

Two Worlds: Carbon Pricing Splits Steel Industry



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How Carbon Pricing is Creating Two Incompatible Steel Markets

Executive Summary

The global steel industry is undergoing its most profound structural transformation since industrialisation - not through technological revolution or market consolidation, but through the emergence of **two fundamentally incompatible production systems** divided by carbon pricing. One system, encompassing the European Union, United Kingdom, and parts of developed Asia, operates under increasingly stringent carbon constraints with costs approaching €100 per tonne of CO₂. The other, including India, the Middle East, and much of the developing world, faces effectively zero carbon costs.

China occupies a unique middle position - simultaneously continuing massive conventional capacity expansion whilst leading global investment in green steel pilot projects. This dual-track approach will largely determine whether global convergence toward universal carbon constraints occurs by 2035 or gets delayed beyond 2040.

The divide creates cost differentials exceeding **€150 - 200 per tonne of steel by 2030**, fundamentally reshaping investment strategies, trade flows, and competitive dynamics. The EU's CBAM, fully implemented by 2026, transforms this economic divergence into hard trade barriers that will reconfigure global steel markets more profoundly than any tariff regime in history.

The Carbon Cost Chasm: Quantifying the Divergence

The economic foundation of the steel industry's division rests on a widening chasm in carbon costs that has emerged with startling rapidity since 2021. Under the EU ETS, carbon allowance prices have surged from approximately €30 per tonne in early 2021 to sustained levels above €80 per tonne by 2024, with projections suggesting €100 - 120 per tonne by 2027 as free allocation phases out completely.



Production Cost Implications

For integrated steelmakers using blast furnace - basic oxygen furnace (BF-BOF) technology, carbon costs translate directly into production economics. A typical BF-BOF operation emits approximately 2.0 - 2.3 tonnes of CO₂ per tonne of crude steel produced. At €100 per tonne of CO₂, this creates a carbon cost burden of **€200 - 230 per tonne of steel** - equivalent to 25 - 30% of total production costs under current market conditions.

Electric arc furnace (EAF) producers using scrap steel face lower but still significant carbon costs of €50 - 100 per tonne of steel, depending on electricity sources and scrap processing emissions. Meanwhile, steel producers in genuinely unconstrained regions face effectively zero carbon costs. India, the world's second-largest steel producer with approximately 140 million tonnes of annual capacity, has no carbon pricing mechanism. The Middle East, increasingly important for steel production given abundant energy resources, similarly operates without carbon constraints.

The Competitive Distortion

This divergence creates immediate competitive distortions that compound over time. A German integrated steelmaker facing the €200+ per tonne carbon burden competes against Indian producers with zero carbon costs but otherwise similar production economics. This cost differential - potentially reaching €150 - 200 per tonne by 2030 - exceeds the profit margins that steel producers typically achieve, making fair competition impossible without trade intervention.

The situation deteriorates further when considering that carbon-constrained producers must simultaneously invest billions of dollars in decarbonisation technologies (hydrogen-based direct reduction, carbon capture, electrification) whilst their unconstrained competitors can continue optimising conventional blast furnace operations. This creates a double burden: higher operating costs today plus massive capital expenditure requirements for tomorrow's low-carbon technologies.

China's Strategic Ambiguity: The Decisive Middle Ground

China defies simple categorisation in the carbon divide. The country's position will largely determine whether global steel decarbonisation succeeds or fails, given that China produces over 1 billion tonnes annually - more than 50% of global steel output and roughly equal to the rest of the world combined.

The Dual-Track Reality

China's national ETS, launched in 2021, covers only the power sector and trades at approximately ¥80 - 90 per tonne (€10 - 11) - barely 10% of EU carbon prices. Steel production faces no mandatory carbon costs, creating the same zero-carbon operating environment as India or the Middle East. Over 50 million tonnes of new conventional blast furnace capacity was announced for 2024 - 2026, demonstrating continued confidence in traditional steelmaking economics.



