1Lattice

Precision Engineering Industry Report

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GLOSSARY OF ABBREVIATIONS USED

S.No.	Abbreviation used	Full form
1	AC	Alternating Current
2	AMP	Automotive Mission Plan
3	BESS	Battery Energy Storage System
4	BEV	Battery Electric Vehicle
5	BS-VI	Bharat Stage VI
6	CAGR	Compounded annual growth rate
7	CBET	Cross-Border Electricity Trading
8	CEF	Connecting Europe Facility
9	COP	Climate Change Conference
10	CSS	Coil & Spiral Spring
11	CNC	Computerized numerical control
12	CY	Calendar Year
13	DC	Direct Current
14	DOT	Department of Transportation
15	DIN	Deutsches Institut für Normung
16	DSS	Disk & Strip Springs
17	EMU	Electric Multiple Unit
18	EU	European Union
19	EV	Electric Vehicles
20	FAME	Faster Adoption and Manufacturing of Electric Vehicles
21	FRA	Federal Railroad Administration
22	FY	Financial Year
23	GDP	Gross Domestic Product
24	GW	Gigawatt
25	GWLW	Gallock Wedge Lock Washers
26	HCV	Heavy Commercial Vehicles
27	HVAC	Heating, Ventilation, and Air Conditioning
28	ICF	Integral Coach Factory
29	IEA	International Energy Agency
30	INR	Indian Rupees
31	IRA	Inflation Reduction Act
32	IRSDC	Indian Railway Station Development Corporation
33	ISO	International Organization Standardization
34	KM	Kilometer
35	LCV	Light commercial vehicle
36	LBH	Linke Hoffmann Busch
37	MCF	Modern Coach Factory
38	MCV	Medium commercial vehicle
39	NHSRC	National High-Speed Rail Corporation
40	NITI	National Institution for Transforming India
41	NIP	National Infrastructure Pipeline
41	NRP	National Rail Plan
43	OHVs	Off-Highway Vehicle
44	PLI	Production Linked Incentive
45	PPP	Public-Private Partnership

46	PURPA	Public Utility Regulatory Policies Act
47	PV	Photovoltaic
48	RCF	Rail Coach Factory
49	RPS	Renewable Portfolio Standard
50	SMAM	Sub-Mission on Agriculture Mechanization
51	US$	United States Dollar
52	WLW	Wedge Lock Washers
53	Y-o-Y	Year on year

EXCHANGE RATE TABLE

Year (FY)	Rs. Equivalent of one US$	Euro equivalent of one US$	Year (CY)	Rs. Equivalent of one US$	Euro equivalent of one US$	Pound equivalent of one US$
2015-16	66.33	1.13	2016	67.95	1.05	1.36
2016-17	64.84	1.08	2017	63.93	1.20	1.29
2017-18	65.04	1.23	2018	68.36	1.14	1.34
2018-19	69.17	1.12	2019	69.89	1.12	1.28
2019-20	70.49	1.08	2020	74.18	1.21	1.28
2020-21	73.20	1.18	2021	74.50	1.20	1.38
2021-22	74.50	1.16	2022	76.10	1.10	1.24
2022-23	80.32	1.04	2023Q3	82.25	1.07	1.24
2023-24H1	82.40	1.07	-	-	-	-

Executive Summary

The global & Indian economy is poised for strong growth in the next 5 years

Global economy has rebounded after the economic downturn of COVID-19 and is expected to increase at an average of 4.9% from CY22 to CY28. India is expected to maintain the highest growth rate, with its current Y-o-Y growth rate standing at 3.7% in CY22 and projected to grow at ~6% by CY28. This fueled with other government initiatives like Make in India, Production Linked Incentive (PLI) scheme & others will boost the domestic manufacturing industry.

High demand for disc & strip springs (DSS) and wedge lock washers (WLW) in Industrials will lead the market growth for DSS & WLW

The global DSS & WLW market was valued at ~US$ 891M in CY23 and is projected to grow at a CAGR of 6.1% during CY23-26. The Indian DSS & WLW market is showing the similar growth trajectory and is expected to register a CAGR of 6.6% during FY24-27, with the market value in FY24 being ~US$ 115M.

Industrial sector compromising of heavy machinery like equipment's used in manufacturing, infrastructure & others, contribute the maximum revenue share in the DSS & WLW market. The growth is largely accreditable to the increase in steel demand to fulfill the growing urbanization & construction needs. After industrial, mobility sector consisting of automobiles (such as four-wheelers and two-wheelers) & railways is the biggest contributor to the revenue of DSS & WLW. In automobile sector, demand is fueled by the growing consumption of passenger cars in countries like India & Brazil. The renewable energy sector comprising of wind & hydro energy is another key growing market. Here, the focus on government policies to mitigate international climate change will boost growth.

The coil & spiral springs (CSS) market will witness growth due to the surge in demand of EV vehicles in India

As per 1Latttice analysis, the Indian market for CSS was valued at ~US$ 459M in FY24 and is expected to grow at a CAGR of 9.8% during FY24-27. The market growth is credited to factors like growing automobile industry & rapid urbanization.

The major consumption of CSS happens in the mobility largely applied in the commercial vehicles, automobiles & railways. Coil springs are used in eVs to reduce the overall vehicle weight. Penetration of eVs in the 2-wheeler market stands at ~5% and in 4-wheeler market is ~1% as of FY23 in India. This growing penetration will largely increase the demand. After mobility, the major consumption happens in the industrial sector. Here, the focus on Indian government to develop India's industrial participation through schemes like PLI, Urban Infrastructure Development scheme is boosting growth.

Ageing of infrastructure & growth in renewable energy market will lead to high demand for Special Fasteners (SFS)

As per Universal Consulting report on "Shortlisting Attractive Global Opportunities: Fasteners", the global market for SFS was valued at ~US$ 97,326M in CY23 and is expected to grow at a CAGR of 6.7% during CY23-26. The Indian market for SFS was valued at ~US$ 6,580M in FY24 and is expected to grow at a CAGR of 18.0% between FY24-27.

This strong growth in the market can be attributed to different factors like growth in the renewable energy industry & ageing of infrastructure. Globally, most of the revenue is currently contributed by the mobility sector in which demand is majorly in the automobile sector. The industrial sector contributes almost equivalent revenue to the mobility sector, in which the majority of demand comes from heavy machinery. The policy support from different countries focusing on development of clean energy is a key growth driver for the renewable energy sector.

Global Market Size*					
Product category	**Market size (CY23) (US$ M)**	**Segment**	**Market size (CY23) (US$ M)**	**Sub-segment**	**Market size (CY23) (US$ M)**
DSS + Wedge Lock Washers	**891.2**	Renewable energy	45.9	Renewable energy	45.9
		Industrial	703.9	Off-highway	397.5
				Electrical equipment	281.5
				Heavy machinery	24.8
		Mobility	141.4	Mobility	141.4
SFS	**97,325.5**	Renewable energy	10,154.6	Renewable energy	10,154.6
		Industrial	41,184.3	Off-highway	3,953.8
				Electrical equipment	1,226.1
				Infrastructure & heavy machinery	36,004.4
		Mobility	44,427.9	Railway	5,561.1
				Automotive	38,866.8
		Others	1,558.8	Others	1,558.8
Total	**98,216.8**		**98,216.8**		**98,216.8**

Note(s): Gala has presence in Indian CSS market and yet to enter global CSS market

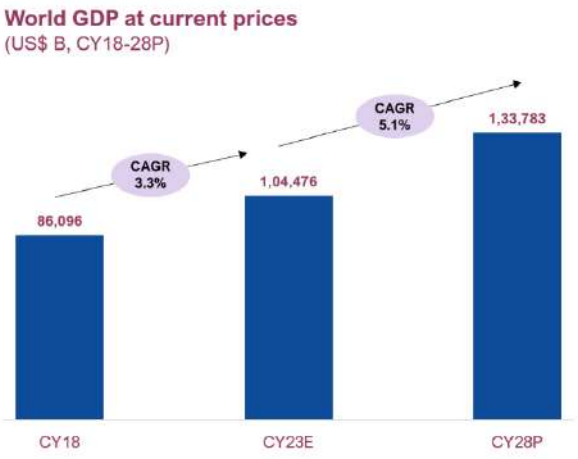
Indian Market Size					
Product category	**Market size (FY24) (US$ M)**	**Segment**	**Market size (FY24) (US$ M)**	**Sub-segment**	**Market size (FY24) (US$ M)**
DSS + Wedge Lock Washers	**114.8**	Renewable energy	1.4	Renewable energy	1.4
		Industrial	95.8	Off-highway	77.4
				Electrical equipment	17.5
				Heavy machinery	0.9
		Mobility	17.7	Mobility	17.7
CSS	**458.5**	Industrial	31.9	Off-highway	21.2
				Infrastructure	10.8
		Mobility	426.6	Commercial vehicles	22.6
				Automotive	404.1
SFS	**6,580.0**	Renewable energy	424.4	Renewable energy	424.4
		Industrial	2,799.1	Off-highway	539.5
				Electrical equipment	61.7
				Infrastructure & heavy machinery	2,197.8
		Mobility	3,217.3	Railway	1,236.1
				Automotive	1,981.2
		Others	139.3	Others	139.3
Total	**7,153.3**		**7,153.3**		**7,153.3**

01 Macro-Economic Overview

1. Macro-Economic Overview

1.1 Global macroeconomic overview

1.1.1 The global GDP is expected to rise at a CAGR of 5.1% from CY23-28, having grown at a CAGR of 3.3% from CY18-23



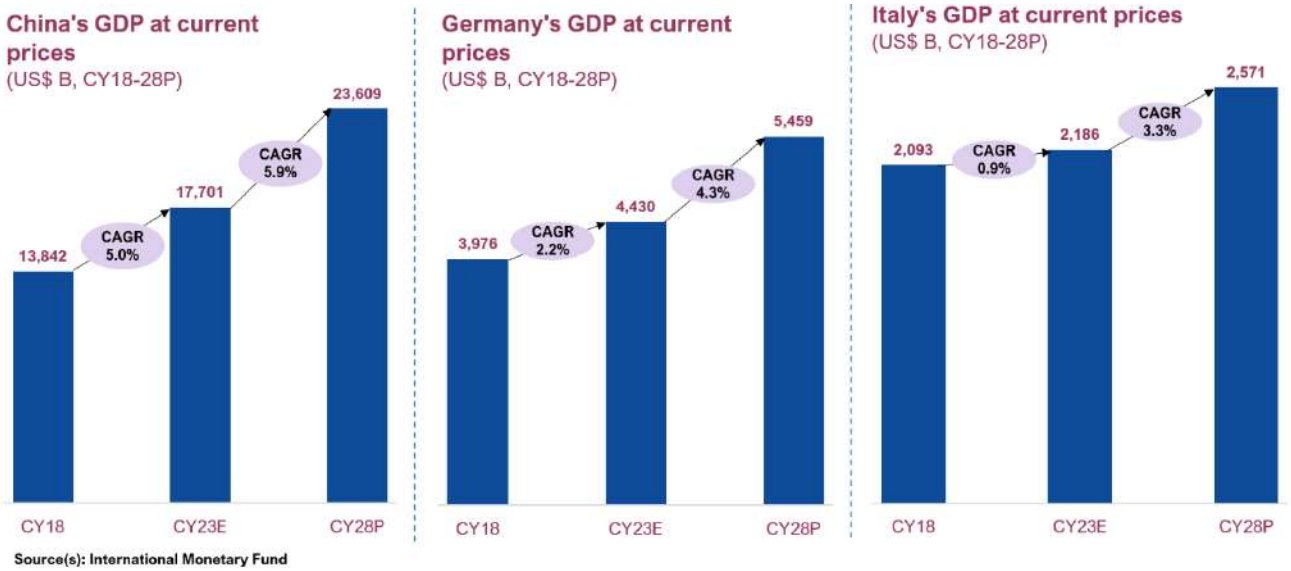
Real GDP growth – Germany, Italy, USA, China, India, USA, and UK (Y-o-Y growth %, CY18-28P)

Region	CY18	CY19	CY20	CY21	CY22	CY23E	CY28P
World	3.6%	2.8%	-2.8%	6.3%	3.5%	3.0%	3.1%
Germany	1.0%	1.1%	-3.8%	3.2%	1.8%	-0.5%	0.9%
Italy	0.9%	0.5%	-9.0%	7.0%	3.7%	0.7%	0.9%
China	6.8%	6.0%	2.2%	8.5%	3.0%	5.0%	3.4%
India	6.5%	3.9%	-5.8%	9.1%	7.2%	6.3%	6.3%
USA	2.9%	2.3%	-2.8%	5.9%	2.1%	2.1%	2.1%
UK	1.7%	1.6%	-11.0%	7.6%	4.1%	0.5%	1.5%

Note(s): In the analysis of global benchmarks, the timeline has been kept as CY and not FY
Source(s): International Monetary Fund

The global economy has rebounded after the historic economic downturn caused by the COVID-19 pandemic. After a significant decline in CY20, recovery was driven by extended fiscal support, adaptation to new work patterns, and vaccine distribution. Global GDP grew at the rate of 3.3% in CY23, slightly lower than expected due to the geopolitical crisis of the Russia-Ukraine war. GDP further growth is projected to average 5.1% from CY23 to CY28. In comparison, India is expected to maintain the highest growth rate, with its current Y-o-Y growth rate standing at 6.3% in CY23 and projected to grow at 6.3% by CY28.

