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ISA Steel InfraBuild Summit 2023

Unlocking steel potential in the
Indian building, construction and
infrastructure sectors

September 2023

the 1990s, the number of people in the world who are under 15 years of age is expected to increase from 1.1 billion to 1.5 billion.

As the world's population grows, the demand for food and other resources will increase. This will put pressure on the environment and on the world's food supply.

One of the ways to meet this demand is to increase the efficiency of food production. This can be done by using better farming techniques and by using more resources.

Another way to meet this demand is to reduce the amount of food that is wasted. This can be done by using food more efficiently and by reducing the amount of food that is thrown away.

There are many other ways to meet this demand, and it is important that we find ways to do so. This will help to ensure that everyone has enough to eat and that the environment is protected.

One of the most important things we can do is to make sure that we are using resources in a sustainable way. This means that we are using resources in a way that does not harm the environment and that we are able to use them for generations to come.

There are many other things we can do to help meet the world's growing demand for food and other resources. It is important that we all do our part to help make the world a better place for everyone.

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Executive summary

The steel industry has been one of the pillars of the Indian economic growth story. India has emerged as a global hub for the steel sector and taken significant steps towards becoming self-reliant in manufacturing activities, including the steel industry. India is currently the second-largest steel producer and consumer in the world.¹ It is poised for further growth, backed by the rapid economic development and government push towards strengthening the steel industry. India has targeted to achieve 300 million tonnes (MT) of crude steel capacity by FY31² and 500 MT by 2047.³ With scope for greater economies of scale and penetration in value-added special steel products, the next 25 years seem promising for the Indian steel industry.

The Indian per capita consumption of steel is about 78 kg,⁴ whereas the global average is about 233 kg.⁵ These numbers suggest that there is significant scope to increase per capita steel consumption and therefore, steel demand in the country. According to the current scenario, the majority share of domestic consumption can be attributed to the building, construction, and infrastructure sectors. These sectors are expected to demonstrate strong growth in the future and can propel Indian finished steel consumption to 230 MT in FY31.⁶ This knowledge report focuses on opportunities, challenges, and key interventions to unlock steel potential in these sectors.

Uttar Pradesh has been chosen as a destination for this summit due to its significant potential in terms of steel consumption. It has one of the highest populations in the country and a relatively lower per capita steel consumption. The government is investing heavily in development projects and the Y-o-Y steel consumption growth in FY23 was double to that of India.

Domestic steel industry scenario:

India's crude steel production grew at a Compounded Annual Growth Rate (CAGR) of 7.2 percent from 2000 to 2022.⁷ India produced 125.32 MT crude steel in FY23,⁸ registering a 4.2 percent Y-o-Y growth, whereas most steel producing countries showed a decline. The key drivers for steel demand include growth of the infrastructure sector (rail, airports, ships, bridges, and pipelines), growth of the housing sector (both urban and rural), growth of commercial real estate, and growth in the automobile and capital goods sector. Of the 120 MT⁹ of steel consumed in FY23, the building, construction and infrastructure sectors contributed about 83 MT.¹⁰ India is also a net exporter of steel with an export of 6.7 MT and import of 6.02 MT in FY23.¹¹

Building, construction, and infrastructure sector scenario:

The building, construction, and infrastructure sectors account for 65-70 percent of the total demand.¹² Except the disruption caused by Covid-19 in FY21, steel consumption within these sectors consistently increased over the past four years, achieving a CAGR of 4.5 percent.¹³ The expected growth trajectory for these sectors indicates an anticipated rise of 5-6 percent in demand for building and construction and 8-10 percent for infrastructure until FY25.¹⁴ Forecasts suggest that by FY31, the total finished steel consumption is expected to reach 230 MT,¹⁵ with about 153 MT¹⁶ attributable to these sectors. Demand drivers for this sector include urban housing, rural housing, industrial construction, commercial real estate, and infrastructure projects being implemented by the government. The building, construction and infrastructure sectors have a limited import of steel as domestic steel players are capable of meeting the demand.

¹World Steel Association

²National Steel Policy, 2017

³Deloitte Steel Outlook 2030-2047

⁴<http://www.cidc.in/support/ICM%202023/Steel.pdf>

⁵<http://www.cidc.in/support/ICM%202023/Steel.pdf>

⁶<http://www.cidc.in/support/ICM%202023/Steel.pdf>

⁷<https://www2.deloitte.com/in/en/pages/about-deloitte/articles/India-steel-2023.html>

⁸Ministry of Steel, Monthly report March 2023

⁹Ministry of Steel, Monthly report March 2023

¹⁰Industry interviews

¹¹<https://www.ibef.org/industry/steel>

¹²Industry interviews

¹³Deloitte analysis

¹⁴ISA Knowledge Report 2021

¹⁵<http://www.cidc.in/support/ICM%202023/Steel.pdf>

¹⁶<http://www.cidc.in/support/ICM%202023/Steel.pdf>

¹⁷<https://www.macrotrends.net/countries/IND/india/urban-population#:~:text=India%20urban%20population%20for%202022,a%202.34%25%20increase%20from%202018.>

¹⁸<https://pib.gov.in/PressReleasePage.aspx?PRID=1754499>

Focus areas to increase steel use:

At present, about 36 percent of India's population resides in urban areas.¹⁷ By 2030, urban population is expected to contribute about 75 percent to the GDP.¹⁸ Therefore, increasing steel use in this segment will boost the demand significantly. The potential demand areas in urban housing include steel-based buildings, bridges, steel reinforced pavements and roads, pre-engineered buildings, crash barriers, transit buildings, solar rooftop panels, and steel pipes for water and sewerage transportation.

The rural population accounts for about 64 percent of the population and per capita steel consumption is only 21 kg¹⁹ (about 1/10th of the urban consumption). The scope to increase per capita consumption in the rural segment, is significant. The potential applications can be steel structures for rural houses and public facilities (Anganwadi, bio toilet, public library, etc), steel-based grain silos and cold storage, warehouses, steel pipes for irrigation, metal roofing, steel doors and windows, farm equipment, etc. However, rural areas face certain challenges (awareness, affordability, availability, and skillsets) in the adoption of steel. Steel producers and government bodies need to make collaborative efforts to address these challenges.

Policies to boost demand growth:

The Indian government has already taken several initiatives in the housing and infrastructure to increase domestic steel consumption. The notable government schemes include PMAY (urban and gramian), AMRUT, Smart Cities Mission, National Infrastructure Pipeline, Sagarmala, Bharatmala, DFC, UDAN, and Jal Jeevan Mission. These government schemes are expected to generate 90–100 MT of the steel by FY30.²⁰

However, there are further avenues to increase per capita steel consumption and thus, enhance the total national steel demand. The government may consider the following focus areas while developing future policies.

- Promoting development of steel-based buildings and structures
- Promoting steel-based bridges
- Compare Life Cycle Cost (LCC) for the selection of construction material during government infrastructure projects
- Provide tax incentives based on the carbon footprint of the developed buildings/structures
- Develop detailed standards for steel-specific structures
- Ensure availability of fire-resistant steel
- Develop skills to ensure availability of fabricators and mechanics

- Build awareness about steel use and its benefits
- Provide Performance Linked Incentives (PLI) for steel used in the building, construction, and infrastructure sectors

Focusing on sustainability and circularity:

Sustainability in construction entails strategically minimising environmental impact and ensuring optimal utilisation of construction material to reduce future raw material consumption. Although alternative construction materials to steel such as wood, cement, aluminium, and FRPs (Fiber Reinforced Polymers) are available, their suitability needs to be evaluated based on their total life cycle. Using steel in the building, construction and infrastructure sectors can significantly enhance circularity due to the following factors:

- Recyclability and reusability
- Design flexibility and adaptability
- Efficient manufacturing and reduced waste
- Longevity and durability
- Energy and emission savings

The government has already introduced policy measures to promote sustainability in the steel industry. Some of these measures are Steel Scrap Policy 2019, Waste Management Rules, and Green Building initiatives. Future initiatives that may be taken up for the building and construction and infrastructure sectors include developing energy-efficient designs, green-building certifications, and use of Building Information Modelling (BIM) to reduce wastage and prioritise construction materials on the basis of life cycle cost. To promote the sustainable use of construction materials, the government may focus on policies such as considering LCC in the project planning stage, modifying General Financial Rules (GFR) 2017, and providing tax incentives to buildings made of circular materials.

With the support of these schemes and measures, steel consumption in the building, construction, and infrastructure sectors can significantly increase in the next few years. These sectors will account for the primary share of demand in FY31. As the government is already working on several transformational initiatives, special focus may be provided on advocating new applications for steel, promoting sustainable practices, developing the required skillsets, and deliberating on the policies that will determine the future landscape of the steel industry in India. Therefore, key stakeholders from the government and the industry must collaborate to understand challenges, identify opportunities, and work towards a common goal for the overall development of the nation.

