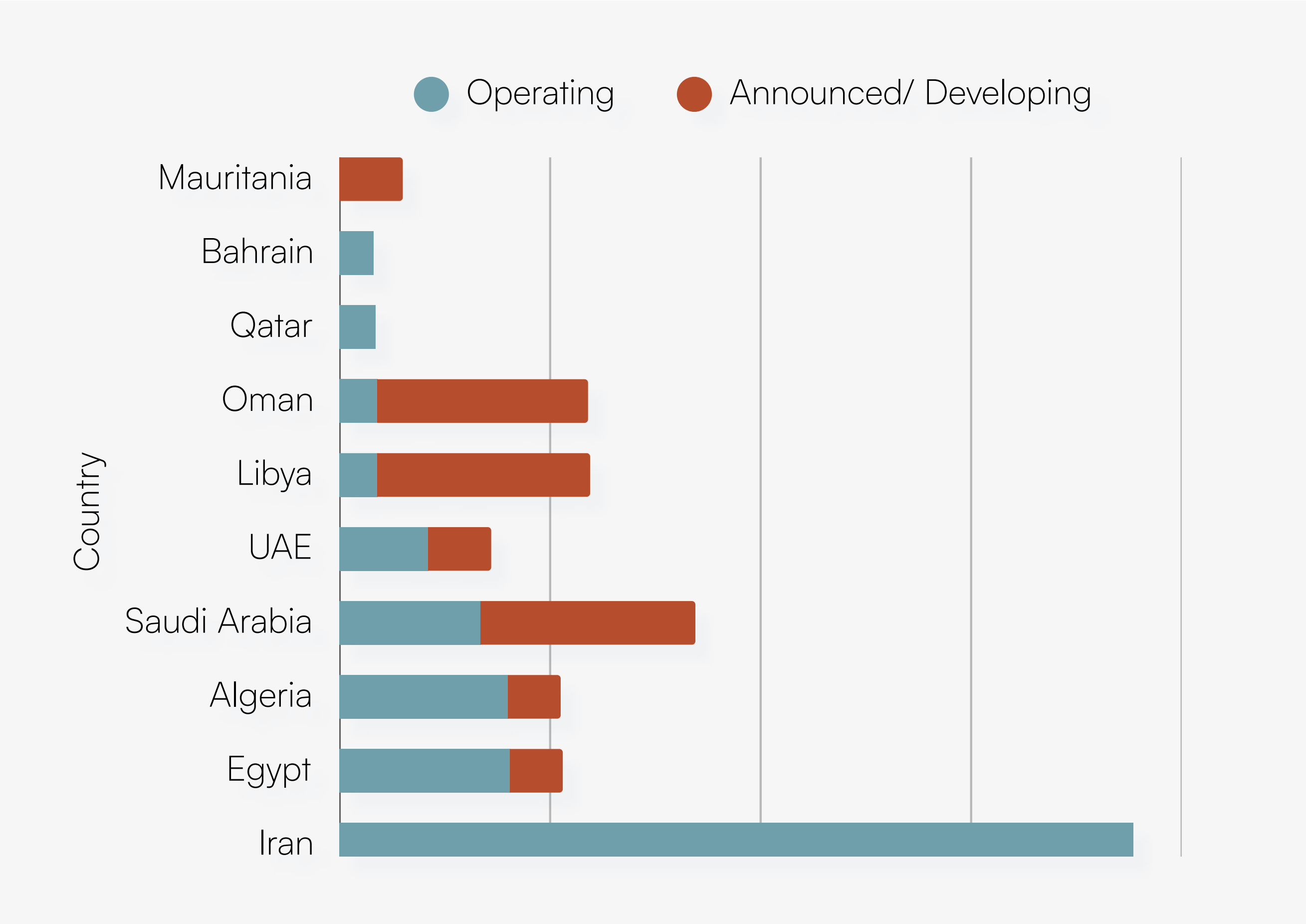
Despite producing only 3.6%[93] of global crude steel, the MENA region is the world's largest DRI producer. In 2024, the region produced what represents 44.4% of the global DRI production (Figure 6), contributing 62.53 million tons out of the 140.81 million tons produced worldwide.[94]

FIGURE 6. DRI Production: The MENA region vs. rest of the world 2024[95]



As a global powerhouse in DRI production, the region has a large installed base of DRI-EAF plants and a skilled workforce with decades of operational experience. The first DRI plant in MENA was commissioned in El Dikheila, Egypt, in 1986.[96] Figure 7 maps current and announced DRI capacity across the MENA region.

FIGURE 7. Operating and planned DRI capacity in the MENA region[97, 98]



The MENA region's large DRI production share stems from its natural gas endowments. Natural gas has been the backbone of the MENA region's iron and steel industry. Since the 1980s, several MENA countries installed DR modules using local gas to produce iron.* However, relying heavily on natural gas without credible hydrogen-transition plans also face a rising risk of becoming stranded as CBAM prices climb and hydrogen scales.

While European and Asian producers must build entirely new systems, MENA countries can focus on upgrading existing ones. Switching from natural gas to green hydrogen is more feasible and faster in the MENA region than almost anywhere else. The established infrastructure and proven know-how position MENA to lead in supplying low-carbon DRI/HBI.

* The main DRI technologies operating in the MENA region: MIDREX, HYL/Energiron, and BERED.

> Switching from natural gas to green hydrogen is more feasible and faster in the MENA region than almost anywhere else.

B. Renewable Advantage: Lowest-Cost Path to Green Hydrogen

Beyond its strong existing and planned DRI capacity, the MENA region holds a major advantage in renewables. The region receives 22–26% of the world's solar energy.[99] It also has prime wind sites, including Morocco's Atlantic coast, Egypt's Gulf of Suez, and north-western deserts in Saudi Arabia and southern Oman.[100]

This potential yields record-low Levelized Cost of Electricity (LCOE) with solar Power Purchase Agreements (PPAs) consistently coming in less than 2 US cents/kWh. Saudi Arabia's Al Shuaibah solar project set the world record for the lowest solar electricity price at 1.04 cents/kWh as of 2025.[101] The 600 MW Al Ghat Wind project in Saudi Arabia achieved the world's lowest wind tariff at 1.56 cents/kWh; the lowest LCOE for wind energy projects.[102]

This gives the MENA region a decisive cost edge in green hydrogen, a critical element in the economics of green iron. The Levelized Cost of Hydrogen (LCOH) is significantly influenced by the cost of renewables, which accounts for over 50% of the hydrogen production cost.[103] This low-cost clean energy, combined with emerging green hydrogen projects, give MENA a crucial advantage for green iron and steel.

Real projects already demonstrate the MENA region's cost advantage in Saudi Arabia (NEOM Green Hydrogen; new Yanbu hub), Oman, Egypt, and Morocco. This momentum sits atop national hydrogen strategies and frameworks, either officially launched or under development, in several MENA countries, including the UAE, Oman, and its government program via Hydrogen Oman (HYDROM) auctions,* Egypt, Saudi Arabia, Morocco, Algeria, Tunisia, and Jordan.[104] UAE's EMSTEEL and Masdar completed the MENA region's first green hydrogen steelmaking pilot in Abu Dhabi (Oct 2024), and in August 2025, EMSTEEL delivered a hydrogen-based rebar to a domestic customer.[105]

* Oman has Clear, investable policy via HYDROM and Royal Decree 10/2023 (land regime for renewables/H_2), plus rolling auctions (Rounds 1–2 in 2023–24; Round 3 launched Apr 2025). This underpins future H_2-DRI/HBI flows and port build-outs/export corridors.

C. Central Geography

The MENA region's strategic location provides a major logistical edge, complementing its technical and energy strengths. Located at the crossroads of Europe, Asia, and Africa, it offers efficient maritime access to major steel producers. Gulf and Red Sea ports reach Europe via Suez and to Asia via the Indian Ocean in fewer days than distant suppliers, reducing freight, inventory, and emissions in landed cost.

Under carbon tariffs, buyers compare total landed cost, which includes Free on Board (FOB) price,[*] carbon costs (e.g., CBAM certificates), freight and insurance, tariffs and duties plus any applicable fees or VAT. Shorter routes and lower CO_2 HBI can tilt costs in the MENA region's favor. The MENA region's location grows more vital as proposals for "green iron corridors" emerge to link production and consumption hubs.[106] It is well-positioned as the central hub of these emerging trade routes, connecting its cost-competitive iron production base to the industrial cores of Europe and Asia. Even with efficient shipping, moving processed iron thousands of kilometers adds energy and financial costs that erode margins for remote producers compared with those in MENA.[107]

* FOB is the base price for the goods delivered onto the vessel at the port of departure.