1.1.2 Germany is expected to grow at a CAGR of 4.3% from CY23-28P; over the same period China and Italy are expected to grow at a CAGR of 5.9% and 3.3% respectively



Source(s): International Monetary Fund

China is leading among all the developing economies and is expected to become the top economic power by CY50. China's current GDP is US$ 17,701B and is expected to be US$ 23,609B by CY28, growing at a CAGR of 5.9% over CY23-28. Due to its globally acclaimed engineering sector and superior quality exports, Germany's GDP is expected to reach ~US$ 5,459B in CY28, growing at a CAGR of 4.3% over CY23-28. Italy, known for its significant contributions to global fashion, automotive industries, and tourism, is expected to reach a GDP of ~US$ 2,571B, growing at a CAGR of 3.3% over CY23-28.

1.1.3 Global GDP per capita is expected to increase at a CAGR of 4.1% from CY23 to CY28

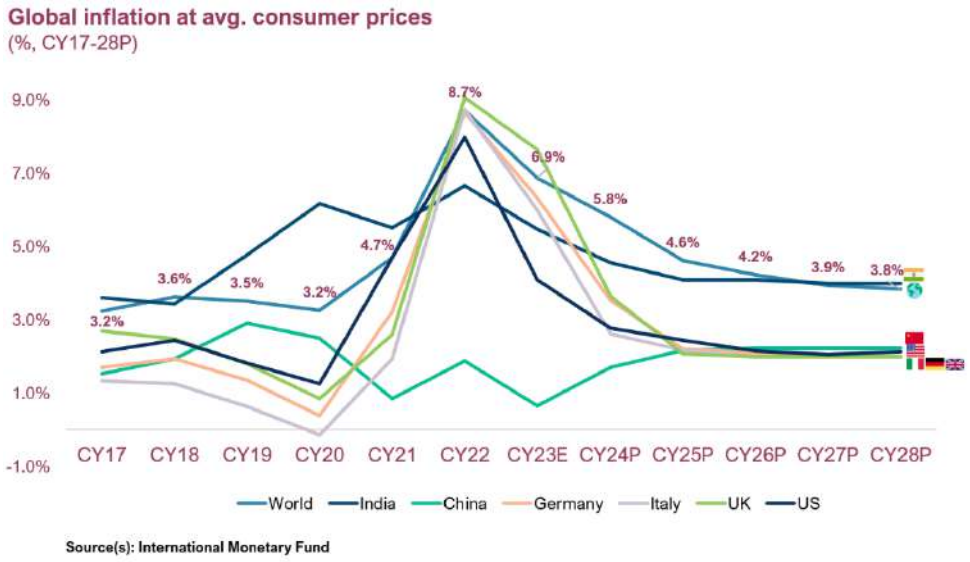
GDP Per capita growth
(US$, CY18-28P)

Region	CY18	CY23	CY28P	CAGR (CY18-CY23)	CAGR (CY23-CY28P)
WORLD	11,457	13,333	16,296	3.1%	4.1%
CHINA	9,849	12,541	16,803	6.9%	6.0%
GERMANY	47,961	51,384	60,260	1.4%	3.2%
ITALY	34,918	36,812	41,660	1.1%	2.5%
USA	62,788	80,412	95,302	5.0%	3.5%
UK	43,378	48,913	65,894	1.3%	6.1%

Source(s): International Monetary Fund

The International Monetary Fund (IMF) projects that global GDP per capita will grow at an average rate of 4.1% annually from CY23-28. This rise can be attributed to several key factors, including technological innovation, globalization, and increased educational attainment. China stands out as one of the fastest-growing economies globally, with a rapidly increasing GDP per capita. The IMF forecasts an average CAGR of 6.0% per year for China between CY23 and CY28P. This growth is primarily driven by China's substantial investment in infrastructure, education, and research and development. The IMF predicts Italy's and Germany's GDP per capita to grow at an average rate of3.2% during the same period.

1.1.4 Global inflation has reached a peak of 8.7% in CY22 and is expected to eventually normalize to 3.8% in CY28

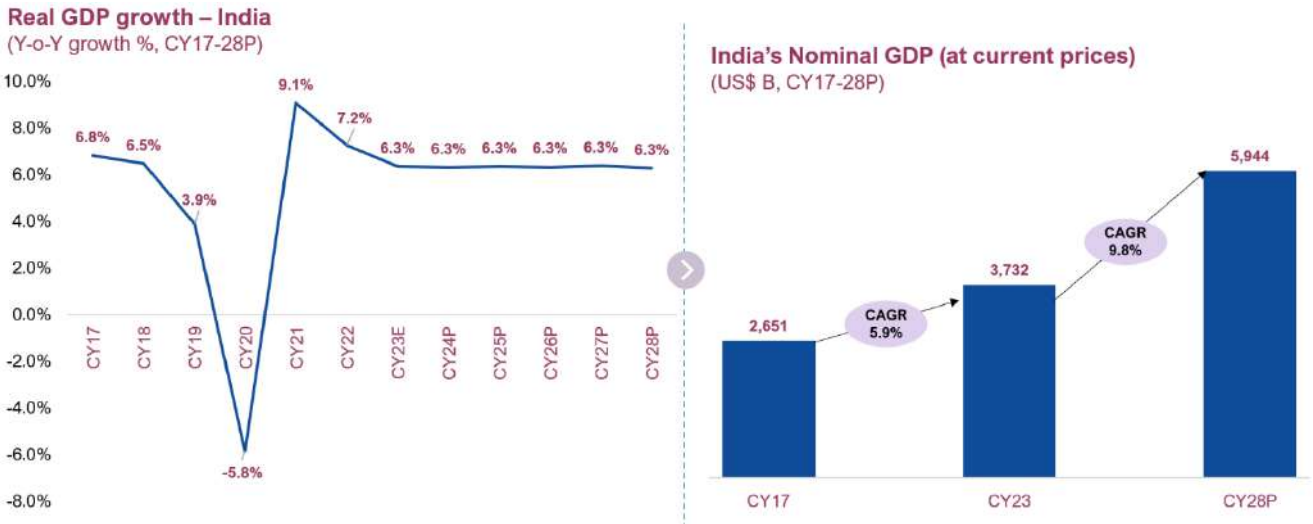


Source(s): International Monetary Fund

Global inflation is forecasted to decline steadily, from 8.7% in CY22 to 6.9% in CY23 and 5.8% in CY24, due to tighter monetary policy aided by lower international commodity prices. Core inflation is generally projected to decline more gradually. Although inflation has been high in many countries, it is projected to decrease, with an average global inflation rate of 3.8% in CY28.

1.2 India macroeconomic overview

1.2.1 India's GDP was at US$ 3,732B in CY23 and is estimated to reach US$ 5,944B in CY28, growing at a CAGR of 9.8% from CY23 to CY28



Source(s): International Monetary Fund

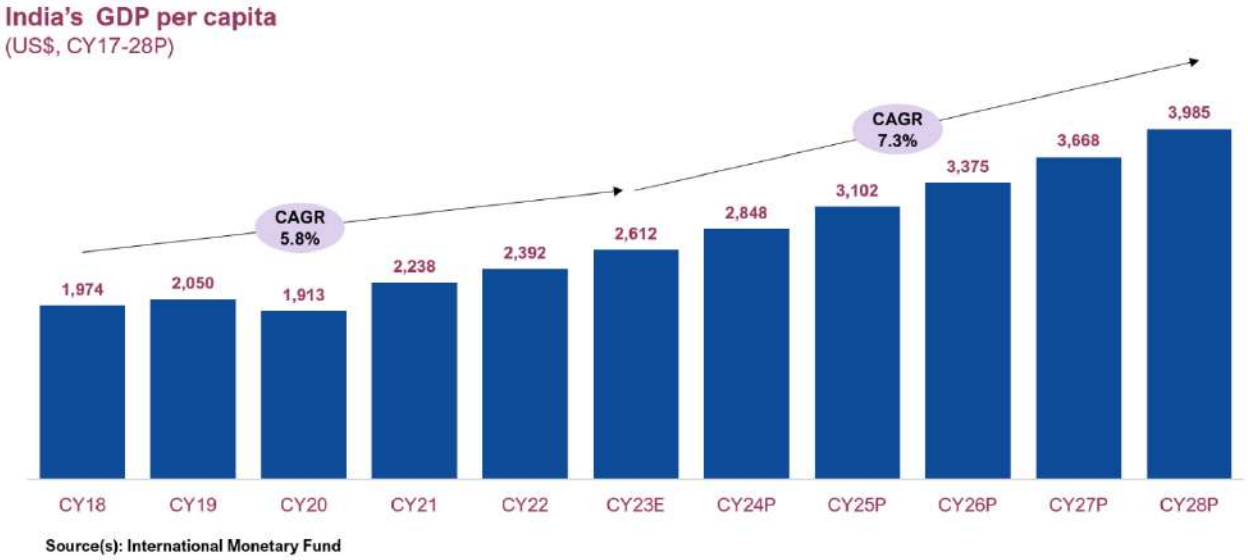
India is the fifth largest economy in CY23 and is expected to be the third largest by CY30. India's GDP (at current prices) grew from US$ 2,651B to US$ 3,732B between CY17 and CY23. The increase can be attributed to the robust reforms like GST, corporate tax revision, revised FDI limit, and growth across sectors. The real GDP growth

is expected to reach 5.9% Y-o-Y growth in CY23, and eventually stabilize and maintain a growth rate of 6.3% till CY28.

Over the next 10-15 years, India is anticipated to be among the top economies of the world on the back of rising demand, robust growth in various manufacturing and infrastructure sectors, and an increase in private consumption. India's manufacturing sector is on a robust growth trajectory, with output surging to its highest levels in nearly three years, with the Manufacturing Purchasing Manager'' Index reaching an impressive 58.6 in August CY23. Key economic indicators such as steel production, cement production, and vehicle sales continue to show strong growth, indicating positive momentum in the manufacturing sector.

The automobile industry is a significant part of India's economy, contributing to about 7.1% of the GDP. With the help of policy interventions and initiatives by the government, the industry is aiming to double its size by CY24 compared to CY22. Simultaneously, the railway industry in India is going through a major transformation, with efforts to modernize and expand the network and improve both passenger and freight services. This industry is also exploring new opportunities and challenges, including the development of high-speed rail corridors, incorporating renewable energy sources, implementing digital solutions, and fostering regional connectivity and cooperation.

1.2.2 In CY23, India's per capita GDP is US$ 2,612, and it is projected to reach US$ 3,985 by CY28, growing at a CAGR of 7.3% from CY23 to CY28



India's per capita income is expected to climb by almost 7.3% from CY23 to CY28, the expected rise from US$ 2.3K to US $3.9K in per capita income is pivotal in India's transformation into a middle-income economy. The importance of external trade and growing household consumption are significant factors contributing to India's economic growth. With a large domestic consumption base, substantial per capita income growth, and a demographic advantage, India is positioned as a market with vast growth opportunities.

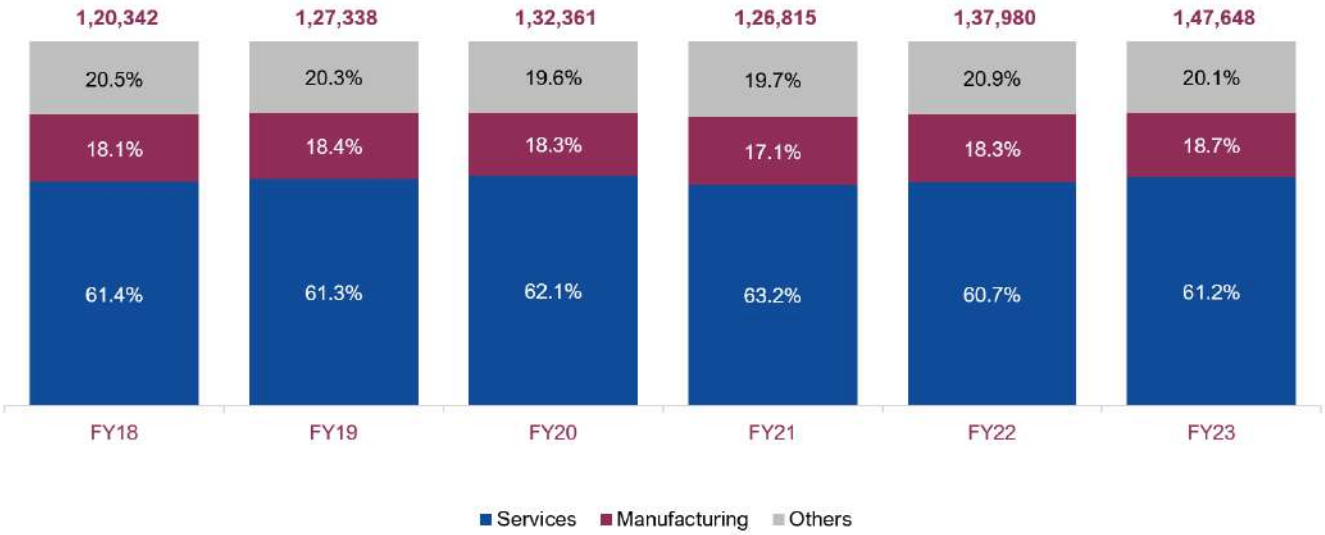
1.2.3 In CY23, India's inflation rate was 5.5%, and it is anticipated to decrease moving forward, gradually stabilizing at around 4.0% by CY28

Russia-Ukraine war in CY22 has led to Geopolitical crisis creating energy and food supply distribution and thus led to an unprecedented rise in prices. In India, inflation has become stable, this positive trend is backed by the Consumer Price Index (CPI), which decreased to 5.0% in September'23, down from 6.7% in CY22. The Indian government and the Reserve Bank of India (RBI) have instigated measures to control inflation and improve the economy's health. RBI has maintained steady repo rates so as not to cause unwanted disruptions in the market. The government has also taken steps such as reducing the excise duty on petrol and diesel and cutting import duty on key raw materials and crude edible oils. The decrease in inflation rates in future years can be attributed to the government's implementation of economic policies that manage inflation – these include monetary policies, fiscal policies, and supply-side policies.

