Unlocking green steel demand

An assessment of India's automotive, infrastructure and construction sectors

July 2025

INDIA GREEN STEEL COALITION

Confederation of Indian Industry

WWF

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Acknowledgement

The transition towards green steel has become one of the major topics in the steel industry. The whitepaper "Unlocking green steel demand: An assessment of India's automotive, infrastructure and construction sectors" has been prepared by Ernst & Young (EY)-Parthenon in collaboration with WWF-India & CII-Green Business Centre (GBC). Bernt Nordman, Head of Climate Program of WWF Finland, is an advisor to the project. We are thankful to Mr. R.K. Goyal, Chairman - India Green Steel Coalition (IGSC) for his inputs and to the IGSC steering committee members for their inputs. We are extremely thankful to all stakeholders who supported the development of this whitepaper, and for providing valuable feedback that helped shape the contents and finalize the recommendations. Finally, we would like to thank all the members of the team who were involved in the development process at various stages of the initiative. The report is produced under a project funded by WWF Finland. The report does not necessarily reflect the views of the funder.

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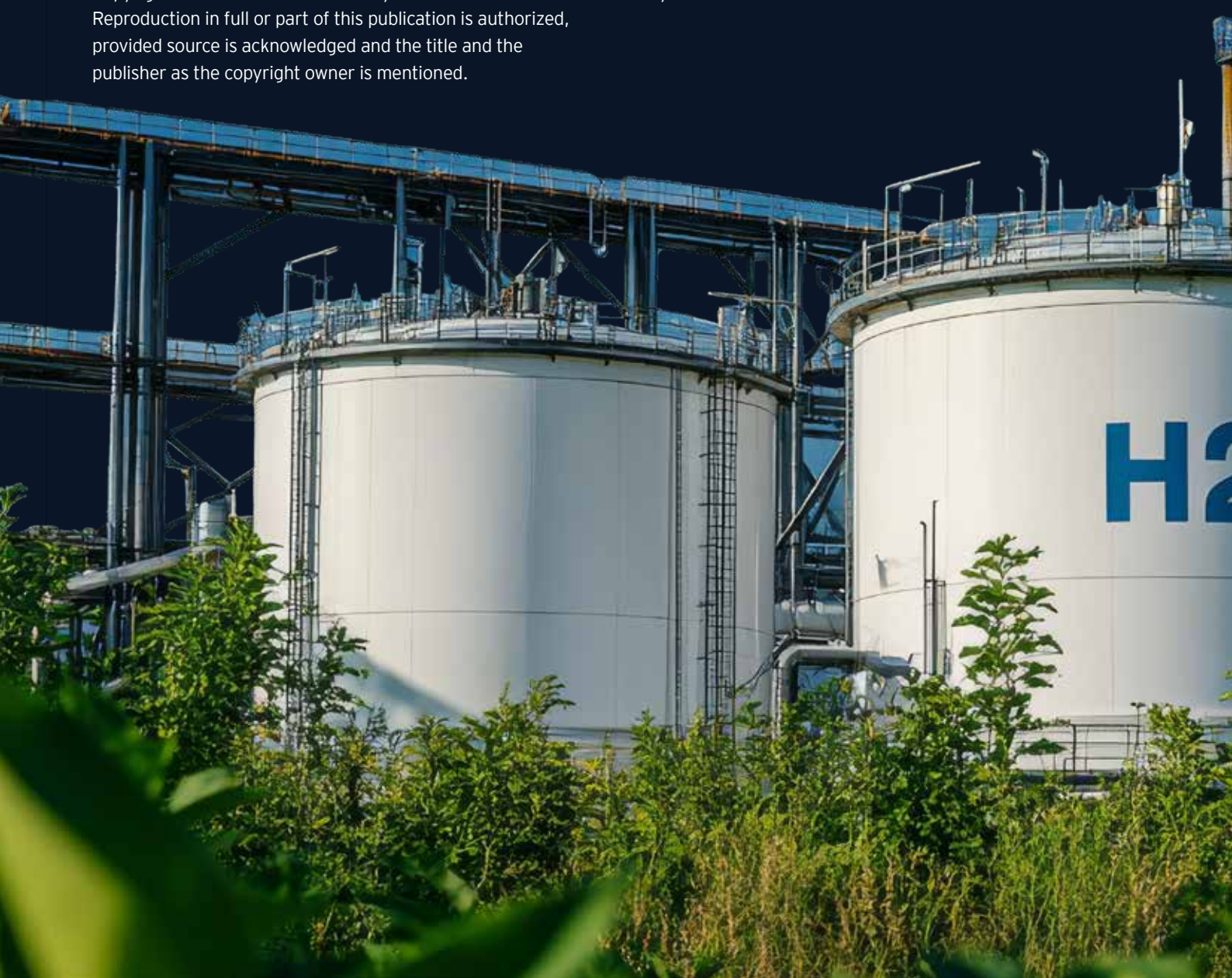

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List of common abbreviations

Abbreviation	Definition
BF	Blast furnace
BOF	Basic oxygen furnace
CBAM	Carbon Border Adjustment Mechanism
CCUS	Carbon Capture, Utilization and Storage
CP	Carbon Price
DRI	Direct reduced iron
EAF	Electric arc furnace
EU ETS	European Union Emissions Trading System
MMT	Million metric ton
MMTPA	Million metric tons per annum
NG	Natural gas
RE	Renewable energy
USD	US dollars

01 Executive summary

The steel sector is a cornerstone of India's economic growth, contributing significantly to infrastructure and industry while also being a major source of greenhouse gas emissions. It currently accounts for approximately 8% of India's total carbon emissions, underscoring the urgent need for decarbonization as the country pursues its climate goals. Today, India's steel consumption stands at 136 million metric tons (MMT), projected to increase to 220 MMT by FY30 and further to 390 MMT by FY50. This growing demand is driven by three key sectors– automotive, construction and infrastructure– which together account for over 70% of consumption and are also poised for rapid growth.

Although demand for green steel in India is currently negligible, it is expected to rise significantly over the coming decades. By FY30, demand is projected to reach 4.49 million tons, driven primarily by the construction sector at 2.52 million tons, followed by infrastructure at 1.5 million tons, and automobiles at 0.48 million tons. This early uptick will be fueled by growing urbanization and a shift towards sustainable building practices. By FY35, demand is set to reach 24.89 million tons, and will more than double again to 73.44 million tons by FY40, largely due to the green transition in infrastructure and automotive manufacturing. By FY50, green steel demand is projected to peak at 179.17 million tons, with construction accounting for more than half, and infrastructure and automobiles continuing to contribute significantly. Meeting this demand will require widespread adoption of green hydrogen-based DRI technology, along with sustainable production methods such as electric arc furnaces and molten oxide electrolysis.

The transition towards green steel is driven by a notable price premium due to its higher production costs and the impact of carbon pricing on traditional fossil-based steelmaking. Currently, the premium on green steel produced through H_2DRI technology stands at US$210 per ton, translating to a 3.7% increase in construction project costs, 5.2% in infrastructure projects, and 4.1% in automotive manufacturing. However, as green hydrogen costs decline and technology scales up, the premium is projected to drop significantly. By 2030, the green steel premium will fall to US$7 per ton, reducing cost impacts across sectors to below 1% by 2035-2040. In contrast, the continued use of carbon-intensive BF-BOF steel will lead to rising costs due to escalating carbon taxes.

The transition towards green steel is driven by several key factors: economic incentives that promote the use of low-carbon technologies, increasing downstream demand for sustainable products, advancements in technology that enhance the feasibility of green steel production, and regulatory mandates pushing industries towards sustainability.

Currently, India exports approximately 7 MMT of iron and steel, and its products to the EU, with projections indicating a 50% increase by 2030. However, the implementation of the European Union's Carbon Border Adjustment Mechanism (CBAM) poses significant challenges for Indian steel exporters. Without proactive decarbonization efforts, these exports could face a tax impact of INR19,277 crores by 2030. This projected taxation stems from an emission intensity differential of ~106% between Indian and EU steel, a year-on-year reduction in the EU Emissions Trading System (ETS) benchmarks, and a gradual reduction of free allowances, which will inflate the prices of carbon certificates currently at US$71 per ton of CO_2.

Given the potential financial repercussions on key export sectors, it is crucial for India to implement regulatory measures that facilitate the decarbonization of the steel industry. This can be achieved through a variety of policy initiatives. Firstly, India could establish a comprehensive carbon pricing mechanism, encouraging industries to reduce emissions. Developing a carbon credit trading scheme would allow companies to buy and sell carbon credits, fostering innovation and investment in green technologies. Additionally, setting regulatory mandates for emission reductions aligned with international standards will promote accountability and transparency. Financial incentives for adopting low-carbon technologies, such as capital subsidies for green steel production processes, can further accelerate the transition. Strengthening public-private partnerships to drive research and development in low-emission technologies will also play a vital role.

As India faces the challenges and opportunities associated with rising steel demand and the global shift towards sustainability, developing a robust policy framework is essential. By adopting strategic regulatory measures, fostering innovation and aligning with international standards, India can enhance its competitive position in the global steel market while contributing to a sustainable future. The transition to green steel is not merely a response to external pressures; it presents a significant opportunity for India to lead in sustainable industrial practices and secure its economic growth in an increasingly carbon-conscious world.

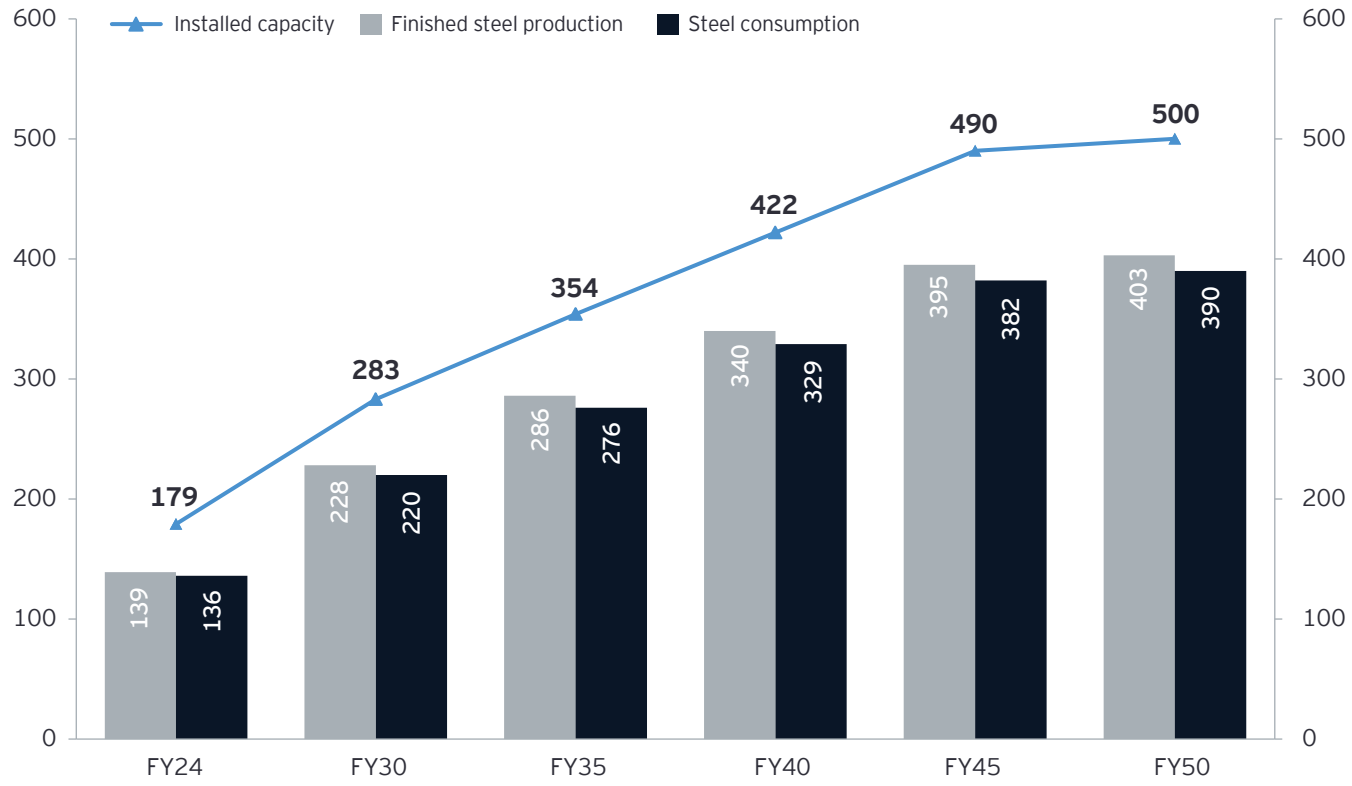
02 Indian steel sector: 500 MMTPA capacity by 2047

As India embarks on its journey towards becoming a US$30 trillion economy by 2047, the steel sector stands as a cornerstone of this transformation. Steel is more than a commodity; it is the lifeblood of industrialization and innovation. The evolution of India's steel industry over the next two decades will mirror the country's broader aspirations of self-reliance, sustainability and global leadership. The Indian steel industry has experienced remarkable growth in recent years. In the last five years, the world's steel capacity grew by approximately 62 million tons, and India contributed 6% to this expansion[1]. India's impressive performance in the steel sector underscores its pivotal role in the international arena, bolstered by initiatives like Atmanirbhar Bharat that promote domestic manufacturing.