04

The MENA Region's Opportunities in Green Iron and Steel

Iron and steel's value creation is shifting away from shipping raw iron ore toward "green iron" as HBI makes reduced iron stable and tradable. The MENA is well placed in this new geography to seize multiple opportunities. This part outlines the baseline opportunity: securing upstream concentration and DR-grade pelletizing (with optional exports) while scaling midstream HBI export. We then present additional opportunities.

Baseline Opportunity

A. Moving up the value chain

The MENA region can capture more value chain elements in two steps. First, capture upstream value by upgrading imported fines/concentrate into DR-grade pellets. Second, scale midstream HBI (green iron) exports by integrating pelletizing with DRI and briquetting. This enables large-scale low-CO2 HBI exports using cheap renewables/hydrogen, while European and Asian mills melt it in EAFs. It is the fastest way to monetize MENA's electricity cost edge, capturing midstream margins now while positioning for future downstream steel demand without requiring full in-region milling capacity (Figure 8)

Near-term upstream opportunity: The region can expand beyond converting imported DR-grade pellets to DRI by capturing earlier stages such as concentration and pelletizing at scale. This includes an explicit export opportunity for DR-grade pellets. Bahrain and Oman, though not significant iron ore hubs, have built industrial hubs on this value-addition model: importing iron ore fines and concentrate, processing them locally, and exporting high-value DR-grade pellets to regional steelmakers. Notable examples include Vale's pellet plants at Sohar, Oman, which can produce 9 million tons annually, and Foulath's Gulf Industrial Investment Co. complex in Bahrain, with a capacity of over 12 million tons annually. Countries such as Saudi Arabia, Egypt, and Algeria can replicate this model both to feed regional HBI lines and supply pellets into constrained markets such as Europe, while midstream capacity scales.

Midstream Opportunity: The main export product is HBI. With CBAM pricing carbon at the EU border, if HBI is produced in MENA using low-carbon power and hydrogen, its embedded CO_2 decreases, so the CBAM line item shrinks. It can then land more competitively in Europe as feedstock for EAFs. In practice, buyers optimize for total landed cost, not just the factory price, and the combination of shorter routes compared to other regions, plus green HBI, can tip the math in the MENA region's favor.

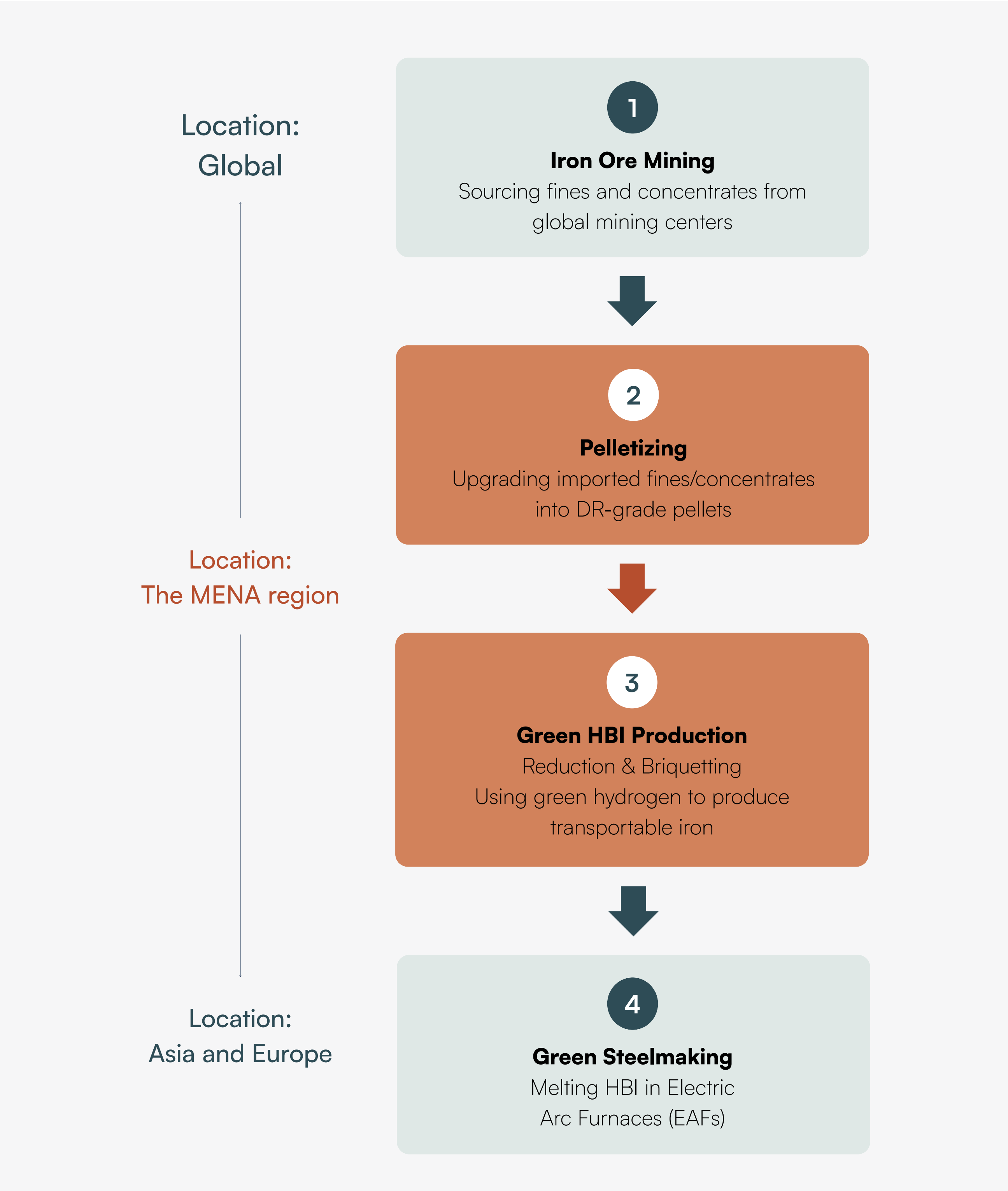
The MENA region's ability to scale green iron exports ultimately depends on securing high-quality DR-grade feedstock. In this regard, Mauritania's vast iron ore reserves* offer a strategic upstream complement and a natural extension of the region's value chain.[108] Integrating Mauritania's concentrate into MENA pelletizing hubs could diversify supply, enhance resilience, and reduce dependence on traditional exporters like Brazil — currently the main supplier — or Australia.

This upstream opportunity is amplified by Europe's LKAB, historically a leading supplier of DR-grade pellets, pivoting from merchant pellets to hydrogen-reduced sponge iron (DRI/HBI) via the HYBRIT** route. As LKAB reallocates pellet feed to its own hydrogen-based DRI, merchant DR-grade pellet availability tightens, strengthening the case for MENA pelletizing integrated with HBI exports.[109]

* Mauritania has iron ore reserves in the range of 2 billion tons and exports about 14 million tons of iron ore annually; it plans to increase to over 45 Mt annually by 2030.

** HYBRIT (Hydrogen Breakthrough Ironmaking Technology) is a Swedish initiative by SSAB, LKAB, and Vattenfall to replace coal/coke in ore-based steelmaking with fossil-free hydrogen.

FIGURE 8. Iron and steel value chain: The MENA region's baseline opportunity



Additional Opportunities

B. Premium market access under climate trade policies

The MENA region's reliance on natural gas-based DRI-EAF routes already provides a clear emissions advantage over traditional blast furnace methods. With the EU's CBAM coming into force and similar climate measures gaining traction in parts of Asia, iron and steel with a lower-carbon footprint is starting to develop a competitive market advantage. Lower carbon iron produced via DRI-EAF can initially benefit from natural-gas availability, but any cost advantage is contingent on low gas prices and modest carbon prices. Because DRI units are hydrogen-ready, producers that switch early will secure lasting market access, while those that delay risk losing premiums and forfeiting market access.

Alongside carbon policies, Europe is tightening trade measures by imposing provisional dumping duties on several exporters like Japan, Vietnam, China, and Egypt, as part of its broader trade defense strategy.[110] The recently announced Steel and Metals Action Plan signals more structural measures to shield EU producers from global overcapacity.[111] With many Asian suppliers deterred and Turkey's shipments are constrained by EU steel safeguard quotas,[112] European importers are turning to suppliers outside quota limits, such as Saudi Arabia and Algeria.[113]

Asia, though slower in adopting CBAM-style policies, is also shifting. Market and regulatory changes are creating incentives for Asian countries like Japan and South Korea to import HBI from the MENA region, rather than produce high-emissions steel domestically or buy from traditional higher-emission suppliers.[114] Key drivers include rising carbon costs, climate compliance, expensive domestic green hydrogen, and supply security concerns.