¹⁹<http://www.cidc.in/support/ICM%202023/Steel.pdf>

²⁰Deloitte analysis



About ISA Steel InfraBuild Summit

The Indian Steel Association (ISA) is the voice of India's robust and growing steel industry. ISA came to life to create a conducive environment for steel production in the country and has since worked towards representing the interests of the Indian steel ecosystem both nationally and at international forums. Its members together account for 65 percent of crude steel production in India. ISA's vision is to "work towards transforming the Indian steel industry into a global leader." It aims to achieve this by facilitating discussions on key issues, challenges, and opportunities related to the Indian steel industry and the entire gamut of issues related to steel making, steel consumption, and steel usage.

Steel, often referred to as the backbone of modern civilisation, is a testimony to human innovation and resilience. It has been

instrumental in shaping our cities, our infrastructure, and our industries. Due to its strong flexibility and adaptable versatility, steel has become the choice of many architects and builders. The focus today in infrastructure projects is not only to choose a material that is versatile and safe but at the same time considers its sustainability aspects, cost-effectiveness over its life cycle, and reduced time of completion for early benefits and lower social cost.

To unlock this potential of steel and transform the construction and infrastructure landscape in India, the Indian Steel Association (ISA) plans to organise the ISA Steel InfraBuild Summit in key cities across India. The summit will serve as a platform for stakeholders to explore the latest trends and developments in the construction and infrastructure sectors and promote the use of steel in these sectors.

This year, ISA plans to conduct its inaugural ISA Steel InfraBuild Summit on the theme “Transforming Construction and Infra Landscape,” at Lucknow, Uttar Pradesh. This topic is particularly relevant in the current context as both sectors are expected to demonstrate strong growth in the future. This growth will be backed by the economic development focus and infrastructural spending by the government. This growth can help boost domestic steel consumption, thus helping to achieve the 300 MT

steel production capacity by FY31 as envisioned in National Steel Policy 2017.

Deloitte has developed this report for the ISA Steel InfraBuild Summit. The report shares a holistic perspective of opportunities in the building, construction, and infrastructure sectors, along with the challenges and key government support needed to boost steel demand.

Prospects of Uttar Pradesh for steel consumption growth

Uttar Pradesh is one of the largest Indian states and home to about 23.5 crore people.²¹ Its economy has been developing rapidly and ranks third in terms of Gross State Domestic Product (GSDP) amongst Indian states. The state's Gross State Domestic Product (GSDP) for FY23 was INR 20,48,234 crore (showing growth of ~10 percent from FY22). GSDP is expected to grow at 19 percent in FY24 to reach INR 24,39,171 crore.²²

The economy of Uttar Pradesh is a dynamic one as it reflects a blend of agriculture, industry, services, and cultural legacy. Due to its enormous potential in developing sectors and ongoing development projects, the state is crucial in determining the economic landscape of India; these factors offer prospects for long-term economic growth.

The UP economy is also important for the steel industry. India's steel consumption increased from 106 MT in FY22 to 120 MT in FY23.²³ Therefore, India showed 13.2 percent Y-o-Y increase in domestic consumption. For Uttar Pradesh, FY22 steel dispatch was 7.605 MT and FY23 dispatch was 9.621 MT.²⁴ Therefore, Uttar Pradesh's Y-o-Y steel consumption growth was 26.5 percent, which is almost double of India's growth. Therefore, Uttar Pradesh is a promising destination for the steel industry.

The state government has also been playing an active role in boosting the demand in the steel industry. According to the allocation made in the state budget of FY24, a total of INR 99,634 crore has been earmarked²⁵ for infrastructural, rural, and urban development. Under the Pradhan Mantri Awas Yojana (Grameen), 12,39,877 houses are targeted for construction in FY24. This allocation is poised to further stimulate the overall

demand for steel as these development projects are expected to improve per capita steel consumption.

Yamuna Expressway Industrial Development Authority (YEIDA), Greater Noida Development Authority, and Noida Development Authority have been created under UP Industrial Act of 1976, to promote the systematic development of the state. Uttar Pradesh State Industrial Development Authority (UPSIDA) is the nodal agency in the state mandated for organised industrial development. UPSIDA plays a pivotal role in fostering industrial growth in the state. The implementation of the following major projects by UPSIDA is poised to drive significant industrial growth, consequently resulting in substantial surge in steel consumption:

- Trans Ganga City, Unnao
- Saraswati Hi-Tech City, Prayagraj
- Flatted Factory, Surajpur
- Industrial Area Dibiyaapur, Auraiya
- Integrated Manufacturing Cluster, Agra

In the next few years, Uttar Pradesh's steel demand is anticipated to increase significantly. The focus on steel-intensive projects is evident with ambitious initiatives, such as creation of industrial corridors and smart cities, and upgraded transportation networks. The importance of steel as a fundamental building material is pivotal to the growth story of Uttar Pradesh as the state concentrates on developing its industrial and infrastructure environment.

²¹<https://www.populationu.com/in/uttar-pradesh-population#:~:text=Uttar%20Pradesh%20population%20in%202023,%2C%20updated%2031%2C%20March%202022.>

²²Annual Budget of Uttar Pradesh Government FY 2023-24

²³ISA

²⁴ISA

²⁵prindia.org/budgets/states/uttar-pradesh-budget-analysis-2023-24



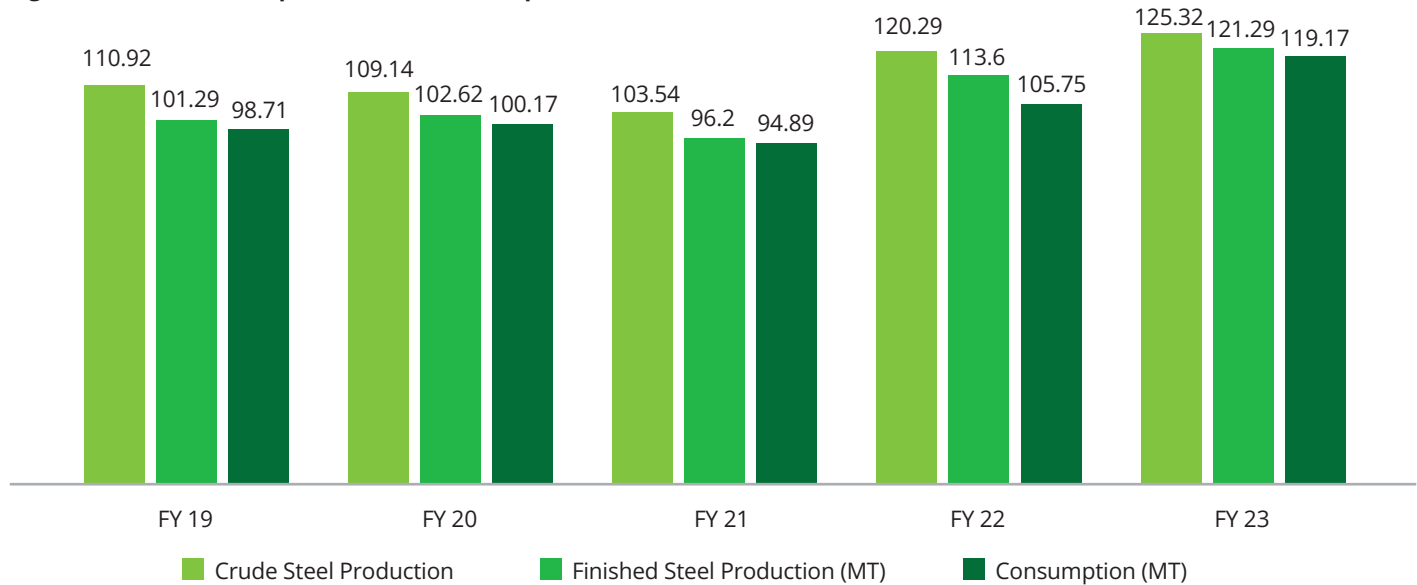
Overview of the Indian steel industry

India is the second-largest producer and consumer of crude steel globally with 125.32 MT of crude steel production in FY23,²⁶ registering an increase of ~4.2 percent compared with 120.29 MT in FY22. India's crude steel production grew at a CAGR of 7.2

percent from 2000 to 2022,²⁷ except for a Covid-related decline in FY21. India's crude steel production, finished steel production, and consumption is shown in Figure 1.

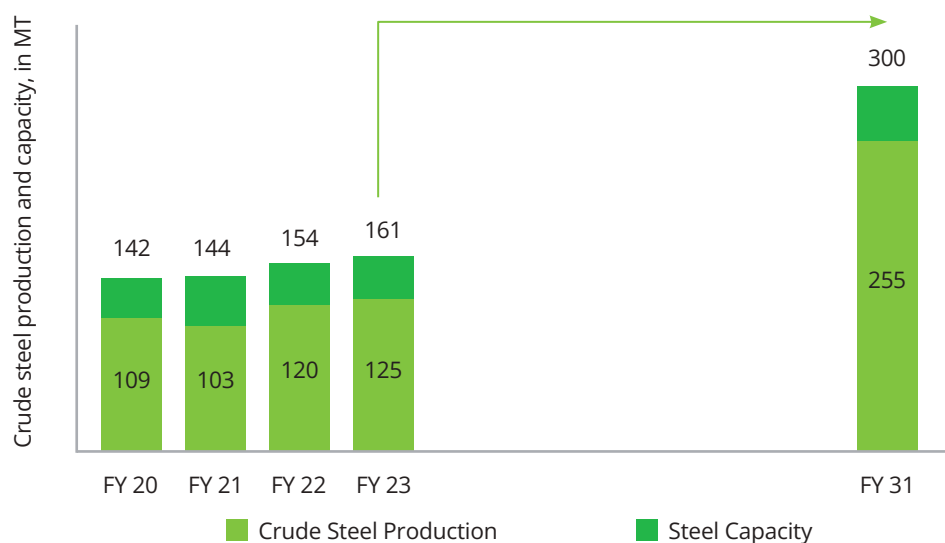
²⁶Ministry of Steel, Monthly report March 2023

²⁷<https://www2.deloitte.com/in/en/pages/about-deloitte/articles/India-steel-2023.html>

Figure 1: Domestic steel production vs consumption


Source: Monthly summary on iron and steel Mar 23, Ministry of Steel

National Steel Policy, 2017 projected the Indian crude steel capacity as 300 MT at the end of FY31. This implies that the crude steel capacity is expected to grow at a CAGR of 8.1 percent between FY23 and FY31 as shown in Figure 2.