1.2.4 Indian Manufacturing Sector overview

The Indian manufacturing sector is a vital component of the country's economic landscape, contributing significantly to GDP growth, employment generation, and overall industrial development. Marked by a diverse range of industries, including automobile, textiles, pharmaceuticals, electronics, and more, the sector reflects India's multifaceted industrial prowess. Initiatives like the ''Make in India'' campaign attracted foreign investment and positioned India as a global manufacturing hub. The government's strategic focus on ease of doing business, policy reforms, and the introduction of schemes such as the Production Linked Incentive (PLI) further emphasizes its commitment to nurturing a robust manufacturing ecosystem.

Contribution of manufacturing towards Gross Value Added
(FY18-23, INR B)

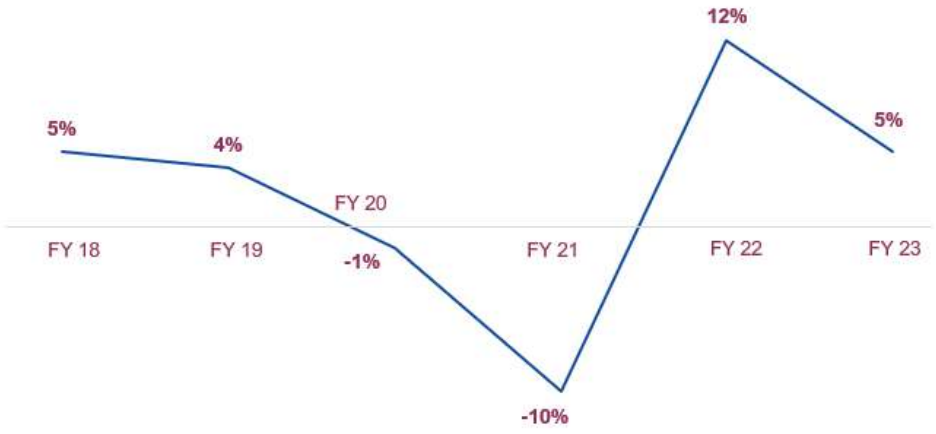


Source(s): RBI Handbook of Statistics on Indian Economy

With a growing emphasis on innovation, sustainability, and technological advancements, the Indian manufacturing sector is on track for dynamic growth, contributing substantially to the nation's economic resilience and competitiveness on the global stage. The overall contribution of India's manufacturing sector to GVA was 18.7% in FY23. The absolute GVA from manufacturing has increased with a CAGR of 3.4% from FY18 to FY23.

The Index of Industrial Production (IIP) is a key economic indicator that measures the growth of various sectors in the industrial output of a country. The primary purpose of the IIP is to assess the industrial output and production trends in the manufacturing, mining, and electricity sectors. Post COVID-19, IIP witnessed significant growth in FY22, growing at a rate of ~12%. In FY23, IIP continued its growth and rose by ~5% from FY22.

Growth rate of manufacturing IIP – India
(FY18-23, Y-o-Y growth %)



Source(s): Ministry of Statistics and Programme Implementation (MOSPI)

1.2.5 Enabling factors for Indian manufacturing sector growth

The growth of Indian manufacturing sector is influenced by several factors, primarily driven by government initiatives. “Make in India”, creating a favorable environment for industrial expansion. India’s demographic dividend, with a large and skilled workforce, contributes to heightened productivity and innovation. Investments in infrastructure development, technological advancements, and the integration of digital technologies further influence growth.

Global companies’ "China Plus One” strategy, which involves diversifying supply chains and considering India as an alternative manufacturing hub, makes India more attractive to companies around the world. Collaborative efforts between the public and private sectors, coupled with a focus on sustainable practices, play pivotal roles in enabling the sustained expansion of the Indian manufacturing sector.

1.2.5.1 India’s new foreign trade policy 2023

FTP 2023 is a policy that is based on the continuity of time-tested schemes facilitating exports. It is designed to be flexible and responsive to the evolving needs of trade. The policy is based on the principles of trust and partnership with exporters. It focuses on process re-engineering and automation to enhance the ease of doing business for exporters.

The key approach of the policy is based on four pillars:

1. Incentive to Remission
2. Export promotion through collaboration–- Exporters, States, Districts, Indian Missions
3. Ease of doing business, reduction in transaction cost, and e-initiatives
4. Emerging Areas – E-Commerce Developing Districts as Export Hubs and streamlining SCOMET policy

The government has set a target to boost India’s total exports to US$ 2T by 2030, with an equal share coming from both the merchandise and services sectors. The policy emphasizes the promotion and development of exports, shifting from incentive-based approaches to a more facilitative system driven by technology and collaboration principles. FTP 2023 establishes implementation mechanisms within a paperless, online environment, building upon previous initiatives focused on enhancing the ‘'ease of doing business’' Reductions in fee structures and IT-based schemes are aimed at simplifying access to export benefits for MSMEs and other stakeholders.

There are initiatives to encourage the internationalization of the Indian Rupee. Additionally, efforts are being made to enhance manufacturing infrastructure through the establishment of additional ‘'Towns of Export Excellence’' offering export promotion benefits. The government aims to expand initiatives like ‘'Vivaad se Vishwaa’' to minimize potential litigations and foster trust among foreign investors.

1.2.5.2 Make in India

The primary objective of Make in India, which was launched in September 2014, is to attract investment, promote innovation, develop top-tier infrastructure, and position India as a hub for manufacturing, design, and innovation. The development of a robust manufacturing sector remains a crucial priority for the Indian Government. Since its inception, the Make in India initiative has achieved notable milestones and currently, under Make in India 2.0, concentrates on twenty-seven sectors, fifteen of which are manufacturing sectors with tailored ‘Action Plans’.

The Department for Promotion of Industry & Internal Trade (DPIIT), overseeing ‘'Invest India’' to facilitate foreign investments, has strategically identified twenty-four sub-sectors. These include automobiles, chemicals, medical devices, auto components, defence manufacturing, electronic systems, and more. The selection is driven by considerations such as local competency, potential for import substitution, export opportunities, and the

potential for increased employment. This focused approach aims to enhance and stimulate local manufacturing in key sectors critical to India's economic growth.

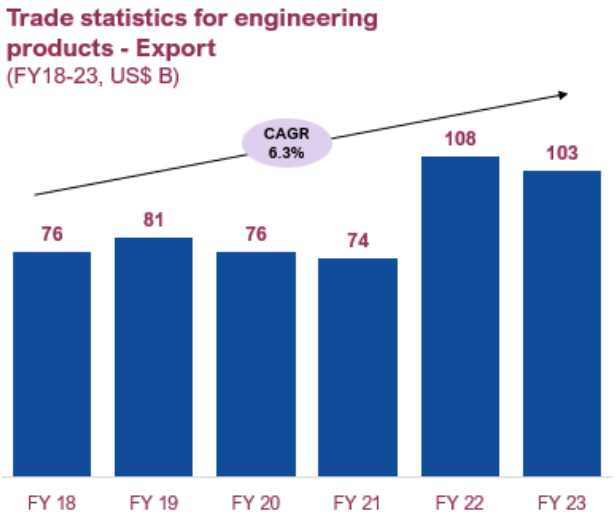
1.2.5.3 Production Linked Incentive (PLI) scheme

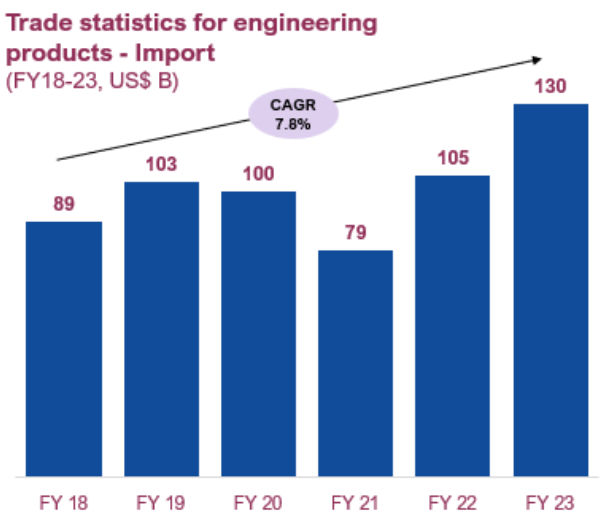
In 2020, India introduced the PLI scheme to boost domestic production by providing subsidies and encouraging exports, accompanied by higher import substitution and employment generation. PLI scheme spans fourteen crucial manufacturing sectors, including mobile manufacturing, manufacturing of medical devices, automobiles and auto components, pharmaceuticals, drugs, specialty steel, telecom and networking products, electronic products, and drones and drone components.

The government has allocated over INR 1.9 lakh crore for the periodic implementation of the PLI scheme. The government is closely analyzing PLI's effectiveness, considering job creation, cost per job, etc. Depending on its success, there is a likelihood that the PLI scheme may be expanded to include other manufacturing segments in the future.

1.2.6 Trends in engineering product

The engineering products segment in India has historically experienced a trade deficit, indicating that the value of high-end engineering goods imported into the country has consistently exceeded the value of the exported goods. In FY22, due to recovery from the pandemic, exports increased to US$ 108B from US$ 74B in FY21. The exports have been rising at a CAGR of 6.3% from FY18 to FY23. Imports, on the other hand, have been increasing at a CAGR of 7.8% from FY18 to FY23. India, in FY22, witnessed a surplus as imports only increased to US$ 105B in FY22. However, due to high inflation rates and elevated commodity prices, the value of imports increased to US$ 128B in FY23.





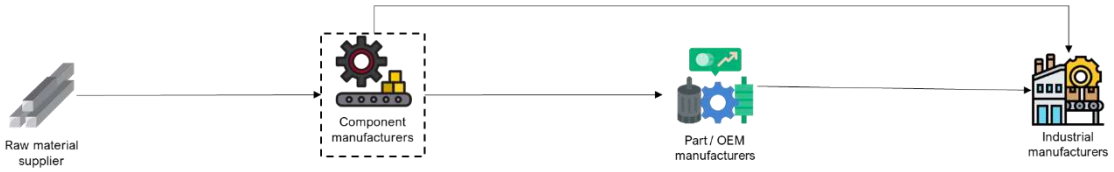
Source(s): Ministry of Commerce and Industry, Dept. of Commerce dashboard

02

Component Supply Chain & End User Industries

2. Component supply chain & end-user industries

Gala Precision Engineering is positioned as a precision component manufacturer in the supply chain, supplying specialized fastening solutions, disc springs, strip springs, coils, spiral springs, and wedge lock washers. Their primary clientele consists of major OEMs, tier 1 & channel partners, spanning diverse industries including renewable energy, railways, automotive, electrical, and more.



Raw Materials	Component	Part / OEMs	Industries
 Steel sheets  Steel rods	 DSS & WLW	• **Renewables:** Yaw brakes, thrust bearing mechanism • **Industrials:** Wire spacers, dampening springs, safety fail brake • **Mobility:** Clutch, brake, transaxle, torque limiter, hydraulic motor	• **Renewables:** Wind turbines, & hydroelectric power plants • **Industrials:** Electricals, heavy machinery, & off-highway vehicles • **Mobility:** Automobiles, & railways
 Steel wires	 CSS	• **Industrials:** Actuator • **Mobility:** Clutch, engine, suspension	• **Industrials:** Control valves, off-highway vehicles • **Mobility:** Automobiles, commercial vehicles, & railways
 Steel rods	 SFS	• **Renewables:** Fastening solution • **Industrials:** Fastening solution • **Mobility:** Fastening solution	• **Renewables:** Wind turbines, hydroelectric power plants & solar panels • **Industrials:** Off highway vehicles, heavy machinery & electricals • **Mobility:** Railways