Japan's steel decarbonization roadmap identifies hydrogen-based DRI imports (as HBI) from low-cost regions a key pillar.[115] Japan's Itochu Corporation and JFE Steel, a major steel producer, already plan to source 2.5 Mt of DRI annually from the Middle East under a long-term contract, supplying its Kurashiki EAF starting from 2028 via outsourced iron reduction in the UAE.[116] Japan's revised hydrogen strategy sets hydrogen targets and limitations. However, the inherent challenges regarding supply and hydrogen import makes HBI/DRI imports an alternative hydrogen energy vector and pathway for the Japanese steel industry's decarbonization.[117]

South Korea's ETS (K-ETS)[118] has so far delivered weak price signals, failing to drive meaningful decarbonization.[119] In June–July 2025 auctions, K-ETS carbon price was about $ 6–7 per tCO_2,[120] far below EU levels. The low price offers little protection against border measures like the EU's CBAM. In January 2025, the government released a 10-year roadmap outlining the ETS policy direction from 2025 onward.[121] It is expected that auctioned allowances will increase sharply from 2025, raising carbon costs for South Korean steelmakers. This creates an opening for MENA, whose lower-carbon iron will become more competitive as South Korean producers face higher costs under the revised K-ETS.

China's Emissions Trading Scheme is being extended to include steel, adding another layer of carbon costs for local producers. In March 2025, China's Ministry of Ecology and Environment approved the expansion of its ETS, once limited to the power sector, to cover steel, cement, and aluminum.[122] This narrows the price gap between China's cheap "grey" steel and cleaner steel or iron imports.

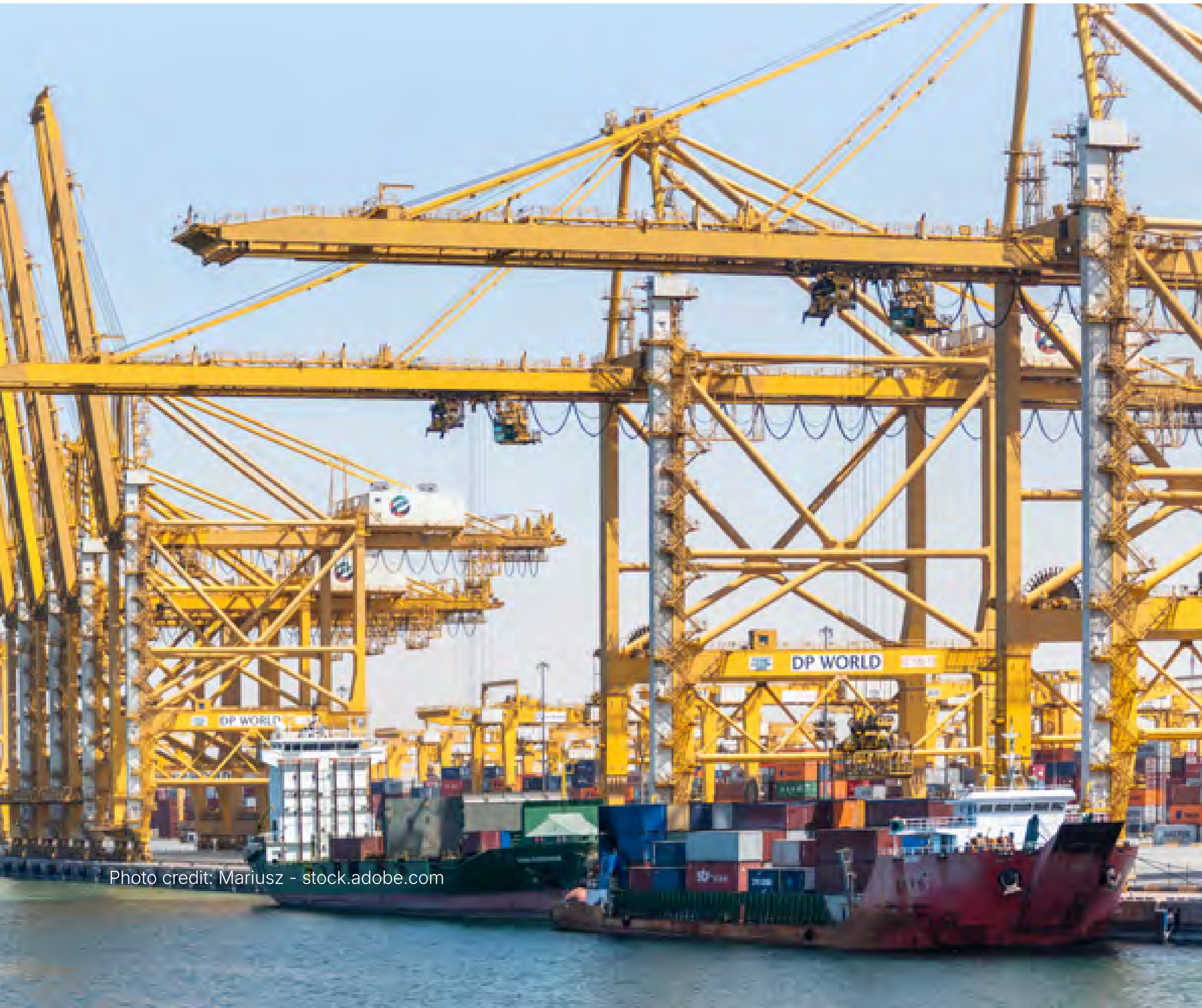


Photo credit: Mariusz - stock.adobe.com

C. Regional integration

The MENA region can unlock major gains through specialization and regional complementarity. Currently, cooperation is limited: MENA economies are often more integrated with outside regions than with each other and frequently competing directly with one another for export opportunities and investments, especially in Europe.[123]

Harnessing national strengths, the MENA region can build a robust, multi-nodal industrial and economic structure. Shared infrastructure, such as roads and ports, together with regional systems for Monitoring, Reporting, and Verification (MRV) and Environmental Product Declarations (EPD), could support this structure and streamline compliance with global trade regulations.

Rather than each country building a full value chain, MENA countries can accelerate progress by linking specialized hubs into a cohesive Green Iron Corridor. For example, pellet hubs like Bahrain and Vale Oman already convert imported concentrates into high-quality feedstock. Vale's planned "Mega-Hubs" in Saudi Arabia,[124] Abu Dhabi's Khalifa Economic Zones Abu Dhabi (KEZAD), and Oman will run concentration and briquetting plants to supply both local and export EAF markets.[125] Downstream, EU policies are creating a premium market for hydrogen-derived HBI imports from MENA to decarbonize European EAF production. Connecting these nodes forms a network that enhances efficiency and investment viability.

D. Geopolitics and resilience

The emerging spatial decoupling of steelmaking comes amid a broader trend of geoeconomic fragmentation. Global producers are rethinking supply chains in response to geopolitical tensions, protectionism, and the push for resilience.

The iron ore trade, long dominated by Australia and Brazil, created systemic vulnerabilities, especially when either was disrupted. In early 2025, Rio Tinto, a leading mining company, experienced a 9% decline in exports to a six-year low after a cyclone hit Australia's Pilbara region. In 2022, flooding in Vale's Brazilian mines forced a temporary halt at some of its operations.[126, 127]

As supply chains decentralize, there is an opportunity for regions like the MENA to become a key player in an emerging industrial architecture due to its abundant renewable energy and strategic location. Ongoing supply shocks, from the war in Ukraine to Red Sea shipping disruptions, are pushing buyers to seek diversified, low-risk sources. The MENA region's stable infrastructure, energy security, and existing trade ties with Europe and Asia provide a reliable alternative to traditional exporters. Conflict and instability limit parts of the MENA region, but do not negate its potential. It is important not to treat the region as a monolithic. Several sub-regions, led by the Gulf Cooperation Council (GCC), have demonstrated strong economic and political resilience.[128] North African peers benefit from proximity and dense EU trade links. These differences support a multi-node, resilient corridor design. For investors, these fundamentals reduce project risk, enhance bankability of long-lived assets (ports, power, hydrogen, DRI/HBI), and position the GCC as a credible hub for green-iron corridors despite regional risks.

Trade Pathways for the MENA's Green Iron and Steel

The opportunities outlined highlight areas of value creation. The following trade pathways show how to operationalize these opportunities, shaped by regulation, scale, resilience, security, and regional collaboration.

These four pathways are not mutually exclusive and can be pursued individually, in combination, or sequenced into multi-layered strategies for regional leadership in emerging green-iron trade. The objective of this section is to aid strategic planning by presenting pathways that can be pursued individually or combined as market, policy, and cost conditions evolve, Table 5 summarizes these four pathways.

