

2047

STAINLESS STEEL VISION

OVERVIEW DOCUMENT

APRIL 2022



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Foreword



K K Pahuja
President, ISSDA

As we celebrate 75 years of India's independence, the domestic stainless steel industry is at the cusp of accelerated growth. Ensuring a high growth trajectory is the government's Vision India@2047, when India will complete 100 years of Independence.

The Indian Stainless Steel Development Association (ISSDA), which has been at the helm of development of the industry since 1989, is also formulating a Stainless Steel Vision 2047 document.

The document will serve as a roadmap for the industry, based on deep research from CRISIL and inputs from all stakeholders.

To be sure, India will remain one of the fastest growing stainless steel markets and the second largest globally for the next several years. This study, while looking at past demand patterns, provides a look into the future, assessing emerging demand segments and connecting these with the government's policy enablers.

Infrastructure, renewable energy, agricultural industries, smart cities, defence, and aerospace are some of the segments that will require considerable volume of stainless steel, in addition to transport, process, and oil and gas industries. Building long-lasting maintenance-free infrastructure, and focusing on life cycle cost and value proposition, rather than just initial cost, are some of the encouraging trends and enablers for the stainless steel industry. In fact, stainless steel can support nation-building with sustainable solutions across sectors, where 3-4% of the gross domestic product (GDP) is lost to corrosion.

Stainless Steel Vision 2047 is intended to not only serve as an input for policymakers, but also help the industry be future-ready.

Indeed, the Indian stainless steel industry has to quickly adapt to changes in the business environment by continuously developing new market segments, upgrade technology, undertake digitisation and skill development, advocate free and fair international trade, and address climate change challenges.

Stainless steel can help fight the effects of climate change with the rise in demand for renewable energy, carbon capture systems, water conservation, reusable bottles and containers, and transportation of hydrogen. It is also one of the materials that effectively contributes to the circular economy.

In this context, ISSDA's Vision document dovetails into its motto: *To strive for a corrosion-free world and a sustainable society.*

Jai Hind

Preamble

Vision India 2047 paves the way for a futuristic India by the 100th year of Independence. The vision envisages wholesome and sustainable growth led by technology leadership across all the growth pillars of the economy, to be realised through planned and structured efforts over the next 25 years. The objective is to achieve prosperity across all segments of population along with strengthened global presence.

Infrastructure, construction and logistics would be the key focus areas instrumental in making the envisioned transition. Stainless Steel Vision 2047 has been developed around the contours of the envisaged growth across these areas. It highlights the role of stainless steel, with its significant current and potential applications, in the larger scheme of things to showcase its contribution in achieving the overall India vision.

This document forecasts the demand-supply trends through 2047, taking into consideration the economic growth targets for the country and specific operational and policy initiatives required to achieve those. It also discusses the support required from the government in terms of policy interventions across the value chain.



1 Executive summary

Stainless steel has emerged as metal of choice owing to its superior qualities, such as good strength to weight ratio, aesthetics, hygiene (it offers), resistance at high temperatures and complete recyclability. These properties enable its application across several end-use industries such as architecture, building and construction (ABC), automobiles, railways, transport (ART), consumer durables and process industries.

The stainless steel industry in India has a healthy mix of large and mid-sized corporates, including public sector and micro, small and medium enterprises (MSMEs), spread across the country.

India has an installed capacity of 6.6-6.8 million tonne (MT) of stainless steel with capability to produce a wide range of products as per national and international standards. Domestic demand for stainless steel (flat and long) clocked a compound annual growth rate of about 5.2% over fiscals 2016-2020 to reach 3.7 MT. However, the pandemic-led disruptions led to demand contracting by 14-15% on-year in fiscal 2021 to 3.2 MT. Stainless steel demand is expected to witness a volume growth of 19.5-21% to reach 3.7-3.9 MT in fiscal 2022 supported by a low base, a stable macroeconomic environment and normalised government spending.

In the medium term, CRISIL Research expects stainless steel demand to register a CAGR of 6.5-7.5% over fiscals 2022-2025 and reach 4.6-4.8 MT. Further, over the long term, as India aspires to become a \$40 trillion economy by 2047, sectors such as construction, infrastructure, and manufacturing – key contributors to the gross domestic product – are expected to drive stainless steel demand growth. Thus, CRISIL Research projects stainless steel consumption to reach 12.5-12.7 MT and 19-20 MT by fiscals 2040 and 2047, respectively; consequently, the per capita consumption of stainless steel will reach 8-9 and 11-12 kg, from current ~2.5 kg. In order to meet the estimated demand, India needs to develop enough capacities, while improving capacity utilisation in the long run. This implies that we need to increase the capacity by 4.5 times over the next 25 years to reach 30-32 MT by fiscal 2047.

India continues to be the second-largest consumer of stainless steel globally. To achieve the desired growth by fiscal 2047, optimise the import-export balance and improve capacity utilisation, the Indian stainless steel industry will need more support from the government in terms of policy interventions in areas such as raw material security, infrastructure and logistics support, downstream skill upgradation and technology upgradation, and research and development, to increase the intensity of usage across end-use industries and to encourage new-age applications. Some of the desired interventions are discussed in detail in the subsequent sections.



2 Overview of stainless steel industry

2.1 Introduction

Stainless steel is a wonder alloy with unique properties

Stainless steel is an iron alloy with minimum 10.5% chromium. It is superior to carbon steel, as chromium acts as an alloying agent, imparting corrosion resistance properties. Other alloying elements such as nickel, molybdenum, and nitrogen are added to enhance the structure and properties of stainless steel, including strength and cryogenic toughness.

In fact, stainless steel can be a substitute for other materials, such as carbon steel, aluminium, etc, as it has several qualities, such as:

- Better strength to weight ratio: Stainless steel offers high strength in combination with good ductility making it a suitable material for light and load bearing structures
- Aesthetic: Stainless steel does not require any surface painting. It is available in various finishes such as polished, satin, mirror and many more. This provides aesthetic look to the surface.
- Inert material: It does not contaminate the medium in contact and is widely used for food processing, storage and service.
- Hygienic: Surfaces/components made up of stainless steel are easy to clean. This quality makes it preferred choice for strict hygiene conditions like process industries and kitchen application
- Resistance at high temperatures: It is far more resistant to oxidation or shape deformation than ordinary carbon steel, and grades such as 310 were specifically developed for use at high temperature.
- Complete recyclability: It is an eco-friendly material

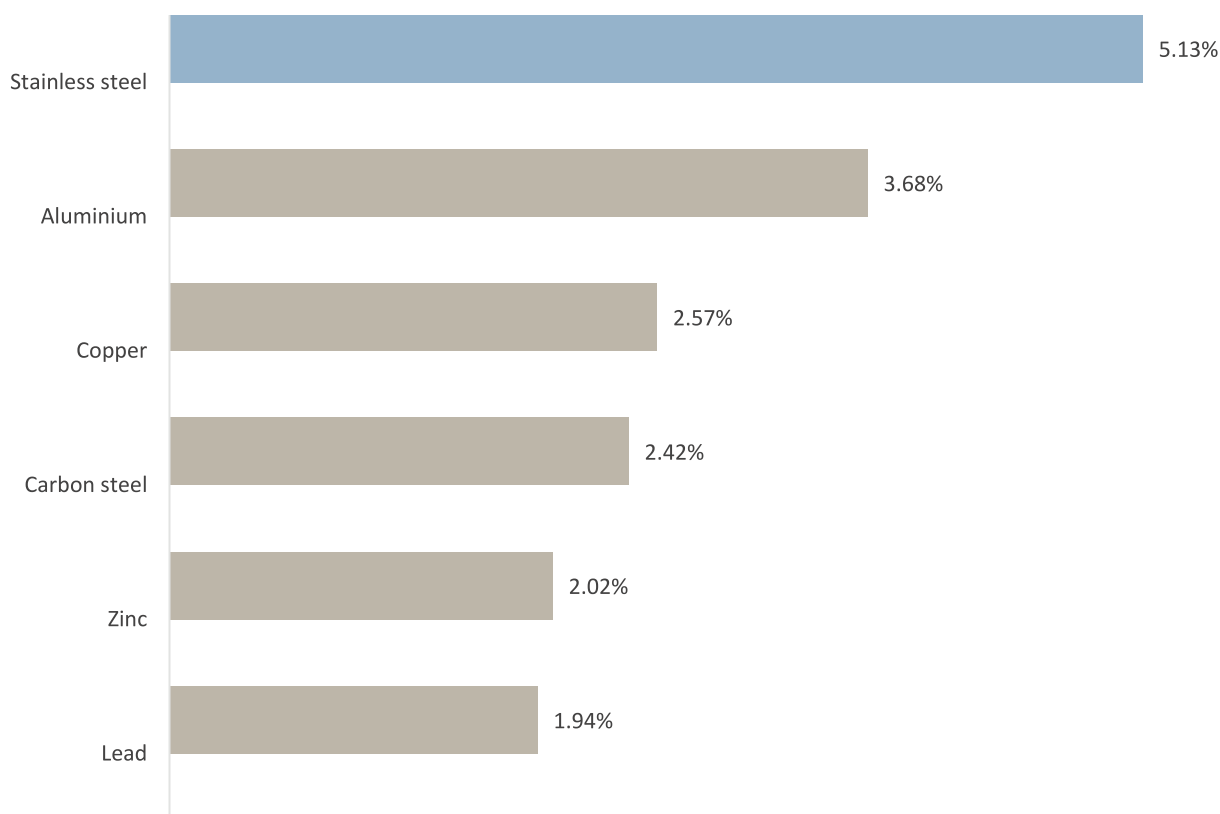
- **Easy to fabricate:** Stainless steel is a versatile engineering material which can be easily deformed, shaped, machined and welded.

Based on the alloying elements employed, stainless steel is classified into 200, 300 and 400 series. The most widely used is the 300 series, which has general composition of chromium (16-26%), nickel (6-22%), molybdenum in some grades and rest is iron. Nickel and molybdenum contribute bulk of the cost of stainless steel.