Yet simultaneously, **China leads the world in green steel pilot investment**. Baowu Steel's 2 million tonne hydrogen-based direct reduction (H2-DRI) project in Inner Mongolia represents one of the world's largest green steel facilities. HBIS Group's 1.2 million tonne hydrogen steel facility in Hebei Province and over 20 pilot carbon capture, utilisation and storage (CCUS) projects across major steel facilities demonstrate technological ambition. Estimated cumulative investment in Chinese green steel pilots totals **\$15 billion - \$20 billion for 2023 - 2030** - exceeding comparable European programmes.

These pilots represent less than 2% of China's annual production, but their strategic significance extends far beyond current capacity. China is developing the technological capability and operational experience to pivot toward low-carbon steelmaking at scale whenever policy imperatives demand it.

Strategic Calculations Behind the Dual Approach

China's dual-track strategy reflects sophisticated policy calculations. With over 50% of global production serving primarily domestic demand, Chinese producers face no near-term competitive disadvantage from carbon costs. The government can delay mandatory steel sector carbon pricing whilst pilots mature technologically and capital costs decline.

Chinese producers are developing green steel capacity specifically for export markets implementing carbon border adjustments. This creates a divided production system - conventional steel for domestic and unconstrained export markets (Southeast Asia, Africa, Middle East), green steel for EU and other constrained markets. The strategy maximises current returns whilst maintaining access to premium export markets as CBAM tightens.

By leading green steel pilot development, China aims to dominate the eventual global transition, exporting both green steel and the technologies for producing it. Chinese companies developing proprietary H2-DRI systems and CCUS technologies could licence these globally, creating new revenue streams beyond steel sales.

China's Trajectory Determines Global Convergence Timing

If China implements meaningful steel sector carbon pricing by 2030 - 2032 - even at modest levels of ¥200 - 300 per tonne (€25 - 37) - the "unconstrained" market shrinks from 85% to roughly 30% of global production. This would accelerate convergence dramatically, as remaining unconstrained producers (India, Middle East, Southeast Asia) face isolation in shrinking markets.

Conversely, if China's pilots remain marginalised whilst conventional expansion continues through 2035, the carbon divide persists for decades. Current signals suggest China is hedging both directions. The 14th Five-Year Plan (2021 - 2025) includes carbon peak targets but no steel-specific carbon pricing. The 15th Five-Year Plan (2026 - 2030), currently under development, will reveal whether China commits to steel sector carbon constraints or extends the dual-track approach indefinitely.

CBAM: The Wall Dividing Two Markets

The EU's Carbon Border Adjustment Mechanism represents the institutional response to carbon cost divergence, but its implications extend far beyond traditional trade policy. CBAM fundamentally differs from conventional tariffs in ways that create hard barriers between carbon-priced and non-priced steel markets.

Mechanism and Implementation

CBAM requires importers of steel and other carbon-intensive products to purchase certificates corresponding to the embedded carbon emissions in their imports, effectively equalising carbon costs between EU domestic production and imports. The system entered a transitional phase in October 2023 with reporting requirements, progressing to full implementation with financial obligations from 1 January 2026.

By 2034, when EU ETS free allocation to steel producers phases out completely, CBAM will impose the full carbon cost differential on imports. An Indian steel producer shipping to the EU would face CBAM charges of approximately €200 per tonne for integrated steel, assuming EU ETS prices of €100 per tonne and typical blast furnace emissions of 2.0 - 2.3 tonnes CO₂ per tonne of steel. This represents 25 - 30% of the steel's value - far exceeding traditional tariff levels.

Why CBAM Differs from Traditional Tariffs

Unlike traditional tariffs that create frictional costs but allow trade to continue at adjusted prices, CBAM creates categorical barriers based on production methods. Steel produced with high carbon intensity becomes economically non-viable in EU markets regardless of other cost advantages. An Indian producer with 20% lower labour and energy costs cannot overcome a 25% CBAM charge through operational efficiency alone.