The National Steel Policy (NSP) of 2017 has been instrumental in this achievement, setting forth ambitious objectives to reach a crude steel capacity of 300 million tons by the fiscal year 2030-31[2]. This target includes a projected production of 255 million tons of crude steel out of which 230 million tons is finished steel. The policy's goals are to ensure India's self-reliance in steel production and to serve both the domestic and global markets. The policy landscape is not just about capacity targets, it shapes the future of downstream sectors. It is now increasingly becoming aligned with India's national priorities such as Affordable Housing, Smart Cities, Make in India, and clean mobility. These linkages are critical as the country witnesses rising demand for steel-intensive assets across sectors. It focuses on expanding capacity, improving quality and adopting practices that are sustainable. Looking to the future, India seeks to triple its current installed capacity by increasing its annual steel production capacity to 500 million tons by the year 2047.

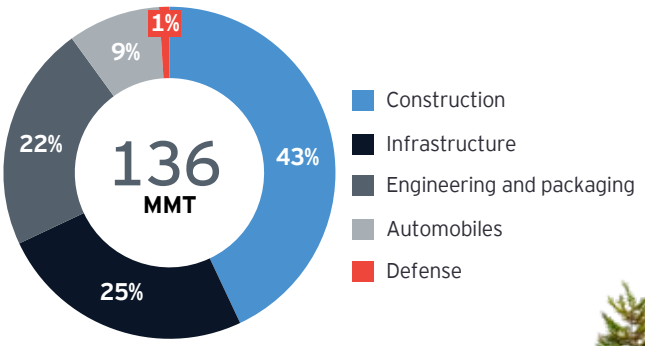
1. *PIB, October 2024, India's Steel Industry: Story of Growth and Global Leadership*
2. *PIB, May 2017, National Steel Policy 2017*

Figure 1: India's steel production target vs. steel demand (MMT)

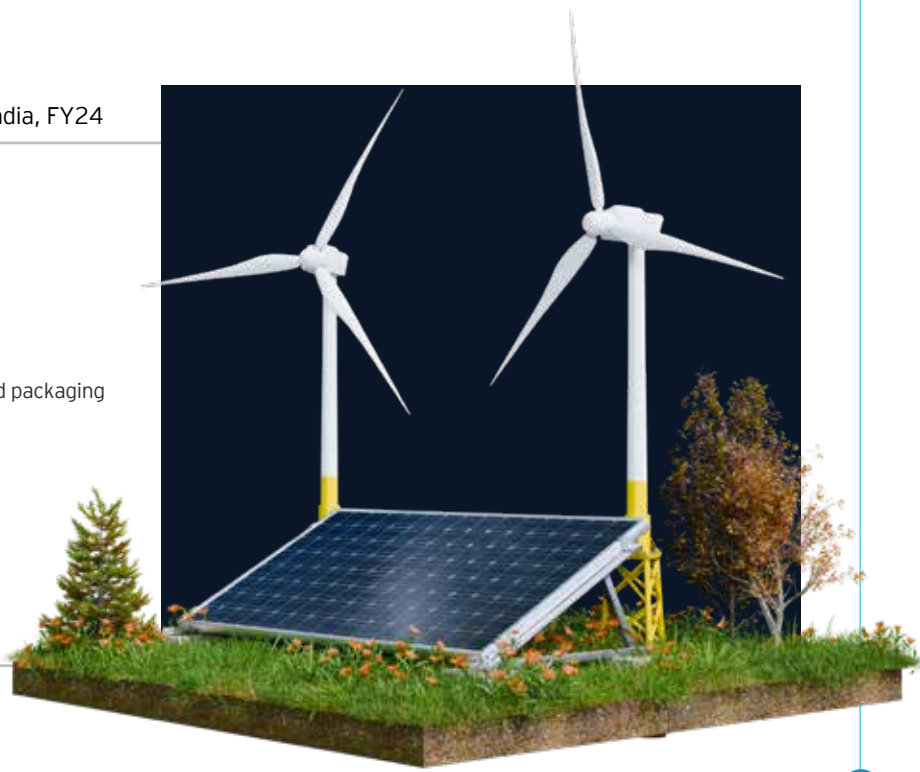


Source: EYP Analysis

Figure 2: Steel consumption in end-use sectors of India, FY24



Source: Ministry of Steel, Annual Report FY24



In India, the primary sectors driving steel consumption include construction, which accounts for 43% of the usage, followed by infrastructure development at 25%, engineering and packaging at 22%, automotives at 9%, and defense at 1%.

The construction and infrastructure sectors collectively account for 78% of the demand for finished steel in India. The construction sector includes rural and urban residential projects, commercial and institutional structures, while the infrastructure sector encompasses transportation networks, railways, airports, ports, urban transit systems, energy projects and waste and water management facilities.

In FY24, the country's total steel consumption reached 136 million tons. Despite this, India's annual per capita steel consumption stands at 97.7 kg, which is only one-third of the global average, indicating significant potential for growth in steel usage across various sectors.

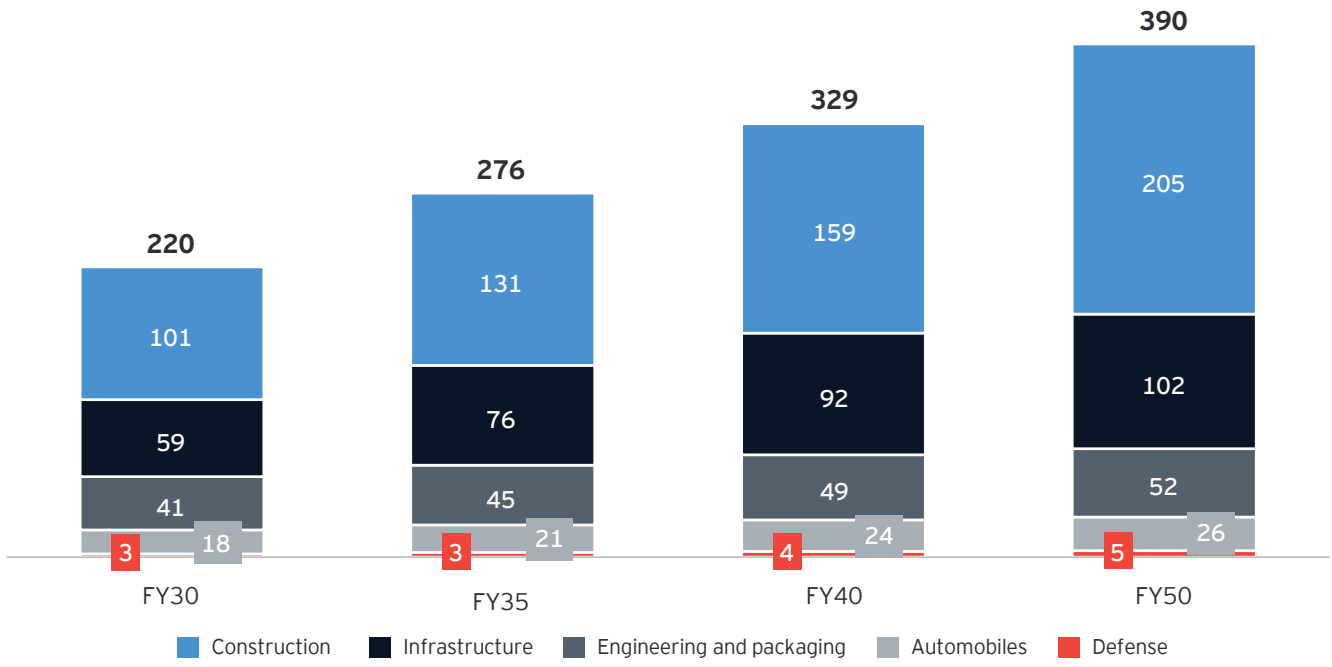
The low per capita consumption also reflects an opportunity. India's demographic dividend, rapid urbanization and government-led capital expenditure are poised to unlock a new wave of demand. By FY31, it is anticipated that India's total steel demand will surge to approximately 230 million tons. This expansion is expected to be propelled by the construction sector, which will benefit from an increasing urbanization rate and a higher steel intensity in construction practices. Additionally, the infrastructure segment is poised for growth, with investments in roads, railways and airports contributing to a rise in steel usage.

The data presented in Figure 3 provides a comprehensive forecast of steel consumption trends from fiscal year 2030 to 2050. It highlights a progressive increase in the demand for steel, with projections indicating the steel consumption shall reach 390 MMT in FY50. The construction and infrastructure sectors emerge as the dominant consumers, with the construction sector alone expected to require 205 million metric tons (MMT) of steel by FY50. Similarly, the infrastructure sector is predicted to reach a consumption level of 102 MMT by the same fiscal year.

In addition to these primary sectors, the engineering and packaging sector is poised for significant growth, albeit on a smaller scale. The automobile sector showcases a consistent rise in steel demand, which can be attributed to the burgeoning automobile industry. By FY50, the steel demand from this sector is expected to reach 26 MMT. Furthermore, the defense sector, while modest in its current consumption, is on an upward trajectory that suggests promising growth prospects. The analysis emphasizes the pivotal role that steel plays in the advancement of these key sectors, serving as the backbone for their development and the nation's progress.

Overall, the forecast underscores the importance of strategic planning in the steel industry to meet the growing demands of these diverse sectors. It also suggests that the steel industry's expansion is closely tied to the nation's economic growth, with the potential to significantly contribute to India's infrastructure and industrial development. India's National Steel Policy aims to increase per capita steel consumption to 160 kg by FY31 from the current 97.7 kg in FY24. The anticipated growth in steel demand across these sectors reflects the dynamic nature of the Indian economy and the need for robust supply chains to support this expansion.