Stainless steel has outpaced metals such as aluminium, copper, and carbon steel

Stainless steel has outpaced other metals such as carbon steel, aluminium, and copper, owing to rising demand from various end-segments. This growth has, in turn, benefitted the nickel and chromium markets, which are interlinked with the stainless steel market.

Comparison of demand growth of various metals over CY 1980 to CY 2020 (CAGR)



Note: CY is calendar year

Source: International Stainless Steel Forum (ISSF), CRISIL Research

2.2 Usage of stainless steel across end-use industries

Stainless steel is a versatile metal and has wide range of applications

Inherent properties of stainless steel, such as corrosion resistance, durability, strength, considerable recycled content and salvage value, long life, low maintenance cost, etc, help create sustainable solutions for several sectors. Key end-use industries and applications of stainless steel are:



Automobiles, railways, and transport (ART)

Auto: Wheel rims of motorcycles, footrests, bumpers, fasteners, flanges, handles, trims, wipes, head gaskets, pump bodies, hose clamps, windscreen wiper arms, and seatbelt springs

Railway: Linke Hofmann Busch (LHB) coaches, wagon body, under-slung water tanks, bio-digester tanks, modular lavatory, water tank ceiling, and sidewall members

Other: Fabrication of exhaust collectors, stacks and manifolds, structural and machined parts, springs, castings, tie rods, and control cables



Process industry (food processing, pharma, power, oil and gas, dairy, etc)

Containers, pipework, food contact equipment, splash-backs, housings, and equipment enclosures

Dairy equipment such as storage tanks, processing and packaging machinery, accessories (includes fittings, valve, pumps, lab instruments, etc), and other utilities (includes all other machinery and equipment used to clean/ purify air, water, etc)

Medicine-making machinery and equipment, processing and reaction vessels, storage tanks/vessels, pumps, pipelines and tubes, heat exchangers, scrubber units, taps, and valves

Different parts of boilers, turbines, heat exchangers and condensers, and tubing material for low- and high-pressure feedwater heaters





Architecture, building and construction (ABC)

Structural, interior and exterior usages, decorative furnishings, interiors, exteriors, railings, and cladding embellishments



Consumer goods

Kitchenware: Cooking utensils, high-quality cutlery, and kitchen sinks

Consumer durables: Washing machine drums, casings and panels for microwave ovens, refrigerator doors and other kitchen equipment



Miscellaneous

Razor blade steel, coinage, etc

Note: Long stainless steel products find application in process, construction and consumer goods industries

Source: CRISIL Research

2.3 Structure of domestic stainless steel industry

Characterised by large players and MSMEs

India has an installed capacity of 6.6-6.8 MT of stainless steel with capability to produce a wide range of products as per national and international standards. The stainless steel industry in India has a unique structure with a healthy mix of large and mid-size corporates, including public sector and MSMEs, spread across the country.

Large players producing a wider range of stainless steel long and flat products include Jindal Stainless Group, Viraj Group, SAIL/Salem Steel, Rimjhim Ispat, Shah Alloys, Panchmahal Steel, Sunflag Steel, Valley Iron, Ambica Steels, Synergy Steel, Mukand Ltd, and Laxcon Steels.

MSMEs are induction furnace units and the so called 'patta' segment, which hold around 35% of the market share. Patta is a narrow strip of chromium-manganese stainless steel with less than 1% nickel. This segment is mainly focused on kitchenware and is highly fragmented comprising small-scale players, generally located in the northern and western regions.

The MSME sector, comprising 500 rolling mills spread across the country, has a capacity of about 1.25-1.5 MT for melting and hot / cold rolling steel, which is the input for utensils and other household applications. The sector generates employment for more than four lakh direct/ indirect workforce. The estimated investment in MSMEs is about Rs 5,000 crore, with additional



Rs 5,000 crore in working capital. The industry is mainly concentrated in Jodhpur (25%), Ahmedabad (25%), Bhiwadi (15%), Jagadhari (15%) and National Capital Region (20%).

Estimated production capacities of stainless steel (Fiscal 2022)

Producer type	Number of units	Stainless steel (melt) capacity (MT)
Flat products	11	~3.3
Long products	17	~1.5
Flat + long products	29	1.8-2.0
Overall	57	6.6-6.8

Source: Indian Stainless Steel Development Association (ISSDA), CRISIL Research

There are large number of manufacturing units in both flat and long segments spread across the country, with healthy competitive market conditions.

Till last year, India was second largest stainless-steel producer but now has been overtaken by Indonesia, where huge stainless-steel capacities have been set up by Chinese companies.

By volume, stainless steel is about 3.5% of total steel production, and by value, it forms 12-15% of overall steel consumption. Stainless steel is a distinct low-volume, high-value industry, which needs to be looked differently from carbon steel. Given the higher growth in stainless steel, it has potential to be 4-5% of the total steel industry by 2047.

Indian stainless steel industry is fully globalised with major raw materials being imported, large imports and exports, and end products prices being driven by both raw material prices and international prices of stainless steel.



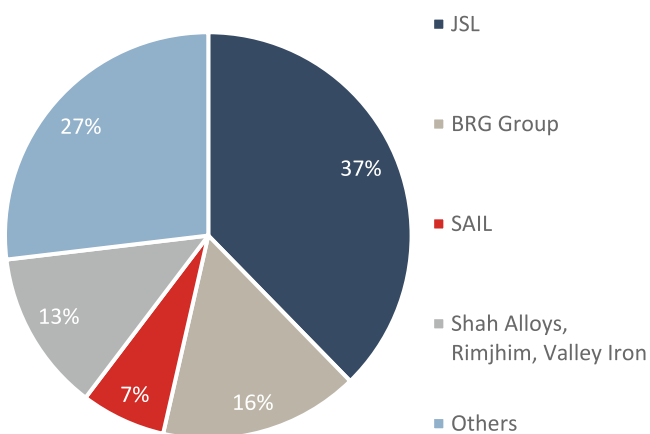
3 Demand-supply in India: fiscals 2016 to 2030

3.1 Stainless steel capacity vs production up to fiscal 2030

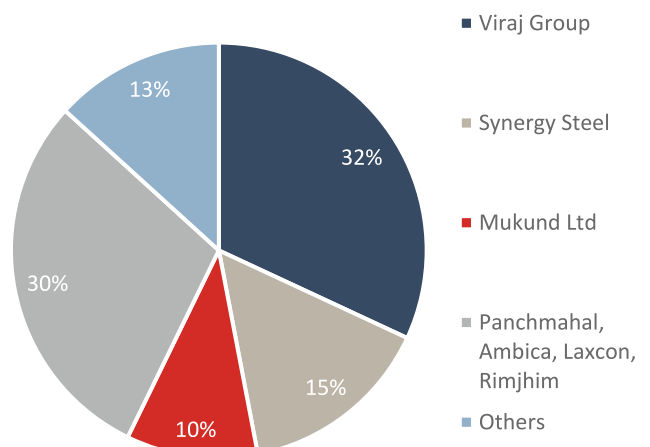
The India stainless steel industry, which posted an ~50% on-year plunge in utilisation levels owing to a nationwide shutdown in the first quarter to contain the spread of the Covid-19 pandemic, revived to 58-60% in fiscal 2022 following an improvement in the economy. During the year, the country's installed stainless steel capacity was 6.6-6.8 million tonne (MT).

Stainless steel melt capacities of major players - Installed (fiscal 2022)

Flat installed capacities: 5.0-5.1 MT



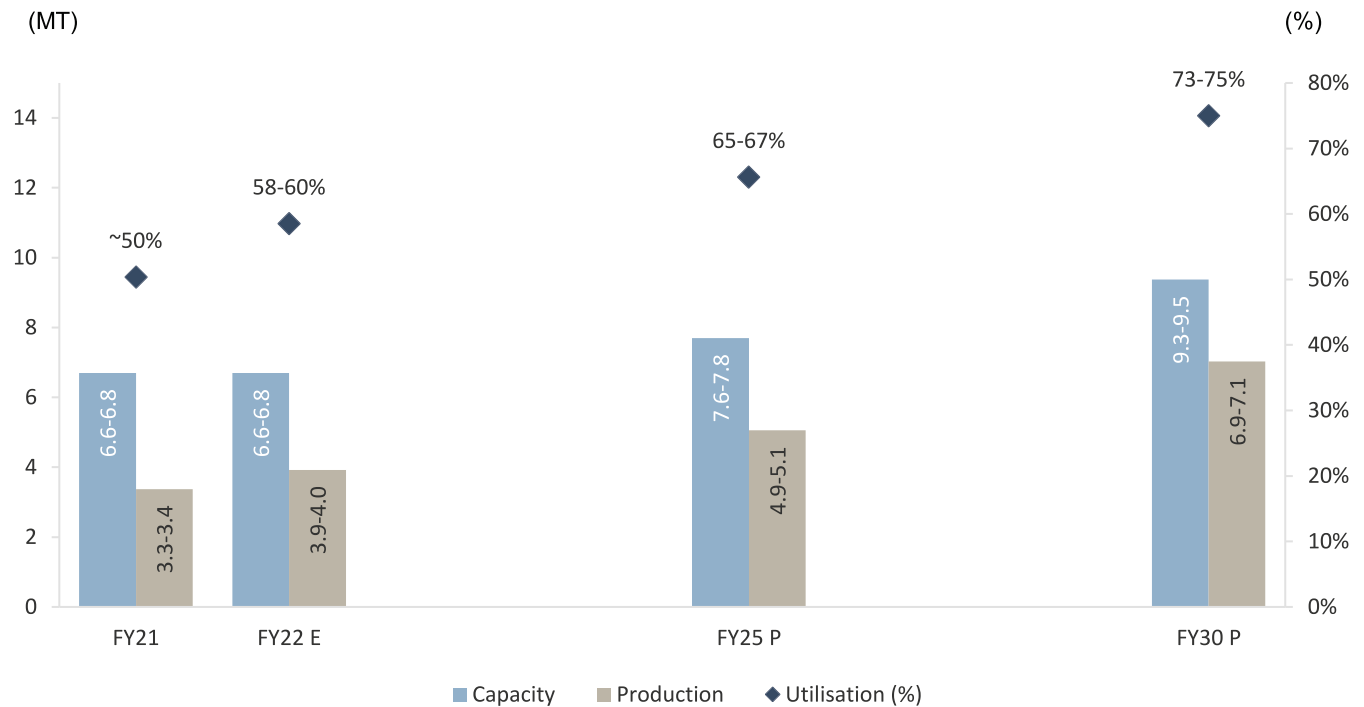
Long installed capacities: 1.6-1.7 MT



Source: Company reports, industry, ISSDA, CRISIL Research

In the medium term, i.e. up to fiscal 2025, a further 1.0-1.1 MT of capacity is expected to be commissioned by Jindal Stainless, which will support production levels to meet rising flat steel demand. Other players are also planning to increase capacities in the medium term. Also, long stainless steel capacities might need to be added for meeting rising domestic long stainless steel demand and maintaining export volume.