Gala's position in supply chain

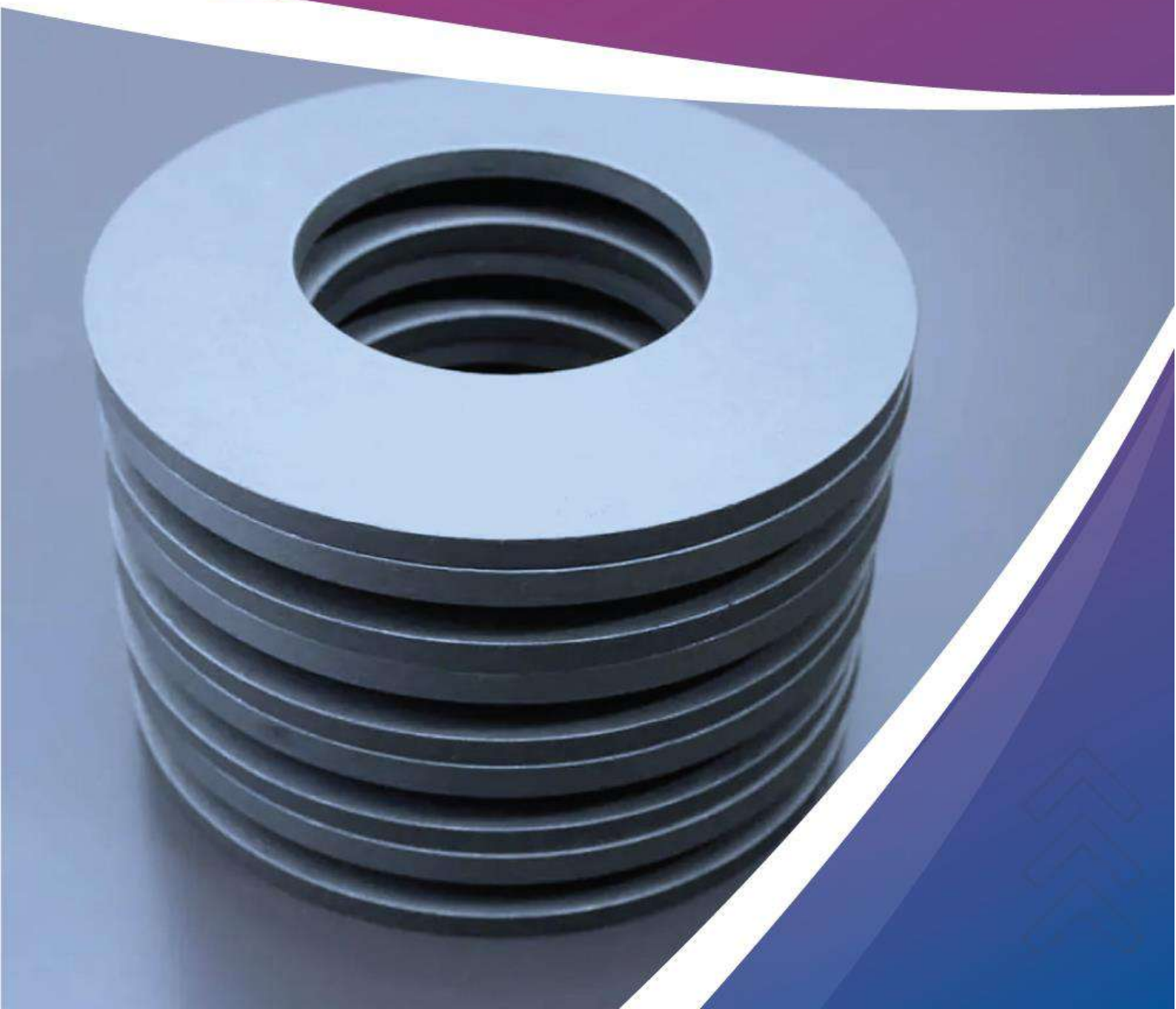
End-user industries: SFS										
	Mobility				Industrial					
Renewables	Railway infrastructure	Automobile	Off-highway vehicle	Heavy machinery	Roadways	Ship building	Industrial infrastructure	Machine building	Electrical power equipment	Others
Wind turbines	Track & station infrastructure	Commercial vehicles	Agricultural tractors	Manufacturing equipment	Crash guard system	New ships	Warehousing	Machining centres	Transformer	Commercial & residential buildings
Hydro electricity	Coaches	ICE - 4W	Combine harvesters	Heat exchangers	Bridges	Ship repairing	Airports	Turning machines / lathe machines	Switchgear	Electronics
Solar		ICE - 3W	Excavators	Tyre machinery			Ports	Milling machines	Insulators	Oil & gas maintenance
Nuclear		ICE - 2W	Dozers	Cement industry			Lifts & escalators	Grinding machines	Energy meters	Aerospace
		EV - 4W	Concrete equipment	Boilers			Valves and actuators	Drilling machines	Transmission towers	
		EV - 3W	Mining / dump trucks	Pumps						
		EV - 2W	Mining shovels	Plant and other equipment						
			Mobile crushers							
			Trailers							
			Earth moving							
			Crushing, pulverizing & screening							
			Forklift							
			Crane							

End user industries: DSS & WLW					
Renewables	Mobility			Industrial	
	Railway infrastructure	Automobile	Off-highway vehicle	Electrical power equipment	Heavy machinery
Wind turbines	Rolling stock	ICE - 4W	Agricultural tractors	Switchgear	Steel processing equipment
Hydro electricity	Track & station infrastructure	EV - 4W	Combine harvesters	Transformer	Heat exchangers
		CNG - 4W	Excavators	Power transmission lines	Elevators
		ICE - 2W	Dozers		Tyre industry
		EV - 2W	Concrete equipment		Cement industry
		Commercial vehicles	Mining / dump trucks		
		ICE - HCV	Mining shovels		
		ICE - buses	Mobile crushers		
		EV - buses			

End user industries: CSS				
Mobility			Industrial	
Commercial vehicle	Automobile	Railway infrastructure	Off-highway vehicle	Industrial infrastructure
ICE – buses	ICE - 4W	Rolling stock	Agricultural tractors	Valves & actuators
EV - buses	EV - 4W	Track & station infrastructure	Combine harvesters	
ICE – HCV	CNG - 4W		Excavators	
ICE – MCV	ICE - 2W		Dozers	
ICE - LCV	EV - 2W		Concrete equipment	
			Mining / dump trucks	
			Mining shovels	
			Mobile crushers	

03

Global market for Disc & Strip Springs and Wedge Lock Washers



3. Global market for Disc & Strip Springs and Wedge Lock Washers (DSS & WLW)

3.1 Industry overview

DSS & WLW consists of disc springs & strip springs and wedge lock washers represented below:

Disc Springs

Strip Springs

Wedge Lock Washers

DSS & WLW are spring and fastening solutions used for industrial applications when mechanical devices are required to apply force. Disc springs deliver powerful spring forces in a compact space. Their unique layouts in stacks boost both forces and deflections. Adjusting component geometry allows precise control of the load/deflection curve—a major advantage. WLW are washers with wedge-lock technology, a cutting-edge solution, transform bolted joints by emphasizing tension over friction. They ensure a secure, vibration-resistant joint with exceptional longevity and reliability. These components are used in different industries like renewable energy, railway infrastructure, automobiles, and others. The application varies as per the requirement from load control & regulation, vibration dampers or to provide a damping effect in vehicle transmission, braking systems of wind turbines, and shock absorption depending on industry. Gala Precision Engineering's Wedge Lock Washer has been tested successfully in Germany and is in conformity with the requirements of Standard DIN 25201-4 with the clamp force staying constant after almost 2,000 cycles of the junker test.

The global DSS & WLW market is valued at ~ US$ 891M in CY23 witnessing a CAGR of 6.2% during CY20-23. Gala Precision Engineering has a market share of ~2% in the global DSS market as of CY22*. In this, WLW is contributing ~ US$ 260M as of CY23. The WLW market is mostly dominated by two European manufacturers NordLock (Sweden) & Heico (Germany).

(*Note: Revenue for Gala Precision Engineering taken as of FY23)

3.2 Manufacturing process

3.2.1 Cold process of disc springs with thickness <6mm

The manufacturing process starts with rigorous inspection and testing of incoming raw materials to ensure they meet quality standards. The verified materials are stored in a controlled environment. The subsequent stages include shearing, blanking, precision cutting, and heat treatment. Post-treatment, deburring, machining, and bending are performed. The final steps include oiling surface coating as per customer's requirements, followed by a thorough inspection for compliance with specifications, applying identification labels, and securely packaging for dispatch. Below is the manufacturing process for disc sprigs with **cold processing** through metal pressing, hammer, or rolling for disc springs of <6 mm. For this thickness hot forging is not required due to the greater malleability of steel.
Gala Precision Engineering has implemented various semi-autonomous manufacturing processes to reduce manual intervention. This has improved efficiency and helped in saving ~100 units of manpower between FY18-23. Gala Precision Engineering supplies DSS to leading OEMs due to the adoption of various quality standards such as DIN 2093 and certifications such as IATF 16949 and ISO 9001:2015.

S.No.	Process	Description
1.	 **Raw material inspection & testing**	• This is the initial step where the raw materials are inspected for quality and tested to ensure they meet specifications.
2.	 **Shearing**	• Shearing refers to the process of cutting or shearing the raw material, typically a flat metal sheet into the desired shape and size to create disc springs.
3.	 **Blanking**	• This is a process in which the disc spring is stamped out from a primary metal sheet or coil using a punch and die. The geometry of the die and punch is shaped in the form of the desired product. A punch applies pressure to the metal sheet or coil, exerting a specific amount of load to cut the product
4.	 **Deburring & Drying**	• Deburring is a finishing process that removes burrs, sharp edges, and other imperfections from disc springs.
6.	 **Machining**	• Machining operations may be necessary to achieve precise dimensions or to meet specific tolerances. Machining can involve processes such as turning, milling, or grinding.
7.	 **Bending**	• Bending in disc spring manufacturing refers to the process of shaping or forming the disc spring to achieve the desired configuration.
8.	 **Heat Treatment (austempering)**	• Heat treatment process is to achieve the desired final hardness, strength, and flexibility in the disc springs.
9.	 **Shot Peening**	• Small metal particles are repeatedly directed at the surface of a material, creating controlled plastic deformation, this process induces comprehensive stresses in the material.
10.	 **Scragging**	• Scragging involves subjecting the disc spring to a controlled plastic deformation or stress relieving process to eliminate any residual stresses and stabilise the material.
11.	 **Descaling, & Drying**	• Descaling in disc spring manufacturing refers to the process of removing scale or oxidation from the surface.
12.	 **Coating**	• Disc springs are coated in a phosphating solution containing phosphoric acid and other chemicals and later dried by air, oven or other drying equipment. They are alternatively coated with zinc flake coating for corrosion resistance.
13.	 **Oiling**	• Oiling refers to applying a thin layer of oil on the surface of the spring to provide lubrication and corrosion resistance to the springs.
14.	 **Final inspection**	• A comprehensive inspection of the disc spring to ensure they meet all specified requirements before proceeding to the next stage.
15.	 **Packaging & Dispatch**	• The final step involves packaging the final disc springs securely for dispatch and distribution.

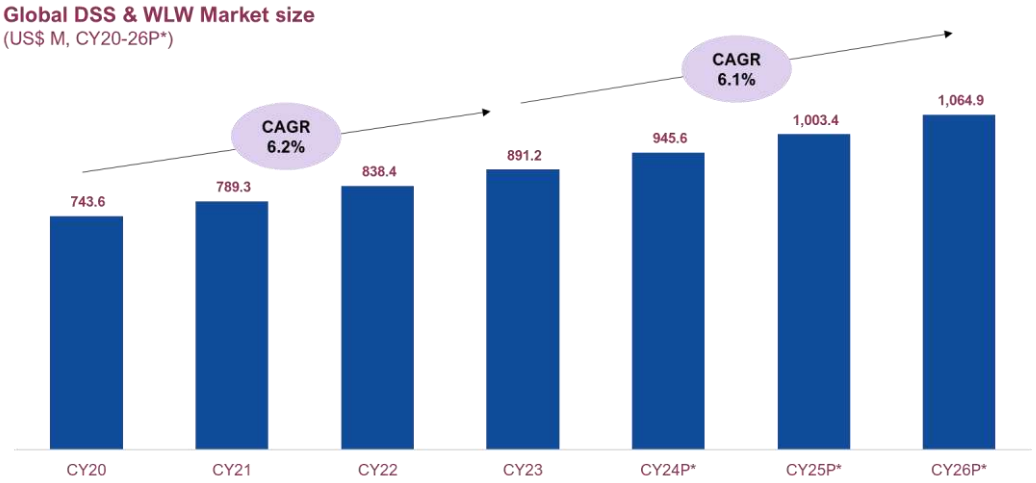
3.2.2 Hot process of disc springs with thickness >6mm

The manufacturing process starts with rigorous inspection and testing of incoming raw materials to ensure quality and adherence to specifications. Inspected materials are stored in a controlled environment. The process includes rod cutting, forging, annealing, and machining, followed by heat treatment, tempering, and coating in a phosphate solution. Oiling enhances corrosion resistance and finishing. A final inspection ensures compliance before assembling, followed by applying identification labels, and securely packaging for dispatch**.** Outlined below is the manufacturing process for DSS through **hot process** for disc springs of >6 mm due to the requirement of hot forging due to reduced malleability of relatively thicker sheets of steel.

S.No.	Process	Description
1.	 **Raw material inspection & testing**	• This is the initial step where the raw materials are inspected for quality and tested to ensure they meet specifications
2.	 **Rod cutting**	• An optimization problem that involves cutting a rod of length into smaller pieces with different sizes
3.	 **Forging**	• Metal shaping process that involves hammering, pressing, or rolling a metal to create a desired shape.
4.	 **Annealing**	• Involves heating the raw material, typically a metal alloy, to a specific temperature and then allowing it to cool slowly in a controlled environment
5.	 **Machining**	• Machining operations may be necessary to achieve precise dimensions or to meet specific tolerances. Machining can involve processes such as turning, milling, or grinding
6.	 **Heat Treatment**	• Heat treatment process is to achieve the desired final hardness, strength, and flexibility in the disc springs, ensuring they can withstand the repetitive loading and unloading cycles
7.	 **Tempering**	• Hardened springs are reheated to a specific, lower temperature and held at that temperature for a certain duration to achieve final hardness
8.	 **Shot Peening**	• Small metal particles are repeatedly directed at the surface of a material, creating controlled plastic deformation, this process induces compressive stresses in the material
9.	 **Scragging**	• Scragging involves subjecting the disc springs to a controlled plastic deformation or stress-relieving process to eliminate any residual stresses and stabilize the material
10.	 **Phosphating & Drying**	• Disc springs are immersed in a phosphating solution containing phosphoric acid and other chemicals and then later dried by air, oven or other drying equipment
11.	 **Oiling**	• Oiling refers to applying a thin layer of oil on the surface of the springs to provide lubrication and corrosion resistance to the springs
12.	 **Final inspection**	• A comprehensive inspection of the disc spring to ensure they meet all specified requirements before proceeding to the next stage
13.	 **Packaging & Dispatch**	• The final step involves packaging the final disc springs securely for dispatch & distribution

3.3 Market forecast and growth drivers

The DSS & WLW market is expected to reach a value of ~ US$ 1,065M in CY26 witnessing a growth of 6.1% during CY23-26P. The end-user industry growth will be the key growth driver for the DSS & WLW market. Renewable energy, automobile & infrastructure are some of the key industries showing good growth potential.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

- **Increase in renewable energy capacity:** As part of the world's climate goals, the leaders of the G20 summit have pledged to triple their installed renewable energy capacity by CY30 from the current capacity of CY23. The focus will be on developing wind, hydroelectric power, and solar energy.
  - **EU:** The European Commission has introduced updated climate change mitigation and adaptation targets for CY30, aiming to raise the current ~32% target to a minimum of ~40% for renewable energy sources in overall energy composition.
  - **US:** The US Interior Department, along with federal agencies, has mandated a boost in renewable energy output on public lands and waters. This involves plans to achieve 30 GW of offshore wind by CY30, 15 GW of floating offshore wind by CY35, and permitting at least 25 GW of onshore renewable energy by CY25.
- **Rise in Infrastructure spending:** Infrastructure spending is projected to increase to ~US$ 3T annually from CY15 to CY40, compared to ~US$ 2T per year from CY07 to CY15. The development of infrastructure requires extensive use of off-highway vehicles, with DSS & WLW used extensively in the off-highway vehicles.
  - **EU**: In the CY21-27 CEF Transport program, ~EUR 26B is allocated for grants to partially fund TEN-T projects across EU Member States. CEF has backed nearly 1,300 projects in the transport sector since CY14, providing a total of ~EUR 30B in support.
  - **U**S: The Bipartisan Infrastructure Deal aims to reauthorize surface transportation programs for five years, channelling an additional ~US$ 110B to address road and bridge repairs while supporting significant transformative projects.
- **Automobile:** Increasing population, urbanization, demand for high-end passenger vehicles, and rising infrastructure spending are expected to drive automobile market growth all over the world.
  - **EU:** The automotive sector significantly fuels Europe's economic growth, innovation, and prosperity, comprising around ~7% of the GDP and contributing ~10% to exports in CY22. Notably, electric vehicle sales in Europe surged by ~62% in the last year, prompting European OEMs to unveil plans for over 150 EV models by CY30 in response to the growing demand for electric vehicles.