More fundamentally, CBAM eliminates the option to "pay to play" that exists with conventional tariffs. CBAM instead requires fundamental changes to production methods - installing carbon capture, switching to hydrogen-based reduction, or using renewable electricity - to reduce embedded emissions and therefore CBAM obligations.

This transforms steel trade from a question of comparative advantage to a question of production compatibility. EU markets become accessible only to producers using EU-compatible low-carbon production methods, effectively creating a separate market system with distinct technology requirements.

China's CBAM Response Strategy

China's dual-track steel strategy appears specifically designed to navigate CBAM barriers whilst maintaining conventional production advantages. By developing 4 - 5 million tonnes of green steel capacity by 2030, Chinese producers can supply EU markets with CBAM-compliant steel whilst redirecting conventional production to unconstrained regions.



This creates competitive advantages over purely unconstrained producers like India or Middle Eastern countries, which face binary choices: invest massively in decarbonisation for EU market access, or accept permanent exclusion from European markets. China's approach maintains access to both market systems, hedging against uncertainty about which ultimately dominates global trade.

KEY TAKEAWAYS: The Steel Industry's Carbon Divide

- **Cost Gap:** Carbon-constrained producers face €200+ per tonne disadvantage by 2030
- **China's Pivot:** \$15-20 billion in green steel pilots whilst maintaining conventional capacity
- **CBAM Impact:** 25-30% cost barrier for high-carbon imports to EU from 2026
- **Investment Split:** EU committing \$50+ billion to decarbonisation vs. zero in unconstrained regions
- **Convergence Timeline:** China's 2030-2032 decision will determine if global alignment occurs by 2035

Investment Consequences: Diverging Capital Allocation

The carbon divide drives fundamentally different investment strategies across regions, creating a global steel industry that increasingly consists of two separate technological systems.

Carbon-Constrained Region Investments

Steel producers in the EU, UK, and carbon-constrained parts of Asia face unprecedented capital requirements for decarbonisation. ArcelorMittal's European operations require an estimated **\$33 billion - \$44 billion through 2030** for hydrogen-based direct reduction (H2-DRI) infrastructure and associated changes. Thyssenkrupp Steel Europe projects \$11 billion for its transformation to climate-neutral production. SSAB's HYBRIT project in Sweden represents \$7.7 billion for 5 million tonnes of capacity.

These investments share common characteristics: extremely long payback periods (20 - 30 years), heavy dependence on government subsidies and carbon contracts for difference (CfDs), and profound technological uncertainty about optimal pathways. German steel producers are committing to H2-DRI despite uncertainty about long-term hydrogen availability and pricing.

China's Divided Investment Strategy

As discussed earlier, Chinese steel investment reflects the country's dual-track positioning. Conventional capacity expansion continues at scale - over 50 million tonnes announced for 2024 - 2026 - whilst green steel pilots receive substantial but focused investment of \$15 billion - \$20 billion through 2030.

This creates portfolio optionality that purely constrained or unconstrained producers lack. The financial logic is compelling: conventional blast furnace capacity costs €400 - 600 per tonne of annual capacity with proven economics, whilst H2-DRI costs €1,200 - 1,500 per tonne with uncertain long-term



competitiveness. By maintaining 98% conventional investment whilst piloting 2% green capacity, China minimises downside risk whilst preserving upside optionality.

Unconstrained Region Investments

Investment patterns in genuinely unconstrained regions - India, Middle East, Southeast Asia - follow purely conventional logic. Indian producers JSW Steel and Tata Steel are expanding conventional integrated operations with minimal green steel investment. Middle Eastern producers like Saudi Arabia's proposed 4 million tonne facility at Ras Al-Khair assume abundant cheap natural gas and zero carbon costs indefinitely.

The economic rationale is straightforward: without carbon costs, conventional blast furnaces remain the lowest-cost production method for most steel grades. These producers are effectively betting that carbon constraints won't reach their regions before conventional investments generate full returns - typically 15 - 20 years.