Stainless steel (melt) capacity and production



E: estimated; P: projected

Source: Joint Plant Committee (JPC), Indian Stainless Steel Development Association (ISSDA), CRISIL Research

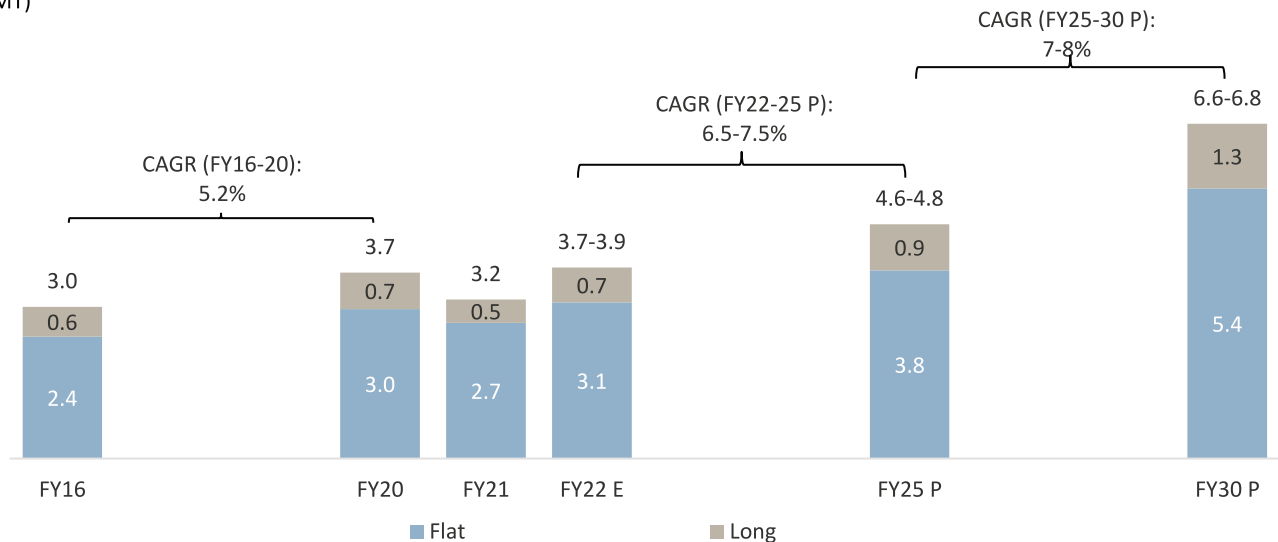
In fact, over fiscals 2025 to 2030, another 1.5-2.0 MT will be commissioned to meet the rising demand for stainless steel owing to rising penetration of the alloy across all end-use industries, growth in end-use industries, and rising demand from new-age applications and maintaining optimum capacity utilisation of 73-75%.

Thus, stainless steel capacity in the country is expected to total 9.3-9.5 MT by fiscal 2030.

3.2 Stainless steel demand in India up to fiscal 2030

Stainless steel (flat and long) demand in India increased at ~5.2% CAGR in volume terms to 3.7 MT between fiscals 2016 and 2020. However, the pandemic severely affected demand, which plunged 14-15% on-year to 3.2 MT in fiscal 2021. In fiscal 2022, stainless steel demand is estimated to rebounded 19.5-21.0% on a low base to 3.7-3.9 MT, supported by a stable macroeconomic environment and normalisation of government spending. During the year, flats are estimated to have contributed 80-85% share of total stainless steel demand.

Stainless steel – flat and long (melt) demand up to fiscal 2030
(MT)



E: estimated; P: projected

Note: The numbers above the bar are total stainless steel demand for that year.

Source: JPC, ISSDA, CRISIL Research

Economic revival, accelerated spending on infrastructure, etc are projected to translate into stainless steel demand posting 6.5-7.5% CAGR to 4.6-4.8 MT between fiscals 2022 and 2025.

Over the longer term, i.e. fiscals 2025 to 2030, CRISIL Research forecasts demand to rise at 7-8% CAGR to 6.6-6.8 MT. The projection assumes India's exports comprise 40-45% and 10-15% share of longs and flats mill productions, respectively, and import of longs and flats at 7-9% and ~20% of mill demand at the end of the projected fiscal.



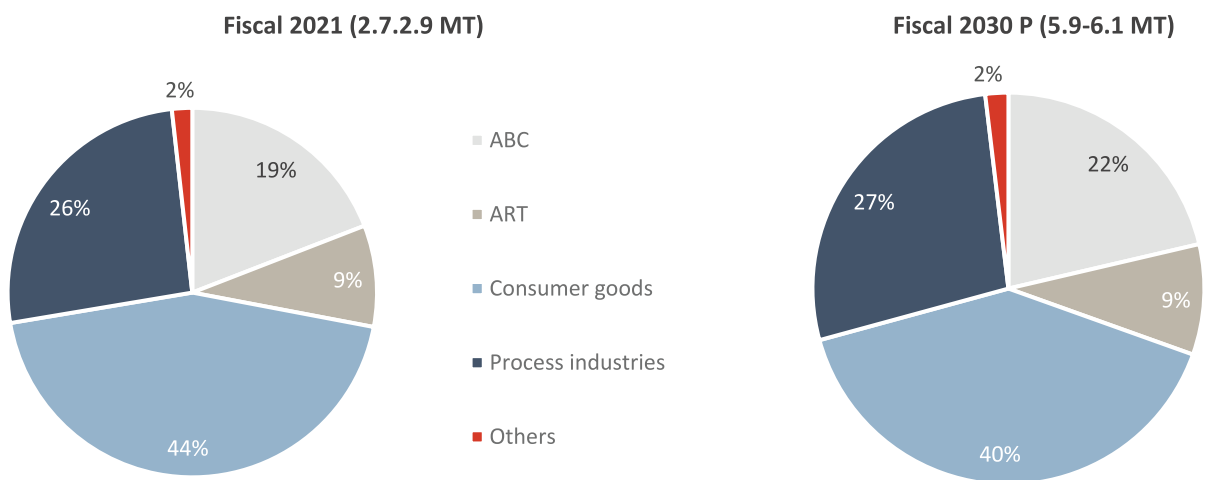
3.3 Market segregation by end-use segments (fiscals 2021 to 2030)

Segment-wise demand of flat steel

Traditionally, stainless steel was primarily used in kitchenware, with a small share in industrial goods. However, over the past few years, there has been increased usage in various applications in automobiles, railways, process industries, and building & construction.

Within the flat stainless steel space, demand is supported by end-sectors such as process industries, consumer durables, and the ABC segment.

Stainless steel (mill) demand segregation - flat and long



P: projected

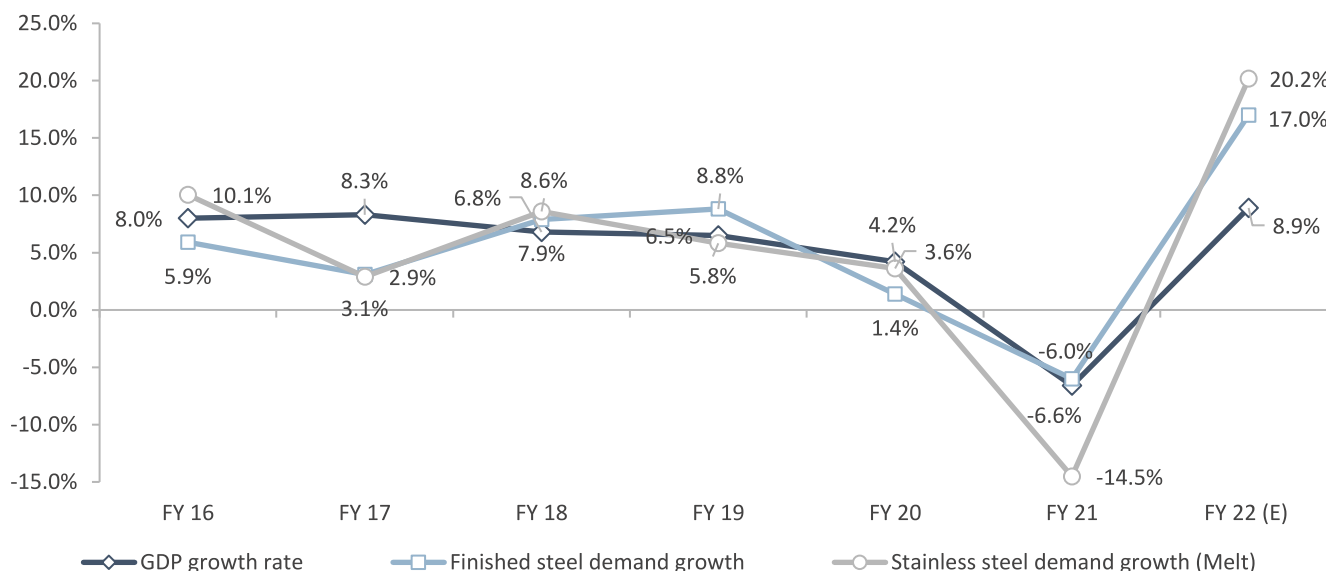
Source: Industry, CRISIL Research

In fiscal 2021, consumer goods (including kitchenware) accounted for the largest end-use segment of the total demand for stainless steel (flat and long) in India at 43-45%, followed by process industries at 25-27%. ABC contributed 18-20% and ART 8-10% of total mill products demand during the year.