TABLE 5. Mapping opportunities to pathways

Opportunity ↓ / Pathway →	A: European Corridor	B: Asian Corridor	C: Continuity First Corridor	D: Integrated MENA Corridor
Baseline: HBI exports	■	■	■	■
Premium Market Access	■	■	○	○
Regional Integration	○	○	■	■
Geopolitics and Resilience	■	■	■	○

Legend: ■ = Core opportunity in the pathway; ○ = Supporting role

Pathway A:

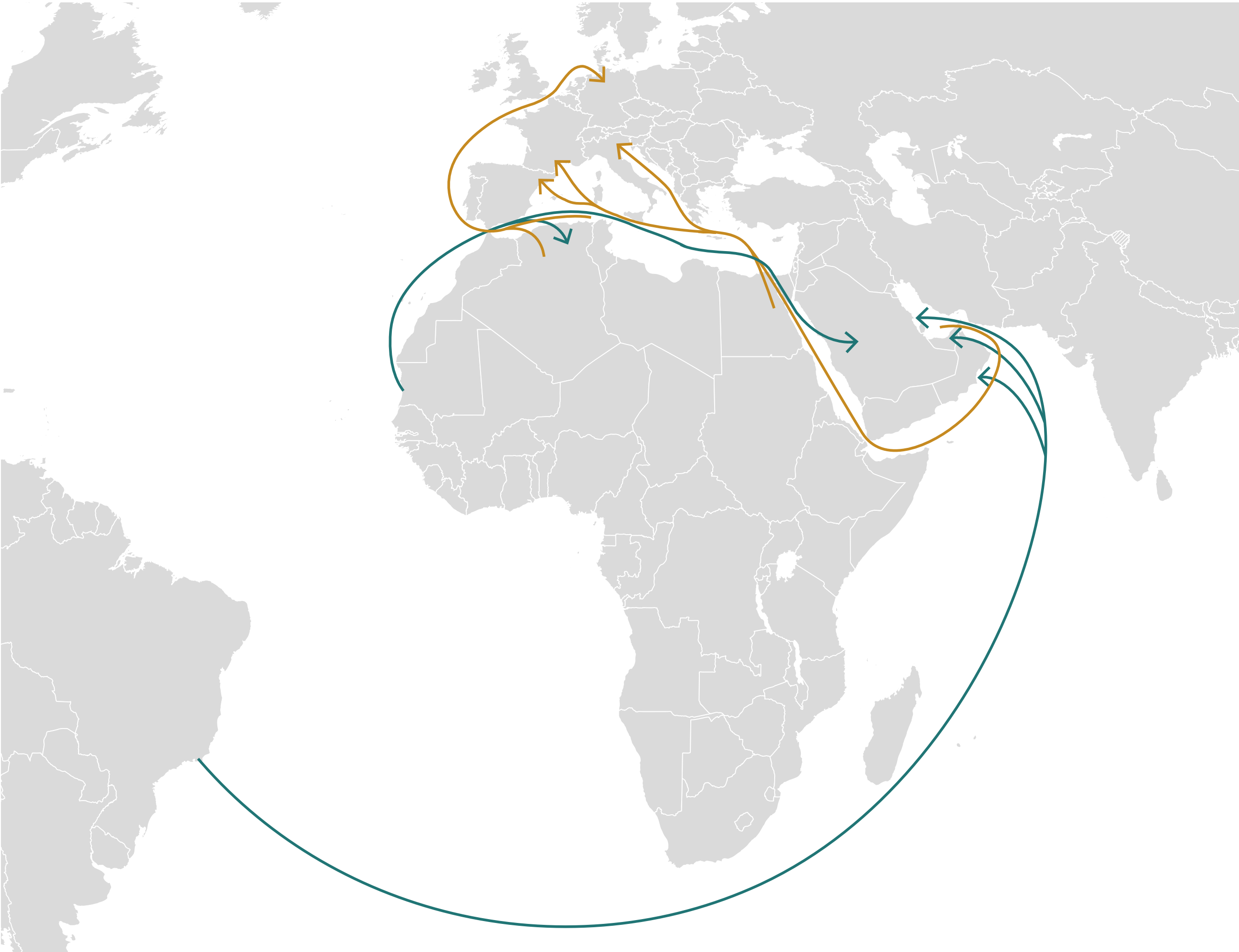
The European Corridor — Regulation Driven

This pathway centers on Europe's green steel demand driven primarily by regulatory pressure, notably CBAM and ETS. CBAM alters the total landed cost of iron and steel products. As a result, lower-emissions HBI faces little or no levy, making it structurally cheaper at the border.

The opportunity involves supplying Europe's growing shortage of green metallic iron, the clean feedstock needed for its expanding EAF fleet, as the decarbonization advances. Europe's high energy costs also make domestic green hydrogen and DRI production uneconomic.

This context sets up a clear supply chain dynamic. MENA producers use abundant low-cost renewable energy to produce certified green HBI, and ship it to Europe; importers can then declare their lower embedded emissions and pay little to no CBAM levy. Competing suppliers with higher-emission iron face a steep CBAM charge, making their product significantly more expensive on arrival (Figure 9).

Figure 9. Pathway A — The European Corridor: Illustrative EU-bound export routes



HBI (primary) and/or DR-grade pellets (possible)

Iron ore feedstock, shown for context

Note: Routes shown are illustrative. The boundaries shown and the designations used on this map do not imply official endorsement or recognition by the Carboun Institute.

Pathway B:

The Asian Corridor
Scale and Security Driven

While Europe offers regulation-driven premium pricing, Asia represents scale opportunities. East Asia's industrial giants, China, Japan, and South Korea, face mounting pressure to decarbonize their heavy industries, driven predominantly by net-zero targets and domestic climate policies, and by rising demand from export markets for low-carbon products. Unlike Europe, Asia's appeal centers on scale and energy security, rather than regulation

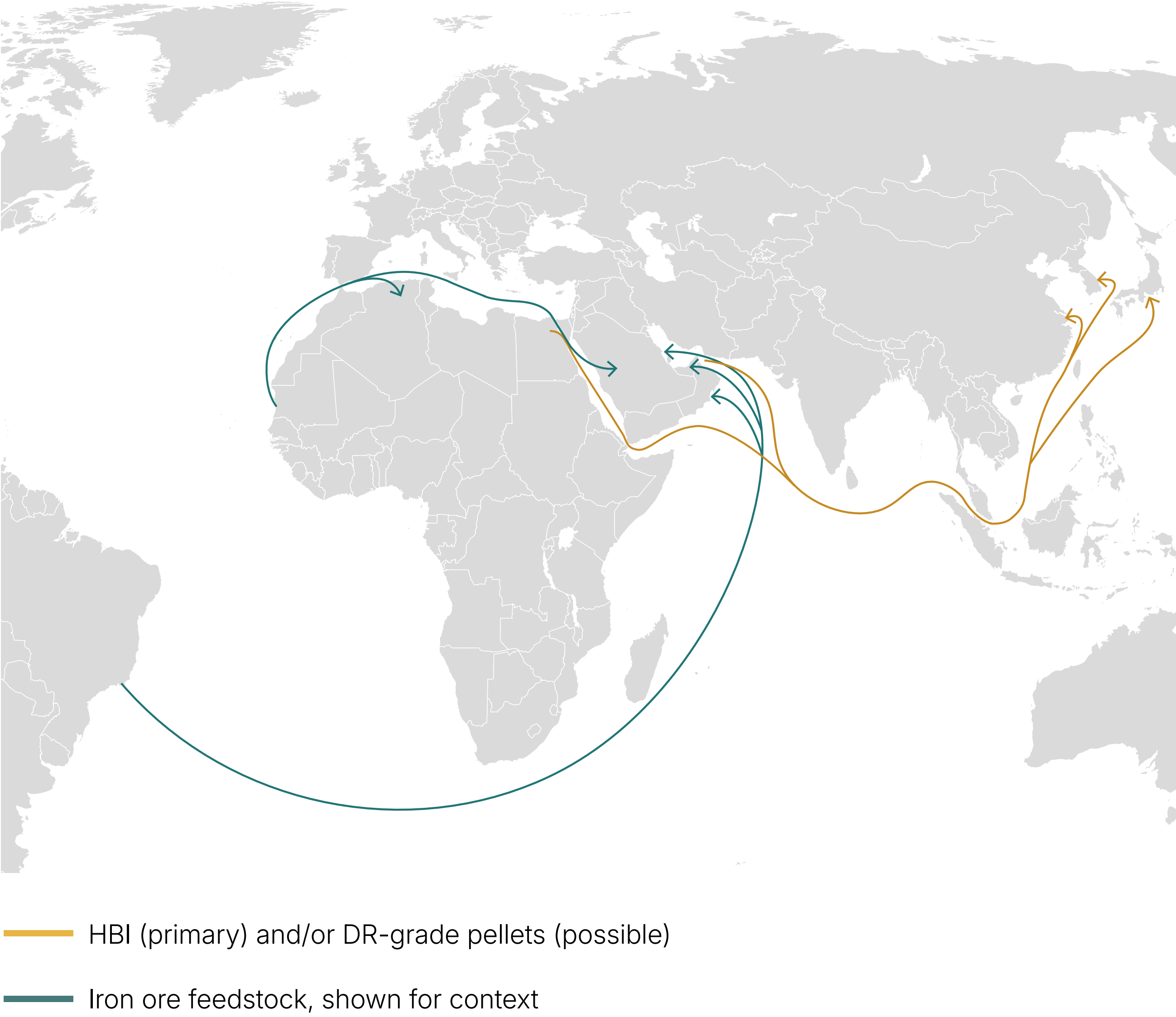
In China, the shift is underway: In 2024, authorities halted new coal-based steel project approvals,[129] and in March 2025, China expanded its ETS to cover steel.[130] The government's new industrial strategy prioritizes EAF expansion and advancing hydrogen-based DR through projects and policy discussions; Beijing set national EAF-share targets of 15% by 2025 and 20% by 2030.[131] Japan and South Korea, both energy import-dependent, are also accelerating their green transitions. Steelmakers such as Nippon Steel[132] and POSCO[133] are committing to replacing blast furnaces with EAFs.