- **US:** The US automobile industry, a significant GDP contributor, has experienced a notable shift toward electric vehicles (eVs). EV sales in the US surged from around 65,000 in CY17 to over 800,000 in CY22, with a ~51% increase in the first half of CY23.

DSS & WLW are used extensively in vehicles like cars, buses & 2-wheelers, for applications in clutches, brakes, or axle lift systems (for buses). Thus, the growth in automobile sector will present itself as a tailwind for the DSS & WLW market.

- **Growth of railways:** Railways offer an efficient mass transportation solution, facilitating cost-effective and seamless travel for both passengers and freight. As the global population and economic activities continue to rise, global railroad industry is anticipated to grow at a rate of ~4% from CY22 to CY30. DSS & WLW play crucial roles in the railway sector, ensuring the safety of rolling stock. Investment around the world is another driving factor for railway industry:
  - **EU:** Connecting Europe Facility which funds strategic investment projects in the areas of transport has reiterated that rail will be receiving the largest share (~€25B out of €33B) of funds.
  - **US:** U.S. Department of Transportation's Federal Railroad Administration has awarded US$ 8.2B for 10 passenger rail projects across the country while announcing corridor planning activities.

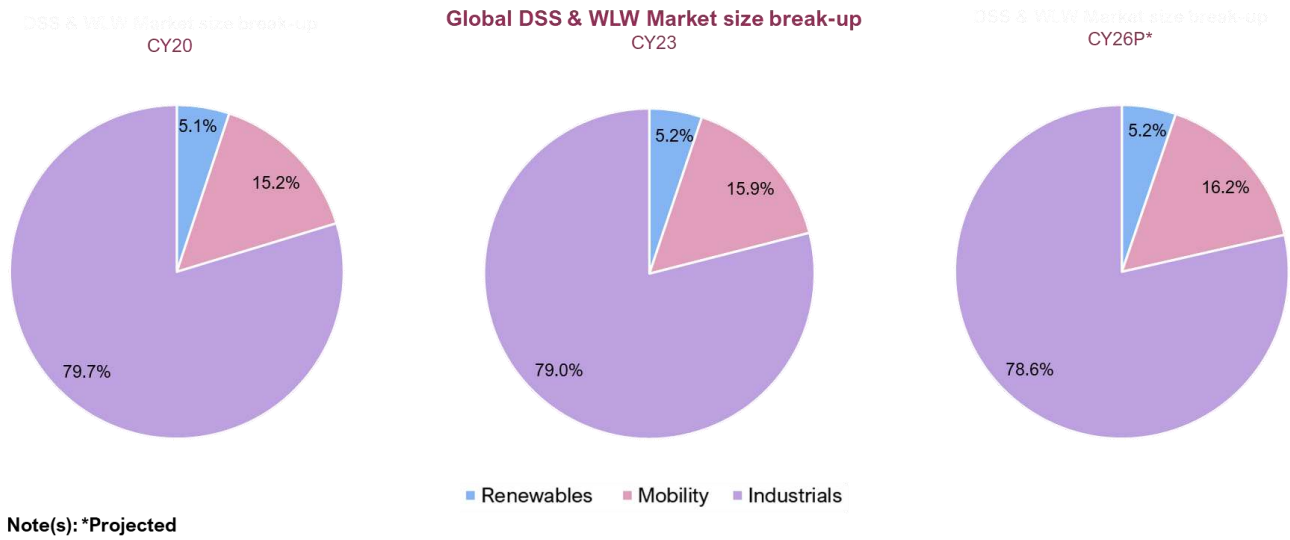
3.4 Industry wise application

DSS & WLW usage & criticality among different end users

Industry	End-user		Uses & Criticality
Renewable	Hydroelectricity		• **DSS** are used in **support systems & bearings of various rotating equipment** to stationary structures while distributing load & preventing damage from constant vibration • **WLW** are used in **penstock, valve & flanges** to prevent water leakage & maintain proper functioning while localizing stress concentrations
	Wind turbines		• **DSS** are applied in **yaw break solutions to control nacelles & blades**, ensuring structural stability • **WLW prevents bolted joints** securing the blades, nacelle & tower in wind turbines **from coming loose**
Mobility	Railway		• **DSS** are used in **suspension systems, couplers, & brakes** of railway infrastructure that help in bolt loading & shock absorption, enhancing ride quality of the train • **WLW** are used to connect railway infrastructure **such as coaches, traction motors & control arms**, & also maintain the tension between nuts & bolts screwed together under intense vibrations & dynamic loads
	Automobiles		• **DSS** are used in **clutch & breaks** of 2-wheelers, 4-wheelers & commercial vehicles **ensuring effective gear change** along with assisting in engaging & disengaging of braking systems in EVs
Industrials	Off-highway	Agricultural	• **DSS** are used in **trans axel, hydraulic motors & torque limiters** of agricultural vehicles helping in handling vibration & offering stability • **WLW** are used in **frame & engine connection of vehicles** to prevent the connections from coming lose over time due to vibrations
		Construction & Mining	• **DSS** are used in **hydraulic motors, torque limiter, hydraulic breaker attachment, & boring breaker attachment** of construction vehicles ensuring safety of overall vehicle • **WLW** are used in frame & engine connection of vehicles to **prevent the connections from coming lose over time** due to vibrations
	Electrical & power		• **DSS** are **used in switchgear in push rod assembly** ensuring stable electrical connection; it is also used in transmission lines as a spacer • **WLW** are applied in the **infrastructure of off-shore & on-shore oil, gas & coal plants** evenly distributing clamping force & preventing the connections from coming lose over time due to vibrations
	Heavy machinery		• **DSS** are **used in elevator safety brakes** which holds the elevator in place in case of failure, ensuring safety; It is also **used in heat exchangers & steel manufacturing industry** • **WLW** are used in **assembling machinery in tire production** plants. In the cement industry, they are used in heavy machinery assemblies to prevent nuts from being loosening due to vibrations & maintains stability under operational stresses

Global market size for DSS & WLW				
Industry		Market size (US$ M)		
		CY20	CY23	CY26P*
Renewables		37.9	45.9	55.8
Industrials	Off-highway	338.5	397.5	467.3
	Electrical & power	233.3	281.5	339.7
	Heavy machinery	20.8	24.8	29.5
Mobility	Automobiles	113.1	141.4	172.6
Total		**743.6**	**891.2**	**1064.9**

Note(s): *Projected



Note(s): *Projected

3.4.1 Renewable energy industry

In the renewable energy industry, DSS & WLW are used in wind energy and hydroelectricity applications.

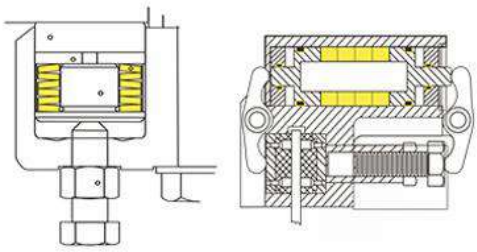
Application for disc springs & wedge lock washer in renewable energy industry:

Disc springs

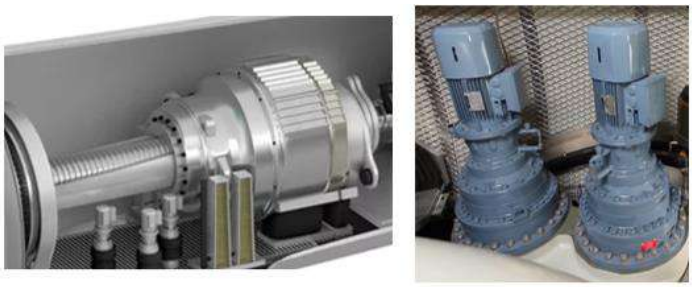
- **Wind turbines:** Disc springs are primarily used in yaw brakes to control nacelles as per the wind direction to maximize energy production
- **Hydroelectricity generators:** Disc springs are used in thrust bearing mechanism, which connects the rotors to the stationary structure

Wedge lock washer

- **Wind turbines:** used in wind turbines to support the fastening of components like nacelle & blade connections
  - Their resistance to loosening in high-vibration environments makes them extremely useful in fastening joints of wind turbines



Disc spring: Yaw bearing and brake system



WLW: Blade & nacelle connections

Essentiality of disc springs & wedge lock washers in renewable energy industry

Disc springs: These are essential for the operation of renewable energy systems, including wind turbines and hydroelectric plants. It plays a crucial role in ensuring structural stability and minimizing the impact of dynamic load. Without these components, the system would be vulnerable to wear and damage, leading to reduced energy production and increased maintenance expenses. Disc springs offer the ability to work with high loads in small spaces.

Wedge lock washers: In renewable energy systems, the structural integrity of various components relies significantly on WLW. Its absence can lead to improperly fastened connections, thus creating safety hazards and possible catastrophic failures in associated structures. The wedge-locking action of these washers ensures that the bolted joints remain secure even in high-vibration environments. GWLW reduces the overall cost of OEMs by reducing the maintenance frequency of critical parts including blades.

Comparison of disc springs & wedge lock washers with key select substitutes in the renewable energy industry

There are different types of springs available as a substitute for disc springs. However, each type of spring provides some specific support which the other type may not be able to provide effectively and efficiently.

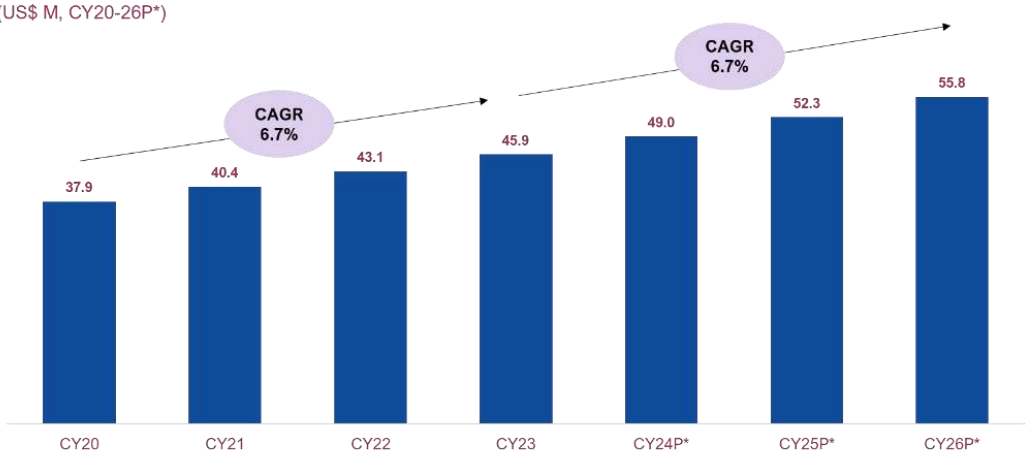
For instance, **wave springs,** which are also known as coiled wave springs or scrowave springs, are a type of spring made up of pre-hardened flat wire in a process called on-edge coiling. Wave springs with multiple turns can easily replace multiple stacked washers, simply by adjusting the number of turns. They are used as bearing preload across motors, brakes & drives for machines used in producing renewable energy. It offers deflection curves with a wider and flatter linear force region, enabling it to meet specific spring force requirements.

However, one critical disadvantage of using wave springs over disc springs is the risk of deformity when exposed to high loads. This is a frequent situation in renewable energy. The force provided by wave springs is lower compared to disc springs, which may result in brake actuation failure. Another notable advantage that Disc springs offer is that they allow for high loads in small spaces compared to wave springs.

In the renewable energy sector, DSS & WLW are indispensable for ensuring structural integrity and safety. Their applications in yaw brake systems, thrust bearing mechanisms, and structural components are crucial. While substitutes like wave springs offer alternatives, they come with their limitations.

As a substitute of wedge lock washers:
Different types of **standard washers** can be used instead of WLW, but reproducing the wedge-locking mechanism with other alternatives is challenging. WLW offers higher security compared to standard washers because they rely on tension rather than friction. They're specifically employed to secure bolted joints exposed to intense vibration and dynamic loads. Unlike WLW, standard washers spread loads over a larger surface area.