Trade Flow Reconfiguration: The Emerging Pattern

CBAM implementation and the carbon divide drive fundamental reconfiguration of global steel trade flows, creating distinct market systems with increasingly limited interaction.

The Protected Carbon-Constrained Market

The EU steel market - approximately 150 million tonnes annually - increasingly becomes a closed system accessible primarily to domestic producers and foreign producers who have invested in low-carbon production. Turkish, Japanese and South Korean producers face stark choices: invest in decarbonisation to maintain market access, or redirect exports to unconstrained regions where the €200+ carbon burden mentioned earlier doesn't apply.

China's Divided Export Strategy

As discussed earlier, China's dual-track approach enables a divided export strategy that purely constrained or unconstrained producers cannot match. Green steel pilot capacity (projected 4 - 5 million tonnes by 2030) targets CBAM-protected markets - EU, UK, and eventually other carbon-constrained regions implementing similar mechanisms.

Meanwhile, conventional capacity (over 1 billion tonnes) serves domestic markets and unconstrained export destinations - Southeast Asia, Middle East, Africa, Latin America. Chinese steel exports, having lost competitiveness in the EU market due to CBAM, redirect overwhelmingly to these unconstrained regions where carbon costs remain irrelevant.



The Shrinking Unconstrained Market Basin

The unconstrained production basin - currently representing about 70 - 75% of global steel production including China's conventional capacity - faces gradual erosion as carbon border adjustments proliferate. The UK introduced its own CBAM equivalent in 2025. Japan and South Korea are exploring similar mechanisms.

As carbon pricing and border adjustments spread, the unconstrained market shrinks whilst the constrained market expands. This creates a ratchet effect where producers in unconstrained regions face growing pressure to decarbonise for market access, even without domestic carbon pricing. India faces this pressure most acutely. With substantial steel exports to the EU (approximately 4 - 5 million tonnes annually) and ambitions to expand global market share, Indian producers cannot indefinitely ignore CBAM barriers.

Pathways to Convergence: How the Two Worlds Must Unite

The current carbon divide cannot persist indefinitely if global climate targets are to be achieved. Several pathways could drive convergence toward universal carbon constraints across the steel industry.

The Climate Mathematics of Convergence

The arithmetic is unforgiving. Global steel production totals approximately 1.9 billion tonnes annually, generating roughly 3.7 billion tonnes of CO₂ - about 7 - 9% of global emissions. Meeting Paris Agreement targets requires reducing steel sector emissions by at least 50% by 2050, implying 1.8 - 2.0 billion tonnes of annual CO₂ reduction.

If only carbon-constrained regions (EU, UK, parts of Japan/South Korea) fully decarbonise their approximately 200 million tonnes of annual production, the emission reduction totals about 350 - 400 million tonnes of CO₂ - roughly 20% of the required reduction. The remaining 80% must come from currently unconstrained regions, particularly China (1 billion+ tonnes), India (140 million tonnes), and the rest of the developing world (300+ million tonnes).

This mathematics makes clear that **convergence is not optional but inevitable** if climate targets are to be met. The strategic question becomes a matter of timing and mechanism rather than whether convergence occurs.

China's Decision as Inflection Point

China's trajectory will largely determine convergence timing. If China implements meaningful steel sector carbon pricing by 2030 - 2032 - even at modest levels of ¥200 - 300 per tonne (€25 - 37) - the unconstrained market shrinks from 75% to approximately 30% of global production. This would create irresistible pressure on remaining unconstrained producers (India, Middle East, Southeast Asia) to follow suit or face isolation in shrinking markets.



Several factors could drive Chinese policy shifts toward steel carbon pricing. Export market access pressures will mount as CBAM and similar mechanisms spread, with Chinese conventional steel facing growing barriers in premium export markets. Implementing domestic carbon pricing would reduce CBAM exposure whilst providing revenue for green steel subsidy programmes. Domestic air quality concerns also favour carbon pricing, as steel production contributes significantly to China's severe air pollution problems.