3.4 GDP growth and stainless steel demand

Improving GDP, led by improved investments and a growing infrastructure sector, supports the stainless steel end-use segments. Stainless steel has also outpaced demand for finished steel over the five-year period up to fiscal 2022, led by improving consumption intensity across key end-segments.

Comparison of GDP growth with stainless steel (melt) and finished steel demand growth



E: estimated

Source: JPC, ISSDA, CRISIL Research

India is the second-largest consumer of stainless steel, and one of the fastest-growing markets. The country's per capita consumption of stainless steel rose from 1.2 kg in fiscal 2010 to ~2.5 kg in fiscal 2022, owing to increasing use of stainless steel in public infrastructure, spurred by government spending. However, It is still far below the global average of 5.5-6.0 kg, which indicates a huge opportunity for growth.

Between fiscals 2021 and 2025, stainless steel demand is expected to increase at 6.5-7.5% CAGR to 4.6-4.8 MT, with demand projected to reach 6.6-6.8 MT by fiscal 2030. The increase in demand will rise per capita consumption of the alloy to 3.0-4.0 kg in fiscal 2025, and 4.5-5.5 kg in fiscal 2030.

Demand for stainless steel in India continues to rise in segments such as process industries and the ABC segment, supported by growth in demand from ART and consumer goods, with the country remaining the second-largest consumer of stainless steel globally.



4 Demand-supply of stainless steel: Fiscals 2040 to 2047

4.1 Consumption pattern

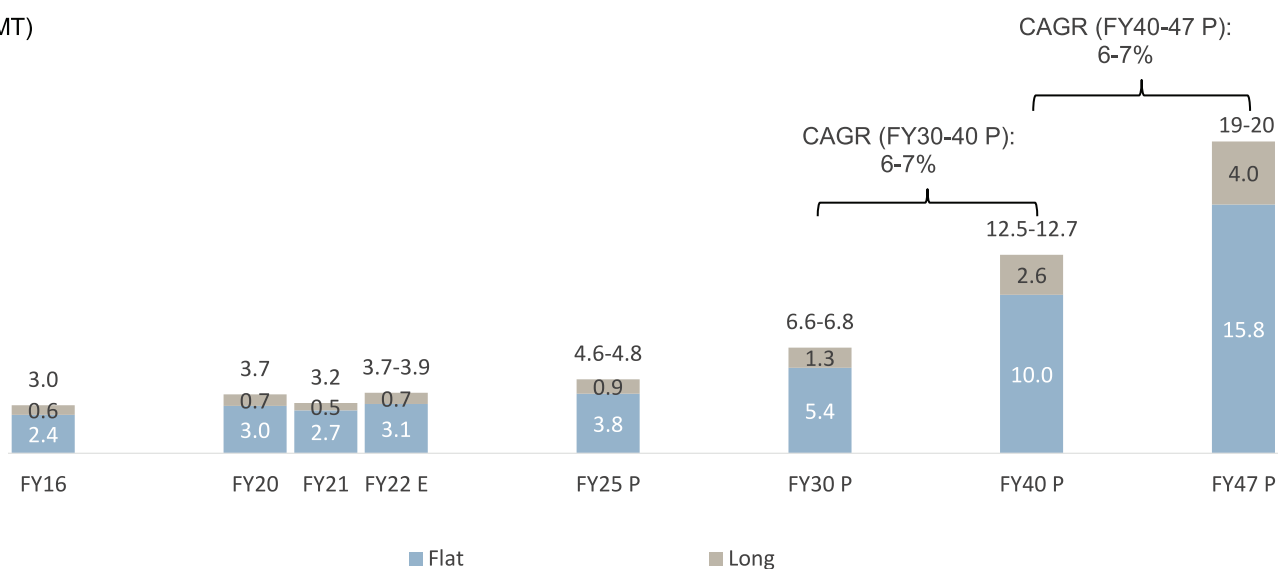
Stainless steel consumption is projected to reach 19-20 MT, as the country grows to a \$40-trillion economy by 2047

As India aspires to become a \$40-trillion economy by 2047, growth will be fuelled by government investment across sectors such as construction, infrastructure, and manufacturing – the key contributors to GDP. Focus will largely be on infra and construction. Manufacturing industries will have a very crucial role to play as well. Demand for transport modes such as passenger and commercial vehicles (PVs/ CVs), and railways will increase. Economic growth will also boost demand for consumer durables. Growth of process industries is bound to improve, too. Faster growth will consequently lead to faster demand for stainless steel from the end-use industries. Incrementally, CRISIL Research has also considered that penetration of stainless steel across end-use industries will increase over the forecast period owing to the unique properties of the alloy.

Considering the country reaches \$40 trillion economy by 2047 and a multiplication factor of 1.03-1.06 between GDP growth and stainless steel demand growth, CRISIL Research projects stainless steel consumption to rise at a CAGR of 6-7% between fiscals 2030 and 2047, to reach 12.5-12.7 MT and 19-20 MT by fiscals 2040 and 2047, respectively.

Stainless steel - flat and long (melt) demand outlook

(MT)



E: estimated; P: projected

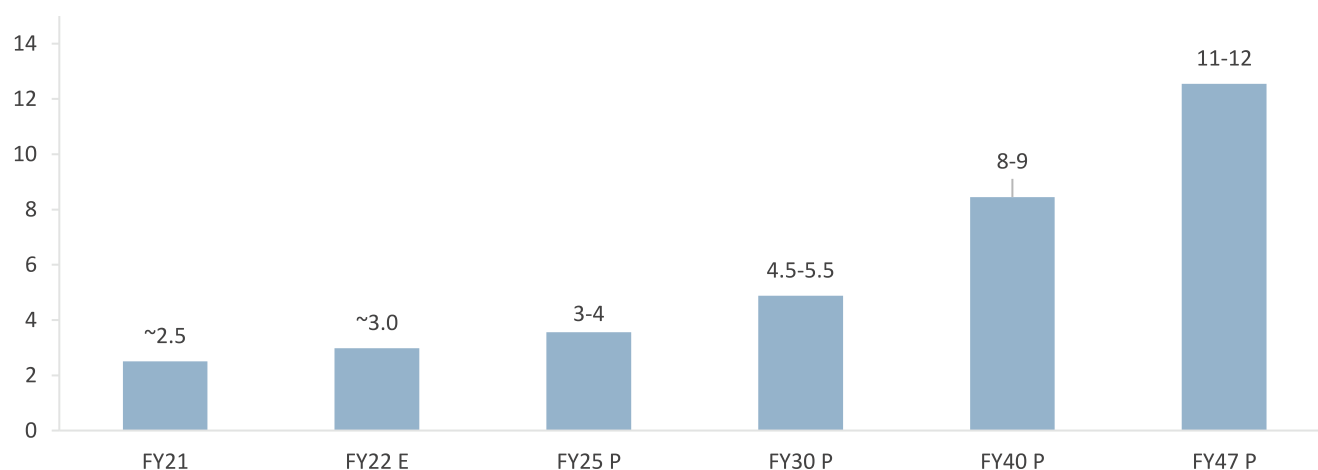
The numbers above the bar charts represent total stainless steel demand for that year

Source: JPC, ISSDA, CRISIL Research

Additionally, considering India's population grows 0.8-1.0% every year, the per capita consumption should reach 8-9 kg and 11-12 kg in fiscals 2040 and 2047, respectively.

GDP growth, increase in demand and per capita consumption of stainless steel

(Kg)



E: estimated

Source: ISSDA, CRISIL Research

4.2 India's stainless steel capacity vs production

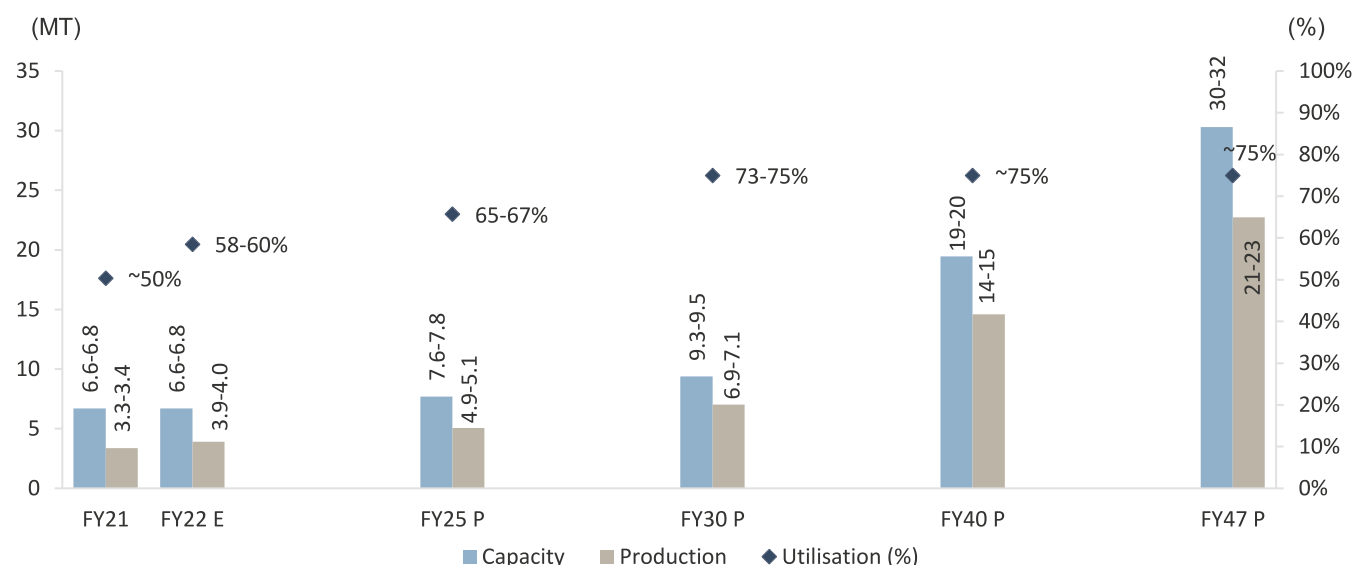
Production-to-capacity ratio needs to improve over the long term to meet rising demand

As discussed in the earlier sections, as of fiscal 2022, India has an estimated installed stainless steel capacity of 6.6-6.8 MT. The utilisation level of the industry is estimated to have improved from ~50% in fiscal 2021 to 58-60% in fiscal 2022.