Figure 3: Forecasted steel consumption in end-use sectors (MMT)



Source: EYP Analysis

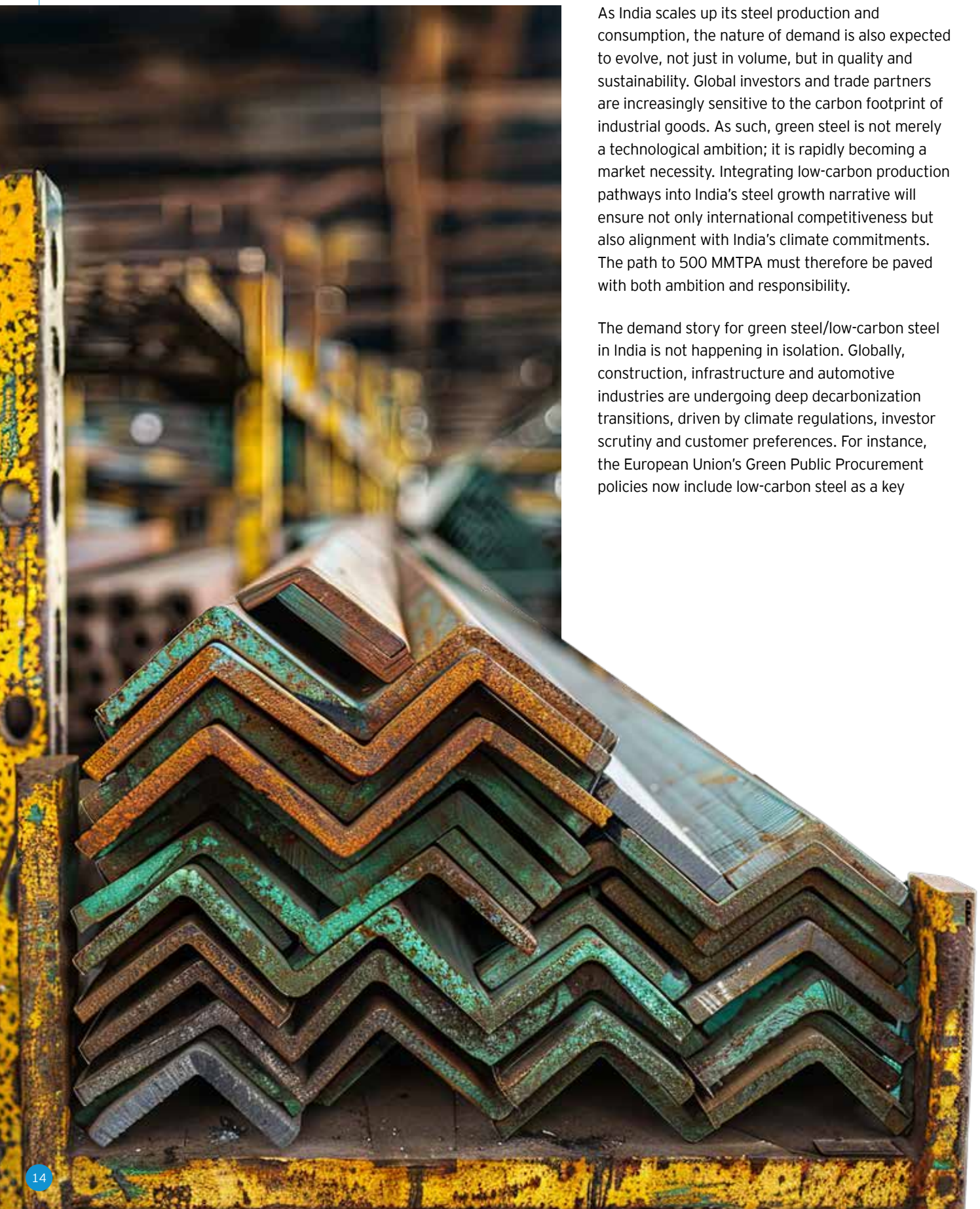
Key notes for the analysis

01 Finished steel demand projections are analyzed based on growth rate of each end-use sector over FY30, FY40 and FY50

Table 1: Steel consumption CAGR over the fiscal years across the sectors

Sector	CAGR			
	FY24-FY30	FY30-FY35	FY35-FY40	FY40-FY50
Construction	9.69%	5.34%	3.95%	2.57%
Infrastructure	9.62%	5.19%	3.90%	1.04%
Engineering and packaging	5.34%	1.88%	1.72%	0.60%
Automobile	6.99%	3.13%	2.71%	0.80%
Defense	20.03%	0%	5.92%	2.26%

03 Demand for green steel in India



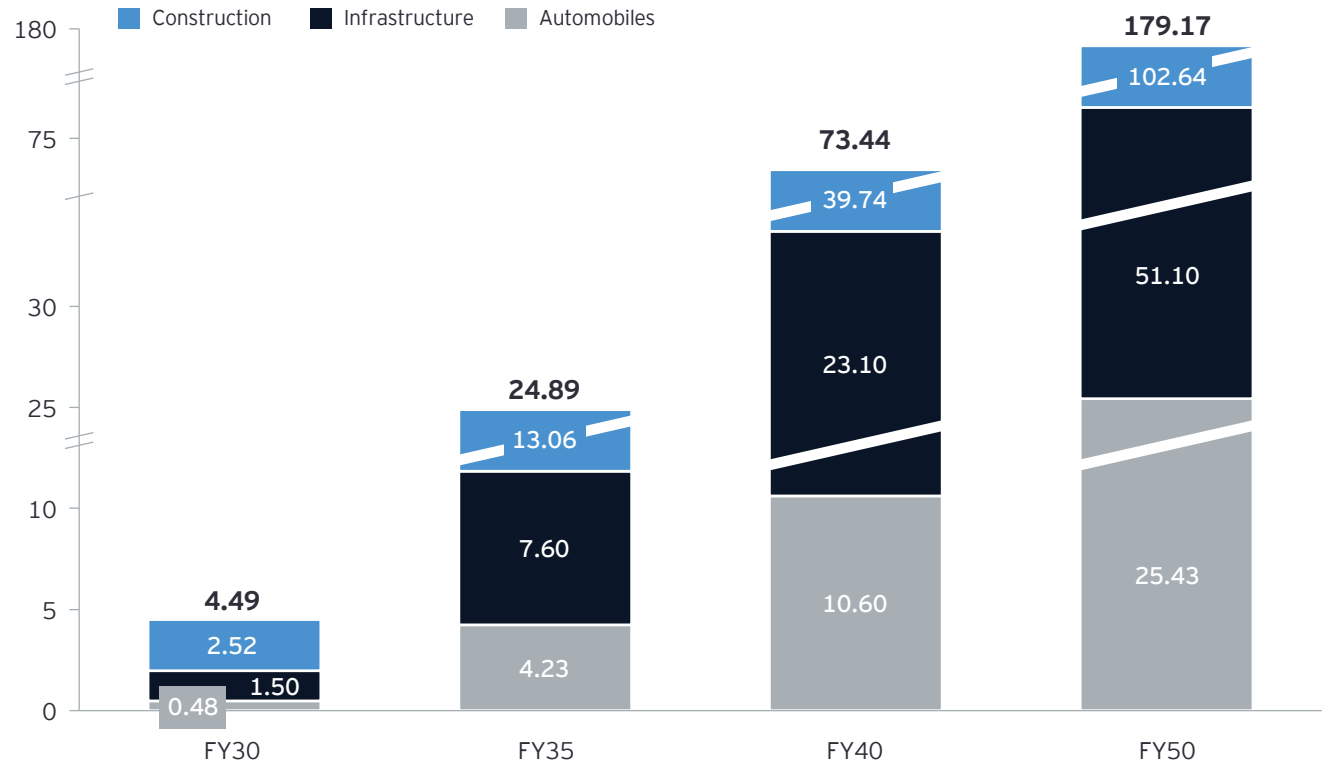
As India scales up its steel production and consumption, the nature of demand is also expected to evolve, not just in volume, but in quality and sustainability. Global investors and trade partners are increasingly sensitive to the carbon footprint of industrial goods. As such, green steel is not merely a technological ambition; it is rapidly becoming a market necessity. Integrating low-carbon production pathways into India's steel growth narrative will ensure not only international competitiveness but also alignment with India's climate commitments. The path to 500 MMTPA must therefore be paved with both ambition and responsibility.

The demand story for green steel/low-carbon steel in India is not happening in isolation. Globally, construction, infrastructure and automotive industries are undergoing deep decarbonization transitions, driven by climate regulations, investor scrutiny and customer preferences. For instance, the European Union's Green Public Procurement policies now include low-carbon steel as a key

criterion in infrastructure contracts. Automakers have already launched initiatives to integrate green steel into their supply chains. These global signals are now influencing Indian companies, especially those integrated into global value chains, to pivot towards green steel, even in the absence of domestic mandates. India's real estate developers, infrastructure companies and automakers are aligning with global ESG benchmarks and emission reduction targets, making green steel adoption both a reputational and strategic imperative.

As Indian industries align themselves with global climate goals and domestic policy imperatives, green steel (emission intensity less than 0.5 tCO_2/t crude steel) production routes, such as green hydrogen-based DRI-EAF, and scrap-based EAF powered by RE, are emerging as critical solution to reduce carbon emissions in steel production. The demand for green steel is projected to increase exponentially over the next few decades, driven by ambitious net zero targets of end-use sector companies, especially on Scope 3, and sectoral growth. Public procurement also plays a crucial role in driving demand for green steel by setting sustainability benchmarks in government projects. The government also plans to roll out policies around public procurement. A closer analysis of the green steel demand trajectory, as depicted in the accompanying graph, highlights this growth across key sectors: automobiles, infrastructure and construction.

Figure 4: Demand for green steel in construction, infrastructure and automobile sectors in India (MMT)



Source: EYP analysis based on primary interaction/interviews

Key notes for the analysis

01 Inputs were taken from three prominent auto companies, and two prominent construction and infrastructure companies

02 Green steel demand over the years is calculated based on net zero targets of the companies holding more than 85% cumulative share in automobile, construction and infrastructure sectors

03 In automobile sector, steel consumption across various automobile sub-segments, namely Light Commercial Vehicles, Medium & Heavy Commercial Vehicles, Passenger Vehicles, Two-Wheelers, and Three-Wheelers has been analyzed based on two key factors: Per-unit steel usage and projected growth of each sub-segment through FY50. The analysis also considers the evolving share of Internal Combustion Engine vehicles and Electric Vehicles (EVs) within each sub-segment.

04 The estimated demand for green steel is derived based on the assumption that automotive companies will begin procuring green steel at least 10 years prior to achieving their net zero or Scope 3 targets. This transition is modeled to start with 10% green steel procurement in the first year, increasing by 10% points each subsequent year

05 In construction sector, steel consumption was analyzed for residential buildings, commercial spaces, industrial, and institutional builds. The infrastructure sector covers analysis of steel consumption in transport, railways, airports and ports, urban transits, energy, and waste and water infrastructure.

06 The estimated green steel demand from construction and infrastructure sectors is based on scenario-based demand estimation, wherein certain percentage of overall steel demand is green steel, which is derived on basis of improving ESG and sustainability ratings, net zero targets, government's public procurement, etc.

Table 2: Total steel (conventional + green) consumption of sectors (MMT)

Sector	FY30	FY35	FY40	FY50
Construction	101	131	149	205
Infrastructure	59	76	92	102
Automobile	18	21	24	26

Currently, the demand for green steel remains negligible across these sectors. However, a significant shift is observed by FY30, where total demand reaches 4.49 million tons, with the construction sector taking the lead at 2.52 million tons. Infrastructure follows with a demand of 1.5 million tons, and the automobile sector, at 0.48 million tons, begins to show early signs of adoption. The construction sector's dominance in this phase reflects India's need to meet its expanding urbanization requirements while adhering to greener building practices. Sustainable construction materials like green steel are becoming central to reducing emissions associated with real estate and civil engineering projects.

By FY40, total demand for green steel nearly triples to 73.44 million tons, compared to FY35. The construction sector's contribution rises to 39.74 million tons, solidifying its position as the largest consumer of green steel. Infrastructure projects also see significant growth, reaching a demand of 23.10 million tons. The automobile sector, at 10.60 million tons, reflects the automotive industry's transition to cleaner manufacturing processes.