The MENA region can be Asia's go-to partner for green iron. For countries like Japan and South Korea, this is as much about energy as it is about steel: HBI made from DRI using renewable-energy-based hydrogen acts as green hydrogen in solid form. It avoids the high cost and technical complexity of transporting hydrogen as gas or liquid. Thus, green HBI becomes a clean energy vector, not just a raw material.

This pathway creates a scale-driven supply chain based in the MENA region and extending to East Asia's industrial hub. Giga-scale green iron facilities in the MENA region use solar and wind power to produce low-emissions HBI via green hydrogen. The HBI is then shipped to ports in China, Japan, and South Korea, where it fuels next-generation EAFs, enabling Asian steelmakers to meet rising demand for low-carbon flat steel, especially in high-value sectors such as automotive, shipbuilding, and electronics.

For energy-importing nations like Japan and South Korea, this trade also delivers energy security. Transporting HBI in solid form avoids the technical and financial challenges of shipping gaseous hydrogen or ammonia. Green HBI acts as a stable, energy-dense, shippable, hydrogen-derived product that embeds low-carbon energy, turning a steel trade route into a green energy corridor (Figure 10).

Figure 10. Pathway B — The Asian Corridor: Illustrative Asia-bound export routes



Note: Routes shown are illustrative. The boundaries shown and the designations used on this map do not imply official endorsement or recognition by the Carboun Institute.

Pathway C:

The Continuity-First Corridor

Resilience Driven

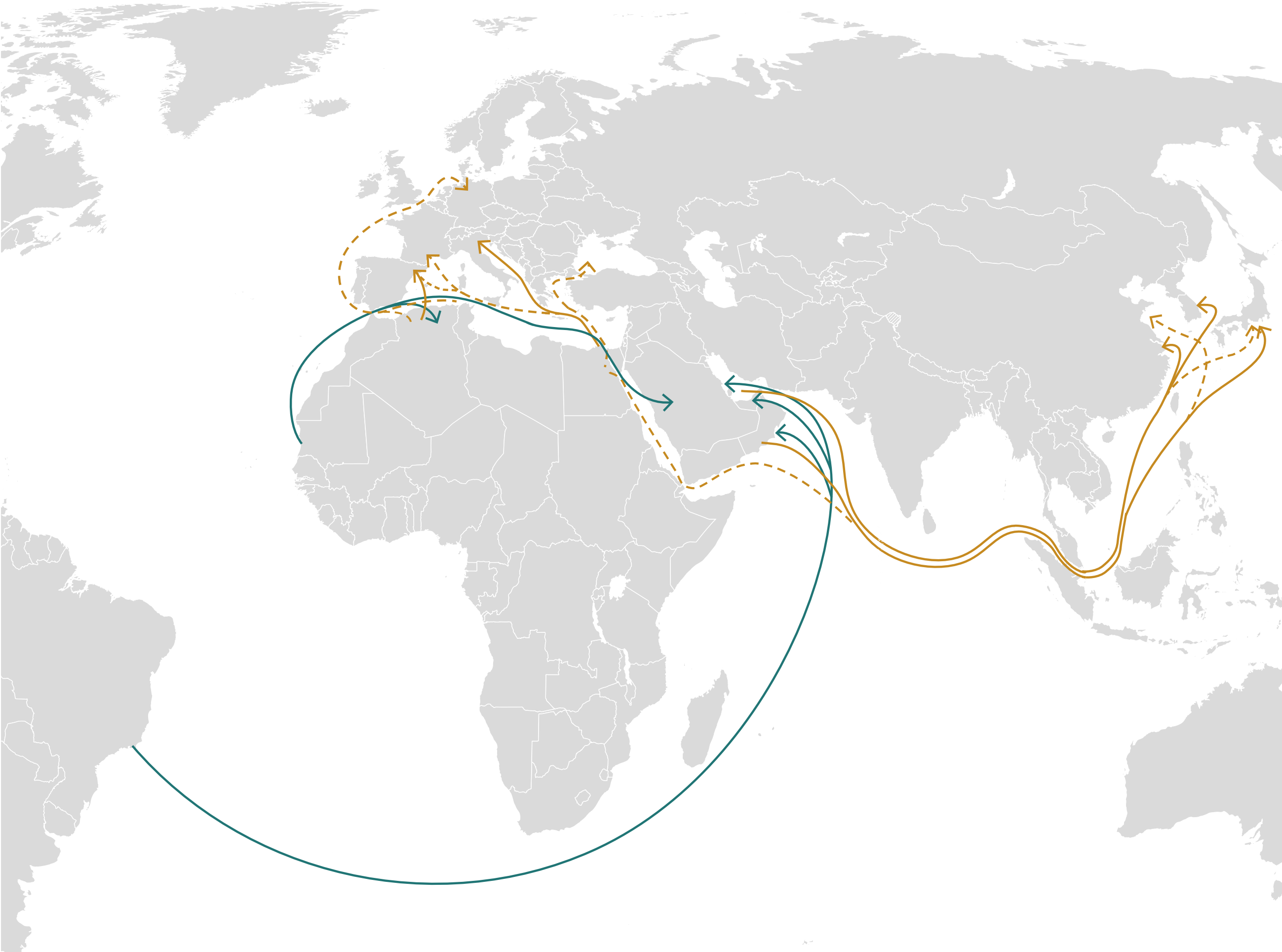
Global disruptions, from pandemics to geopolitical tensions, have exposed the fragility of concentrated supply chains.[134] The legacy iron ore trade is centralized, creating major choke points; Australia and Brazil dominate seaborne exports, so a disruption in a key producer can have cascading global effects. Geoeconomic fragmentation is pushing buyers toward proximity, redundancy, and political alignment.[135]

The MENA region can capitalize on these shifts through redundant, multi-node DR-grade pellets and green iron (HBI) export corridor, making resilience a premium attribute in long-term off-takes. Sovereign backing of green industrial projects, especially in the GCC, adds stability and long-term commitments that attractive to global partners.[136] North African peers, though more fiscally constrained, can leverage EU proximity and trade ties.

This pathway prioritizes redundancy and recoverability as core design criteria: multi-node siting across sub-regions, resilience-linked contracts (multi-origin clauses), pre-booked alternative routes (Mediterranean short-sea for EU), strategic HBI buffers, and a common MRV/EPD to keep volumes CBAM-ready even during shocks. It targets buyers with high disruption costs (auto/electronics) who are prepared to pay for assured continuity.

In this pathway, the MENA region builds redundant nodes to avoid a single point of failure. A European automotive manufacturer or an Asian electronics giant makes a strategic procurement decision driven not only by cost and carbon footprint, but primarily by a corporate mandate to ensure a resilient supply with shorter, faster routes that are less exposed than distant mining basins (Figure 11).

Figure 11. Pathway C — Continuity & Redundancy (Illustrative)



Primary route (HBI / DR-grade pellets)

Alternate route (redundancy option)

Iron ore feedstock, shown for context.

Note: Routes shown are illustrative. The boundaries shown and the designations used on this map do not imply official endorsement or recognition by the Carboun Institute.

Photo credit: frantic00 / Shutterstock.com

Pathway D:

The Integrated MENA Corridor Cooperation Driven

This pathway envisions a connected, intra-regional approach, with MENA countries (and even nearby neighbors like Turkey) specialize in their strengths to build a shared green steel industry. It focuses on regional specialization and clustering, with pragmatic overlap where hydrogen and port infrastructure advantages make dual role efficient. A regional iron and steel value chain also provides a pathway for economic diversification, especially for GCC countries seeking to move beyond hydrocarbons.