In the long run, the rise in stainless steel melt demand from 3.7-3.9 MT in fiscal 2022 to 19-20 MT in fiscal 2047 would necessitate higher domestic production. In order to meet the estimated demand, India needs to develop enough capacities, while improving the capacity utilisation in the long run. This will also help the industry remain aligned with the country's vision of Aatmanirbhar Bharat and, thus, aim to reduce imports. Therefore, considering the capacity utilisation at ~75%, total capacity of the Indian stainless steel industry should reach 19-20 MT by fiscal 2040 and 30-32 MT by fiscal 4047. This implies that we need to increase the capacity by 4.5 times over the next 25 years. This is considering target of exports for longs and flats as a percentage of mill production at 33-35% and 10-12%, respectively, in fiscal 2047.



Stainless steel (melt) capacity and production outlook



E: estimated; P: projected

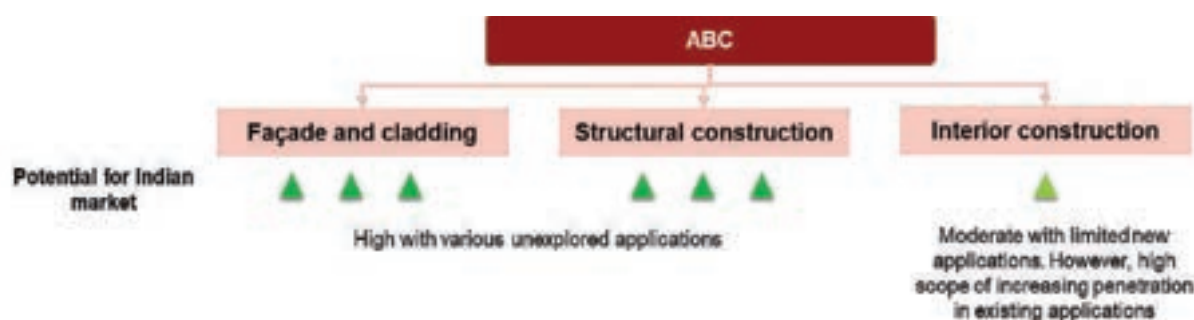
Source: JPC, ISSDA, CRISIL Research

Typically, stainless steel consumption rises with increase in GDP and industrialisation. The penetration of the alloy is expected to improve due to new age applications across segments owing to its unique properties.

4.3 New-age applications to boost domestic consumption of stainless steel

Stainless steel has enormous growth potential in India. To reiterate, consumption of the alloy is expected to grow with India realising its vision of becoming a \$40-trillion economy by 2047. Some of the evolving and new-age applications of stainless steel that will drive demand in the long run are discussed below:

ABC



Facade and cladding

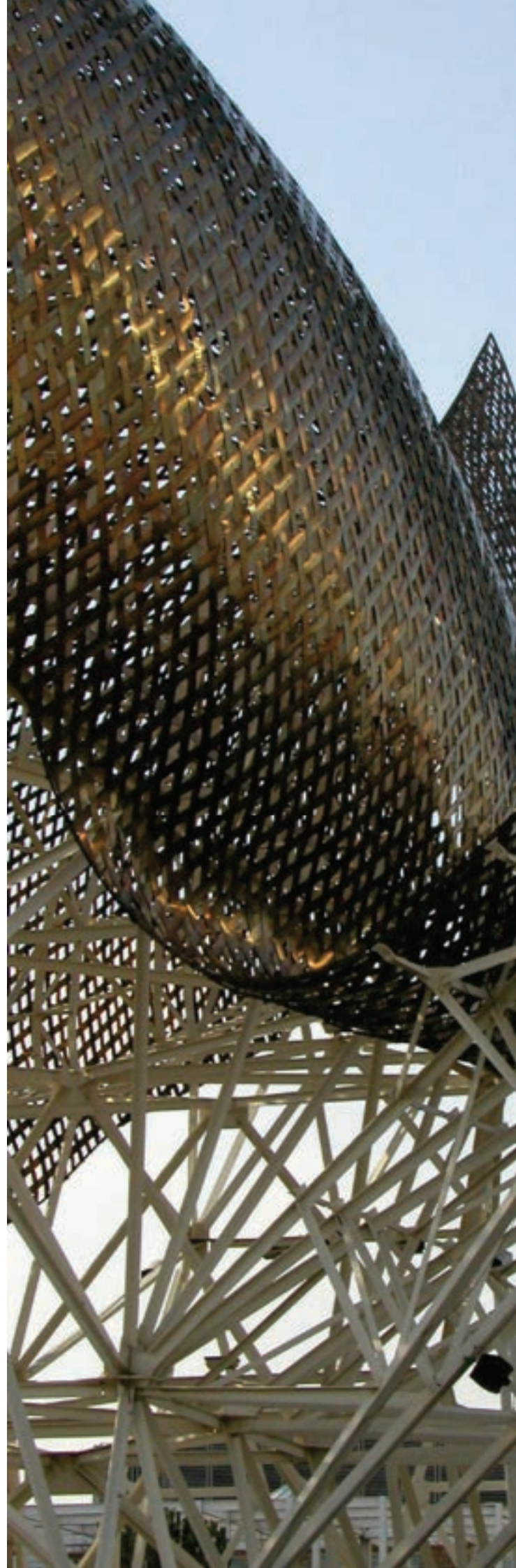
Stainless steel façade and claddings are sustainable and cost-effective for buildings. They provide a cutting-edge, modern, contemporary and futuristic appeal as well as high durability and corrosion resistance.

Stainless steel façades are popular worldwide and have a wide range of applications in architectural constructions, such as museums, airports, commercial complexes, and housing projects. However, in India, usage of stainless steel facades is in the nascent stage. Transit buildings, such as airports and Mass Rapid Transport System (MRTS), have been using stainless steel in areas such as bollards, column claddings, ticket counters, benches, escalators, lifts, handrails, and canopies.

Construction (structural and interior)

Globally, stainless steel is preferred for the construction of load bearing structures and disaster-proof infrastructure as stainless steel offers high resistance to corrosion, good strength to weight ratio, and enhanced safety. Such applications are increasing in India as well and are likely to propel the future growth of stainless steels in the country. Some of such applications are:

- **Reinforcement bars for concrete structures:** On account of its ability to provide maintenance free long life to civil structures, stainless steel reinforcement bars are gaining acceptance in civil construction, especially near coastal regions. The government initiative to promote sustainable infrastructure based on the life cycle concept will provide impetus towards further usage of stainless steel reinforcement bars in India. Going head, this application is expected to attract enormous demand for stainless steel in India
- **Stainless steel for support structures:** Stainless steel is a popular material because of its durability and longevity. It also offers maintenance-free service life and advantages of safety as it retains structural strength even at elevated temperatures, like case of an accidental fire. As a result, structural stainless steel is used in road over bridges and foot over bridges. In future, use of stainless steel for support structures is likely to grow at a rapid pace.
- **Disaster-proof infrastructure:** Due to properties such as durability, reduced corrosion resistance and lower weight, stainless steel is extensively used in disaster-proof infrastructure such as dams, floodgates, earthquake-resistant structures, and seawalls.
- **Water tanks and plumbing applications:** Stainless steel is resistant to oxidation by biocides and inert to water. It is low



on maintenance and offers ease of cleaning. This material is most suitable for water storage such as overhead water tanks and plumbing applications. Water storage tanks and leak proof plumbing solutions made of stainless steel are expected to gain popularity in the country.

Other emerging stainless steel applications across public infrastructure

The government has rolled out ambitious programmes such as the Atal Mission for Rejuvenation and Urban Transformation; Smart Cities Mission; Swachh Bharat Mission; Sagarmala; and Transit Oriented Development for the expansion and modernisation of the metro rail network, railways, airports, and bus rapid transit. These programmes are aimed at improving rural and urban infrastructure. Because of the various advantages of stainless steel over other construction materials, its penetration is increasing across all modern infrastructure.

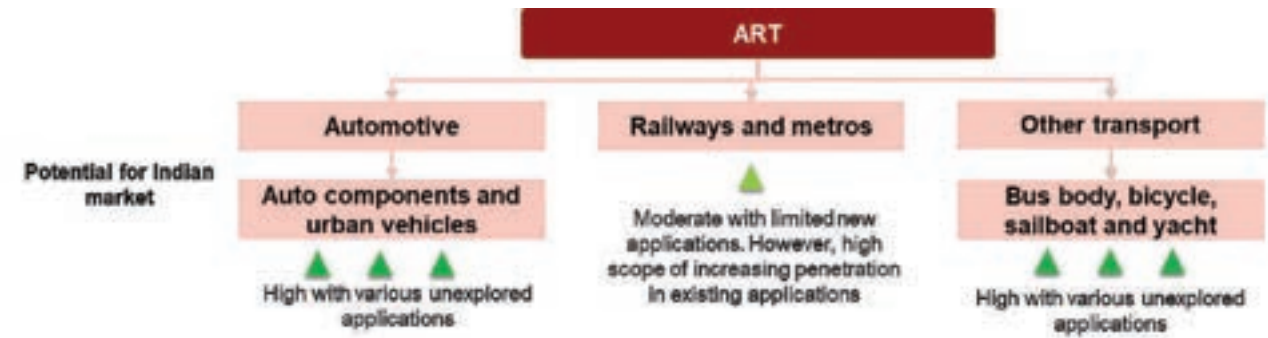
Currently, different state governments offer different incentives/benefits under their respective green building initiatives. Stainless steel is a green product. It is recyclable, does not produce toxic run-off, and offers durability and longevity. Even if the alloy finds its way to a landfill it is not detrimental to soil, water or air. Therefore, with increasing concept of green buildings in India and effective laws/policies on national level for the same, demand for stainless steel is expected to grow from this segment.