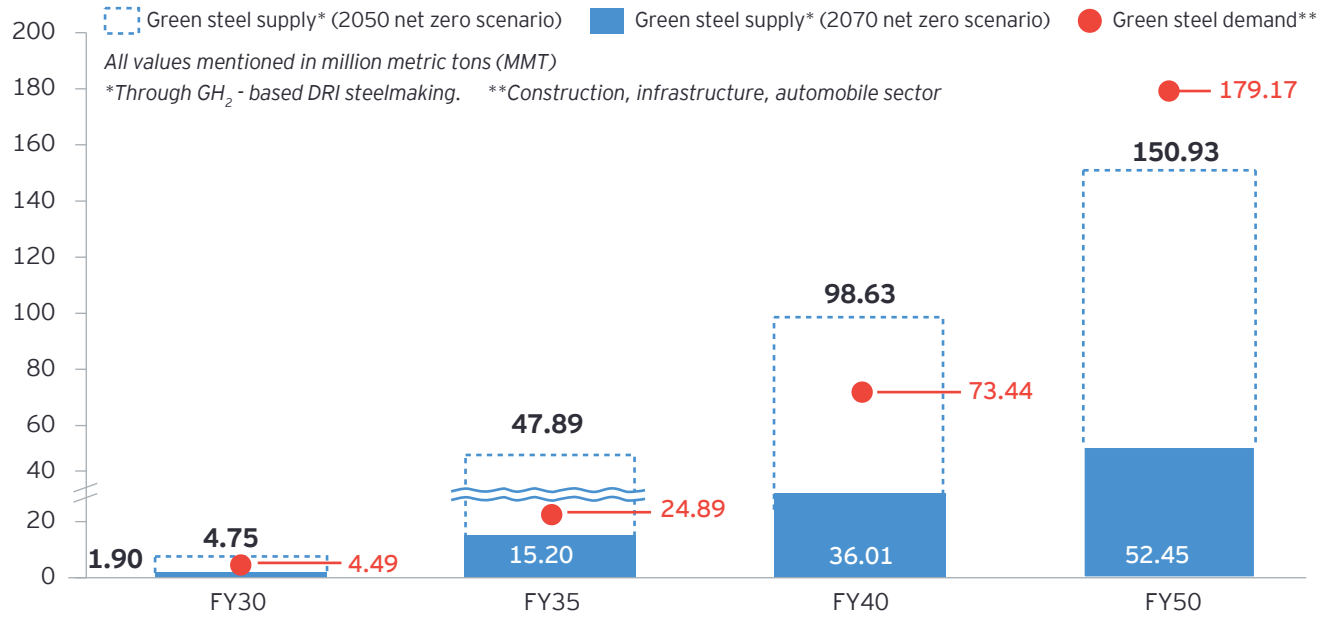
By FY50, the demand for green steel reaches a staggering 179.17 million tons, underscoring the scale of India's green transition. The construction sector remains the largest consumer at 102.64 million tons, accounting for more than half of the total demand. Infrastructure demand also grows steadily to 51.10 million tons. The automobile sector, while smaller in absolute terms, registers a demand of 25.43 million tons, marking a significant leap compared to earlier

years. At this stage, green steel is expected to become a mainstream material in automobile manufacturing, supporting the development of carbon-neutral vehicles.

The trends evident from this analysis highlight the pivotal role of green steel in India's sustainability journey. The construction sector is expected to continue to drive the bulk of the demand, fueled by sustainable urbanization and eco-friendly building materials. Infrastructure, as the backbone of economic growth, may remain a key contributor, with mega projects incorporating green steel to align with net zero commitments. Meanwhile, the automobile sector, although a smaller segment, could see exponential growth as automakers adopt low-carbon technologies and aim for greener supply chains.

With the construction, infrastructure and automobile sectors driving demand, innovative green hydrogen-based Direct Reduced Iron (DRI) steelmaking and alternative green production methods are poised to transform the industry. India's path to decarbonization hinges on scaling green steel production to bridge the anticipated supply-demand gap

Figure 5: Green steel supply-demand gap in construction, infrastructure and automobile sectors in India (MMT)



Source: EYP Analysis

Key notes for the analysis

01 The representation of green steel supply in India is derived from our analysis presented in the whitepaper titled 'Role of green hydrogen in the Indian steel sector'

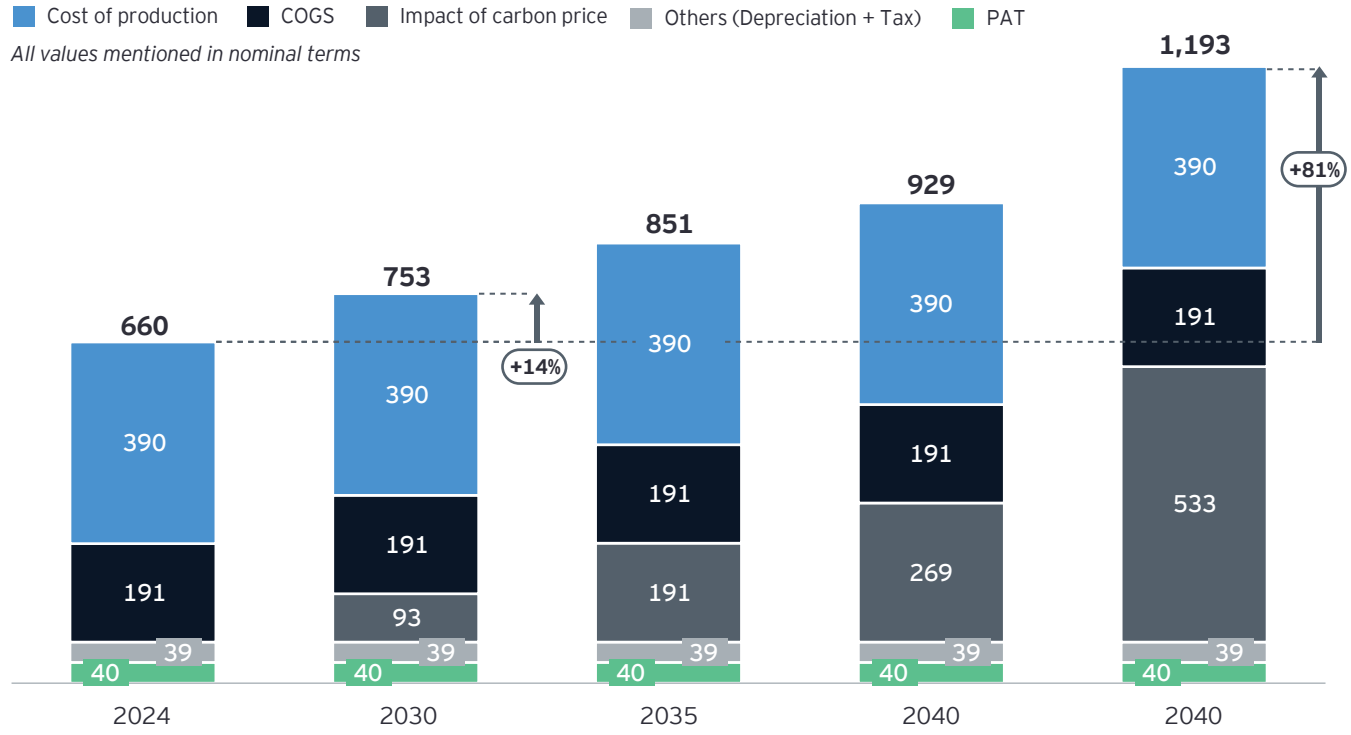
In the net zero 2070 scenario, H2 DRI steelmaking is projected to supply nearly 36, and 52 MMT of green steel in FY40, and FY50, respectively. The accelerated 2050 net zero scenario indicates significantly higher production levels, with outputs of nearly 99, and 151 MMT for the same years. However, demand in these periods will climb steeply to 73 MMT and 179 MMT. This creates a substantial supply-demand gap under the 2070 scenario, reaching deficits of 103%, and 241%, respectively. In the accelerated 2050 scenario, while the supply of GH2 DRI steel suffices up to FY40, a 19% shortfall emerges by FY50. Addressing this gap necessitates the adoption of supplementary green steel production methods, such as scrap-based electric arc furnaces powered by renewable energy and molten oxide electrolysis (MOE). These alternative technologies will be pivotal in ensuring India meets its green steel demand while achieving sustainable industrial growth.

04 Premium on green steel

The green steel premium refers to the additional cost associated with producing steel through green steelmaking processes, such as using GH2-DRI or EAFs powered by renewable energy, instead of traditional steelmaking routes. This premium reflects the higher capital and operational expenditures required to adopt cleaner technologies and decarbonize the steel value chain. The concept is important as it acknowledges the financial gap between conventional and sustainable steel production, incentivizing early adopters and enabling the transition towards net zero targets in the hard-to-abate steel sector. However, widespread acceptance of this premium hinges on supportive policies, carbon pricing mechanisms and the willingness of end-users to pay more for green steel production.

As efforts to decarbonize the steelmaking facilities intensify, carbon pricing might play a pivotal role in driving emissions reduction. The impact of carbon pricing on steel production through the Blast Furnace-Basic Oxygen Furnace (BF-BOF) route is significant and transformative. The analysis in Figure 6 highlights how the carbon prices, could elevate the final sales price of steel. The starting point for this trajectory is the current sales price of US$660 per ton of steel, which primarily consists of production costs, cost of goods sold (COGS), and other operational overheads. Specifically, production costs and COGS constitute approximately 88% of the total price, leaving a smaller portion for taxes, depreciation and profit after tax (PAT). Our analysis accounts for PAT to remain constant despite the introduction of carbon pricing. This implies that the additional financial burden imposed by carbon regulations is directly passed on to customers. The carbon price impact, therefore, acts as an externality, exacerbating production expenses while necessitating a proportional rise in the steel sales price. The emission intensity associated with BF-BOF steel production in India makes it particularly susceptible to this effect, as carbon-intensive processes are inherently more vulnerable to regulatory cost escalations.

Figure 6: Impact of carbon price on sales price of BF-BOF steelmaking (US$/t steel)



Source: EYP Analysis

Key notes for the analysis

01 The analysis is based on the average figures of five prominent integrated BF-BOF steelmakers in India.

02 Price components like COGS, depreciation, tax, PAT, etc., is analyzed from the annual reports of the companies.

03 PAT is kept constant in order to analyze the steel prices.

04 The analysis considers an Indian carbon price of ~US$58/$tCO_2$ by 2030, ~US$115/$tCO_2$ by 2040 and ~US$229/$tCO_2$ by 2050

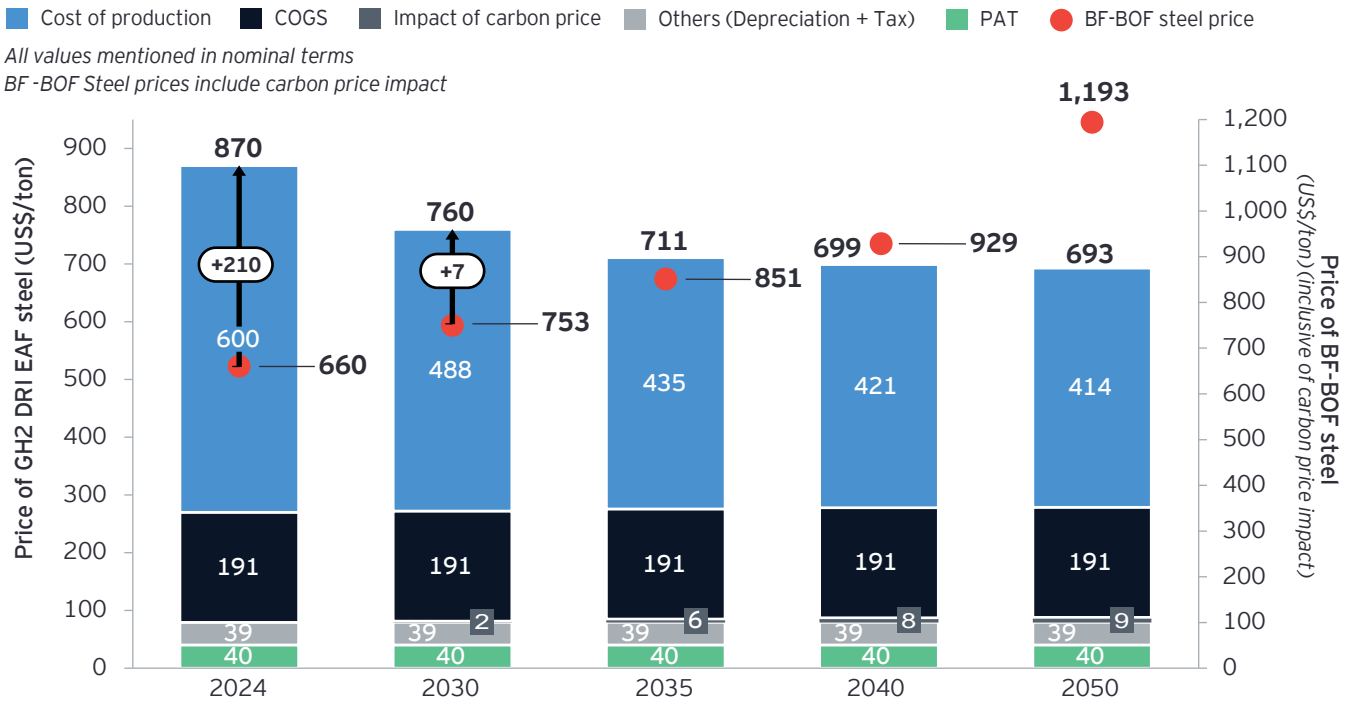
Projections based on this externality indicate a steady yet pronounced increase in steel prices over the coming decades. By 2030, the sales price is expected to rise from the current US$660 per ton to US$753 per ton, representing a 14% increase. This upward trend becomes more pronounced by 2050, with the sales price projected to reach US$1193 per ton—a substantial 81% increase relative to the 2024 baseline. The trajectory underscores the escalating financial implications of carbon pricing as emission reduction mandates grow stricter in alignment with global climate commitments.