Global renewables DSS & WLW Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The renewable energy industry is subjected to growth due to government policies focusing on mitigating international climate change. Regions like the European Union and China have aimed to increase their renewable energy production capacity significantly. This increase in demand for renewable energy will lead to an increase in consumption of DSS & WLW.

- **Increased energy production:** Compared to CY15-20, onshore wind additions will be ~25% higher on average till CY26. IEA forecasted that the annual onshore wind addition will be 75 GW per year on an average from CY21-26. By CY26, the total offshore wind capacity is forecasted to be more than the triple current capacity and will account for one-fifth of the global wind market.
- **Government policy action:**
  - **COP26:** Agreements like COP26 will accelerate the adoption of renewable energy from CY21-26, with a ~95% increase in global power capacity coming from renewable energy. The expansion of renewable energy capacity in the United States is ~65% greater than in the previous five years.
  - **USA:** The Inflation Reduction Act of CY22 provides tax incentives for clean energy and extends the Investment Tax Credit to offer a ~30% credit. The act also introduces a Production Tax Credit of US$ 0.0275/kWh for eligible investments in wind, solar, energy storage, and others, subject to prevailing wage and apprenticeship criteria for projects over 1 MW AC. Additionally, the IRA of CY22 includes federal tax incentives for commercial projects using geothermal water source heat pumps to save energy.
  - **EU:** The EU, in line with the European Green Deal, has raised its targets for renewable energy and energy efficiency. By CY30, it aims for a minimum of 42.5% renewable energy share and a goal of ~45%. Additionally, there's a commitment to improve energy efficiency by ~12%.

- **Energy security:** Countries are becoming more inclined towards renewable energy sources like solar and wind due to concerns about energy security arising from Russia's invasion of Ukraine. This shift aims to decrease dependence on imported fossil fuels, the prices of which have experienced significant increases. The global capacity for renewable power is projected to increase by ~2,400 GW between CY22-27.

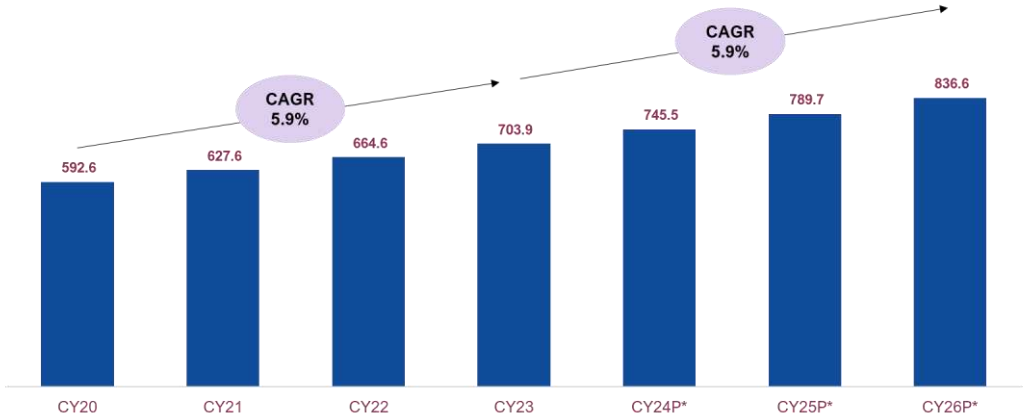
  Investment in hydroelectricity: In CY22, hydroelectricity generation rose by nearly 70 TWh (~2%), totalling 4,300 TWh. To achieve Net Zero Emissions by CY50, hydropower aims for a CAGR of ~4% from CY23-30, targeting 5,500 TWh yearly. However, recent growth falls short, emphasizing the need for stronger efforts, particularly in permitting and project sustainability. Hydropower, a vital clean energy component, deserves recognition and support. Europe commissioned a record 2 GW of pumped

storage hydropower in CY22, while the U.S. enhanced hydropower support with the Inflation Reduction Act in August CY22.

3.4.2 Industrials

The industrial sector encompasses off-highway vehicles, electrical & power equipment, and heavy machinery. DSS & WLW play a crucial role in various internal components of off-highway vehicles, including transaxles, torque limiters, and hydraulic motors. Additionally, DSS & WLW find applications in transmission lines, transformers, and elevators. The projected value of the overall DSS & WLW market for industrials is anticipated to reach ~US$ 837M by the end of CY26P. This growth is primarily attributed to substantial investments by governments in infrastructure, construction, and the renewable energy industry. The industrial sector is expected to experience future growth, with a CAGR of 5.9% during the period from CY23-26P.

Global industrial DSS & WLW Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

3.4.2.1 Off-highway vehicle

Off-highway vehicles refer to all types of vehicles utilized for non-transportation-related purposes such as agriculture, construction, and mining. Common uses examples are vehicles such as tractors, combine harvesters, excavators, dozers, dump trucks, etc. DSS & WLW play a critical role in various internal components of off-highway vehicles such as transaxles, torque limiters, and hydraulic motors.

Application of disc springs and wedge lock washers in off-highway vehicles (industrials)

Disc springs	Wedge lock washer
• Plays a crucial role in parts such as transaxles, hydraulic motor, torque limiters, dual-clutch, and hydraulic & boring breaker attachments: – Play an integral part in handling vibrations, offering stability, and ultimately ensuring the safety and effectiveness of these vehicles – Key components in dual-clutch in agricultural vehicles, ensuring a smoother and safer journey for passengers.	• Used in accessories, frame connections, and engine connections – Prevents from loosening up due to the vehicle's constant exposure to vibrations & rough terrain – Ensures that connections stay secure and safe.

Disc spring: Transmission axel

Disc spring: Dual clutch

Disc spring: Hydraulic break & motor

WLW: Frame connection

WLW: Engine connection

Essentiality of disc springs & wedge lock washers in off-highway vehicles (industrials)

Disc springs: Disc springs play a crucial role in keeping off-road vehicles stable and safe, especially when operating in rugged and challenging environments. They help manage vibrations, making sure the ride is comfortable and ensuring that key components like brakes function effectively.

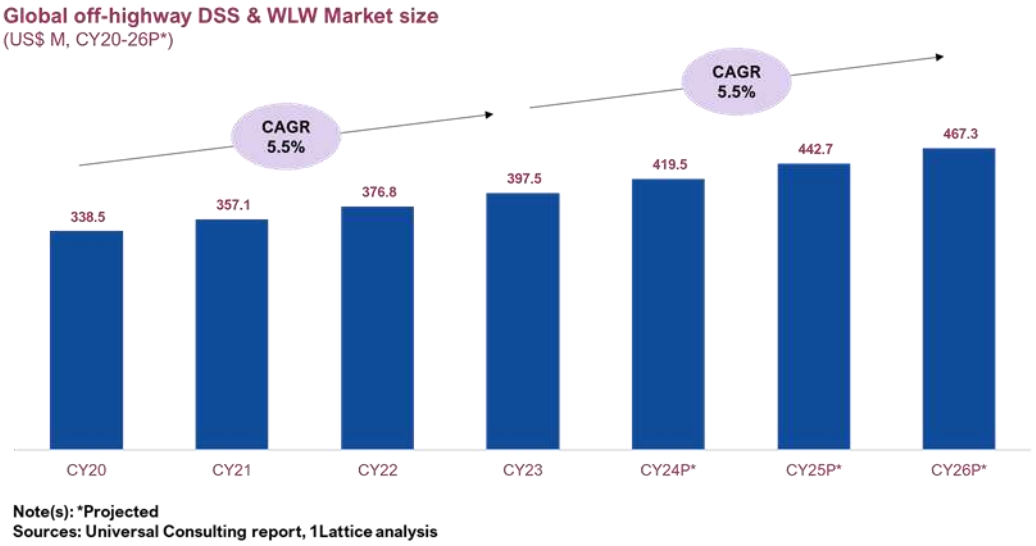
Wedge lock washers: WLW are crucial to keeping off-road vehicles strong and safe. When connections get loose, it can cause accidents or equipment breakdowns, especially when these vehicles face heavy loads and rough terrain. That's why WLW are essential for ensuring the safety and dependability of off-road vehicles.

Comparison of disc springs with key select substitutes in off-highway vehicles (industrials)

Wave springs are an alternative to coil springs which are more compact in nature but have lesser travel and can withstand lesser loads compared to disc springs.

There are different types of wave springs available, such as **nested wave springs** that can take the place of a single disc spring. These are pre-stacked in parallel from a single continuous filament of flat wire, eliminating the need to stack individual springs for higher loads. The spring rate of nested wave springs increases with the number of turns.

Interlaced wave springs, on the other hand, are great for providing heavy loads in small spaces, serving as substitutes for heavy-duty coil springs or disc spring assemblies. These springs are created by intertwining two separate wave springs, causing their turns to interlace throughout the entire length. However, it's worth noting that while wave springs are versatile, they may not be as rugged as disc springs. In heavy-use applications like those in off-highway vehicles, disc springs have the advantage of handling higher loads as compared with other alternatives.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers:

The off-highway vehicle industry is poised for significant growth driven by various factors. Increased investment in infrastructure, aimed at urbanization and bridging investment gaps, is expected to boost the sales of construction vehicles. Globally, large farms are driving the need for agricultural machinery, while raising awareness of mechanization in emerging economies is poised to enhance the market. Furthermore, government policy decisions focusing on infrastructure development and farmer welfare are creating a conducive environment for the growth of off-highway vehicles.

- **Investment in infrastructure**: Multiple investments toward infrastructure have been taken up globally, with the US directing ~US$ 1T of federal funds towards transportation, energy, and climate infrastructure projects. Also, countries comprised by G7 aim to mobilize ~US$ 600B by CY27 to narrow the infrastructure investment gap among partner countries.
  - **EU:** In CY23, European Commission selected 107 transport infrastructure projects to receive more than ~EUR 6B grants from the Connecting Europe Facility (CEF), the EU's instrument for strategic investment in transport infrastructure.
  - Increased infrastructure projects will lead to a higher demand for off-highway vehicles such as excavators, bulldozers, loaders, etc.
- **Mining and resource extraction:** Investment in critical mineral development rose ~30% in CY22 and ~20% increase in CY21 compared to investment in CY20. Growth in mining industry with increased investment along with higher demand for minerals, metals, and energy resources, will lead to an increase in sales of heavy machinery used in mining operations. The need for automation and mechanization in mining is also a contributing factor in fuelling the demand for off-highway vehicles market.
- **Construction:** In the last decade, more than half of the people (~56%) in the world lived in cities, which is expected to increase to ~68% by CY50. There is a growing requirement for infrastructure projects associated with this development and many countries around the world have been taking initiatives such as:
  - **US**: Administration has revealed almost US$ 400B in public infrastructure and clean energy investments under the Bipartisan Infrastructure Law, supporting the advancement of 40,000 infrastructure projects. These ongoing investments are driving the growth of the construction industry in the United States.
  - **EU:** EU construction industry, constituting ~9% of the GDP, plays a vital role in the economy. It generates jobs, fosters economic growth, and addresses societal, environmental, and energy issues. The European Commission aims to enhance the sector's competitiveness, resource efficiency, and

sustainability, focusing on efficiency upgrades in existing buildings and renovations to stimulate demand.

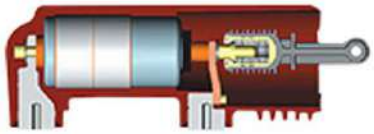
- With the increased number of projects, there will be a higher demand for a diverse range of construction equipment. The progression of urban construction and development necessitates the utilization of various off-highway vehicles, spanning from excavators to cranes.

3.4.2.2 Electrical power equipment

Electrical power equipment refers to the critical elements of electricity generation and transmission such as electricity generation plants and transmission lines. DSS & WLW have various use cases such as the dampening of vibrations in high-voltage transformers and as a component of spacers between individual electricity transmission lines.

Application of disc spring and wedge lock washers in electrical & power equipment (industrials)

Disc springs	Wedge lock washer
• Used in push rod assembly in switchgears. They are also used in bus bars of low voltage switchgear • Used in switchgear along with transmission line wire as a spacer and as a dampening spring in transformers	• Used in onshore & offshore oil & gas plants, in walk-away ladders, exhaust ducts, pipe hanging equipment, cranes – Help maintain the required tightness, reducing the chances of downtime, maintenance issues, and possible safety concerns • Used to evenly distribute clamping force over a wider area, necessary for electrical conductivity



Disc Spring: Medium voltage switchgear

Essentiality of disc spring & wedge lock washers in electrical & power equipment (industrials)

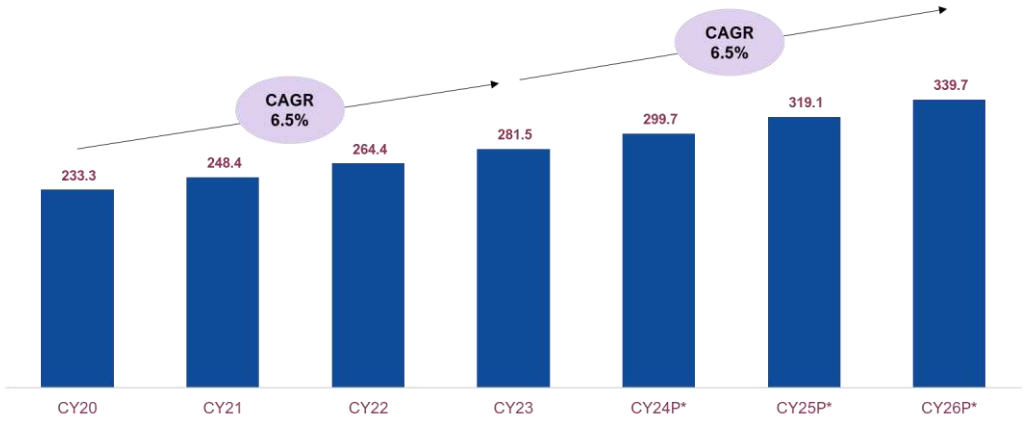
Disc Springs: Disc springs play a crucial role in ensuring stable electrical connections in medium-voltage switchgear.