In India, we see many other growth opportunities for stainless steel. Some of them are:

Category	Application
Facades	Green and transit buildings, cladding
Construction	Support structures, public installations, enclosures, bus shelters, sanitation, water tanks, plumbing, water ATMs, smart poles in smart cities, FOBs and ROB (foot and road over bridge)

Note: Key suppliers include both component and stainless steel material suppliers

ART



Stainless steel has a wide range of applications across automotive, railways and transport segments, as it offers better performance and is fire resistant. It has an aesthetic appeal for sustainable design, where long-term performance is expected.



In the global scenario, applications of stainless steel in ART include development in a direction to achieve lower weight and longer life using higher strength and longevity in areas such as electric vehicles, transportation containers, and other modes of transport.

In India, stainless steel is used in manufacturing for automobiles component, railway wagons and coaches, luxury bus bodies, and metro coaches. These applications of stainless steel are considered one of the most significant demand drivers and is likely to pick up pace.

Stainless steel is increasingly finding application in electric and renewable energy-based vehicles. With the government's increasing focus on promoting these vehicles to address the rising emission issues faced by the country, demand for stainless steel is bound to rise from this segment.

Other emerging stainless steel applications

Other existing applications of stainless steel gaining momentum include stainless steel electric vehicles, bus bodies, fuel tanks etc.

Some of the growth opportunities for stainless steel in India under ART segment are:

Category	Application
Automobile	Bharat-VI norms
Railways and MRTS	Metro projects, wagon and coaches in railways/ metro rail, stainless steel modular toilets, public seats

Note: Key suppliers include both component and stainless steel material suppliers

Consumer durables

Properties of stainless steel, such as high toughness, ductility and low maintenance, have increased its utilisation in consumer goods such as cookware, washing machines, and refrigerators.

Stainless steel is used in white goods, as it is resistant to corrosion, can be easily fabricated, offers good mechanical properties over a wide range of temperatures, and can be given a range of exclusive finishes.

In India, stainless steel has been a dominant material in household kitchens in the form of utensils. It is being used in commercial and modular kitchens.

Some of the upcoming applications of stainless steel include reusable boxes and tri-ply cookware. Tri-ply cookware includes pressure cookers, frying pans, woks, and other cooking utensils. As the name suggests, these are made up of three layers of material sandwiched together; often, inner and outer layer of stainless steel with a middle layer of aluminium. These cookware are gaining popularity in Indian kitchens.

Following are the key growth opportunities for stainless steel under consumer durables industry:

Category	Application
Electronics	Washing machines, refrigerators, and microwave ovens
Kitchenware	Modular kitchen, reusable boxes, and tri-ply cookware

Process industries



Stainless steel has a wide range of applications across process industries, such as use in pharmaceuticals for production of intravenous medications and industrial machinery due to high corrosion resistance and lower weight.

It is inert to most food environments and, hence, is an ideal material for the food industry. Worldwide, it is a standard practice for dairy and meat industry equipment and processing plants to be made of stainless steel.

In India, it is widely used by the dairy sector. It is also used in meat, oil and beverage processing equipment.

Some of the growth opportunities for stainless steel in India under process industries:

Category	Application
Process industries	Containers, pipelines and tubes, heat exchangers, food contact equipment, storage tanks, condensers, processing and packaging machineries, processing and reaction vessels, accessories (includes the fittings, valve, pumps, and lab instruments), and other utilities (includes all other machinery and equipment used to clean/ purify air and water)



5 Policies needed to drive stainless steel consumption

In order to achieve the desired growth by 2047, the Indian stainless steel industry will need more support from the government in terms of policy interventions to increase the intensity of usage. CRISIL Research has identified few areas, where efficient government policies/ initiatives can help the industry grow in the long run.

5.1 Impact on capacity requirement, capex, resources, and employment generation (direct + indirect)

The government has been giving a lot of thrust to 'Make in India' since 2014, and capacity addition in critical sectors is key to the success of this initiative. While making the manufacturing sector the frontrunner of the economy, there is a need to focus on other sectors that will deliver maximum strategic impact. Clearly, stainless steel fits the bill. Increase in consumption of the alloy at 6.5-7.5% and 6-7% CAGR between fiscals 2022 & 2025 and 2025 & 2047, respectively, will entail more capacity addition in the future.

Raw material security

Raw material, accounting for about 70% of the total cost of sales, is the single largest cost component for stainless steel producers. Thus, a secure and uninterrupted raw material supply chain is critical to enjoy a competitive advantage.

Stainless steel production requires various raw materials such as ferro nickel, nickel, ferro moly, ferro silicon, ferrochrome, and molybdenum. Stainless steel scrap is also used to produce stainless steel products. The prices of these metals are volatile due to fluctuating consumer demand, speculation, demand-supply imbalance, and market conditions (political unrest or financial stress/uncertainty in the economy). The industry needs a long-term policy vision, allowing duty-free imports of raw materials at a sustainable rate.

Stainless steel scrap: Stainless steel manufacturers are dependent on stainless steel scrap imports as it is available in the country in limited quantities. This is due to the long life cycle of stainless steel (30-40 years) and given the fact that stainless steel usage has picked up in the country only in the past 20-25 years. The government needs to make sure this key raw material is adequately available.

- In order to ensure availability of sufficient quantities of good quality scrap, there is a need to establish scrapping centres all over the country. Scrapping yards need to be set up from where such scrap can be purchased by stainless steel manufacturing units. These centres should be encouraged to find ways to segregate stainless steel scrap from other iron and steel scrap. CRISIL Research strongly emphasises on regulatory support to modernise the Indian stainless steel recycling industry. Modern technology will also ensure maximum and quality recovery from the used metal.
- Further, there is a need to provide capital subsidy for setting up such centres, lending at concessional rates of interests and tax incentives for at least the initial 5 years.
- Also, focus should be on facilitating the setting up of scrapping centres through easing of the policy guidelines and handholding the centre operators for regulatory compliance.
- Zero customs duty on stainless steel scrap and steel scrap imports should be continued till the time the country becomes self-sufficient in it.

Ferro alloys: A typical feature of the industry is the inter-changeability of production between ferro chrome and ferro manganese by smaller players based on the prevailing market scenario, which has largely been responsible for no major capacity addition over the years. The following interventions are proposed to ensure availability of ferro alloys:

- Export duty at 30% on chrome ore needs to be continued on a long-term basis to ensure availability of the raw material at a competitive price
- For the entire range of ferro alloys, the operations are raw material intensive. Fluctuation in raw material prices affects players' profitability. Support is sought to develop a mechanism to control price volatility
- The ferro alloy industry is power intensive and is driven by the steel and stainless steel industries. Thus, the producers of ferro alloys may be encouraged and supported to set up larger units to achieve adequate economies of scale. Efforts should be made to provide necessary raw material linkages and stable supply of power to grow ferro alloy units.

Nickel is not produced in India and the entire demand is met through imports. On the back of increased stainless steel production in India, consumption of ferro nickel increased at a CAGR of ~30% between fiscals 2016 and 2020. Growth in imports of ferro nickel is directly proportional to growth in stainless steel with few considerations such as ample amount of availability of stainless steel scrap and changes related to duties on imports of ferro nickel. Hence, the government needs to rationalise the import duty on ferro nickel to improve the cost competitiveness of the domestic industry. Simultaneously, research and development (R&D) needs to be pursued to extract nickel from the lateritic ore overburden available in Sukinda Valley, Orissa.



Infrastructure and logistics

The cost of logistics plus hedging cost (on account of exchange rate fluctuations) becomes substantial during import and export. Increase in lead time involved in international trade results in blockage of working capital for any industry. Thus, road and rail infrastructure are fundamental to the stainless steel industry's health.

Focus on **PM Gati Shakti Scheme** driven by the seven engines of roads, railways, airports, ports, mass transport, waterways and logistics infrastructure aimed at world class modern infrastructure and logistics synergy is expected to support the Indian stainless steel industry. Other interventions sought for infra and logistics are as follows:

- Transportation of raw materials and finished goods through inland waterways and coastal shipping should be promoted. A collaborative effort is proposed to be made in conjunction with Inland Waterways Authority of India along with other concerned ministries to facilitate debottlenecking of inland waterways transportation through dredging, modernisation of jetties, simplifying the approval process for environmental and coastal regulation zone (CRZ) clearances, and improved connectivity with road through dedicated corridors and rail
- To encourage export opportunities and be competitive, a port-led development of stainless steel clusters under the aegis of the Sagarmala programme is being implemented. Specific ports along the eastern coast with adequate container loading facility need to be identified and earmarked since bulk of the raw materials for stainless steel as well as finished goods are moved in containers
- Increasing availability and allocation of rakes to the stainless steel sector is also an effective way to support the industry

Downstream skill upgradation: Potential collaborations and need for training centres

The stainless steel industry is capable of generating sizable employment, both direct and indirect. As per industry interactions, the industry is capable of generating about 10,000-12,000 direct and indirect jobs per MT of capacity. Therefore, government attention is sought across the following areas:

- There is a need to encourage and sponsor research and development at academic and research institutes to develop new grades and new applications of stainless steel.

- Some stainless steel manufacturers are taking initiatives and training fabricators. However, training stainless steel fabricators should be undertaken at a larger scale and the existing training facilities should be enhanced further.
- Possible collaborations should be worked out with National Skill Development Corporation (NSDC) and Skill India Programme for targeted execution and delivery of skill development modules under the aegis of the Skill India Mission.
- There is huge potential for setting up downstream industries in stainless steel but many start-ups and entrepreneurs struggle to find technical support. The government may consider setting up a Centre of Excellence for stainless steel to guide and encourage budding start-ups and young entrepreneurs in setting up their stainless steel-based manufacturing units.
- Further, inducting stainless steel in the curriculum of technical institutes would also be a step in the direction of making skilled manpower available to the industry.