Figure 2: India steel production and capacity projection


Source: PIB and JPC

Growth drivers for the Indian steel sector

The rapid infrastructure development in India, along with the increasing population and urbanisation, has led to a rise in demand for steel products. In the past 10–12 years, India's steel sector significantly expanded driven by strong local demand.

Production increased by 75 percent since 2008,²⁸ while domestic steel demand expanded by almost 80 percent.²⁹ The ability to produce steel has also risen simultaneously, and the expansion has been largely organic.

²⁸<https://www.ibef.org/industry/steel>

²⁹<https://www.ibef.org/industry/steel>

Key demand drivers for domestic steel consumption are shown below:

- **Infrastructure sector**

The sector focuses on the development and expansion of airports, rail networks, fuel transportation pipelines, power generation and transmission lines, roads, and bridges. This sector is largely driven by government spending. According to Economic Survey 2018, about INR 4.5 trillion³⁰ of investments are required until 2040 to develop infrastructure. Economic Survey 2019-20 indicates that India needs to spend about US\$ 1.4 trillion³¹ or about INR 110 lakh crore over the next five years on infrastructure to become a US\$ 5 trillion economy.

- **Building and construction sector**

The sector focuses on the development of urban housing, rural housing, commercial real estate, and industrial construction (warehouses, data centres, etc.). At present, about 29 percent³² of the steel demand in the country is in real estate constituting residential, commercial, and institutional buildings. However, the market share of steel frame-based construction is lower than 10 percent; for the developed nation, the share is as high as 80 percent.³³

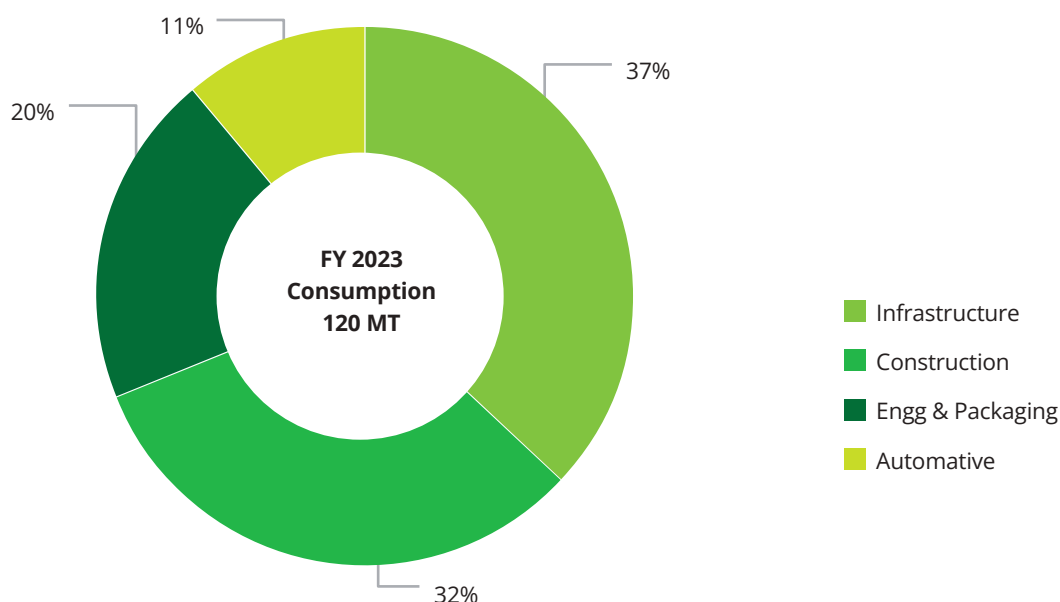
- **Automobile sector**

As a result of the rapid urbanisation and increased per capita income, this sector has been growing consistently. The sector's contribution to national GDP reached about 7.1 percent in FY23 from 2.77 percent in 1992-93.³⁴ The total export of automobiles grew by 35.9 percent in FY22.³⁵ Being the largest two- and three-wheel manufacturer in the world, the sector aims to double its size to INR 15 lakh crore by end-2024.³⁶ The automobile sector is anticipated to undergo substantial growth over the next 10 years.

- **Engineering and packaging sector**

It includes capital goods, consumer durables, general engineering products, electrical goods, etc. The sector is expected to grow by 10-12 percent in FY24.³⁷ About US\$ 112 billion³⁸ of capital goods are expected to be produced by 2025. This sector is expected to have a significant share of ~21 percent in the total finished steel consumption of India by FY31.³⁹

Figure 3: Steel demand by sector in FY23



Source: Industry Interviews

³⁰<https://economictimes.indiatimes.com/news/economy/infrastructure/india-will-need-usd-4-5-trillion-till-2040-for-infra-development-amitabh-kant/articleshow/66445530.cms?from=mdr>

³¹https://www.indiabudget.gov.in/economicsurvey/doc/vol2chapter/echap08_vol2.pdf

³²<http://www.cidc.in/support/ICM%202023/Steel.pdf>

³³<http://www.cidc.in/support/ICM%202023/Steel.pdf>

³⁴Research unit, PIB Ministry of Information & Broadcasting, Feb 2023

³⁵Research unit, PIB Ministry of Information & Broadcasting, Feb 2023

³⁶Research unit, PIB Ministry of Information & Broadcasting, Feb 2023

³⁷<https://indbiz.gov.in/capital-goods-sector-to-grow-by-16-18-in-fy24-crisil/>

³⁸<https://www.investindia.gov.in/sector/capital-goods>

³⁹<http://www.cidc.in/support/ICM%202023/Steel.pdf>

In FY 2019, domestic steel consumption was 98.71 MT.⁴⁰ Notably, the construction sector accounted for about 43 percent of this overall demand, while the infrastructure sector contributed about 25 percent.⁴¹ Together, these sectors drove a combined consumption of about 67 MT (i.e., 68 percent of the total demand).

Looking ahead to FY23, the demand surged significantly in both infrastructure and construction domains, reaching a combined total of about 81–83 MT⁴² of the overall 120 MT of steel consumed (i.e., 68–69 percent). Therefore, the combined share of these sectors remained unchanged as the pre-Covid era. However, Covid-19 affected the housing and real estate sector. As a result, steel

demand from the building and construction sector grew at a slower pace than the infrastructure sector.

In FY23, steel demand from the building and construction sector was estimated at 42–44 MT⁴³ (about 35–37 percent of the total consumption). On the other hand, steel demand from the infrastructure sector was 36–38 MT⁴⁴ (about 30–32 percent of the total consumption). Thus, steel demand from infrastructure rose from 25 percent in FY19 to 31 percent in FY23. This shift is primarily attributed to the government's unwavering commitment to implement infrastructure development projects across India.



⁴⁰Monthly reports of iron and steel

⁴¹Industry interviews

⁴²Industry interviews

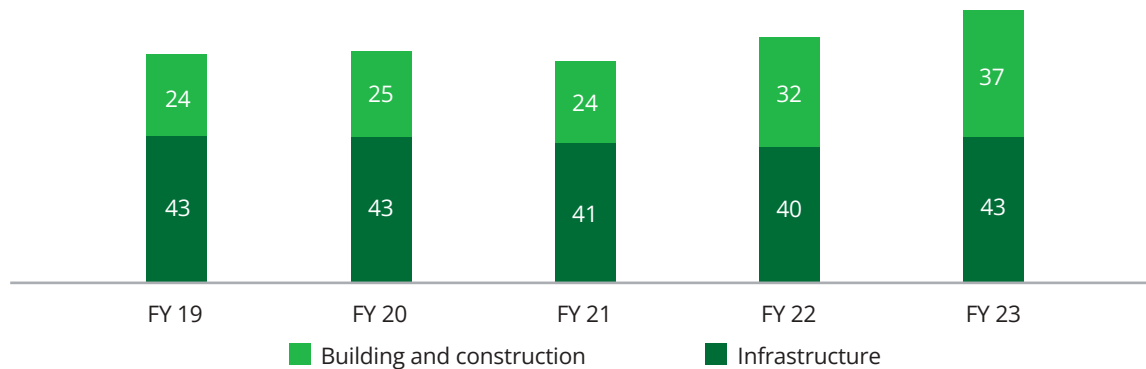
⁴³Industry interviews

⁴⁴Industry interviews



Key trends in the building, construction and infrastructure sectors

Except the disruption caused by Covid-19 in FY21, steel consumption within the building, construction and infrastructure sectors increased consistently over the past four years, at a CAGR of 4.5 percent.