The underlying data reflects that while the absolute cost of production remains relatively constant at US$390 per ton over this period, the incremental cost introduced by carbon pricing becomes increasingly dominant. By 2040, the carbon price impact and associated regulatory burdens will account for a significant portion of the total steel price. This shift highlights a broader economic challenge for the steel industry: balancing climate mitigation objectives with affordability and competitiveness in the market. Unless technological advancements or alternative low-carbon production pathways like green hydrogen-based DRI-EAF are adopted, BF-BOF steel producers may face challenges maintaining price stability in a carbon-constrained economy.

The introduction of green steel produced through green hydrogen-based Direct Reduced Iron (H_2 DRI) technology represents a significant step towards decarbonizing the steel industry. Unlike conventional Blast Furnace-Basic Oxygen Furnace (BF-BOF) methods, H_2 DRI offers a cleaner pathway to steel production, reducing emissions intensity substantially. However, this transition to green steel comes at a cost, introducing a green steel premium driven by higher initial production costs, though carbon pricing can enhance its competitiveness by making fossil-based steelmaking more expensive.

The current baseline sales price of steel stands at approximately US$660 per ton, where 88% of the total price comprises production costs and cost of goods sold (COGS). For H_2 DRI steel, the initial cost structure is markedly higher, necessitating a premium of around US$210 per ton over the baseline. This premium reflects the relatively high production costs of green steel in its early adoption phase, largely driven by the cost of green hydrogen and the infrastructural investments required to scale up H_2 DRI technologies. As such, the early years of green steel production place a notable financial burden on producers, which is anticipated to be transferred to consumers.

Figure 7: Green steel premium and impact of carbon price on sales price of H2 DRI steelmaking (US$/ t steel)



Source: EYP Analysis

Key notes for the analysis

01 The analysis considers an Indian carbon price of ~58 $/tCO2 by 2030, ~115 $/$tCO_2$ by 2040 and ~229 $/tCO2 by 2050

However, the dynamics of H_2 DRI steel pricing are set to shift favorably over the coming years due to two critical factors: the falling cost of production and the minimal impact of carbon pricing on this production route. As global initiatives to scale up green hydrogen advance and renewable energy becomes increasingly affordable, the cost of producing H_2 DRI steel is expected to decline significantly. This reduction in production costs will play a pivotal role in narrowing the green steel premium. By 2030, the sales price of H_2 DRI steel is projected to decline to US$760 per ton, which would narrow down the premium to US$7 per ton. Beyond 2030, H_2 DRI steel will no longer carry a price premium. This represents a substantial decrease from the initial US$210 premium, signaling progress towards making green steel more cost competitive.

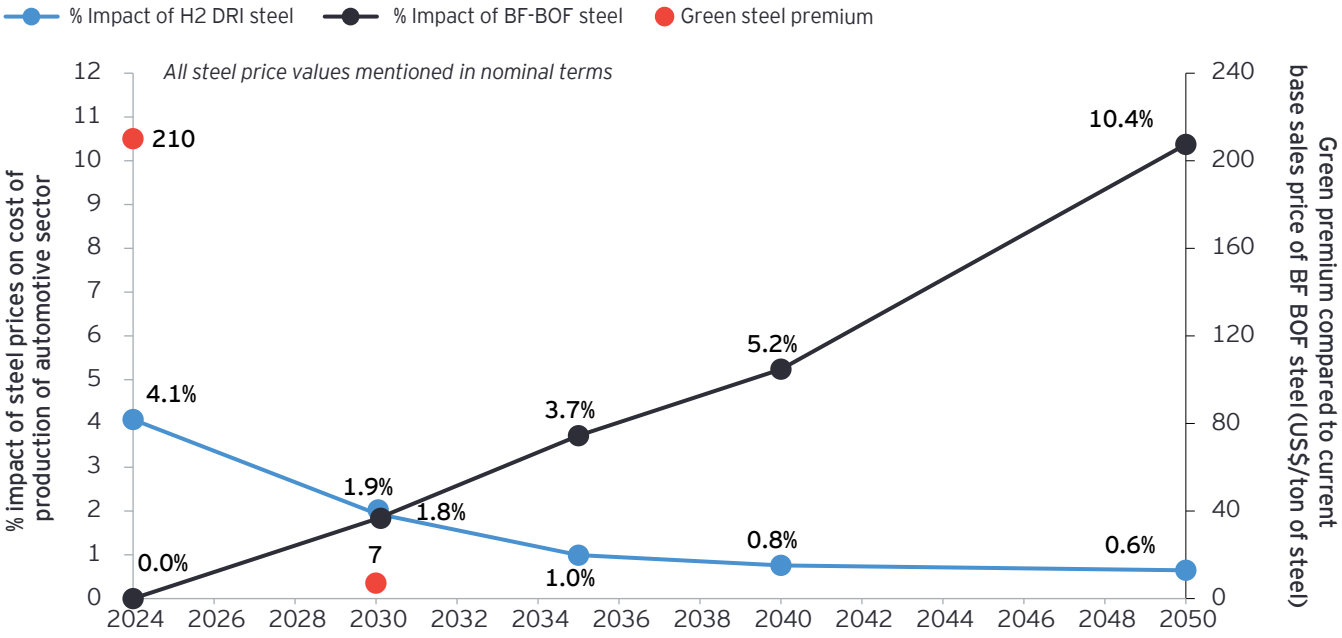
The production cost of H_2DRI steel is expected to decline further, enabling the sales price to reach US$693 per ton by 2050. The minimal impact of carbon pricing on H_2DRI steel further enhances its competitiveness, as producers of BF-BOF steel will continue to face rising carbon tax burdens over the same period. In contrast, H_2 DRI steel will benefit from its low-emission profile, mitigating the external cost pressures associated with carbon regulations.

This evolving cost landscape underscores the critical role of technology, policy and market incentives in driving the adoption of green steel. While the initial premium poses challenges for widespread adoption, the projected decline in costs offers a clear pathway towards affordability.

The transition to green steel is also a significant factor influencing the cost dynamics of automotive manufacturing, construction and infrastructure projects. As the industry pivots towards low-carbon solutions, the impact of green steel premiums and carbon taxes on production costs will play a crucial role in shaping the economic feasibility of adopting sustainable practices. Below is a sector-wise analysis of the current and projected cost impact of adopting green steel in these sectors.

Currently, the adoption of H_2 DRI green steel increases automotive production costs by approximately 4%. This is due to the impact of the green steel premium. However, this impact is projected to decrease to less than 1% by 2035-2040, as the green steel premium reduces over time. Steel, accounting for 50% to 60% of a vehicle's weight and 15% to 20% of its production value, plays a pivotal role in determining overall manufacturing costs. At the present green steel premium of US$210 per ton, this results in a modest 4.1% cost increase for automakers. In contrast, continuing to use BF-BOF steel beyond 2030 could raise production costs by 4% to 5% in nominal terms due to escalating carbon taxes and emissions-related penalties. The projected decline in green steel premiums underscores the long-term economic viability of sustainable steelmaking, positioning it as a cost-effective solution to decarbonize automotive production while mitigating environmental impact.

Figure 8: Green steel premium and carbon tax impact on automotive production cost



Source: EYP analysis based on primary interaction/interviews

Key notes for the analysis

01 Inputs were taken from three prominent auto companies in India.

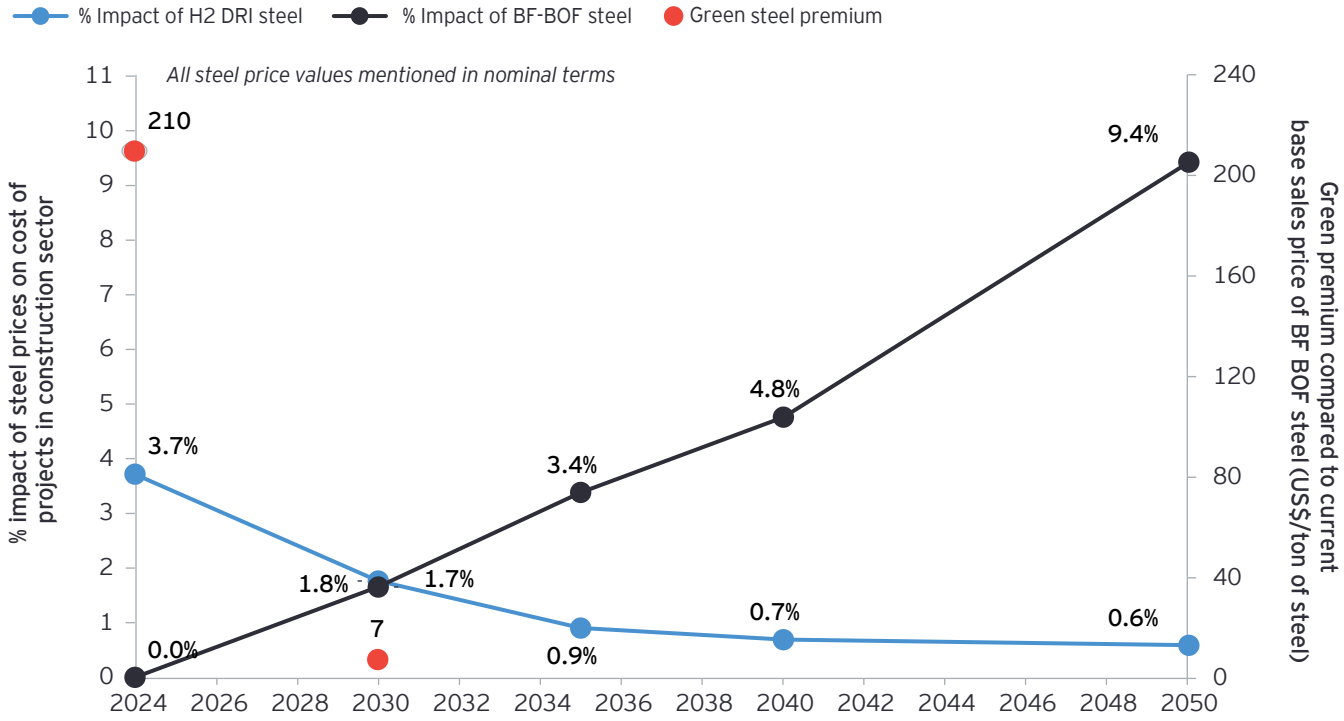
02 Annual reports of top auto companies in PV sub-segment were referred for financial metrics like revenue, PAT, PBT, revenue per PV for the analysis.