The stainless steel industry is capable of generating sizable employment, both direct and indirect. Stakeholders in the industry believe it is capable of generating about 10,000-12,000 direct and indirect jobs per MT of capacity.

Environment management

Stainless steel being completely recyclable at the end of its useful life makes it one of the greenest metals available and achieves the circular economy target. The following interventions would help the Indian stainless steel industry in the long run:

- **Circular economy:** Stainless steel scrap is one of the key raw materials for the industry. Thus, government support is essential to ensure availability of adequate scrap for the domestic industry at competitive prices as mentioned earlier.
- Further, in order to align with Prime Minister Modi's vision of meeting 50% of our energy requirements from renewable energy by 2030 and achieving net-zero carbon emissions by 2070, there is a need for the stainless steel industry, too, to use renewable energy. Using processes such as steam generation from waste heat instead of propane-fired boilers would help the industry reduce CO₂ emissions.
- The government can consider awarding carbon points to units that recycle stainless steel on a large scale



5.2 Impact of Aatmanirbhar Bharat, Make in India, the PLI scheme, and changing technology on demand growth

Government initiatives such as Aatmanirbhar Bharat, Make in India and Production Linked Incentive (PLI) scheme are steps taken in the right direction.

The Make in India programme was launched in September 2014, with the aim to transform India into a global hub for manufacturing, research and innovation. Twenty five sectors were recognised under this initiative and the programme encouraged companies under these sectors to manufacture their products in India. Growth of the stainless steel industry is conducive to most of the sectors identified under the programme such as food processing, construction, automobile and pharmaceuticals.

Policies can be framed to encourage and promote domestic brands across various industries. Also, companies using indigenous raw materials in their production processes should be provided some benefits. Similarly, the Make in India initiative should be promoted in the true sense, i.e. manufacturing parts in India should be encouraged and mere assembling in India should be discouraged via appropriate incentives or taxes to the manufacturers.

Aatmanirbhar Bharat Abhiyan was also launched on similar lines. The Government of India launched this mission in May 2020, to make India self-reliant. One of the major elements of Aatmanirbhar Bharat is less reliance on imports. Thus, as discussed earlier in different sections, in order to remain aligned with the vision of Aatmanirbhar Bharat, the government's support is needed to add capacities, optimise import-export balance, control raw material prices, and improve capacity utilisations by means of various policies.

Moreover, the stainless steel sector has developed some high-end grades by adding substantial value in duplex and 400 series. There is a need to strengthen such efforts of the industry by providing the PLI incentive in specialty stainless steels. Specific grades for the scheme need to be identified in consultation with the industry.

Some other policy interventions to support the overall stainless steel industry are discussed as below:

Technology upgradation and R&D

- Product development is another important area which needs to be supported through investment grants by the government. Measures need to be taken to ensure development of special steel and alloys to minimise dependence on imports
- Also, industry-academia linkages should be encouraged for new product developments and innovation in the sector
- R&D should be strengthened to understand and study new-age application of stainless steel globally and its applicability in India. Large producers in the country are already investing in R&D. Moreover, chances of collaborating with Steel Research & Technology Mission of India (SRTMI) should be explored to further strengthen R&D in the stainless steel sector
- One of the key reasons for quality deficiency in stainless steel or steel in the secondary sector operating through induction furnaces is the lack of refining facilities. While many stainless steel units are equipped with Argon Oxygen Decarburisation (AOD)/ Vacuum Oxygen Decarburisation (VOD) to make quality steel, others may require some kind of incentive to install refining units

Industry 4.0: Advantages of digitalisation in stainless steel industry

Adoption of Industry 4.0 will help the industry enhance its competitiveness. It will help the industry optimise the processes, supply chain, distribution channels, etc, as Industry 4.0 leads to integration and digitalisation of all the processes across the value chain. The government may consider development of specific digital business solutions for MSMEs, which can be easily adopted by them.

Product quality and efficiency

- While production and imports of sub-standard products pose a threat to the industry, it also puts users' safety at risk. Thus, mandatory adherence to prescribed Bureau of Indian Standards (BIS) should be ensured
- The Steel and Steel Products (Quality Control) Order ensures Quality Control Orders (QCO). Three stainless steel standards are included in the QCO and non-adherence to these orders should be heavily penalised. Efforts should be taken to bring more and more products under the QCO
- The government should also encourage and support setting up world class quality testing facilities and upgrading the existing ones to facilitate better compliance to QCO

Health and safety

Health and safety of the workers should be top priority for all the manufacturing units. The following interventions are sought on this front:

- On-the-job training on maintaining a safe workplace should be provided regularly. Small-sized units which cannot afford to conduct such trainings on their own need to be facilitated by the Ministry of Steel.
- A healthy and safe work environment leads to overall efficiency of the entire industry. Thus, a system should be devised to track if the companies are strictly practising the prescribed safety standards and strict action should be taken against the defaulters.

5.3 Other initiatives to drive stainless steel adoption in end-use industries

ART: Automotive Mission Plan 2016-2026 and vehicle scrappage policy are some of the government initiatives that will support growth of the domestic auto industry.

In February 2016, the government decided to skip the Bharat Stage (BS)-V emission standards and move directly to BS-VI norms by April 2020. Stainless steel is extensively used in BS-VI-compliant exhaust systems, with its weight increasing from ~20 kg to ~30 kg in CVs. Also, ferritic grades such as 409L, 436L, 439, 432, 441, and 444 are ideal for BS-VI-compliant exhaust systems owing to their resistance to heat, oxidation and corrosion. Additionally, introduction of the vehicle scrappage policy is expected to boost stainless steel demand in the automobile sector.

Application of stainless steel has expanded to various parts such as pump bodies, heat shields, wipers, airbag containers, belt springs, and hose clamps. Further, increased safety features are expected to raise stainless steel intensity per vehicle in the future.

Demand for the alloy will also be driven by rising penetration of stainless steel in railway rolling stock. The Indian Railways has completely switched to LHB coaches that have stainless steel shells. Increasing penetration of stainless steel wagons and coaches, rising usage of the alloy in rail infrastructure, proposed station modernisation and dedicated freight corridors (DFC) are expected to drive demand for stainless steel from railways.

ABC: Stainless steel is a popular choice of material because of its durability and longevity. It also offers maintenance-free service life and advantages of safety, such as the ability to retain structural strength even at elevated temperatures as in case of an accidental fire. There is a need to encourage usage of stainless steel in the ABC segment such as application in modernisation of existing infrastructure and construction of new ones.

5.4 Trade flow: Review and forecast

India is a net exporter and net importer of long and flat stainless steel, respectively

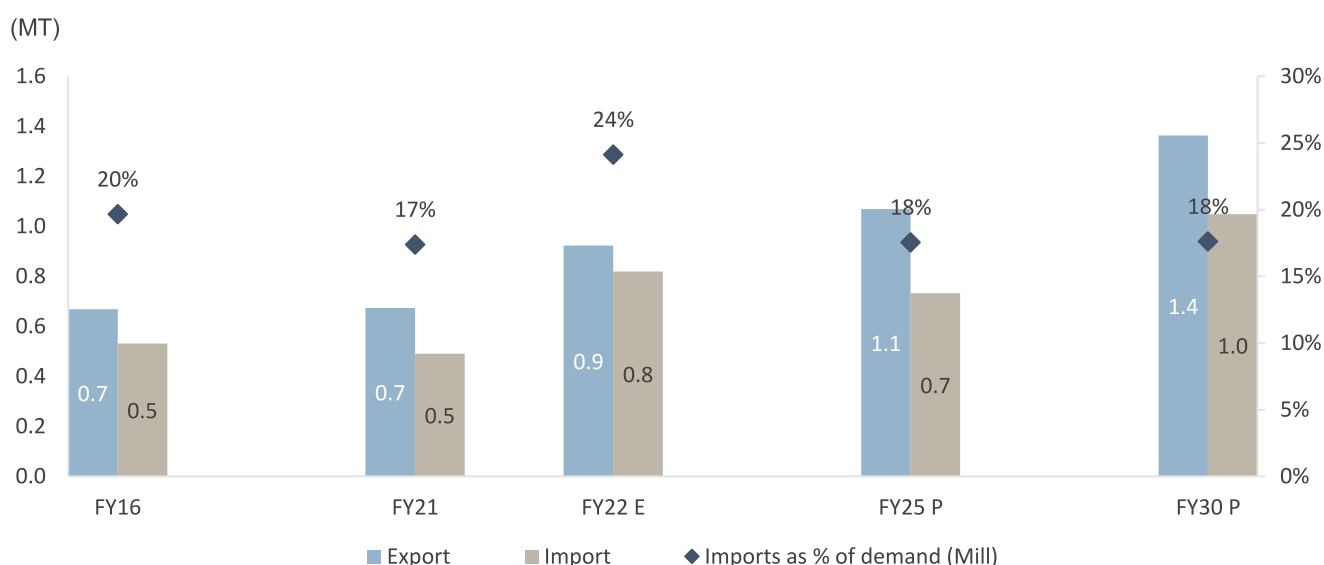
While India has been a net exporter of stainless steel over the past several years, the country is a net importer of flat stainless



steel. While flats' share in total stainless steel exports has ranged largely between 35-45% since fiscal 2016, flats have accounted for minimum 90% of the total stainless steel being imported in the country, over the same duration. High level of imports of flats has been one of the major challenges for the Indian stainless steel industry. This has led to low capacity utilisation in the country and shutdown of small units. India imports from Indonesia, Korea, China, Japan, Malaysia, and Vietnam, amongst others.

Import of stainless steel is estimated to have jumped in fiscal 2022 to 0.82 MT from 0.53 MT in fiscal 2016, with sizable rise in import from ASEAN countries and countries with free trade agreements (FTAs).