Figure 4: Historical steel consumption in the building, construction, and infrastructure sectors (in MT)

Source: PIB and Primary Research

Key demand drivers

These sectors foresee demand growth of 5-6 percent for building and construction and 8-10 percent for infrastructure until FY 2025.⁴⁹ This steep increase in demand is propelled by several key factors mentioned below:

- **Rapid urbanisation**

The development of tier-II and tier-III cities and smart cities, rapid population growth, changing nuclear family dynamics, and the replacement of makeshift shelters through government programmes, will collectively contribute to this growth. By 2030, the urban population in India should be about 630 million;⁵⁰ 75 percent of the GDP⁵¹ will come from urban areas.

- **Real estate growth**

This involves expanding industrial, residential, and commercial construction, and promoting affordable housing and urban development initiatives. India's real estate sector is expected to touch a US\$ 1 trillion⁵² market size by 2030, accounting for 18-20 percent of India's GDP. Real estate demand for data centres is expected to increase by 15-18 million sq. ft. by 2025.⁵³ Urban housing will be significantly driven by the thriving expansion

of affordable urban housing and the increasing trend of constructing high-rise buildings in tier-II and tier-III cities. Rural housing growth will be driven by government-led initiatives aimed at upgrading kutchha houses to concrete structures. Enhanced rural area connectivity will play a crucial role in boosting steel consumption.

- **Government infrastructure spending**

According to the National Infrastructure Pipeline, about INR 1.5 lakh⁵⁴ crore of infrastructure projects will be implemented in the next few years. The government's budget support for road infrastructure rapidly increased, reaching about INR 1.4 lakh crore⁵⁵ in FY23. Capital expenditure on railway infrastructure steadily increased over the past four years, with a budget of INR 2.5 lakh⁵⁶ crore allocated in FY23. The railway sector is also poised for growth, driven by governmental plans for railway network expansion, alleviation of freight line congestion, expansion of metro systems, and initiation of high-speed rail projects. The number of airports with civilian flights doubled in the past nine years, from 74 in 2014 to 148 in 2023.⁵⁷

Current import trends

A majority of Indian imports consist of flat steel products, making up 92 percent⁵⁸ of the total imports in FY23. The import of long products is insignificant; and the building, construction, and infrastructure sectors mainly use long products. Therefore, these sectors have a limited import of steel. Almost all the products are

available within the country and produced by integrated steel players and smaller players. A small amount of steel is imported by projects located in coastal areas (due to lower landed cost of imported steel in coastal areas).

⁴⁹ISA Knowledge Report 2021

⁵⁰<https://pib.gov.in/PressReleasePage.aspx?PRID=1754499>

⁵¹<https://pib.gov.in/PressReleasePage.aspx?PRID=1754499>

⁵²<https://www.ibef.org/industry/real-estate-india>

⁵³<https://www.ibef.org/industry/real-estate-india>

⁵⁴<https://indiainvestmentgrid.gov.in/national-infrastructure-pipeline>

⁵⁵<https://pib.gov.in/FeaturesDeatils.aspx?NotelId=151518&ModuleId%20=%202>

⁵⁶<https://pib.gov.in/FeaturesDeatils.aspx?NotelId=151518&ModuleId%20=%202>

⁵⁷<https://pib.gov.in/FeaturesDeatils.aspx?NotelId=151518&ModuleId%20=%202>

⁵⁸https://jpcindiansteel.nic.in/writereaddata/files/Trend%20Report%20May%202023_3.pdf

Portfolio of major producers

The top six integrated steel producers (JSPL, JSW, Tata Steel, SAIL, AMNS, and RINL) collectively contribute about 57 percent to the overall production of finished steel.⁵⁹ In FY23, JSW (19.3 MT), Tata Steel (19.5 MT), and SAIL (15.3 MT) emerged as the top producers of finished steel.⁶⁰ Following closely are JSPL, AMNS, and RINL, contributing 5.4 MT, 6.7 MT, and 3.6 MT⁶¹ to finished steel, respectively.

As mentioned previously, the building, construction, and infrastructure sectors predominantly rely on long steel products. Long products encompass classifications such as bars and rods, rebars, merchant bars, wire rods, and railway materials. These

items are typically manufactured by subjecting blooms/billets to hot rolling or forging processes to achieve practical shapes and dimensions.

The market for long steel products in India is characterised by intense competition and a mix of significant and smaller participants. TATA Steel, JSW Steel, SAIL, JSPL, and RINL are the key manufacturers of long steel products in the country. The above-mentioned companies collectively produce about 33 percent⁶² of long products, while the remaining share is divided amongst medium-scale and small-scale producers.

Table 1: Current product portfolio of Indian steel producers for the building, construction, and infrastructure sectors

Market segment	Current product portfolio
Individual house builders	Rebars, TMT, doors and windows, roofing sheets, plumbing pipes, tubes, wires
Corporate and government bodies	Prefabricated houses and offices, water kiosks, modular toilets, office cabins and warehouses, rooftop houses, EV charging station, smart toilets for smart cities, and customised pipes
Infrastructure	TMT rebars (higher diameter rebars and corrosion-resistant steel) HR, tubes, crash barrier, PC strands, and steel structural, railway materials, HR plates including chequered plates, PM plates
Housing and commercial	Ready build cut and bend bars, tubes, PC strands, WAMA – GC for walling, GalvaRos for Heating Ventilation and Air-Conditioning (HVAC) and false ceiling segments, and doors and window frames

Source: Industry interviews

Benchmarking steel use with other countries

Steel use in India is lower than that in some developed countries. Indian per capita steel consumption is only 78 kg against the global average of about 233 kg.⁶³ Other countries, such as the US and Japan, have a per capita consumption of 279 kg and 443 kg, respectively.⁶⁴

⁵⁹SteelMint

⁶⁰JPC

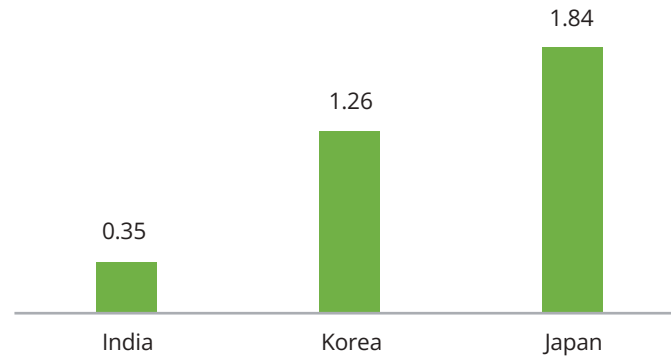
⁶¹JPC

⁶²JPC

⁶³<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1896882#:~:text=The%20per%20capita%20steel%20consumption,world%20per%20capita%20steel%20consumption.>

⁶⁴<https://worldsteel.org/steel-topics/statistics/world-steel-in-figures-2023/#apparent-steel-use-per-capita-%3Cbr%3E-2018-to-2022>

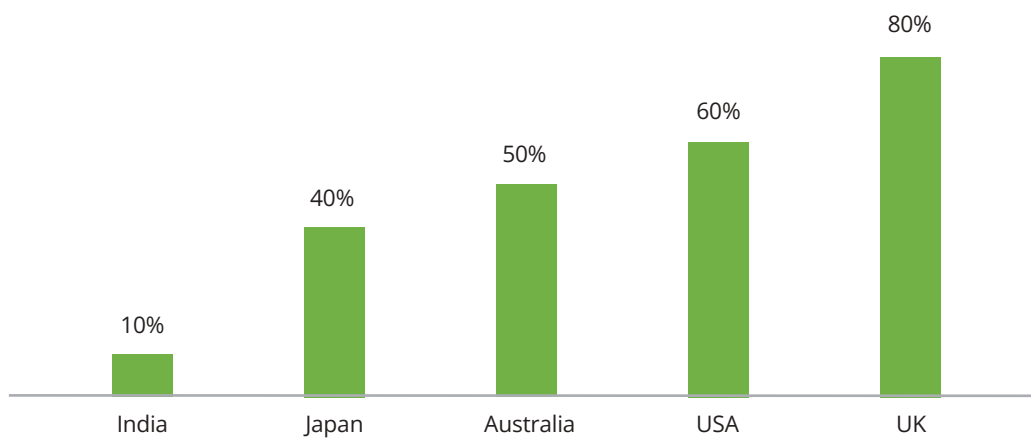
Figure 5: Steel to cement ratio



Source: Ministry of Steel

The market share for steel framed construction is also low in India as shown below.

Figure 6: Share of steel framed construction



Source: SAIL

The above figures indicate that such countries use more steel than cement and there is significant potential to increase steel consumption in India.



Focus areas to increase steel use

Potential applications in urban areas

Currently, about 36 percent of India's population resides in urban areas.⁶⁵ With the introduction of rapid urbanisation and development of smart cities, this figure is expected to cross 50

percent⁶⁶ in the next few decades. Therefore, increasing steel use in this segment will significantly boost demand.