The opportunity involves building a symbiotic regional value chain underpinned by the existing infrastructure and the evolving value-addition layout. The following illustrative (not prescriptive) configuration shows how this corridor could work:

- Feedstock hubs: Oman and Bahrain with deep ports and established logistics expand on their role as hub for importing iron ore and exporting DR-grade pellets for regional HBI/EAF plants and constrained external markets.

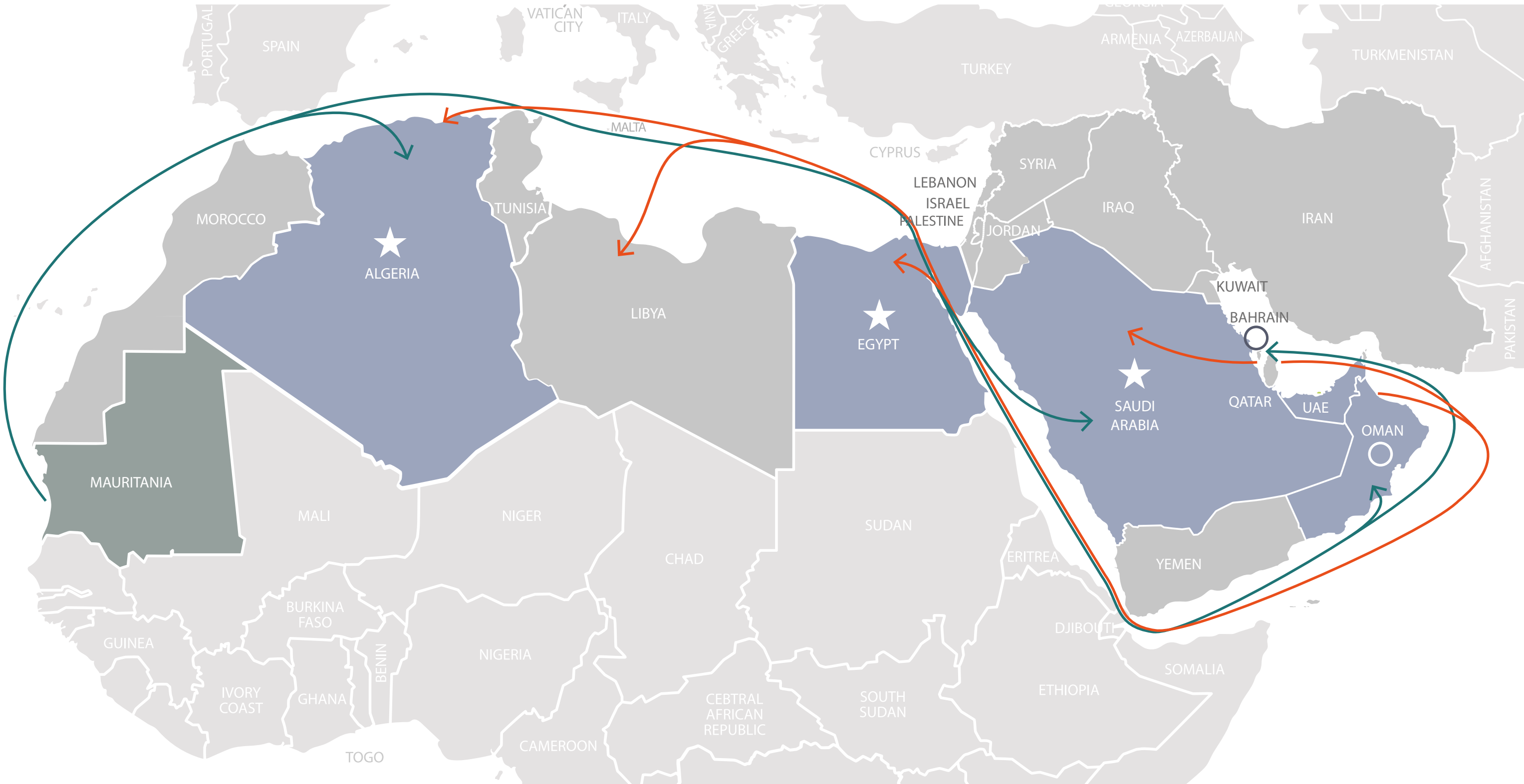
- HBI powerhouses (shared regional hydrogen ambition): Countries such as Saudi Arabia, Egypt, the UAE, and Oman could draw on the competitive renewables and active hydrogen strategies to convert pellets into green HBI, prioritizing domestic and regional EAF demand while keeping optionality to export to EU/Asia.

- Regional steelmaking leaders & onsite HBI: Egypt, Saudi Arabia, and Algeria, strong in steelmaking and, in the case of Saudi Arabia and Egypt, also advancing national hydrogen programs, would receive pellets, produce HBI onsite co-located with EAFs, consume it internally as principal load centers, and export green steel.

- Launchpad to new markets: Leveraging geographic proximity, this integrated ecosystem serves demand centers in Europe, Asia, and Africa.

This pathway prioritizes regional EAF steelmaking by routing pellets/HBI to MENA producers. Surplus HBI flows by short-sea routes to the EU and Asia, where policy and buyer demand favor verified low-carbon feedstock. It localizes much of the value chain, supporting an economic base less reliant on oil and gas revenues (Figure 12).

Figure 12. Pathway D — Integrated MENA Corridor (illustrative)



Regional Steel Leader

Feedstock Hub (DR-grade Pellets)

Potential HBI Powerhouse (Renewable and H_2): Priority to regional EAFs with export option

Major Iron Mining Source

Intra-regional DR-grade pellet flows

Iron ore flows

Note: Routes shown are illustrative. The boundaries and names shown, and the designations used on this map do not imply official endorsement or recognition by the Carboun Institute.

5

05

Conditions for Success

This part reframes core hurdles to operationalizing and scaling the green iron trade corridors as conditions for success, and specifies measures to meet them. The result: corridors that are demand-secured, credibly certified at the border, resilient to price cycles, and durable under shifting policy.

Making the Trade Corridors Work

The MENA region has real opportunities to become a major green iron and steel player, but faces significant hurdles and risks. Seizing it requires meeting a set of conditions for success. This section restates five key risks as success conditions and the measures to meet them so the trade corridor is bankable, demand-secured, verifiable, and price-resilient to market cycles, premium-eligible, and durable under policy change. Table 6 summarizes each condition and its core measures; the subsections that follow expand on each condition.

TABLE 6. Conditions for success and practical measures

Condition for success	Measure
Boosting bankability	Apply the financing triangle: secure long-term off-takes, anchor sovereign support, and involve credit agencies to de-risk investment
Securing early market access	Build a corridor-wide MRV/EPD backbone and align with a domestic carbon-pricing mechanism to unlock CBAM deductions
Anticipating volatility	Adopt structured pricing with an EUA-linked floor and an avoided-CBAM share
Maintaining cost-competitiveness under premium uncertainty	Ramp H_2 blending in natural gas-based DRI and scale with cost/off-take signals
Diversifying markets and aligning standards	Diversify export markets: build multiple trade routes and align certification with EU/Asia standard

A. Boosting Bankability

Turning a green iron corridor from an idea into a commercial reality hinges on getting three key financing pieces in place. First, long-term, credit-worthy off-take agreements, often with buyers taking project stakes to lock in revenue and signal real demand. Second, sovereign backing through land access, infrastructure support, tax breaks, or special industrial zones, to reduce red tape and lower setup costs. Third, involvement from multilateral institutions or export-credit agencies offers protection against political risks and allows for longer, more manageable loan terms.

Case Study

Stegra's green steel plant in Boden, Sweden exemplifies this blended finance model. Stegra secured funding after locking in over 60% of its planned 2.5 million tons output through a seven-year contract.[137] The total secured funding amounted to approximately €6.5 billion, including debt financing, equity funding, and grants.[138] The sovereign backing came from Riksgälden (Swedish National Debt Office), through a state guarantee covering 80% of a €1.2 billion loan,[139] in addition to direct state aid from the Swedish Energy Agency. The funding structure also includes significant support from Export Credit Agencies (ECA), with senior debt from Multilateral Development Banks MDBs benefiting from the export credit cover.[140]

B. Securing Early Market Access

To secure market access and command higher prices for green steel or HBI, MENA producers must support their claims with robust data. From 2026, every ton of HBI or steel entering the EU will need a CBAM-compliant emissions declaration, with Asian buyers expected to demand similar proof.

This requires unified, corridor-wide systems to measure, report, and verify (MRV) embedded carbon across four critical stages:

- Upstream pellets
- Iron Reduction
- Briquetting and storage
- Shipping

MRV is increasingly becoming a trade enabler and will play an essential role in reducing friction and audit risk at the EU border. By building this MRV framework from the outset, green iron corridors can capitalize on premium prices and reduce financial risks, even before local hydrogen production is fully scaled up.