Wedge lock washers: WLW provides better protection against vibrations compared to regular washers. This helps in decreasing downtime by reducing the need for frequent retightening of fasteners. Additionally, they enhance safety and prevent accidents leading to long-term usage and less maintenance cost.

Comparison of disc springs with key select substitutes in electrical & power equipment (industrials)

Wave springs can be used as substitutes for disc springs in electrical and power equipment, providing similar load-bearing capacity while saving space and reducing torsional loads. However, it's important to note that while wave springs can save space, they have a lower load capacity compared to disc springs. Additionally, their more intricate design and vulnerability to wear and tear could affect their long-term reliability, as discussed earlier.

Global electrical & power equipment DSS & WLW Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

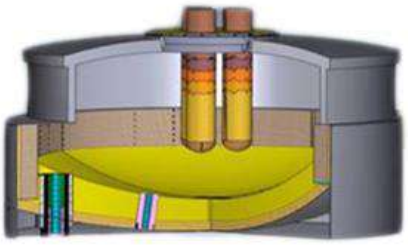
Growth drivers

The electrical and power equipment industry is driven by multiple growth drivers. The global transition towards electricity is spurring rigorous expansion of electric infrastructure. Power electronics, essential for electrification processes, are poised for substantial growth. Prioritizing grid resilience through investments in grid management is creating opportunities for innovative products and improved margins. Simultaneously, industries are shifting towards more electrified processes to reduce carbon emissions and enhance efficiency, necessitating specialized equipment.

- **Power electronics**: Power electronics are crucial for all electrification devices because they handle power conversion, like changing it up and down and converting between AC and DC. This growing need for power electronics is a big reason why there's a higher demand for semiconductors. Demand from industrial electronics, which accounts for ~10% of total semiconductor demand, is expected to increase by ~9% annually between CY20-25.
- **Investment in grid resilience:** Smart grid is a modern electricity network using advanced tech to control the flow of electricity from different sources to meet varying demands. In order to achieve Net Zero Emissions by CY50, investments in smart grids must increase by 100% by CY30, particularly in emerging markets. For this, the U.S. has allocated ~US$ 3B for 58 projects in 44 states under the President's Bipartisan Infrastructure Law to enhance electric grid resilience and reliability. Europe has decided to install ~510 GW of new renewable energy capacity (~70% connected to distribution grids), which implies an34s estimated 940 GW of renewable energy installed capacity by CY30.
- **Electrified industrial processes**: Manufacturers of electrical equipment and machinery get about ~40% of their energy from electricity. These industries are expected to be leaders in using more electricity in the future. Many companies in the industrial manufacturing sector are likely to use electrified systems more, making the future look good for this trend.
- **Growing renewable energy industr**y: The global new investment in renewable energy skyrocketed to ~US$ 358B in the first six months of CY23, a ~22% rise compared to the start of last year. This will lead to growing demand for switchgear, transformers, and transmission lines as they are critical infrastructure to renewable energy sector. Solar and wind power are inconsistent, so medium-voltage switchgear helps control and redirect electricity for stable grids, resulting in increased growth for low and medium-voltage switchgear. These sources are often in remote areas, needing transmission lines to deliver power to populated areas. Transformers manage variable generation by adjusting voltage levels for efficient transmission.

3.4.2.3 Heavy machinery

Disc spring: Elevator safety breaks

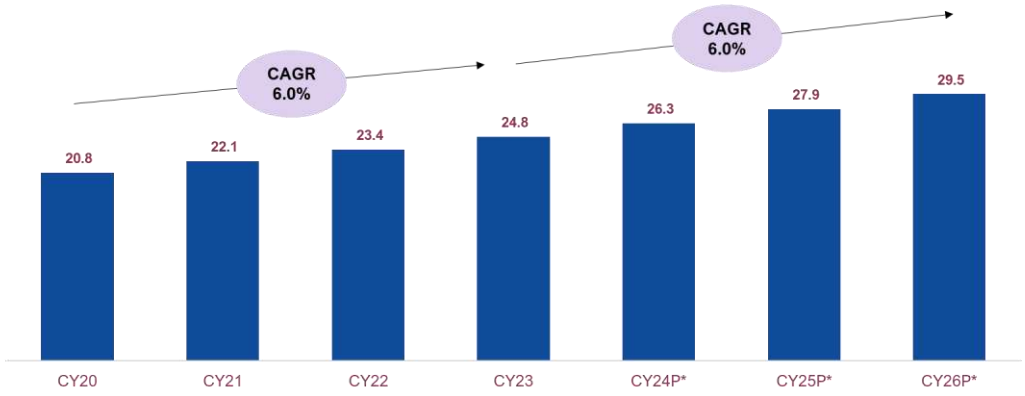


Disc spring: Electric steelmaking furnace

Disc spring: Refining furnace

Heavy machinery refers to various equipment that enables or powers the inner workings of various industries such as manufacturing, infrastructure, and air conditioning. DSS & WLW play multifaceted roles in each of these industries, for instance, disk spring assemblies are used in elevator safety breaks which hold elevators in place in case of failure. The global DSS & WLW for heavy machinery market was valued at ~ US$ 24M in CY23 witnessing a CAGR of 6.0% during CY20-23.

Global heavy machinery DSS & WLW Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth overview:
The heavy machinery industry is poised for robust growth driven by key factors. Heavy machinery is used for steel production, & growing steel demand due to construction needs, and urbanization, Furthermore, heat exchangers benefit from energy-efficient solutions and urbanization-driven HVAC demand. Global infrastructure investments are expected to boost industries, including cement, construction equipment, and components like disc springs & strip springs, during both the construction and operational phases.

Steel processing industry

- Global steel demand is expected to rise in the coming years, with a rate of growth of ~2% in CY24
- Industry is expected to grow due to the rapid development of industrial setups, urbanization, & construction sector
- Steel sector in the EU has an annual turnover of EUR 166B, accounting for 1.3% of the EU GDP and US iron and steel industry accounts for more than ~US$ 520B in economic output.

Elevators

- Rate of growth of urban land has exceeded that of population growth by ~50%
- Increasing demand for land, coupled with limited land resources has resulted in the need for high rise constructions
- As a result, increasing the need for elevators in modern construction

Heat exchangers

- Heat exchangers play a crucial role in a wide range of industries, including industrial processes, HVAC systems, automobile, & power generation
- Rapid urbanization is expected to increase demand for industrialization and HVAC equipment in emerging economies

3.4.3 Mobility

Mobility encompasses both the automobile and railway sectors. DSS & WLW are integral to 4-wheeled and 2-wheeled vehicles, contributing significantly to the clutch and brake mechanisms of vehicles. There has been prevalent growth in the mobility sector with automobile contributing a major portion of it. This growth is primarily attributed to the increasing adoption of electric vehicles in the automobile industry, along with increased demand of passenger vehicle in developing countries like Brazil and India. Government investment in railway is also driving the demand for mobility.

3.4.3.1 Railway industry

In the railway industry, DSS & WLW are primarily used for rolling stock & infrastructure.

Applications for disc springs & wedge lock washers in railway industry (mobility)

Disc springs	Wedge lock washer
• **Suspension systems** for railways to help stabilize the rolling stock while moving on tracks • **Couplers and brakes**, helping to manage the dynamic loads and vibrations experienced by railway vehicles	• To connect crucial railway infrastructure & coaches like pull rods, compressors, traction motors, and the control arm of coaches • Their ability to remain secure in high-vibration settings proves highly beneficial in railway infrastructure

WLW: Pull rod connection

WLW: Traction motor

WLW: Coach control arm

Essentiality of disc springs & wedge lock washers in the railway industry (mobility)

Disc springs: These are essential for the proper functioning of railway suspension systems and applications where dynamic spring-like motion is required. They are used for bolt loading and shock absorption while ensuring passenger comfort and safety. Without these components, the ride quality of trains would be significantly compromised, with a greater risk of damage or derailment.

Wedge lock washers: WLW is essential for maintaining the reliability of railway infrastructure. They prevent loosening while maintaining bolt preload under the intense vibrations and dynamic loads generated by rail traffic. WLW enhances safety, reduces maintenance costs, and extends the lifespan of essential railway equipment.

Comparison of disc springs & wedge lock washers with key select substitutes in the railway industry (mobility)
Wave springs have the capability to dampen vibrations and absorb impact energy within train systems. Additionally, they contribute to minimizing the overall size and weight of an assembly by as much ~50%. These springs excel in shock absorption, load distribution, and stabilizing rail systems. In comparison, disc springs can deliver a greater force within a confined space when contrasted with wave springs.

As a substitute of wedge lock washers:
Traditional washers, with their thin, often round, or square plates featuring a central aperture, also emerge as substitutes. Typically used to evenly distribute force from threaded fasteners like bolts, traditional washers offer an alternative to WLW. These washers play a crucial role in distributing loads while fastening components like push-pull rods, control arms of coaches, and traction motors. However traditional washers fail to encounter challenges in high-vibration environments, potentially loosening up and posing risks to cargo and lives.

Growth Drivers

The DSS & WLW market is poised for growth, driven by the energy-efficient and sustainable nature of railways, particularly in developing countries like China and India. Increased investments in railway infrastructure and the versatility of railways in meeting various transport demands sustainably further contribute to the market's potential for expansion.

- **Decarbonized and sustainable mode of transport:** Railways offer mass mobility solutions, for both freight as well as passengers, carrying ~8% of passenger and ~7% of global freight transport while accounting for only ~2% of the world's transport energy demand, making it one of the most energy-efficient modes of transport.
- **Growth in developing countries:** Emerging markets and developing economies hold a ~60% share of global GDP. With growth expected in developing countries, governments across the world are relying on railways to cater to the complementary mobility demand that accompanies economic growth. Of the ~45% increase in railway activity across the world from CY19 to CY30, ~80% of this growth is expected to occur in China and India.
- **Increased investments in railway infrastructure:** Global investments into railway infrastructure have seen a significant increase across nations.
  - **Europe** aims to complete the core of the Trans-European Transport Network by CY30. European Union's Sustainable and Smart Mobility Strategy aims to increase rail freight by twofold and high-speed rail activity by threefold by CY50. Over the past decade, Europe has invested over ~EUR 39B in the rail sector, leading to the construction or upgrade of nearly 2,000 kilometers of tracks and 304 stations, along with the purchase and rehabilitation of over 1,100 rolling stock units.
- **US** has invested ~US$ 16B in new funding for 25 passenger rail projects on Amtrak's Northeast Corridor. Bipartisan Infrastructure Deal allocates ~US$ 66B to enhance rail infrastructure, upgrading the Northeast Corridor, and expanding high-quality rail service beyond the northeast and mid-Atlantic regions.
- **Solution for diverse mobility needs:** Railways do not only cater to long-distance travel but also cater to short-distance urban mobility needs (through metro train systems), providing a reliable, affordable fast alternative to road travel. High-speed trains also offer a high-quality substitute for short-distance intercontinental logistics. This capacity to meet varied transport demands offers enormous growth potential.

3.4.3.2 Automobile industry

The automobile industry consists of 4-wheeled & 2-wheeled vehicles powered by internal combustion engines and electric drivetrains, along with heavy commercial vehicles. Various types of strip springs such as clip springs, etc. play a critical role in the functioning of the vehicle's clutch and & brake mechanism.

Application of strip spring in the automobile industry (mobility)

Strip springs

- They find widespread utility in the automobile sector:
  - Commonly employed in brake and clutch assemblies to optimize performance
  - Can be used in mechanisms that assist in engaging or disengaging the regenerative braking system in EVs

Strip springs for brakes

Strip springs for clutch

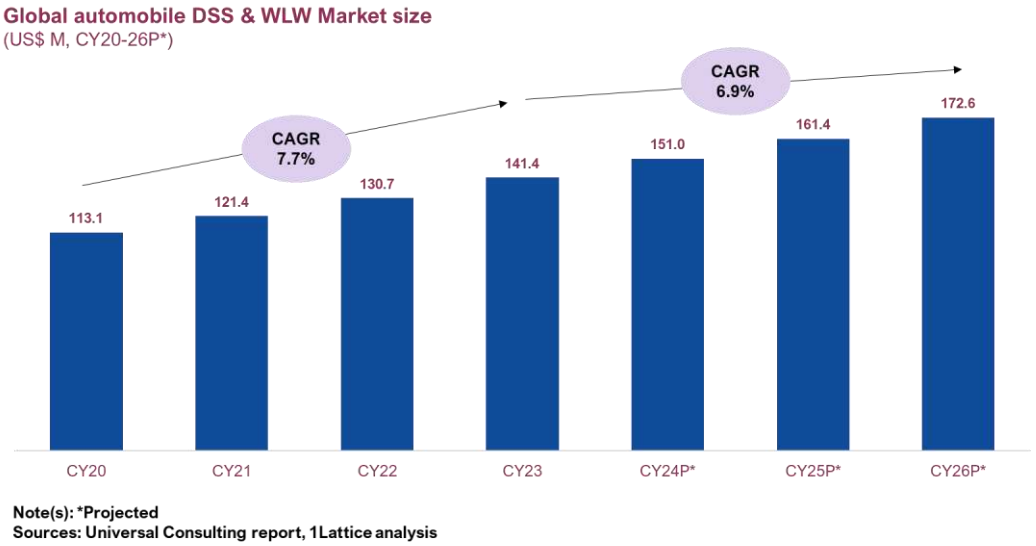
Strip springs (Slotted Belleville Springs) for clutch

Essentiality of strip spring in the automobile industry (mobility)

Strip springs are crucial for the proper operation of clutch and brake systems. Without them, a vehicle would have difficulty changing gears and stopping effectively, jeopardizing both driver safety and the overall functionality of the automobile.