⁶⁵<https://www.macrotrends.net/countries/IND/india/urban-population>

⁶⁶<https://www.thehindubusinessline.com/economy/policy/half-of-indias-population-will-be-living-in-urban-areas-by-2030-says-puri/article64287919.ece#:~:text=By%202030%2C%2050%20per%20cent,of%20Housing%20and%20Urban%20Affairs.>

In the urban segment, the promising growth areas can be as follows:

- **Residential buildings**
Modern apartments for nuclear families with communal amenities
- **Commercial buildings**
Collaborative, open workspace designs
- **Retail**
Large malls, warehousing, cold storage for multinational retailers
- **Hospitality**
Budget hotels, serviced apartments, convention centres
- **Government infrastructure**
Development of highways, pipelines, etc.

The following potential applications can enhance steel use in the above-mentioned growth areas:

- Steel-based, high-rise buildings and structures allow a higher floor-to-surface area ratio due to lower column sizes. Light Gauge Steel Framed (LGSF) structures can be used for low-rise buildings. For example, in Afghanistan, steel has been used to build the parliament building in Kabul. Similarly, the LGSF technology is being used for lighthouse projects in India.
- Steel-based bailey bridges and flyovers are gaining popularity because of lower construction time and higher longevity.
- Continuously Reinforced Concrete Pavement (CRCP) and steel-reinforced roads can have a longer life than only concrete roads.

Potential applications in rural areas

The current Indian rural per capita consumption of steel is about 21 kg.⁶⁷ While the country has been showing strong migration trends from rural to urban, the key to unlocking further demand lies in the rural segment.

The key challenges in increasing rural steel consumption can be categorised as follows:

- **Awareness:** Limited knowledge of steel-based solutions and lifecycle cost assessment for steel products is a key deterrent for increased steel adoption.
- **Affordability:** The relatively lower per capita income of the rural economy is leading to the use of alternative construction materials.
- **Skillset and ecosystem:** There is lack of knowledge and vendors to carry out steel fabrication and awareness about application use.

- Crash barriers along national highways and expressways may be explored to enhance safety in the transportation sector. In addition, NHAI plans to set up steel-based wayside amenities every 50-60 km along the highways, with restrooms, petrol pumps, ATMs, etc.
- Pre-Engineered Buildings (PEBs) may be used to develop data centres, convention centres, supermarkets, stadiums, etc.
- Transit buildings may focus on using stainless steel in bollards, column claddings, ticketing counters, benches, escalators, lifts, handrails, canopies, etc.
- Gates and facades can be made of steel for higher longevity. Similarly, car parking structures and bus shelters can be made of steel.
- Solar rooftop panels can use steel due to its strength, corrosion resistance, and weldability.
- Smart poles (in smart cities) made of steel can house environmental monitoring stations, Wi-Fi hotspot, CCTV cameras, and normal lightings.
- Steel roofing and sheds, and steel shoring and scaffolding systems could be developed.
- Steel pipes are being laid to carry gas from port locations. City gas distribution networks can be a major steel consumer. The use of steel pipes may also be enhanced for water and sewage transportation.

- **Availability:** Due to the wide geographical spread, limited road access, and poor warehousing arrangements, steel availability is a constraint for the rural economy.

The following potential applications can enhance steel use in rural areas:

- Use steel structures with solar set-ups for various rural facilities, such as houses, anganwadis, bio-toilets, public libraries, schools, and nursing collages. India plans to set up 300 GW solar capacity by 2030 (currently about 70 GW⁶⁸). This growth, coupled with steel use, can significantly boost steel demand.
- Use food processing and storage facilities for agricultural purposes. Steel can be used to build food processing machinery, construction of grain silos, and cold storage, along with other infra-support structures.

⁶⁷<http://www.cidc.in/support/ICM%202023/Steel.pdf>

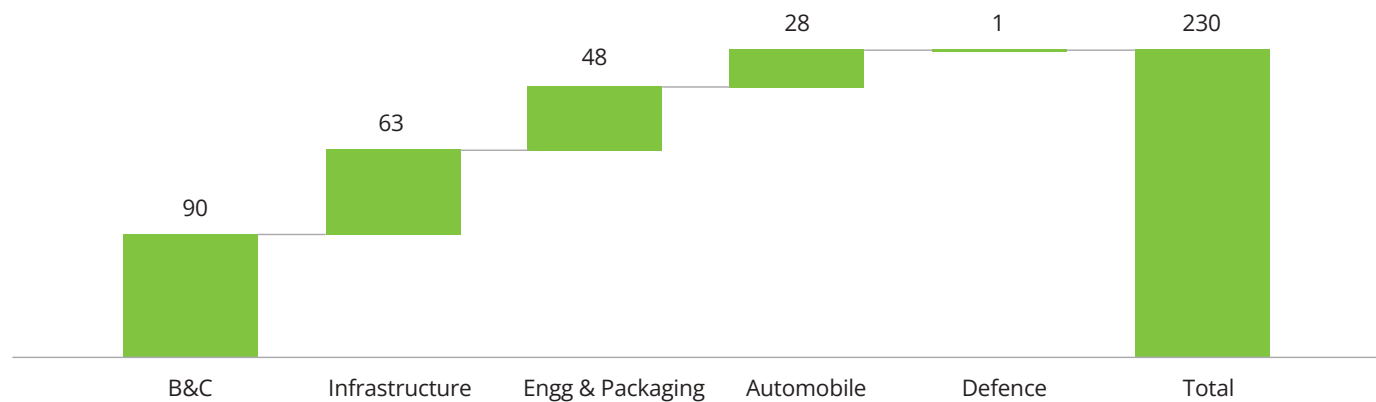
⁶⁸<https://energy.economictimes.indiatimes.com/news/renewable/india-now-has-70000-mw-of-solar-power-generation-capacity-rajasthan-leading-the-pack/102577162>

- Set up multiple warehousing facilities through co-operative societies due to the ability to create large span spaces at a low cost.
- Ensure increased use of steel pipes in irrigation and water pipelines. Numerous canals for irrigation can be converted into steel pipe-based irrigation. This will increase demand for steel and free-up land area for other applications. Water tanks may also be built.
- Promote metal roofing. According to the 2011 census, 66 percent of the rural households have non-metal roofing⁶⁹ that may be converted into steel.
- Consider using steel for making doors and windows.
- Promote steel use in dairying and animal husbandry by setting up steel shelters and manufacturing dairy machinery from steel.
- Use steel for agricultural and farming purposes such as farm equipment, machinery, tractors, and trailers.

Demand scenario driven by enhanced steel use

India is projected to be a US\$ 5 trillion economy by FY27,⁷⁰ and the steel industry’s growth has a well-established correlation with GDP growth. Therefore, steel demand will increase manifold in the next few years. The expected total finished steel demand by sector in FY31 is shown below:

Figure 7: Anticipated finished steel demand by sector in FY31 (in MT)



Source: SAIL

⁶⁹ISA Knowledge Report 2021
⁷⁰International Monetary Fund report
⁷¹<http://www.cidc.in/support/ICM%202023/Steel.pdf>
⁷²<http://www.cidc.in/support/ICM%202023/Steel.pdf>
⁷³<http://www.cidc.in/support/ICM%202023/Steel.pdf>
⁷⁴<http://www.cidc.in/support/ICM%202023/Steel.pdf>
⁷⁵<http://www.cidc.in/support/ICM%202023/Steel.pdf>

Based on industry estimates, steel demand from the building and construction sector is expected to reach about 90 MT⁷¹ and steel demand from the infrastructure sector is expected to reach about 63 MT in FY31.⁷² Therefore, the combined demand from these two sectors will be about 153 MT. This will account for about 67 percent of the total 230 MT⁷³ of the steel demand in FY31.

One of the major types of steel that will be used in these sectors is steel bars and rods. Of the 120 MT of steel consumption in FY23, steel bars and rods accounted for about 50 MT⁷⁴ of consumption. In the future, they will account for about 73 MT in FY31.⁷⁵ Of these 73 MT, about 47 MT is expected to be consumed by the building and construction sector and about 19 MT will be consumed by the infrastructure sector.

Expected supply trends

The future supply scenario is expected to be dominated by the following trends:

- **Capacity growth of leading steel players**

Leading steel manufacturers, such as SAIL, Tata Steel, AMNS, JSW, and JSPL are expanding their capacities to align with anticipated demand to ensure timely production. By FY30, these top five players will have a combined supply capacity of 220 MT.⁷⁶

- **Enhanced efficiency through workshop delivery**

Shift from on-site fabrication to workshop delivery models is gaining traction due to improved quality, timeliness, and cost-effectiveness.