Beyond MRV, MENA producers should pair the corridor with a regionally aligned carbon price for iron and steel. The GCC carbon market is advancing: Saudi Arabia's Voluntary Carbon Market (VCM) has held large-scale auctions, Qatar's Global Carbon Council is CORSIA approved, and the UAE has established a federal National Register of Carbon Credits that came into effect in December 2024.[141]

However, voluntary credits do not qualify as as an "effective carbon price" under CBAM, and should complement, not substitute for, compliance instruments.

C. Anticipating Volatility

The global steel industry has long faced oversupply, especially from China and other parts of Asia, where excess production drives prices down.[142]

Significant MENA investments in green iron and steel would enter highly competitive arenas. Even with the "green" advantage, MENA's products could struggle against cheaper conventional steel from regions without carbon pricing or benefiting from support measures, including subsidies.

Managing this condition requires mechanisms addressing green pricing uncertainty, supported by stronger commercial models and clear risk allocation.[143]

One practical hedge against overcapacity and price swings, or when the market tanks, is a two-tiered pricing architecture. First, pricing floor: MENA producers can set a minimum price by referencing the weekly-average EU Allowance (EUA) to calculate the carbon component, so the contract never falls below a guaranteed minimum that hedges against market downside. This is not a peg to EU domestic iron and steel prices and remains separate from the commodity index. Second, an "avoided CBAM share": to maximize profits, MENA green iron producers can negotiate contracts that include a modest share of the savings buyers gain by avoiding CBAM costs compared to high-emissions iron or steel.

D. Maintaining Cost-Competitiveness Under Premium Uncertainty

OECD projects 0.7% annual global steel demand growth through 2030.[144] There has been a downturn in major markets like China, the EU, and the U.S., where demand remains weak or structurally declining, and profitability is under immense pressure. Other emerging economies, led by India, are bucking the trend with strong demand growth.[145]

Green steel demand may falter if customers resist paying more or if the economy slows. Premiums are vulnerable because they rely on regulation and corporate climate commitments, often losing priority in downturns. MENA producers may need to accept slimmer profits or lean on incentives and subsidies early on. A pragmatic path for the MENA region's green iron ambitions are to start by blending green hydrogen into existing gas-based DRI facilities, with the goal to gradually raise the hydrogen share over time.

For example, Singapore-based Meranti Green Steel is developing a 2.5 million tons per year HBI plant in Duqm, Oman, that will start on a natural-gas/green-hydrogen blend and ramp to 85% hydrogen, with a final investment decision (FID) targeted for mid-2026 and commissioning around 2029.[146]

When the markets slow and green premiums lose traction, trade corridors must still signal bankability. Blended financing supports projects with sovereign wealth funds as co-investors, while export credit agencies absorb premium risk by providing loan guarantees. This shifts credit risk from private lenders to public agencies, unlocking cheaper debt. As with overcapacity risks, we assume long-term off-takes and pricing structures are in place; here, the added de-risking comes from sovereign support and ECA guarantees.

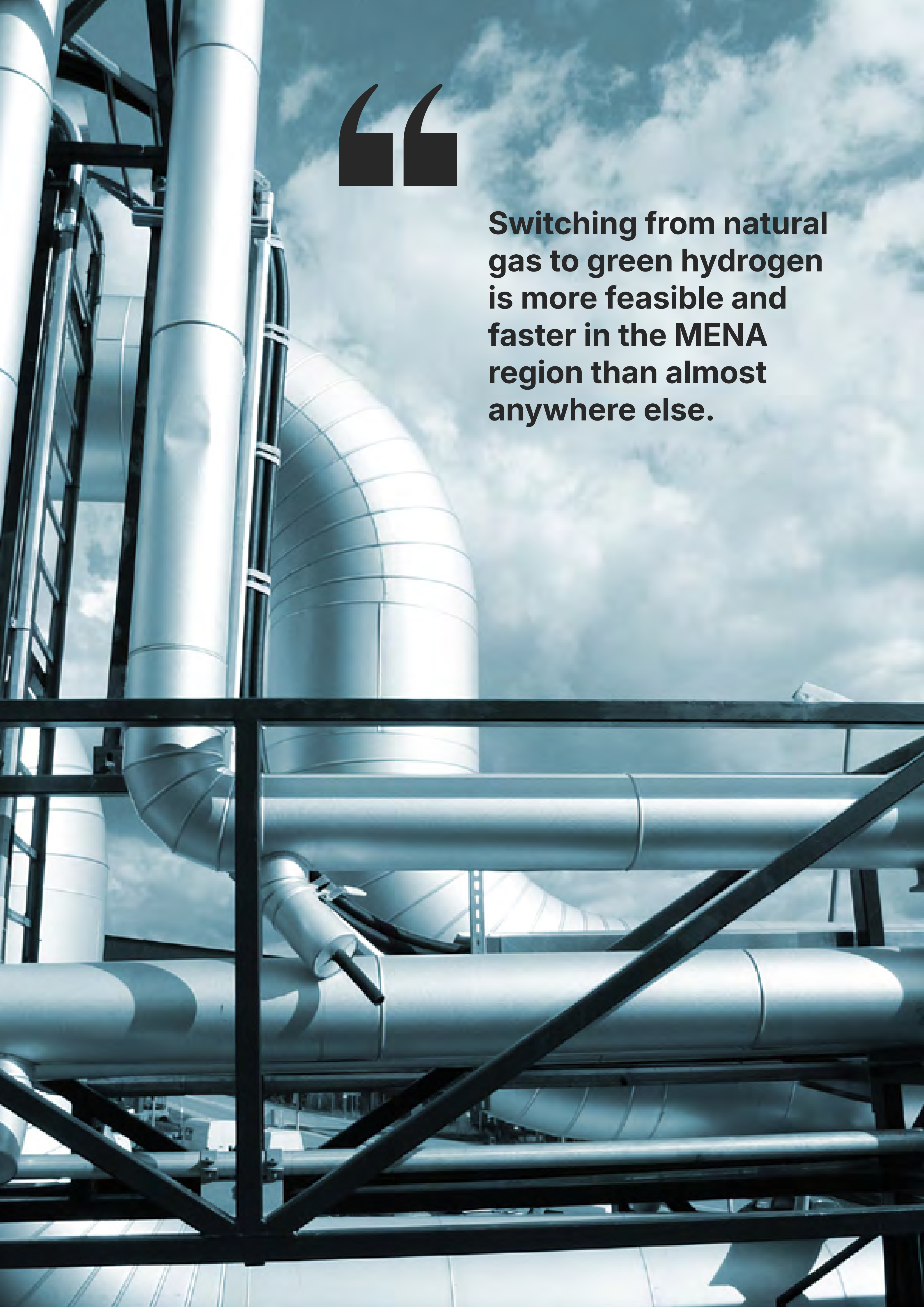
E. Diversifying Markets and Aligning Standards

Carbon-cost and compliance regimes in the MENA region's target markets are uneven: The EU and UK are pushing hard on carbon costs, China is starting to follow, but many emerging economies might not impose tariffs on high-carbon steel. Where key markets like the EU or developed Asia enforce carbon pricing, green iron and steel from the MENA region gains a clear edge. However, in Africa and parts of Asia, where low cost outweighs low carbon, MENA's green products may struggle unless they can match on price. This policy asymmetry makes it difficult for MENA producers to serve multiple global markets.

Trade policies can be unpredictable; if the EU's CBAM triggers diplomatic tensions, Brussels might soften its stance, weakening pressure on importers to switch to greener suppliers. India has been the most vocal critic,[147] and the BRICS bloc collectively rejects CBAM. Russia filed the first formal WTO dispute against CBAM[148] in May 2025.[149]

Against this backdrop, corridor design should intentionally diversify destinations and align standards. This mitigates two risks: exposure to uneven carbon pricing and over-dependence on markets with volatile trade rules. From the outset, MENA producers should cultivate, by default, multiple export markets and explore domestic off-take agreements, shielding the business model from policy shift in any one jurisdiction.

To turn policy fragmentation into a competitive edge, the MENA region could develop its own certification standard for green and iron steel linked to trade diversification strategy. This developed certification should be explicitly aligned with CBAM and other partners' methodologies, and designed for interoperability to ensure it is export-ready.



> Switching from natural gas to green hydrogen is more feasible and faster in the MENA region than almost anywhere else.

06
Policy Recommendations

This paper argues that the MENA region is well-positioned to become a major global hub for emerging green iron production and trade, and that the value chain disruption presents an opportunity for the region. Success depends on symbiotic relationships between key stakeholder groups, each playing a distinct but interdependent role.

The recommendations in this report are grounded in an analysis of the strong market momentum already taking shape across the MENA region, driven by key market forces shaping global demand for green iron and steel. The recommendations aim to optimize the MENA region's ability to capitalize on its competitive market advantage.