India's trade flow of stainless steel: review and forecast



E: estimated; P: projected

Source: Ministry of Commerce, JPC, ISSDA, CRISIL Research

Demand for stainless steel (melt) in the country is expected to swell and reach 19-20 MT in fiscal 2047. Also, the target of reduced dependence on imports in the long run would necessitate addition of more capacity, higher domestic production and improved capacity utilisation.

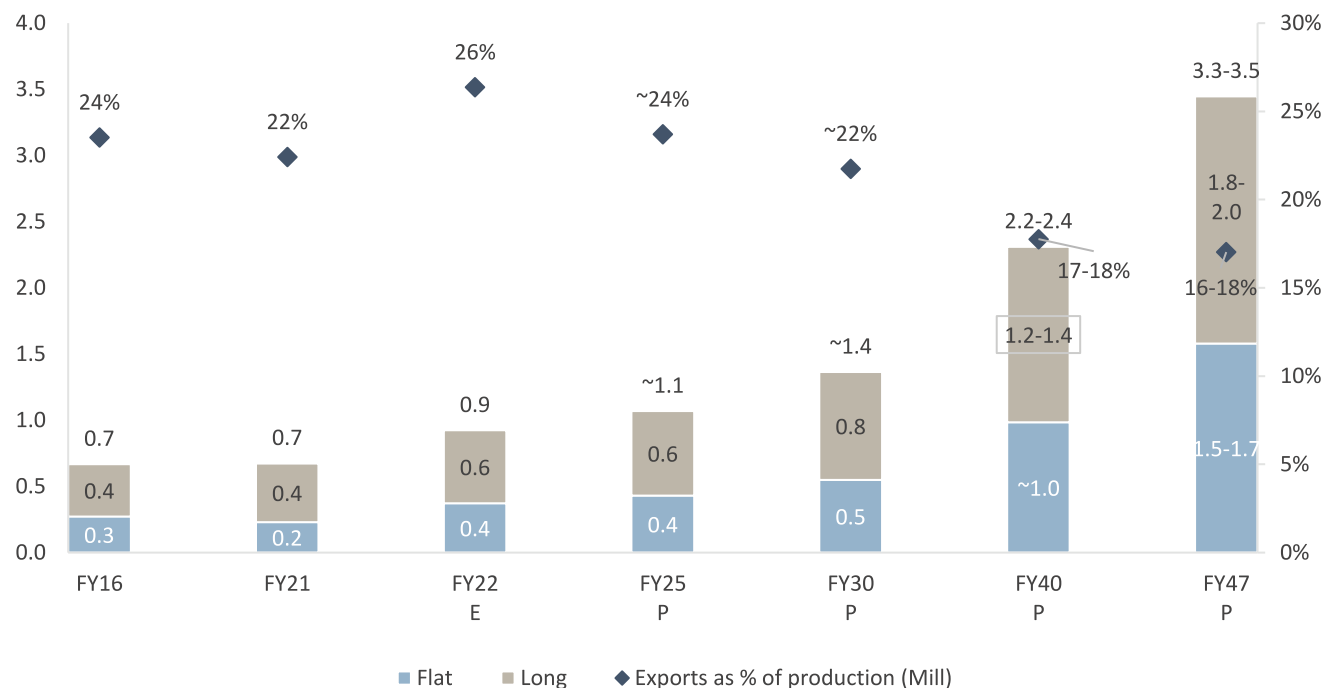
Increase in export of stainless steel

Total export of stainless steel rose at a CAGR of 2.4% from 0.67 MT in fiscal 2016 to 0.74 MT in fiscal 2020. The pandemic hampered exports, dragging it down by 8.3% to 0.67 MT in fiscal 2021. It is estimated to have increased at a rate of 35-40% on-year and reached about 0.92 MT in fiscal 2022.

Further, with demand for stainless steel rising and Indian producers working towards improving capacity utilisation from ~50% in fiscal 2021 to 73-75% in fiscal 2030, India will be able to meet domestic demand and cater to the export opportunity as well. While India should aim to reduce dependence on imports, improving exports of stainless steel should also be targeted to rise at a CAGR of ~5% and reach 1.1 MT in fiscal 2025. The country should focus on ramping up exports to reach 3.3-3.5 MT, at a CAGR of 5-6% between fiscals 2025 and 2047.

Export of stainless steel: review and forecast

(MT)



E: estimated; P: projected

The numbers above the bar charts represent total stainless steel export for that year

Source: Ministry of Commerce, JPC, ISSDA, CRISIL Research

Signing FTAs with India's major markets, namely the EU and US, and negotiations towards reducing the non-tariff barriers would encourage exports. Efforts should be taken to cover the stainless steel sector under the Remission of Duties and Taxes on Exported Products (RoDTEP) scheme.

Given the fact that the capital goods industry is still at a development stage in India and there is a limited base of capital goods for the stainless steel sector in the country, continuation of the Export Promotion Capital Goods (EPCG) scheme is the need of the hour. Further, high reliance on imports for raw materials also necessitates the continuation of the Advance Authorisation Scheme (AAS) for the sector.

There is also a need to promote R&D to understand the usage and application of stainless steel in the export market and develop products and facilities to cater to the export opportunity in the long term. Any collaboration with international players, in this direction, should also be explored.



6 Annexure

6.1 New-age applications: Global case studies

ABC

Category	Application	Global example	Grade used
Facade cladding	Museum	Governador Plácido Castelo Stadium - Castelão Arena	444/2B
	Airport	Interior pedestrian hall at Mexico city international airport	304, with interior and exterior polished finish
	Housing project	New Gambetta Housing Complex, Nantes	EN 1.4307
Fixtures	Shower booths	Shower booths at Grand Hyatt, Fukuoka	Extra low-interstitial ferritic stainless steel – NSSCFW2
Construction	Earthquake-proof construction	Toride Naruto (museum in Japan)	Toughen Z (hot-dip, galvanised steel plate of SUS 430)
	Rehabilitation of historical heritage		Duplex stainless steel rebar
	Electrical enclosures	Electric enclosures for BHP's Olympic Dam	316 with No. 4 finish
	Water reservoir	Reservoir in Changwon	STS304, STS444, STS 329 J3L/ 1D, 2B
	Dams and floodgates	Alloy saving duplex stainless steel has been used to improve the resilience of infrastructure facilities against natural disasters	NSSC 2120 (SUS 821L1), SUS 323
	Water tanks	3CR12 material used in municipal water storage tanks in rural areas	3CR12 No. 1
	Seawall against flood type disaster	A new technology called 'Flat Gate' has been advanced after the disaster	NSSC 2120

Category	Application	Global example	Grade used
		9m-high seawall with 20 lock gates installed in Mikayo city	SUS821L1
	Rail bridges	Duplex stainless steel Forta LDX2404 in structural rail bridges	Forta LDX2404, EN 1.4662
	Bridge construction	Ferritic stainless steel rebar was used for bridge construction	SUS 410- SD
	Pedestrian walkway and bicycle bridge	Stal and Rormontage AB in Solvesborg, Sweden, have designed a new pedestrian and bicycle bridge	Lean duplex Forta LDX2404

Note: Key suppliers include both component and stainless steel material suppliers

ART

Category	Application	Global example	Grade used
Automotive	Grommet gasket	Grommet gasket for innovative diesel engine	SUS 301L equivalent
	Bipolar plate for hydrogen cell vehicle	Poss 470C for Hyundai Motors' fuel cell vehicle	Poss 470FC electrochemically modified surface
	Hydrogen fuelling receptacle	Toyota Mirai's fuel cell vehicle	AUS 316L- H2
	MaX	Aperam partnered with market leading companies to produce MaX – the only advanced high-strength stainless steel for body in white and chassis applications	MaX from 0.55 to 1.55
	Turbine hosing	Calsonic Kansei developed CK-SMiTH	Heat-resistant ferritic stainless steel
	Transportation container	Floor and walls of transportation containers are made of Outokumpu stainless steel	Outokumpu 316 plus
	Small electrified urban vehicles	Outokumpu – folded stainless steel for small electrified urban vehicles	Temper-rolled austenitic stainless steel
Transport	Bicycle	AISI 304 for bicycles	EN 1.4301 (AISI 304)
	Yacht	Stainless steel yacht	T316L 2D
	Stainless steel sailboat	Stainless steel used for deck, bathroom, sink, floor and furniture	316L

Note: Key suppliers include both component and stainless steel material suppliers

Consumer durables

Category	Application	Global example	Grade used
Consumer durables	Black stainless steel for premium appliances	Whirlpool, LG, Samsung manufacture a full range of black steel products, which account for 30% of sales	ASTM 430 anti-finger coated
	Refrigerators	PossFD for refrigerant piping	PossFD, No. 2D
	Hard disk drive (HDD) covers	Stainless steel is the best material for covers and other precision parts of HDD	SUS304, SUS430, SUS420
Boxes	Home delivery boxes	In such a case, boxes for home delivery have been introduced	SUS443J1
Kitchenware	Knife blades and cutting tools	Martensitic stainless steel cutlery and kitchen utensils	MA5 (martensitic grade)

Note: Key suppliers include both component and stainless steel material suppliers

Process industries

Category	Application	Global example	Grade used
Pharmaceuticals	Anderson and pure magnetic mixer	For ultra-hygienic mixing and production of intravenous medications, which require high standards of hygiene	304, polished
Industrial machinery	Garbage truck hoppers	Floor of garbage truck hoppers	410 / #1
	Concrete mixer truck	Mixer bowl made of stainless steel	410 / #1
	Urban waste sorting container	For sorting waste	AISI 216
	Mining	For cable buckets	410/ NR*1
Food and beverages	Food, dairy and meat	Need to mandate the use of stainless steel in food processing industries, including food dairy and meat	
	Solar drier	Solar drier increases the life span of vegetables and fruits	3CR12 stainless steel with 2B finish
	Mobile kitchen	The Desert Wolf BOMA 250+ man – a mobile, smart kitchen	304
	Biomass stoves and pot skirt	Uses the familiar rocket design surrounded by a wire cage to improve the stove's stability and reduce burns	430

Note: Key supplier includes both component supplier and stainless steel material supplier

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