- **Expansion in the secondary steel sector**

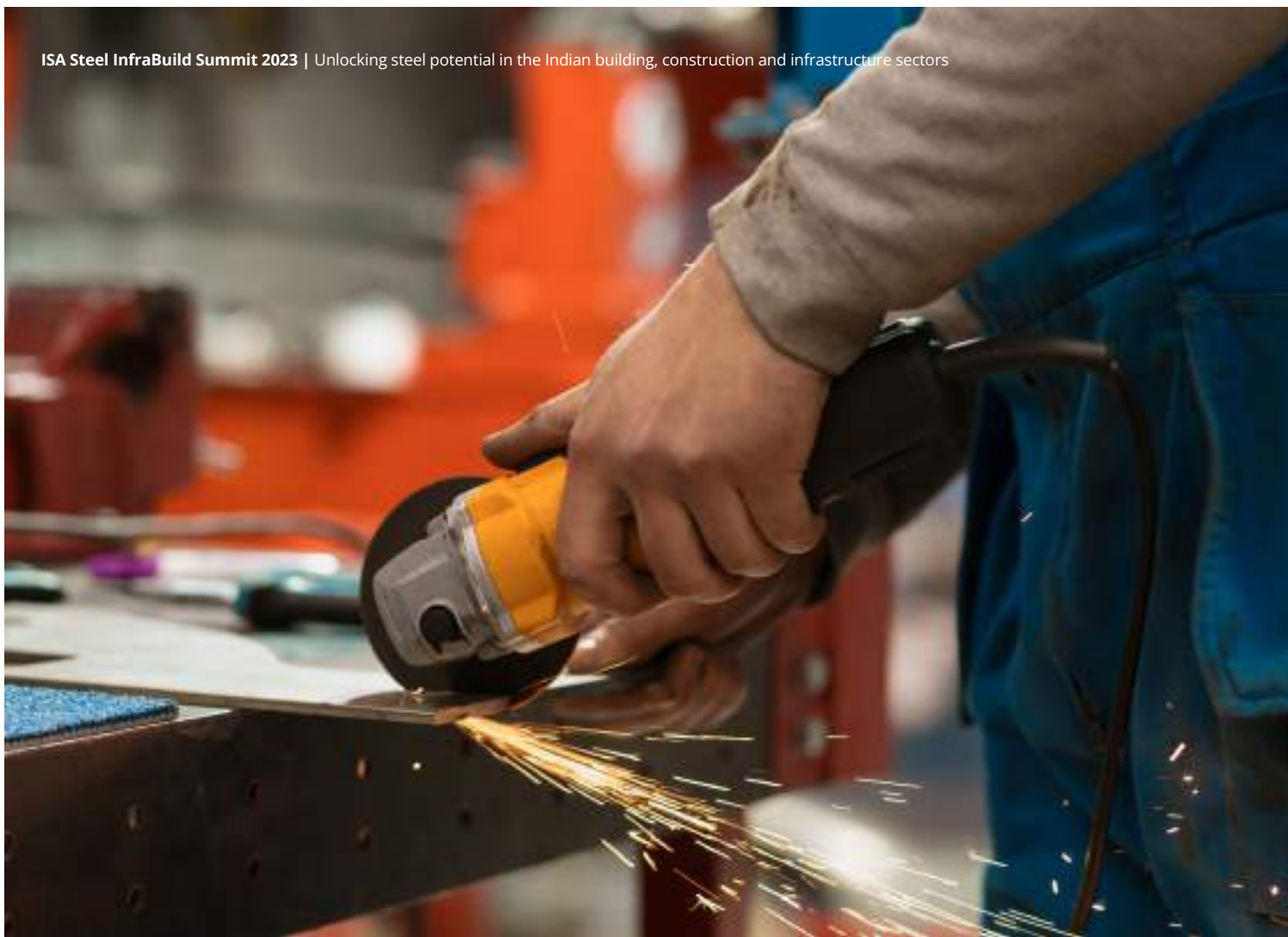
Collaboration between integrated steel players and converters/vendors is envisaged for value-added structures. Similar models have been seen in the aluminum sector with franchise arrangements for last-mile enhancements.

- **Branding and marketing initiatives**

The focus will shift to consumer-oriented steel adoption, including prefabricated steel structures. This may lead to shift from steel retail to creation of consumer perception and brand loyalty.



⁷⁶Deloitte Analysis



Policies to boost demand growth

Existing policies

Pradhan Mantri Awas Yojana (PMAY)

- Launched in 2015, PMAY is a credit-linked subsidy scheme being implemented by MoHUA to ensure affordable housing for low and moderate-income residents of the country.
- The government provides a credit-linked subsidy depending on the income bracket of the individual building their first house. PMAY-Urban and PMAY-Gramin target the urban and rural population, respectively. The Affordable Rental Housing Complexes (ARHC) initiative, which is part of PMAY, involves converting existing infrastructure into new residential buildings. Thus, steel consumption is increasing. PMAY has also encouraged the use of alternative construction technologies, such as LGSF through its light house projects (model housing projects in select cities)
- About 15.8 MT⁷⁷ of steel is expected to be consumed for PMAY. About 2 crore houses have been completed⁷⁸ as part of PMAY-Gramin. About 83,000 houses are targeted to be completed as part of the ARHC scheme; Of which, 5,684 houses have been converted.⁷⁹ However, challenges such as enhancing steel consumption in rural buildings, remain. The ARHC also faces implementation challenges, particularly in urban areas.

⁷⁷<https://realty.economictimes.indiatimes.com/news/allied-industries/about-158-lakh-mt-steel-to-be-consumed-under-pmay-urban-housing-minister/77626933>

Atal Mission for Rejuvenating and Urban Transformation (AMRUT)

- Launched in 2015, AMRUT focuses on the development of basic infrastructure in the sectors of water supply; sewerage and septage management; storm water drainage; green spaces and parks; and non-motorised urban transport, thus boosting steel demand.
- AMRUT is committed to enhancing urban living conditions through essential amenities. It ensures water security by providing tap water and toilet facilities to every urban household.
- As of Dec 2022, 134 lakh water tap connections and 102 lakh sewer connections have been provided through AMRUT.⁸⁰ A major focus area can be promoting the use of steel pipelines and taps through this scheme.

Smart cities mission

- The government is developing 100 smart cities with a focus on improving infrastructure and quality of life using technology.
- Key areas include capital expenditure on water supply, power distribution, sanitation, waste management, and transportation optimisation.
- Until July 2023, 6037 projects with a capex of INR 110,224 crore has been completed.⁸¹ Metro infrastructure plays a significant role, with about 700 km of operational lines in 18 cities and nearly 1,000 km under construction in 27 cities.⁸² Notably, metro projects require about 13,000 MT of various steel types per kilometer.⁸³ A major focus area can be promoting the use of steel-based buildings and other structures through this scheme.

National Infrastructure Pipeline (NIP) 2020-2025

- The National Infrastructure Pipeline (NIP) constitutes a monumental policy initiative aimed at expediting India's infrastructure advancement across diverse industries. Its ambitious objective encompasses not only accelerating growth but also elevating the standards of infrastructure throughout the nation.
- The National Infrastructure Pipeline (NIP) targets multi-sector development projects, covering housing, water, energy, healthcare, and transportation to stimulate economic growth and improve living standards. Key projects have been identified and capex has been earmarked for the implementation. The projected infrastructure investment is about US\$ 1905 billion (about 1.5 lakh crore) until FY25.⁸⁴
- At present, 8964 projects with a total capex of 108 lakh crore is under implementation.⁸⁵ A focus area for the future may be how to increase steel use through these infrastructure projects.

⁷⁸<https://newsonair.com/2022/08/04/2-crore-44-lakh-houses-sanctioned-to-beneficiaries-under-pmay-g-govt/>

⁷⁹<https://www.impriindia.com/insights/affordable-rental-housing-scheme-3/>

⁸⁰<https://pib.gov.in/PressReleasePage.aspx?PRID=1885837>

⁸¹<https://smartcities.gov.in/>

⁸²<https://pib.gov.in/PressReleasePage.aspx?PRID=1646636>

⁸³<https://pib.gov.in/PressReleasePage.aspx?PRID=1646636>

⁸⁴<https://indiainvestmentgrid.gov.in/national-infrastructure-pipeline>

⁸⁵[https://pib.gov.in/PressReleasePage.aspx?PRID=1894919#:~:text=National%20Infrastructure%20Pipeline,-The%20government%20launched&text=The%20NIP%20currently%20has%208%2C964,Monitoring%20Group%20\(PMG\)%20portals.](https://pib.gov.in/PressReleasePage.aspx?PRID=1894919#:~:text=National%20Infrastructure%20Pipeline,-The%20government%20launched&text=The%20NIP%20currently%20has%208%2C964,Monitoring%20Group%20(PMG)%20portals.)

Other key government initiatives

The Indian government has laid special emphasis on infrastructural development through a host of schemes mentioned below:

- **Bharatmala**

It aims to build an ecosystem of nationally connected roads with the help of tunnels, bridges, flyovers, underpasses, and overpasses to provide optimised connectivity. It is focused on connecting remote areas and satellite towns of larger cities. As part of Bharatmala Phase I, about 35,000 km of road projects are being implemented with a capex of INR 5.35 lakh crore.⁸⁶

- **Sagarmala**

It aims to optimise port and logistics infrastructure, reduce logistics costs, promote the development of port-based industrial clusters, and enhance coastal shipping and inland waterways transportation. As part of the Sagarmala programme, more than 574 projects with a capex of INR 6 lakh crore have been identified for implementation until 2035.⁸⁷

- **Construction of dedicated freight corridor**

It aims to build large-scale national railway corridors. This will enable Indian Railways to gain higher revenue from freight transport help to create adequate national rail capacity and guarantee efficient, reliable, safe, and affordable options for transportation of goods. The Cabinet Committee on Economic Affairs approved a capex of ~INR 81,000 crore⁸⁸ for eastern and western DFC.