03 Kerb weight of automotive: 1500 kg; weight of steel per vehicle: 900 kg

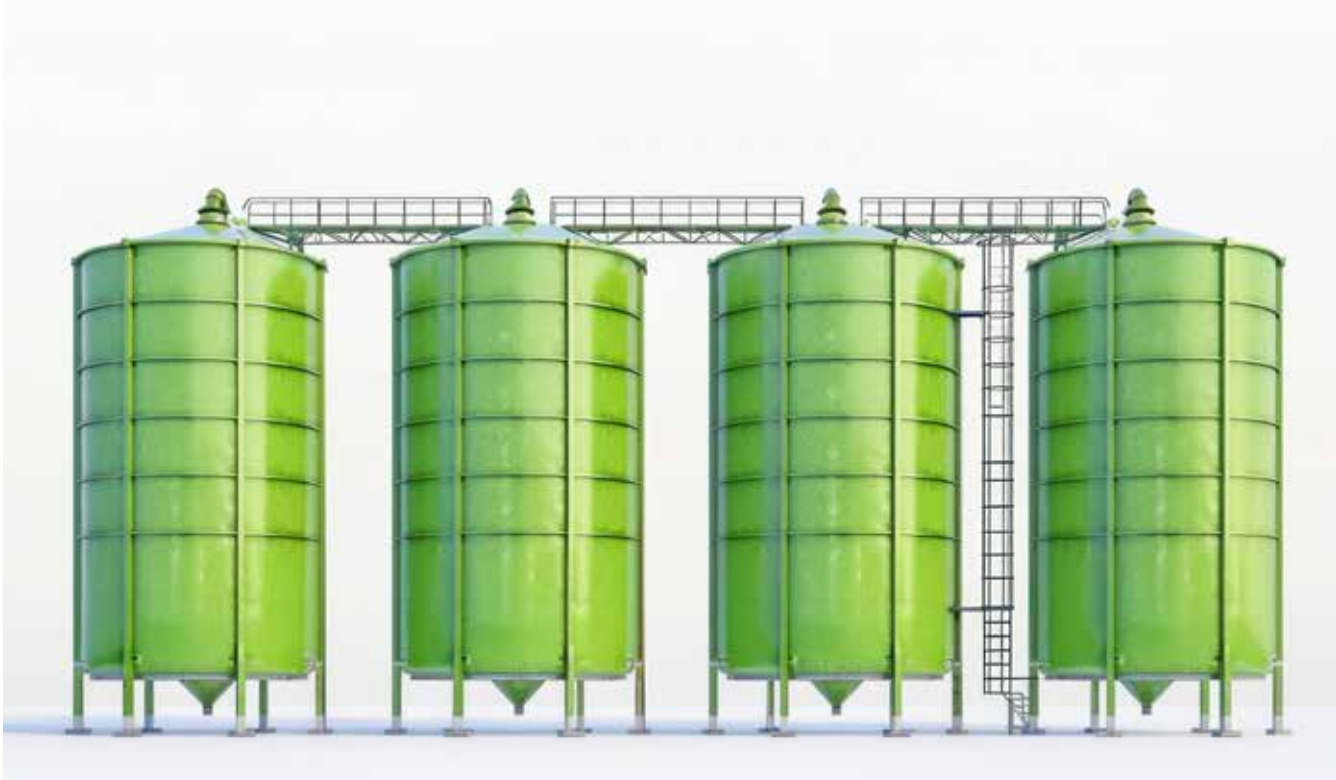
04 The analysis, considers an Indian carbon price of ~US$58/$tCO_2$ by 2030, ~U$115/$tCO_2$ by 2040 and ~US$229/ tCO2 by 2050; Current base sales price of steel for green steel premium comparison: US$660/ton

In the construction sector, the usage of H_2 DRI green steel currently leads to an increase in production costs of approximately 3.7%. Steel, which constitutes 15% to 25% of the value of a construction project, influences overall expenditures. At the present premium of US$210 per ton, this translates to a measurable, yet manageable, 3.7% rise in project costs. Encouragingly, as the green steel premium declines over time, this cost impact is projected to drop to less than 1% by 2035 to 2040, making it a more economically viable option for construction companies. In contrast, continued reliance on BF-BOF steel beyond 2030 is expected to increase production costs by 3% to 10% in nominal terms, driven by escalating carbon taxes and emissions-related costs. The decreasing premium of green steel underscores its potential to not only reduce the environmental footprint of construction but also to ensure cost-effective project execution in the long term.

Figure 9: Green steel premium and carbon tax impact on construction production cost



Source: EYP analysis based on primary interaction/interviews



Key notes for the analysis

01 Inputs were taken from two prominent construction / infrastructure companies in India

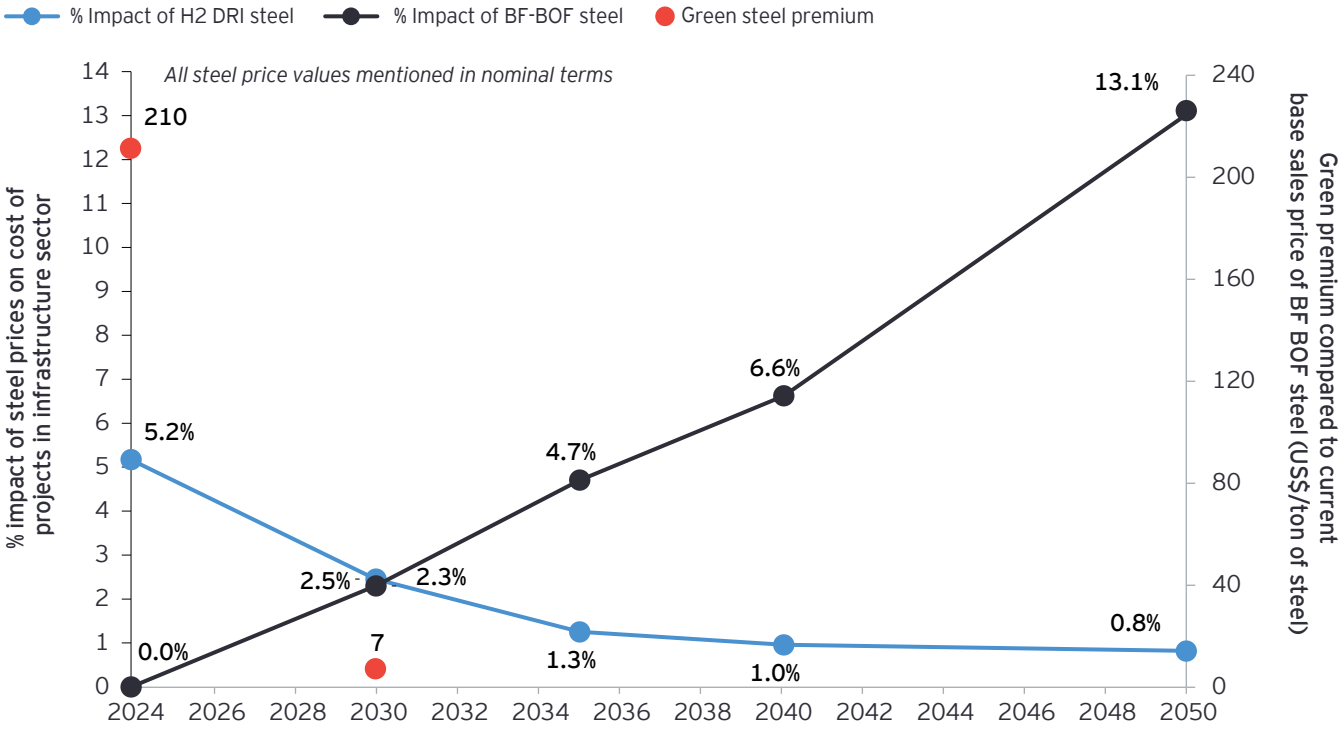
02 Inputs were taken on cost of constructing residential and commercial buildings per sq. ft., including steel consumption

03 Construction cost considered at average of residential and commercial buildings: INR4,170/sqft; weight of steel per sqft:6 kg

04 The analysis, considers an Indian carbon price of ~US$58/$tCO_2$ by 2030, ~US$115/$tCO_2$ by 2040 and ~US$229/$tCO_2$ by 2050; Current base sales price of steel for green steel premium comparison: US$660/ton

Currently, the use of H_2 DRI green steel increases infrastructure projects costs by approximately 5.2%. Steel, accounting for 5% to 20% of the value of an infrastructure project depending on its type, plays a crucial role in determining overall project expenses. At the present green steel premium of US$210 per ton, this results in a 5.2% cost increase for infrastructure developers. However, with the anticipated decline in green steel premiums, this cost increment is projected to reduce to about 1% by 2035 to 2040. By 2050, the figure shall reach around 0.8%. In contrast, continuing the use of BF-BOF steel beyond 2030 is expected to raise production costs by 5% to 13% in nominal terms, driven by rising carbon taxes and emissions-related penalties. This cost dynamic highlights the long-term economic and environmental advantages of adopting green steel, making it a viable solution for building sustainable and cost-efficient infrastructure.

Figure 10: Green steel premium and carbon tax impact on infrastructure production cost



Source: EYP Analysis

Key notes for the analysis

01 Inputs were taken from two prominent construction / infrastructure companies in India.

02 Infrastructure projects include roads, rail and metros, ports, airports for the analysis. The values mentioned are average of the impact of the four categories.

03 The analysis considers an Indian carbon price of ~US$58/$tCO_2$ by 2030, ~US$115/$tCO_2$ by 2040 and ~US$229/$tCO_2$ by 2050; Current base sales price of steel for green steel premium comparison: US$660/ton.

While the initial adoption of H_2 DRI green steel imposes a measurable cost premium across the automotive, construction and infrastructure sectors, the long-term trajectory is one of increasing cost parity and eventual advantage. The projected decline in green steel premiums, combined with the projected rising cost of carbon-intensive steel, shifts the balance in favor of green steel over the next decade. For industry stakeholders, this presents a compelling case for early investment and adoption, not just from an environmental standpoint, but also from a cost-competitiveness perspective. As green steel technologies mature and supply chains stabilize, it is poised to become the default material for sustainable development, enabling sectors to align with net zero targets without compromising on economic performance.

05 What is the impact of CBAM on the Indian steel industry?

The Carbon Border Adjustment Mechanism (CBAM) is a regulatory initiative by the European Union (EU), targeting carbon emissions embedded in imports across six sectors: steel, cement, aluminum, fertilizers, electricity and hydrogen. Designed to counter "carbon leakage"—where production relocates to countries with lenient carbon policies—CBAM imposes carbon pricing on imports from nations without equivalent emissions pricing and controls. For India's steel industry, this regulation intensifies export challenges, as it adds carbon costs to the EU market, demanding alignment with the EU's stringent carbon standards.

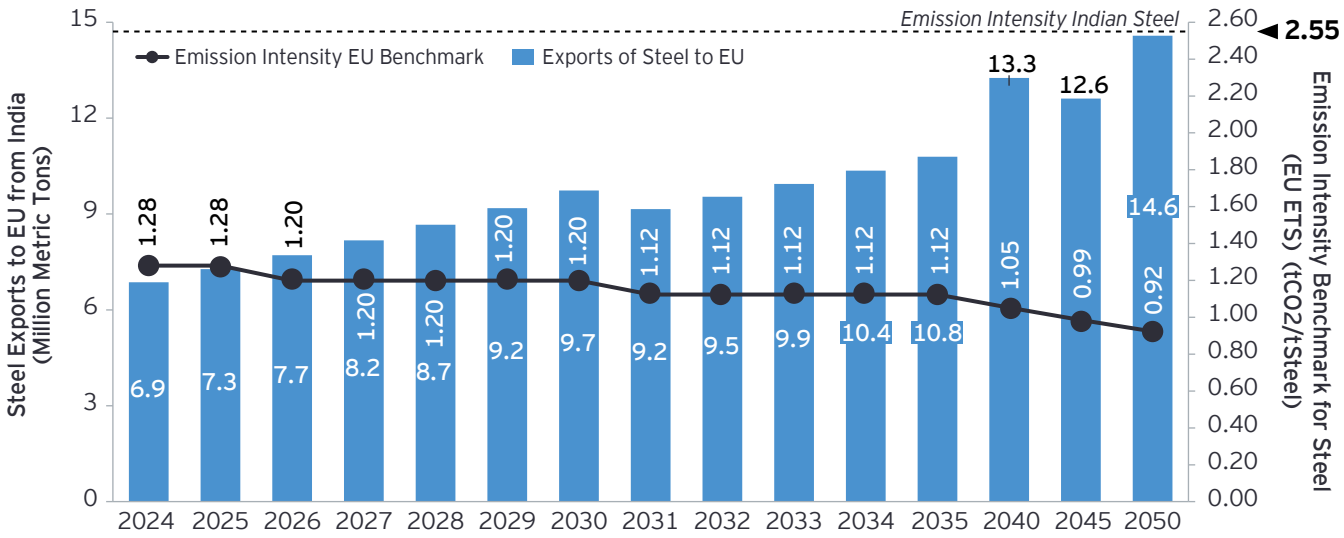
India's steel industry faces a notable emissions gap compared to the European Union's strict benchmarks, posing challenges for competitiveness under CBAM. The EU's emission intensity benchmark for steel (hot metal based), based on the average emissions of the top 10% of its most efficient facilities, is currently at 1.28 tons of CO_2 per ton of steel. In comparison, India's average emission intensity remains at 2.5 tons of CO_2 per ton, underscoring the decarbonization efforts required for Indian steel exports to the EU.