Technology Cost Breakthrough as Convergence Driver

Alternative convergence pathways involve green steel technologies becoming cost-competitive without carbon pricing support. Current estimates suggest H2-DRI could achieve cost parity with conventional blast furnaces when renewable electricity costs fall below \$20 per MWh (currently \$30 - 50 in most markets), electrolyser capital costs decline to \$200 - 300 per kW (currently \$500 - 800), and hydrogen production costs reach \$1.00 - 1.50 per kg (currently \$3 - 6).

These cost reductions are technologically plausible by 2035 - 2040 through manufacturing scale-up and technology improvements. If achieved, green steel becomes economically rational even without carbon pricing, driving voluntary adoption across all regions.

Expanding Carbon Border Adjustments

The proliferation of CBAM-style mechanisms creates market-driven convergence pressure even without global carbon pricing coordination. As more major economies (UK, Japan, South Korea, potentially US, Canada) implement carbon border adjustments, the unconstrained market shrinks progressively. Eventually, producers in unconstrained regions face a binary choice: implement domestic carbon pricing to reduce CBAM exposure, or accept permanent exclusion from constrained markets representing 50%+ of global steel demand.

Strategic Implications for Steel Executives

The carbon divide creates profound strategic challenges for steel industry leadership, requiring decisions about positioning during the transition whilst preparing for inevitable convergence.

Near-Term Positioning (2025 - 2030)

Producers in carbon-constrained regions face an imperative toward aggressive decarbonisation investment whilst lobbying for faster global convergence to protect these investments. Companies must commit to H2-DRI or CCUS despite uncertain returns, recognising that hesitation risks permanent competitive disadvantage if carbon prices continue rising. Purely unconstrained producers (India, Middle East, Southeast Asia) face difficult choices about timing green steel investment: invest early for export market access but risk stranding capital if convergence delays, or maximise conventional returns but risk permanent exclusion from constrained markets.



Long-Term Convergence (2035 - 2050)

By 2035 - 2040, convergence toward universal carbon constraints should accelerate, driven by some combination of Chinese policy shifts, technology cost breakthroughs, or proliferating carbon border adjustments. Companies positioned for this convergence will gain sustained competitive advantages.

The true winners will be those investing now in technologies competitive in the eventual converged, globally carbon-constrained market, rather than those optimising for today's divided reality. Constrained-region producers should continue aggressive decarbonisation whilst building expertise in low-carbon operations that will become universally required. Chinese producers should scale green steel capacity from pilot (2 - 5 million tonnes) to mainstream (50 - 100 million tonnes by 2035), positioning for either domestic carbon pricing implementation or export to expanding constrained markets.

Conclusion

The division of the global steel industry into carbon-constrained and carbon-unconstrained markets represents not a sustainable endpoint but a dangerous transitional phase. The current trajectory - where approximately 10 - 15% of global production decarbonises whilst 85 - 90% continues business-as-usual - will fail catastrophically to meet Paris Agreement targets whilst creating competitive distortions that undermine decarbonisation investment in constrained regions.

China's position will prove decisive. As the producer of over 50% of global steel, China's trajectory determines whether convergence toward universal carbon constraints occurs by 2035 or gets delayed beyond 2040. The country's current dual-track strategy - massive conventional capacity alongside ambitious green steel pilots - creates maximum flexibility whilst indicating that meaningful steel sector carbon pricing could arrive faster than many assume.

The strategic question for steel executives is a matter of timing rather than direction. The companies that will win are those investing now in technologies and capabilities competitive in the eventual converged, globally carbon-constrained market - not those optimising for today's divided reality. Convergence is inevitable; the only questions are when, how, and which companies will be positioned to thrive when the divide finally closes.

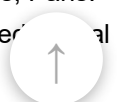
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