- **UDAN initiative**

This is an airport development scheme that aims to connect the nation through a network of airports in various tier II cities. This will make air travel affordable and boost the economic development. The Civil Aviation Ministry has set a target of operationalising as many as 220 airports and starting at least 1,000 air routes.⁸⁹

- **Jal Jeevan Mission**

This scheme aims to provide drinking water through individual household tap connections by 2024 to households in rural India. Until July 2023, about 13 crore rural households⁹⁰ have received tap connections under this scheme.

All the above-mentioned initiatives are expected to boost the future steel consumption significantly. These initiatives will enable the steel players to expand their capacities. The potential steel demand from some of the key government initiatives is shown in the below table:

Table 2: Potential steel demand from government initiatives/sectors

Government initiative/sector	Potential steel demand in FY31
Renewable Sector	25-26 MT
PMAY – Gramin	22-23 MT
Bharatmala	15-16 MT
PMAY – Urban	12-13 MT
Jal Jeevan	7-8 MT
Sagarmala	7-8 MT
UDAAN	2-3 MT
Total	90-100 MT

Source: Deloitte analysis

However, there are further avenues to increase the per capita consumption of steel and thus, enhancing the total national steel demand. The government may consider the following focus areas while developing future policies.

⁸⁶<https://morth.nic.in/bharatmalaphase>

⁸⁷<https://sagarmala.gov.in/projects/projects-under-sagarmala>

⁸⁸<https://dfcil.com/Home/DynamicPages?MenuId=78>

⁸⁹[https://pib.gov.in/PressReleasePage.aspx?PRID=1852532#:~:text=220%20destinations%20\(airports%2Fheliports%2F,been%20awarded%20to%20connect%20156airports.](https://pib.gov.in/PressReleasePage.aspx?PRID=1852532#:~:text=220%20destinations%20(airports%2Fheliports%2F,been%20awarded%20to%20connect%20156airports.)

⁹⁰<https://jaljeevanmission.gov.in/>

Focus areas for future policy-making

- **Promoting the development of steel-based buildings and structures**

Technologies such as LGSF are promoted for making low height buildings in urban and rural areas. It is based on prefabricated structures and can reduce the construction time by half. It also offers a higher surface-to-floor ratio. Steel structures may be mandated in earthquake-prone regions. Steel structures may also be promoted for setting up solar panels, community centres, public libraries, etc.

- **Promoting steel-based bridges**

Steel-based bridges have a higher longevity compared with concrete bridges. This can be a major area for increasing consumption. For example, the Mahatma Gandhi Setu Bridge (made of concrete) was commissioned in Bihar in 1982, but it had to be replaced in about 30 years. A steel framework replaced the entire concrete superstructure. More such initiatives may be taken up in the future – for example, promotion of steel bridges for national highways and expressways.

- **Life Cycle Cost (LCC) comparison for selection of construction material during government infrastructure projects**

An argument in favour of concrete (the typical material of choice over steel) is that it presents a cheaper up-front cost. However, steel is more recyclable and reusable than concrete. Therefore, material procurement tenders should have an LCC comparison criteria between two different materials. Handbooks may need to be developed for composite designs as needed.

- **Tax incentives provided based on the carbon footprint of developed buildings/structures**

As India moves towards reducing its carbon emissions (net zero targeted by 2070) and simultaneously expanding its steel industry, promoting decarbonisation through incentives is essential. Construction using steel takes half the time and no large cranes or vehicles are required (since these are prefabricated); almost all the steel can be recycled. Detailed carbon estimations may be developed when the builders draw up their plans, and they may be taxed accordingly.

- **Detailed standards for steel-specific structures**

Design handbooks to be developed by BIS in line with design handbooks of RCC structures.

- There is a need to develop designs and drawings for smaller steel intensive bridges by MoRTH. Some work has already been undertaken by MoRTH in this direction.
- Modular design standards may be developed for facilities such as anganwadis, bio-toilets, community centers, and public libraries.
- Similarly, standard designs may be developed for building rehabilitation structures to quickly rebuild in case of natural disasters.
- Fire resistant steel, seismic resistant steel, and weather resistant steel may be included in IS 800 (General Construction in Steel) and National Building Code.



- **Ensuring availability of fire-resistant steel**

High rises or hospital buildings have a standard demand of at least two-hour fire rating. Conventionally, expensive coatings are used to adhere to this criterion. Recently, some producers have developed fire resistant steel for serving this purpose. The government may incentivise and promote the use of such steels. Major steel producers must make a full range of rolled sections available to the industry.

- **Promoting the human capital related to this industry**

At present, there is a lack of skilled fabrication mechanics who can install PEBs. Development of this work force is essential to boost the consumption through steel-based buildings. Steel fabrication hubs could be a potential solution and Uttar Pradesh may take a lead in this direction. There is also a need to develop structural steel design expertise across the country. Educational institutes may play a key role by including steel structural design as part of civil engineering curriculum.

- **Branding steel as a suitable material for construction**

One of the major hindrances in the adoption of steel in the rural areas is the perception of concrete being associated with a pukka house. Awareness campaigns may be undertaken (particularly in rural areas) to strengthen the perception towards

steel. These campaigns may highlight beneficial properties of steel (lesser construction time, minimum requirement of water and sand, cost effectiveness, seismic resistance, weather resistance, etc.).

- **Providing PLI incentives for steel used in the building, construction, and infrastructure sectors**

The government has already provided support in the form of INR 6300 crore⁹¹ of PLI incentive to specialty steel. This definition of specialty steel may be modified to include steel products that cater specifically to the building and infra sectors.

- **Developing energy standards for green buildings**

Energy efficiency standards for buildings and infrastructure projects, should be mandated. This will encourage the use of energy-efficient materials such as steel.

- **Developing a dedicated portal or information repository**

The government may consider listing down all the upcoming projects (in the building, construction, and infrastructure sectors) along with the expected steel demand in a dedicated portal. The information repository will help the steel producers to plan their capacity expansions in line with the upcoming demand.

The above-mentioned focus areas will go a long way in shaping the expansion roadmap of the Indian steel industry. Depending on the contours of the fiscal and regulatory structure of the government schemes, steel consumption will increase in the next few years.

⁹¹<https://pib.gov.in/PressReleasePage.aspx?PRID=173772>



Sustainability of steel use

Sustainability in this context entails strategically minimising the environmental impact and ensuring economic viability of the construction material throughout the lifecycle of the project (planning, construction, operation, maintenance, renovation, and demolition).

Potential substitutes to steel products

Although steel has many benefits as a construction material (e.g., longevity and recyclability), other alternative materials are widely used in place of steel products:

Concrete: Concrete beams offer fire resistance, durability, and cost advantages, making them suitable for structures requiring longevity and reduced costs. The size of India's ready mix concrete market was estimated at more than US\$ 15 million⁹² in 2020. It is expected to grow at a CAGR of 9 percent annually until 2026. However, their weight, susceptibility to tension cracking, and longer construction time can be limitations. The choice between concrete and steel beams hinges on factors such as project specifics, budget, and design preferences. This often involves a blend of both materials, i.e., composite to optimise performance and to increase steel-to-cement ratio.

Wood: Wood finds its application particularly in rural and eco-friendly construction projects. It provides economical and eco-friendly construction solutions because of their thermal and sound insulation properties, designing flexibility and natural source. However, they have limitations in terms of fire resistance, susceptibility to decay, and long-term durability in certain environments. Wood's structural strength is usually lower than that of steel. Hence, it cannot be used for medium and large construction and infrastructure projects.

Aluminum: As of 2022, the total demand for aluminum in India stood at 4 million tonnes.⁹⁴ Of this, the building and construction sector consumes about 13 percent.⁹⁵ Aluminum is used in the sector due its lightweight and corrosion-resistant properties. Hence, aluminum roofing sheets are better for coastal regions with heavy rainfall instead of steel roofing sheets. However, the aluminum alternative of steel is more expensive and has lower strength than steel.

Fiber-Reinforced Polymers (FRPs): FRPs are non-corrosive and lightweight, making them suitable for retrofitting and corrosion-prone environments. They are used for reinforcing concrete structures as an alternative to Steel Reinforcement Bars (Rebars). Even though FRPs offer corrosion resistance and ease of installation, they may not have the same structural capacity, ductility, and tensile strength as steel rebars.

Reinforced Thermoplastic Pipes (RTP): RTP pipes are corrosion-resistant and lightweight; they are suitable for fluid conveyance in corrosive environments. These pipes are used for fluid conveyance in infrastructure projects as an alternative to steel-reinforced concrete pipes. RTP pipes provide corrosion resistance and ease of handling, reducing maintenance needs. However, they are not suitable for high-pressure and high-temperature applications as steel-reinforced concrete pipes.