Based on HS Codes 72 and 73, currently, India exports approximately ~7 MMT of iron and steel and its products to the EU[3], with projections indicating growth to 10 MMT by 2030 and 15 MMT by 2050. However, the EU's emission intensity benchmark is anticipated to decrease further due to:

- **Year-on-year reductions in emissions:** The top 10 percentile of EU steel plants are continually lowering their emission intensities, setting a progressively stringent benchmark.
- **Structural reduction of free allowances:** The EU Emissions Trading System (ETS) and CBAM are aligned to gradually phase out free allowances, creating equal carbon costs for domestic and imported steel to encourage fair competition.

3. *Data from Ministry of Commerce and Industry*

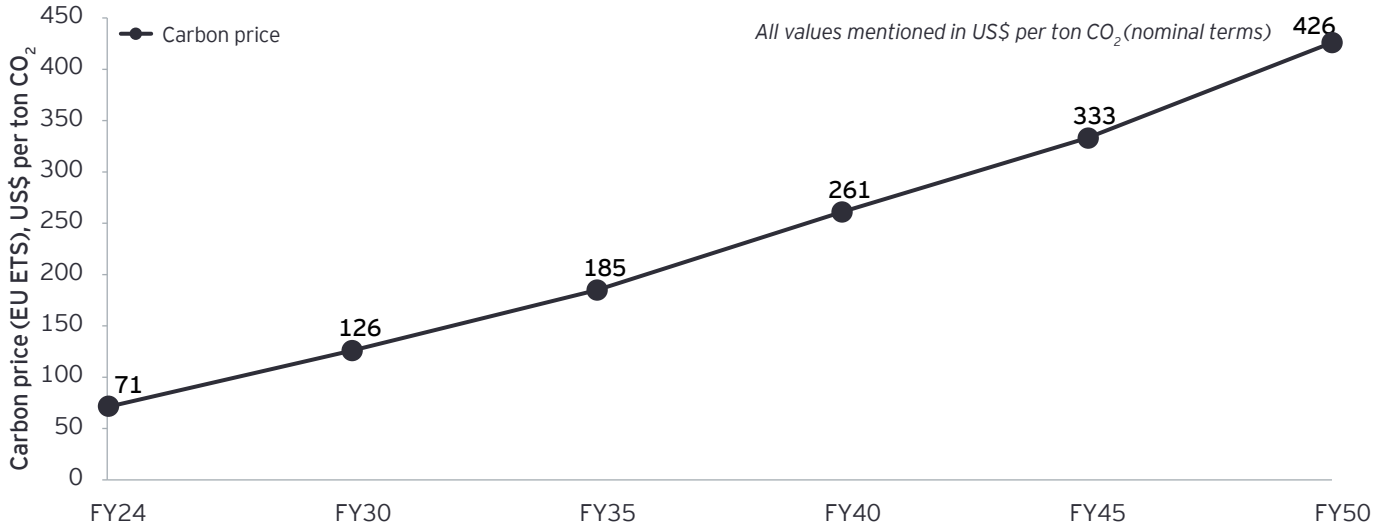
Figure 11: Steel emission intensity benchmarks and EU exports projections



Source: EYP Analysis

These factors imply that Indian producers aiming to increase exports to the EU will may need to adopt low-carbon technologies to meet evolving standards and manage potential carbon compliance costs effectively.

Figure 12: EU ETS carbon price projections

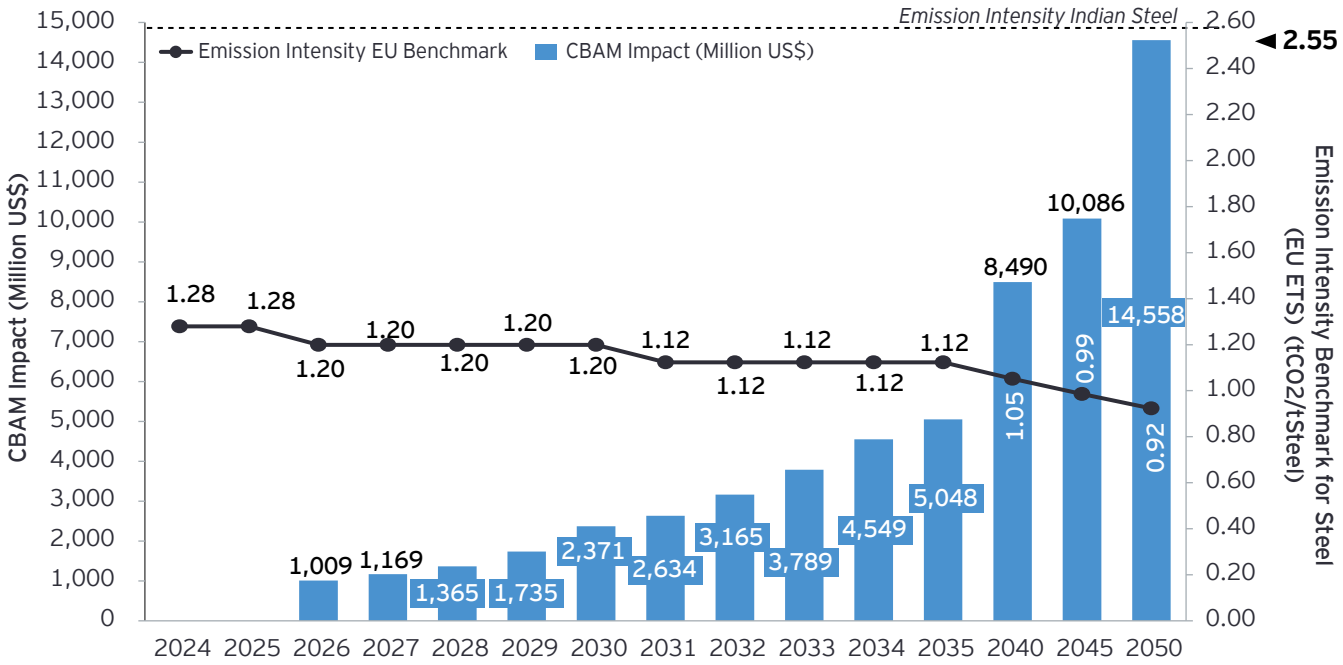


Source: EYP Analysis

Carbon pricing in the European Union currently stands at around US$71 per ton of CO emissions and is projected to increase significantly, reaching US$120 to US$130 per ton by 2030 and US$400 to US$450 per ton by 2050. This rise is driven by several factors:

- **Stringent carbon pricing norms:** The EU's progressive tightening of carbon regulations and annual increases in carbon prices aim to lower emissions across high-intensity sectors like steel.
- **Increasing demand for carbon allowances:** As more companies commit to net-zero targets, the demand for carbon allowances continues to grow. Since the implementation of low-carbon or clean technologies takes time, companies rely on carbon allowances in the interim to meet regulatory requirements, which adds upward pressure on prices.
- **Decreasing supply of emission allowances:** The EU plans to reduce the supply of allowances in the Emissions Trading System, intensifying competition and cost for compliance.

Figure 13: Impact of CBAM (Million US$)



Source: EYP Analysis

Key notes for the analysis

01 Projected decreasing EU emission intensity is based on average step reduction every five years.

Given the high emission intensity differential between Indian and EU steel, the tightening EU benchmarks, phased reduction of free allowances, and projected carbon pricing increase, the financial impact of CBAM on India's steel sector is expected to be substantial:

- **Projected cost impact:** The cost burden could reach US$1,009 million by 2026, increase to ~US$2,400 million by 2030, and further escalate to ~US$14,500 million by 2050.
- **Pressure on Indian steel exporters:** These rising costs create significant pressure on Indian steel producers to adopt low-emission technologies and align with EU standards to maintain export competitiveness.
- **Impact on EU importers:** Sectors in the EU that import large quantities of steel—such as construction, automobile, and infrastructure companies—will bear higher prices, affecting their supply chains and increasing overall project costs.

This highlights the necessity for Indian steel manufacturers to invest in carbon reduction strategies to mitigate long-term compliance costs and adapt to a more carbon-regulated trade landscape.

06 Policy mechanism for steel decarbonization in India

With carbon regulation tightening globally, notably through mechanisms like the European Union's Carbon Border Adjustment Mechanism (CBAM) and the United States' Inflation Reduction Act (IRA), Indian policymakers are increasingly discussing ways to advance decarbonization in the steel sector. CBAM, which effectively levies a carbon cost on high-emission imports into the EU, sets a clear signal for nations to adopt similar mechanisms to ensure competitiveness in carbon-regulated markets. This section explores potential policy mechanisms India could adopt to support steel decarbonization, focusing on the establishment of carbon pricing systems, incentives for low-carbon technology adoption, and mandates to encourage industry participation.

Carbon pricing mechanisms

Carbon pricing is emerging as a critical tool for incentivizing emissions reduction across high-emission industries like steel. These include:

- **Carbon Border Adjustment Mechanisms (CBAM):** Under CBAM, imports into the EU are taxed based on carbon emissions unless the originating country has an equivalent carbon tax. This approach encourages countries exporting to the EU to adopt carbon pricing mechanisms or risk facing additional tariffs. For India, implementing a carbon tax or carbon pricing mechanism would not only ease the financial impact of CBAM on steel exports but also create a consistent policy framework domestically.
- **Proposed Indian Carbon Credit Trading Scheme:** India is exploring its own carbon credit trading scheme, which would price carbon emissions and allow companies to trade carbon credits based on their emissions profile, meaning firms that emit less than their allocated carbon limit can sell excess credits, while those exceeding limits must buy credits to comply with regulations. This mechanism could help industries like steel (once included in the CCTS) offset some costs and fund decarbonization projects, as revenue from

selling surplus carbon credits can be used to mitigate compliance costs and invest in cleaner technologies.

- **Incentivize efficiency:** Companies exceeding emission standards would need to purchase credits, encouraging them to adopt efficient, low-emission processes.
- **Revenue generation for green projects:** Funds generated through this scheme could be allocated to support renewable energy, carbon capture and emissions reduction research.

Regulatory mandates for decarbonization

India could adopt regulatory mandates similar to those in the EU and U.S. to drive decarbonization in the steel sector. These include:

- **Emissions intensity targets:** Set emission intensity reduction targets, similar to the EU's top 10% benchmark, would pressure steel companies to adopt best practices and technologies.
  - **Sector-specific targets:** Define benchmarks for emission intensity based on international standards would make Indian steel more competitive globally.
  - **Mandated reporting and transparency:** Require companies to disclose emissions and energy consumption data, promoting accountability and allowing policymakers to track industry progress.
- **Renewable energy requirements:** Implement renewable energy mandates for large industrial producers would reduce fossil fuel dependency and lower carbon emissions.
  - **Examples:** Policies could mandate a percentage of renewable energy in operations, as seen in sectors impacted by CBAM and the IRA.
  - **Renewable purchase obligations: S**teel companies could be required to meet a portion of their energy demand through renewables, supported by state and central governments through incentives.