Recommendations
For Policy Makers in the MENA Region

Governments play key roles in building robust green iron ecosystems as global green iron markets continue growing. Their core mandate is to enable and de-risk the ecosystem by strategically orchestrating the national resources and policy levers.

> **MENA Governments must formulate clear, enforceable green iron strategies with measurable targets, giving markets the confidence and predictability needed for investment**

A.

Establish a national green iron and steel strategy with clear time-bound targets

Governments in the MENA region must formulate green iron strategies with clarity and enforceable targets. Such green iron strategies must set specific, measurable, time-bound targets providing markets with confidence and predictability needed for green iron development.

These targets should be paired with an appropriate enabling instrument: regulatory, fiscal, financial, market-access, or infrastructure. These targets should also specify a delivery lever, an accountable owner, an indicative resourcing/timeline, to ensure execution rather than signaling.

Setting clear goals for HBI/DRI production capacity provides a clear production pathway for the industry to plan against. This could mean specifying how much HBI/DRI (Mt/y), by which year(s), and for which markets (domestic versus export,) so developers, buyers, and financiers can sequence projects and offtakes accordingly.

This can be complemented by setting sector-specific emissions reduction targets that are well integrated into the national climate policy and into binding national commitments such as the Nationally Determined Contributions (NDC).

Building on national strategies, governments could also mandate the creation of a regional task force, convened under an existing platform such as the GCC Secretariat or the Arab League. Its mandate would be to evaluate the full potential of green iron and steel across the region, harmonize technical and certification standards, and coordinate efforts where national plans overlap.

B.

Deploy "Green Trade Corridor" diplomatic strategies

A proactive diplomatic strategy must be deployed to forge Green Corridor Agreements with key partners like the EU, Japan, and South Korea. This strategy must be bifurcated. For Europe, diplomatic and trade efforts must focus on the “European Green Corridor” pathway, which is driven by regulation. The goal is to negotiate bilateral “Green Corridor” agreements that ensure certified low-carbon HBI from the MENA region receives preferential treatment, guaranteeing frictionless market access. To highlight the region’s MENA’s value proposition, governments in the MENA region should frame HBI as a priority input to Europe’s decarbonization. System-level studies indicate that the EU can lower total system costs and reduce the need for hydrogen networks by importing HBI/steel, especially when iron reduction takes place where renewables and green hydrogen are most competitive, as is the case in the MENA region.[150, 151] On that basis, policy makers should also pursue the EU “lead-market” inclusion for HBI in its development measures such as Steel & Metals Action Plan.

For Asia, the diplomatic narrative must be different. Diplomatic engagement should frame HBI exports as a strategic contribution to Asia’s energy security and industrial competitiveness. This approach, which elevates the already existing trade relationship from a commodity transaction to a strategic energy partnership, is already showing signs of traction, such as the one between Emirates Steel and Japan’s ITOCHU Corporation. These agreements also directly mitigate the risk of policy and standards fragmentation and provide the political and regulatory certainty needed.

C.

Implement a regional carbon pricing mechanism

To maximize value and solidify their global standing, the MENA governments should consider a region-wide carbon price or a tax-and-certification system for heavy industries including iron and steel. MENA should pursue regional alignment and regulatory cooperation toward explicit, compliance-grade carbon pricing for heavy industry. Only a carbon price effectively paid at origin can be deducted from the importer's CBAM bill, since voluntary offsets are not credited.

This policy serves two key goals: firstly, it allows MENA producers to deduct their domestic carbon costs from the EU's CBAM tariffs, keeping that revenue local to fund further decarbonization instead of paying it to the EU. Secondly, it creates a compelling incentive for industries to cut emissions, and speeds up the shift from fossil fuels.

D.

Establish green certification and carbon accounting frameworks

The entire green iron value proposition rests on credible low emissions claims. For MENA-produced HBI, trusted, verifiable, ultra-low carbon footprints provide access to premium-priced European markets. European buyers will naturally gravitate towards the supplier with the most trusted certification regime. Therefore, establishing a certification framework is a central pillar of its competitiveness. The certification standard must be designed from the outset for alignment with the evolving methodologies of key trading partners, including the EU's specific rules for calculating embedded emissions under CBAM and its classification of green hydrogen.

E.

Develop a national "Triangle" financing blueprint

The high capex investments and long payback periods of green steel projects necessitate proactive government financial support to de-risk investment and compete with incentives offered by other regions. By using sovereign support to absorb specific, well-defined risks, e.g., off-take counterparty risk, political risk, governments can significantly lower the cost of capital for private developers, making projects more bankable and accelerating the final investment decision.

F.

Launch a sovereign upstream feedstock strategy

The green iron and steel transition outlined in this paper depends on one critical factor: a reliable supply of DR-grade pellets. However, the structural scarcity of high-quality feedstock cannot be overstated. Governments in the MENA region must engage in proactive "resource diplomacy" with major high-quality feedstock suppliers to secure long-term, stable supplies of this critical input. China's recent creation of the state-backed China Mineral Resources Group (CMRG) illustrates how strategic consolidation of buying power can be leveraged to manage supply risks, price volatility, and supplier relationships, China has treated iron ore not merely as an industrial commodity but as a matter of national security. [152]

Similarly, the MENA region should lead bilateral deals with major ore exporters to dedicate DR-grade concentrates to MENA pellet hubs, diversified by origin and supported by long-term off-takes, logistics access, and shared verification. Mauritania should be prioritized as a proximate upstream partner: Channeling Mauritanian fines/concentrate into the MENA region's pelletizing hubs would diversify origins and underpin production of DR-grade pellets (≥67% iron content) required for hydrogen-ready DRI/HBI lines serving EU and Asia corridors.

In August 2025, Mauritania's SNIM and Saudi producer Hadeed agreed to create the 'Takamul' joint venture to develop a Mauritanian iron-ore mine targeting 12–14 Mt/yr. This represents model of MENA-led resource diplomacy that can be structured to dedicate concentrates to regional DR-grade pelletizing hubs and HBI lines.[153]

This feedstock strategy does not stop at securing ore concentrates abroad, but requires domestic pelletizing capacity so imported concentrates are upgraded locally (as per the model in Bahrain and Oman), feeding DRI hubs and ensuring corridor-ready supply to the EU and Asia. DR-grade pellets are the bottleneck. Upstream iron ore alone does not solve it; pelletizing capacity does.

Recommendations
International Investors and Sovereign Wealth Funds

For private and sovereign capital, the MENA region's green iron transition represents one of the most significant industrial investment opportunities of the coming decade. Capturing this opportunity requires a targeted approach to capital allocation that is aligned with the market signals and policy frameworks identified in this paper.

> **Investors should anchor capital decisions on long-term off-take agreements and target choke points across the value chain to balance risk and returns.**

A.

Anchor investment decisions on secured off-take

The key to managing risk in green iron projects in the MENA region is locking in demand. Following the lead of first-movers like Stegra, investors should require projects to secure long-term, binding off-take agreements for 60–70% of initial production capacity before major capital commitments. These contracts shield against market price volatility and are essential for obtaining project financing.

B.

Diversify investment across the value chain and tilt to chokepoints and enablers

International investors and sovereign wealth funds should adopt a targeted investment approach in MENA's emerging green iron sector that spans the entire value chain. Priority should be given to addressing choke points and enabling assets, particularly upstream DR-grade pelletizing, midstream HBI production, and corridor logistics (ports, storage, and services), to ensure balanced and risk-adjusted returns.

Recommendations
For European and Asian Buyers

Industrial consumers of steel are no longer passive recipients in the supply chain. Proactive buyers are not waiting for a green iron and steel market to emerge. Instead they are creating it.

> **Secure multi-year off-takes for green HBI and, where possible, take minority stakes in promising MENA projects to future-proof supply.**

A.

Evolve from transactional procurement to long-term partnerships

European and Asian buyers should move beyond short-term spot market purchases and toward multi-year binding off-take agreements for green HBI from emerging MENA producers. To further align interests and mitigate supply risk, buyers should follow the precedent set by Mercedes-Benz in Stegra by taking minority equity stakes in promising MENA-based green HBI projects. This innovative mode, "equity for off-take" provides a preferential access that future proofs buyers against possible supply shortages.

B.

Engage directly on regulatory compliance

Buyers should take an active role in validating the credibility of the MENA region's green iron by collaborating with the individual producers to co-develop robust MRV systems for embedded carbon. Such proactive engagements reduce compliance friction and transaction risk, secure access in a tight market, and enable buyers to credibly deliver on their corporate targets.

Specifically, EU buyers should actively partner with MENA suppliers to align carbon accounting, data collection, and certification with CBAM's strict requirements. For EU buyers, alignment ensures CBAM compliance and avoids levies; for Asian buyers, verified low-carbon HBI doubles as a green-energy import that supports energy security.

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