Fiberglass mesh: Fiberglass mesh is corrosion-resistant and used for plastering and reinforcement in lightweight construction as an alternative to steel wire mesh. However, the mesh lacks the tensile strength compared with steel wire mesh. Hence, replacing steel wire mesh with fiberglass mesh can affect the overall durability and strength of structures.

While various materials offer specific advantages in the infrastructure sector, steel remains a preferred choice for its balance amongst strength, ductility, cost-effectiveness, and recyclability. The versatility and durability of steel make it a cornerstone of modern infrastructure, particularly in applications where high strength and long-term reliability are paramount.

⁹²<https://constructiontimes.co.in/all-set-for-a-concrete-growth/>

⁹³<https://constructiontimes.co.in/all-set-for-a-concrete-growth/>

⁹⁴<https://cmr.co.in/wp-content/uploads/2022/09/Assessment-of-secondary-aluminium-industry-in-India-2-Sept-2022-V1.pdf>

⁹⁵<https://www.mgsarchitecture.in/building-materials-products/articles/243-the-growing-demand-of-aluminium-%20extrusions.html#:~:text=While%20the%20major%20consumption%20of,solar%20power%20and%20industrial%20secto>

Circular steel economy

Circularity is an approach in which materials are reused, repurposed, and recycled to minimise waste and environmental impact. Using steel can significantly enhance circularity due to the following attributes:

Recyclability and reusability: Steel is one of the most recyclable materials and can be recycled six times⁹⁶ without losing its properties. This reduces the demand for virgin raw materials and decreases the carbon footprint of new construction. In India, the recycling rate for steel is about 22 percent,⁹⁶ which is envisioned to increase to 35-40 percent⁹⁷ under National Steel Policy, leading to resource conservation. Recycled steel can act as a low carbon building material and will reduce the carbon emission.

Design flexibility and adaptability: Steel's strength and versatility allow for innovative design approaches, such as modular construction and prefabrication. This enables steel-based buildings to be easily reconfigured, expanded, or repurposed without extensive demolition or waste generation. In contrast, concrete structures when dismantled often necessitate blasting.

Efficient manufacturing and reduced waste: Steel fabrication processes have become more efficient, resulting in lower material waste during production. Advanced manufacturing techniques enable precise cutting and shaping of steel components, minimising off-cuts, and optimising material utilisation. In a research study conducted by the University of Wyoming, the life cycle sustainability of two functionally equivalent, nearly-identical, two-lane steel and concrete rural bridges were evaluated. The results showed that the concrete bridge emitted 26.3 percent more embodied carbon, consumed 8.7 percent more energy, recycled 17.8 percent less material, and costed 23 percent⁹⁸ more in comparison with steel bridge.

Longevity and durability: Steel structures are known for their durability and longevity. Their ability to withstand environmental stressors and wear ensures extended service life, reducing the frequency of replacements and associated resource use.

Energy and emission savings: Using recycled steel significantly reduces energy consumption and greenhouse gas emissions compared with producing steel from scratch. According to the World Steel Association, every tonne of scrap used for steel production avoids the emission of 1.5 tonnes of carbon dioxide and consumption of 1.4 tonnes of iron ore, 740 kg of coal, and 120 kg⁹⁹ of limestone.

Existing initiatives for sustainability

Steel Scrap Policy 2019: Aligned with the National Steel Policy, India's "Steel Scrap Policy" drives structured collection, processing, and recycling of scrap steel, aiming to reduce reliance on imports and bolster domestic recycling to enhance circularity.

Waste Management and Recycling Rules: India enforces waste management regulations across industries, including steel, to ensure responsible handling and recycling.

Green Building Initiatives: Initiatives such as Indian Green Building Council (IGBC) and Leadership in Energy and Environmental Design (LEED) incentivise sustainable materials, such as recycled steel in construction.

⁹⁶<https://pib.gov.in/PressReleasePage.aspx?PRID=1896312>

⁹⁷<https://steel.gov.in/sites/default/files/Steel%20Scrap%20Recycling%20Policy%2006.11.2019.pdf>

⁹⁸<https://www.centralsteelservice.com/steel-vs-concrete-which-is-more-environmentally-friendly/>

⁹⁹<https://worldsteel.org/steel-topics/raw-materials/>

Potential initiatives for enhanced sustainability

Material selection: Prioritise steel as a sustainable and energy-efficient material choice due to its recyclability, durability, and potential for modular construction.

Energy-efficient designs: Employ passive design strategies using steel components to enhance thermal performance, reducing reliance on HVAC systems.

Green building certification: Encourage projects to achieve green building certifications, such as Leadership in Energy and Environmental Design (LEED) or Building Research Establishment Environmental Assessment Method (BREEAM), promoting energy-efficient construction practices.

Building Information Modeling (BIM): Use BIM to optimise steel use, reduce wastage, and enhance project efficiency.

Suggested areas of policy-making

- The existing GFR-2017: Rule 136 (1) (iii) stipulates that “no work shall be commenced or liability incurred in connection with it until a properly detailed design has been sanctioned and while designing the project, principles of Life Cycle Cost may also be considered”. This may be amended to “shall be considered”.
- Detailed Project Reports (DPR) of consultants/government departments may ensure that an LCC analysis for steel bridges is included in their reports. Higher initial cost may be chosen if it entails lower life cycle cost and reduced construction time.
- Tax incentives may be provided for houses to promote circular economy; for example, a lower tax may be charged for a building that uses material with >70 percent circular economy.
- Incentives may be provided for manufacturing “green” steel, i.e., steel produced through processes that do not emit carbon dioxide. The existing DMI&SP policy may be modified or a new policy may be developed to cover the specifications. The government may choose to define a certain amount of green steel that must be procured for infrastructural projects.





Conclusion

The next decade holds the promise for a period of significant growth with Indian crude steel production capacity expected to almost double by 2030. Focused efforts from industry players and support from the government, including strengthening the domestic steel consumption, are required to achieve this growth. A robust steel sector will be achieved by enhancing the steel intensity across key consuming sectors, developing a skilled workforce, and nurturing positive perceptions about steel's role. Creating awareness about steel's contributions, both economically and ecologically, will help build a positive perception and boost domestic consumption. Steel is not just a material, it is a partner in our march towards sustainable progress. Indian steel producers can emerge as winners if they remain focused on improving competitiveness and sustainable steel production.

The building, construction and infrastructure sectors have tremendous growth potential in the next few years in terms of increasing domestic steel consumption. These sectors will account

for the primary share of demand in FY31. While the government is already working on several transformational initiatives, special focus may be provided on advocating new applications for steel, promoting sustainable practices, developing the required skillsets, and deliberating on the future policies. The momentum on infrastructural spending should be maintained by investing in roads, highways, bridges, rails, ports, airports, and power transmission lines. Simultaneously, the steel industry is gearing up to meet the enhanced demand. Key players have laid out plans for medium-term capacity expansion plans and are continuously recalibrating towards the Amrit Kaal vision achievement.

Therefore, it is imperative that key stakeholders from the government as well as the industry should collaborate to understand the challenges, identify opportunities, and work towards a common goal for the overall development of the nation. As India moves forward, steel stands as a steadfast ally in the pursuit of a brighter, greener, and more resilient future.

Glossary

Acronym	Full form
MT	Million Metric Tonnes
GDP	Gross Domestic Product
NSP	National Steel Policy 2017
Kg	Kilogram
CAGR	Compound Annual Growth Rate
USA	United States of America
CR	Cold Rolled
SS	Stainless Steel
HR	Hot Rolled
FYXX	Financial Year
JPC	Joint Plant Committee
GP/GC	Galvanised Plain Coils and Sheets
SAIL	Steel Authority of India Limited
JSPL	Jindal Steel and Power Limited
RINL	Rashtriya Ispat Nigam Limited
AMNS	Arcelor Mittal Nippon Steel
DRI	Direct Reduced Iron
MoS	Ministry of Steel
TMT	Thermo-Mechanically Treated
FRP	Fibre Reinforced Polymer
USD	United States Dollar
INR	Indian Rupee
PMAY	Pradhan Mantri Awas Yojna
Km	Kilometre
EV	Electric Vehicles
MW	Megawatt
Y-o-Y	Year on Year
MTPA	Million Tonnes per Annum
NHAI	National Highway Authority of India
MoRTH	Ministry of Road Transport and Highways

The first part of the paper discusses the importance of understanding the cultural context of the research. It highlights the need for researchers to be sensitive to the values and beliefs of the communities they are studying. This is particularly important in the field of education, where cultural differences can significantly impact learning outcomes.

The second part of the paper focuses on the methodology used in the study. It describes the process of selecting participants, collecting data, and analyzing the results. The authors emphasize the importance of using a mixed-methods approach to gain a comprehensive understanding of the research topic.

The third part of the paper presents the findings of the study. It discusses the results of the quantitative data analysis and the insights gained from the qualitative interviews. The authors conclude that there are significant differences in learning outcomes between the two groups, and these differences can be attributed to cultural factors.

The final part of the paper discusses the implications of the findings for future research and practice. It suggests that educators should be aware of the cultural context of their students and tailor their teaching methods accordingly. Additionally, it calls for further research to explore the role of culture in education more fully.

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