Green steel demand creation

India can adopt demand-side policies to create a robust market for green steel:

- **Green public procurement:** Governments can mandate the use of green steel in public infrastructure projects to create a stable demand.
  - **Minimum green steel quotas:** Set procurement targets for green steel in construction, transportation and defense projects, ensuring steady market growth.
  - **Green steel purchase agreements:** Long-term contracts between producers and government to ensure demand stability.

Financial incentives for low-carbon technology

Incentives are essential to accelerate adoption of cleaner technologies in the steel industry, given high upfront costs:

- **Capital Subsidies for Low-Carbon Technology:** Like the IRA of US, which provides tax credits for low-emission technology, India could subsidize initial investments in green steel technologies, such as:
  - **Electric Arc Furnaces (EAF):** A more efficient alternative to blast furnaces, EAFs can significantly reduce emissions.
  - **Hydrogen-based steelmaking:** Supporting pilot projects and R&D for hydrogen-based steelmaking could make India a leader in green steel.
- **Tax incentives and accelerated depreciation:** Providing tax relief for companies investing in low-carbon equipment and processes could enhance adoption rates.
- **Green bonds and financing options:** Issuing green bonds specifically for the steel industry could channel funds into renewable energy and emissions-reducing technology.
  - **Example:** The EU and China have successfully issued green bonds that provide low-interest financing for green infrastructure projects, and India could replicate this model to support steel decarbonization.

Aligning India's policy framework with global regulations

Global carbon regulations impact key Indian export sectors, creating a need for policy alignment to stay competitive:

- **Adopting CBAM-like mechanisms:** India could implement a CBAM-equivalent policy, placing a carbon cost on imported goods with high emissions. This approach would help protect domestic steel producers from international competition while encouraging carbon reduction.
    - **Impact on chemical and cement sectors:** In addition to steel, similar policies could impact other high-emission sectors like chemicals and cement, which are significant contributors to India's GDP and export revenue.

Case study: Green Hydrogen in the IRA: The Inflation Reduction Act of the US has prioritized green hydrogen production, offering substantial tax credits to incentivize low-carbon hydrogen technologies. This legislation is aimed at significantly reducing carbon emissions in the industrial sector, particularly in steelmaking, where hydrogen can replace traditional fossil fuels. India could adopt a similar approach by promoting green hydrogen initiatives, fostering partnerships with technology developers, and providing financial incentives for the development of hydrogen infrastructure to support cleaner steel production.

Collaborative industry-government initiatives

A collaborative approach involving both industry stakeholders and the government is vital for successful decarbonization:

- **Public-Private Partnerships for technology R&D:** Collaboration between government and industry in research and development could advance green steel technologies, such as carbon capture, utilization, and storage (CCUS).
- **Sectoral roadmaps and incentives:** Creating roadmaps with clear decarbonization milestones for each industry, along with financial and technical support, would guide companies on a structured path towards net zero emissions.
- **Industry-led standards:** Encouraging industries to develop voluntary emissions standards that could be later adopted as formal benchmarks, promoting proactive compliance and a smooth transition.

Strengthening India's position in global low-carbon markets

Decarbonization policies would position Indian steel as a competitive player in low-carbon global markets:

- **Export competitiveness in the EU:** With the EU applying CBAM, low-emission steel exports would avoid carbon costs, giving Indian steel companies a competitive edge.
- **Access to green funding:** International investors increasingly favor companies with strong ESG performance. A strong decarbonization policy would help Indian companies attract foreign investment, further bolstering the domestic steel sector.

To remain competitive and align with international carbon standards, India's steel sector must adopt a multifaceted decarbonization strategy. A comprehensive policy mechanism that incorporates carbon pricing, mandates and incentives will ensure that India's steel industry can transition to lower emissions and retain its market share globally.

07 Recommendations

The decarbonization of the Indian steel sector is imperative not only for meeting domestic climate commitments but also for enhancing international competitiveness, particularly in light of global initiatives such as the European Union's Carbon Border Adjustment Mechanism (CBAM). To achieve meaningful reductions in emissions while accommodating projected increases in steel demand, a multifaceted approach is necessary. Below are strategic recommendations aimed at fostering the transition to a sustainable steel industry in India.

Recommendations to government

- **Incentivizing green steel production:** Provide subsidies and tax breaks for green steel production technologies, such as H_2 DRI and electric arc furnaces powered by renewables, to reduce the green steel premium to US$7/ton by 2030 compared to the current US$210/ton.
- **Enhance export competitiveness:** Offer financial support and incentives for steel producers to meet EU emission benchmarks, reducing emission intensity from 2.55 tons of CO_2 per ton of steel to 1.20 tons by 2030.
- **Carbon pricing mechanism:** Implement a carbon pricing mechanism, with carbon price cost of US$90 to US$100 by 2040, to internalize the external costs of carbon emissions and encourage industries to adopt low-carbon technologies and practices.

Recommendations to the industry

- **Adopting low-emission technologies:** Transition to low-emission technologies to meet EU benchmarks and maintain export competitiveness, aiming to reduce emission intensity from 2.5 tons of CO_2 per ton of steel to 1.21 tons by 2030.
- **Increase green steel production:** Scale up green steel production to meet the projected demand of 179.17 million tons by FY50, focusing on H_2 DRI and other innovative production routes to bridge the supply-demand gap.
- **Investing in R&D:** Allocate resources for research and development to innovate and improve green steel production technologies, with the goal of reducing green steel production costs by 30% by 2040.
- **Adoption of cost-saving emission reduction technologies:** Implement energy efficiency and process reconfiguration measures based on "in the money" technologies for cost savings, with banks investing US$72 to US$108 billion to support these efforts.

Recommendations to end-use sectors

- **Green steel procurement:** Encourage the automotive sector to start procuring green steel 10 years ahead of their net zero targets and increase procurement by 10% y-o-y, while construction and infrastructure companies should adopt a certain percentage of green steel in their operations.
- **Willingness to pay premium:** Advocate for the adoption of green steel despite a minor production cost increase of just 3.7% to 5.2% in automobile, construction and infrastructure sectors, emphasizing the environmental benefits and long-term value.
- **Adopt green steel across all projects:** Promote the use of green steel in all types of projects, aiming to meet the projected demand of 179.17 million tons by FY50, to reduce the overall carbon footprint and advance sustainable practices. Green steel can be adopted in green building projects in construction sector.
- **Collaborate with the suppliers:** Work closely with steel suppliers to ensure a steady green steel supply and negotiate favorable terms, facilitating cost management and availability for all projects.

Decarbonizing the Indian steel sector presents both challenges and opportunities. By implementing a comprehensive set of recommendations that encompass policy frameworks, technological advancements, financial incentives and collaborative efforts, India can position itself as a leader in sustainable steel production. The transition to green steel is not only a necessity in light of global carbon reduction mandates but also a strategic opportunity to drive economic growth and secure India's role in the global steel market. With proactive measures and a commitment to innovation, India can successfully navigate the path towards a sustainable and resilient steel industry.

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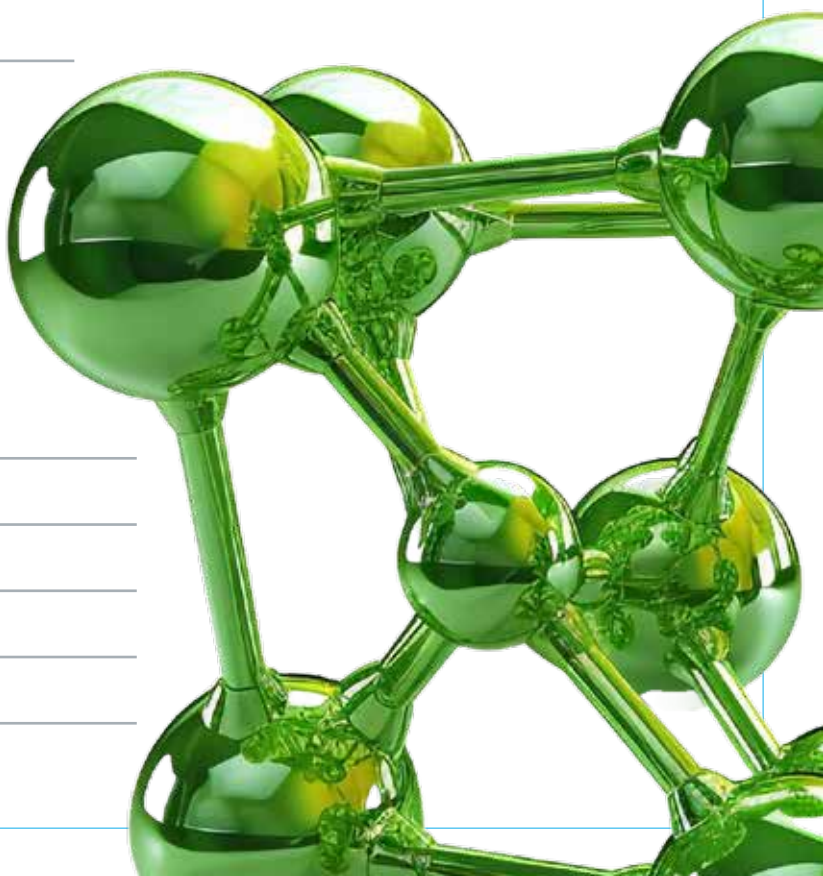

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About India Green Steel Coalition

The India Green Steel Coalition (IGSC) is a joint initiative of WWF-India and the Confederation of Indian Industry (CII) to accelerate the transition to green steel manufacturing and consumption in India. IGSC aims to reduce the emissions intensity of India's steel production by 30% compared to 2023 levels by 2030.

As a multi-stakeholder platform representing ~70% of India's crude steel production, IGSC brings together primary and secondary producers, alongside demand-side players to drive sustainable transformation in this hard to abate sector. IGSC supports industry dialogue through technical reports, capacity building sessions, actions groups on key topics like: renewable energy cluster development for steel sector, and Carbon, Capture & Utilization (CCU); and international expert involvement through WWF network offices.

By addressing key transition challenges and fostering industry-wide collaboration, IGSC will actively engage with policymakers to shape an enabling environment for decarbonization while supporting India's goal of increasing domestic steel production sustainably.

About WWF-India

WWF-India is a science-based organization which addresses issues such as the conservation of species and its habitats, climate change, water and ecological footprint. Over the years, its perspective has broadened to reflect a more holistic understanding of the various conservation issues facing the country and seeks to proactively encourage environmental conservation by working with different stakeholders - Governments, NGOs, corporates and other relevant stakeholders. WWF-India acknowledges the strong linkages of industry's ecological footprint and its impact on nature and biodiversity. Hence, we collaborate with industry partners to addressing such challenges and working on solutions that promote carbon mitigation and adaptation solution. On the similar lines, WWF-India conceptualized India Green Steel Coalition under its "Decarbonization of Steel Sector in India' program that supports Indian Steel Industry to adapt to changing international regulations and standards.

About WWF Finland

WWF Finland is part of the global WWF network that has offices in about 50 countries and operations in over one hundred countries. WWF Finland was established in 1972 and is now the most recognized environmental NGO in Finland. Alongside domestic conservation projects, WWF Finland is working with WWF partners in Asia, Africa and South America. WWF Finland is hosting the WWF global Steel Decarbonisation Workstream.

About CII- GBC

The CII – Sohrabji Godrej Green Business Centre (CII – GBC) is CII's Developmental Institute for Green Practices and Businesses, focused on offering world-class advisory services dedicated to the conservaBAMtion of natural resources. Its mission is to help India emerge as a global leader in green business by 2030.

The Centre promotes sustainable practices and supports businesses through a comprehensive range of services, including Green Buildings, Energy Management Initiatives, Energy Efficiency Initiatives, GreenPro Certification, GreenCo Rating System, Green Entrepreneurship Council (GEC), Solar Vendor Rating Program (VRP) etc.

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