Comparison of strip springs with key select substitutes in automobile industry (mobility)

Strip springs are highly customizable as they are built as per specifications and owing to this high flexibility in terms of applications and use cases met, strip springs are the go-to choice for a high number of applications. Wave springs may be able to meet certain application requirements where strip springs are used, however, their relatively higher manufacturing cost and sensitivity to misalignment may leave them at a disadvantage. Coil springs may also be used to replace stacks of strip springs; however, coil springs take up more space and may be prone to buckling.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers:

The automobile industry is poised for significant growth in the coming years. Evs are set to become a dominant force, with EV sales projected to account for two-thirds of global car sales by CY30. The rise of shared mobility solutions may impact individual car sales, but overall vehicle unit sales are expected to grow steadily. Developing countries like Brazil and India are expected to contribute to an increased demand for passenger cars.

- **Increasing affordability and adoption of Evs:** Evs are forecasted to achieve price-parity with fossil fuel vehicles in Europe by CY24 and in North America by CY26. Since CY16, US EV sales have surged from ~65,000 in CY17 to over ~800,000 in CY22, with a ~51% increase in the first half of CY23. Meanwhile, Europe experienced a ~62% growth in EV sales in the past year, leading European OEMs to unveil plans for over 150 new EV models by CY30. Recent research anticipates a ~40% drop in battery prices to reach US$ 99/kWh of storage capacity by the year CY25, down from the levels in CY22. This decrease in prices is expected to result in a reduction in EV prices, making them more affordable.
- **Growth in developing countries:** Rapid growth in developing economies such as India, Brazil, Bangladesh, etc. is having a proportionate impact on automobile sales and production. In India alone, the share of the automobile sector in GDP has increased from ~3% in CY93 to ~7% in CY23.

04 Indian market for Disc & Strip Springs and Wedge Lock Washers

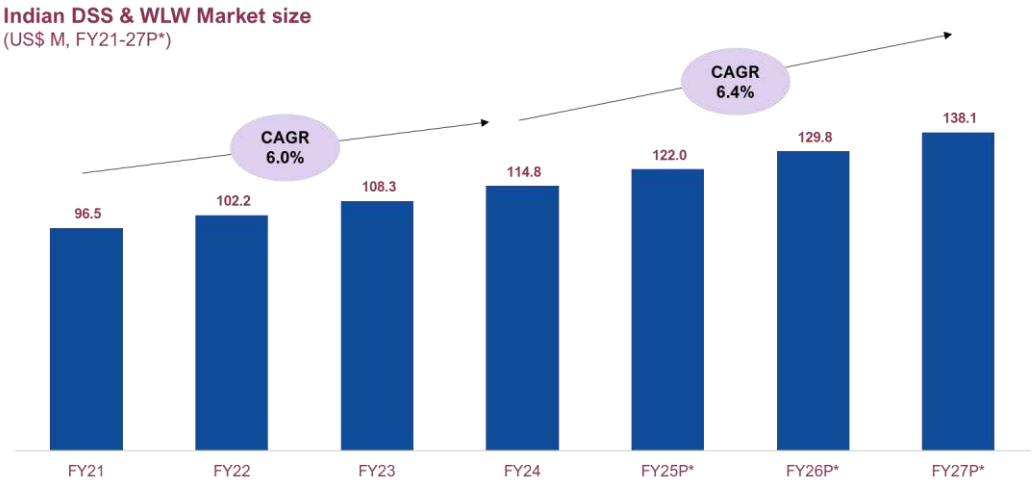
4. Indian market for Disc & Strip Springs and Wedge Lock Washers (DSS & WLW)

4.1 Industry Overview

DSS & WLW serve as spring and fastening solutions employed in industrial settings where mechanical devices are needed to exert force. These elements find application across diverse industries such as renewable energy, infrastructure, automobiles, and more. Their usage spans a range of applications, including pressure controls and regulators, vehicle braking systems, valves, and shock absorbers, tailored to the specific needs of each industry. The Indian DSS & WLW market is valued at ~ US$ 115M in FY24 witnessing a CAGR of 6.0% during FY21-24. Gala Precision Engineering is a major DSS manufacturer & has ~10% market share in the Indian disc spring market as of FY23.

4.2 Market forecast and growth drivers

The Indian DSS & WLW market is expected to reach a value of ~ US$ 138M in FY27 witnessing a growth of 6.4% during FY24-27P. The end-user industry growth will be the key growth driver for the DSS & WLW market. Renewable energy, automobile & infrastructure are some of the key industries showing good growth potential.



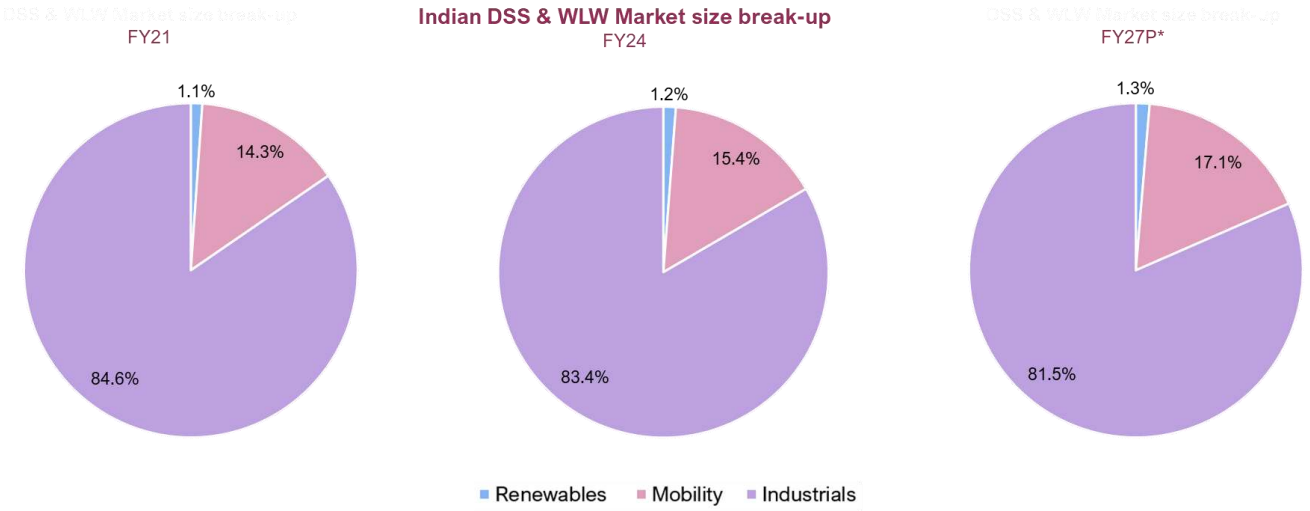
Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

- **Expansion of renewable energy:** The Indian government is actively investing in the renewable energy industry, introducing new policies and targets under COP26. The Union Cabinet has approved the National Green Hydrogen Mission with an initial budget of ~INR 20,000 Cr. PLI scheme in Solar PV manufacturing with financial outlays of ~INR 24,000 Cr introduced under Aatmanirbhar Bharat scheme. This investment will boost demand for DSS & WLW, crucial components in renewable energy infrastructure.
- **Investment in infrastructure:** In Budget FY23-24, spending on infrastructure will go up by ~35% to INR 10 lakh Cr (US$ 122B), making it ~3% of GDP and nearly three times the FY19-20 expenditure. Additionally, a new Infrastructure Finance Secretariat is being set up to boost private investment in railways, roads, urban infrastructure, and power. This increased investment aims to drive demand for DSS & WLW, crucial for ensuring structural stability in infrastructure.
- **Automobile export expansion:** India has a robust market for both local and international sales. In FY23, about ~4M passenger vehicles were sold, and the goal for the Indian automotive industry is to boost vehicle exports by five times from FY16-26. In FY23, total automobile exports from India were around 500,000. Growing exports mean higher demand and production of vehicles, which, in turn, will drive the need for components like DSS & WLW used in crucial parts like clutch and brake systems.

4.3 Industry-wise application

Indian market size for DSS & WLW				
Industry		Market size (US$ M)		
		FY21	FY24	FY27P*
Renewables		1.1	1.4	1.8
Industrials	Off-highway	66.7	77.4	89.9
	Electrical & power	14.2	17.5	21.6
	Heavy machinery	0.7	0.9	1.1
Mobility	Automobiles	13.8	17.7	23.7
Total		**96.5**	**114.8**	**138.1**

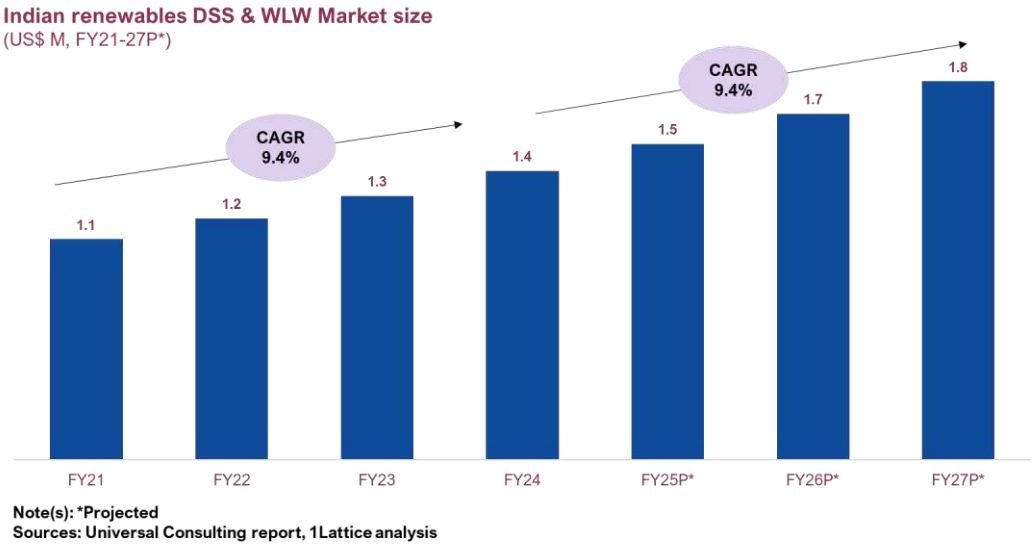
Note(s): *Projected



Note(s): *Projected

4.3.1 Renewable Energy Industry

India has been actively working to achieve its climate change mitigation and adaptation targets by implementing various policies and making substantial investments (~INR 20,000 Cr). It is one of the largest countries in hydro and solar power, continually increasing its capacity through various projects. DSS & WLW play a crucial role in ensuring the structural integrity of wind energy and hydroelectricity plants. These technologies share the same applications, essentiality, and alternatives as previously mentioned in the global section, possessing similar quality and functionality. The market for DSS & WLW in the Indian renewable energy industry was valued at US$ 1.4M in FY24 and is expected to increase at a CAGR of ~9% during FY24-27.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

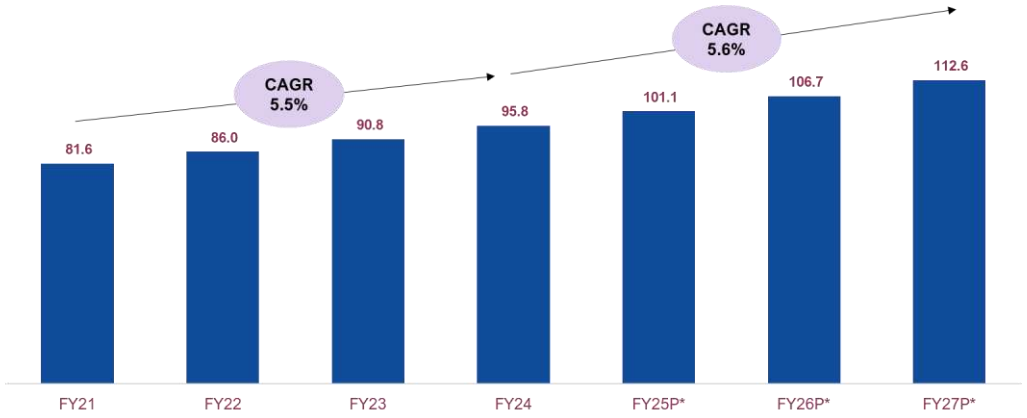
The renewable energy sector is experiencing growth thanks to increased investments and policies aimed at addressing international climate change. The rising demand for electricity and the cost advantages of establishing renewable energy infrastructure are also contributing to this growth. As the demand for renewable energy continues to increase, there will be a corresponding rise in the consumption of DSS & WLW.

- **Rising investment**: In India, investment in renewable energy has reached a record high of ~US$ 15B in FY22, an increase of ~125% over FY21. The government is encouraging this by allowing 100% FDI under automatic routes in the renewable energy sector. Further, technical support including resource assessment & identification of potential sites for wind energy is being provided through the National Institute of Wind Energy.
- **Policies for achieving climate change mitigation and adaptation targets:** Targets set up by India include reducing carbon intensity by ~45%, reaching 450 GW of installed renewable energy capacity, and achieving ~50% cumulative electric power installed from renewable energy, by the end of the decade. It has also approved the Sovereign Green Bonds framework which will aid in attracting foreign & domestic capital to green projects.
- **Cost advantage:** Power generation from solar and wind projects is likely to be cost-competitive relative to thermal power generation in India in coming years. This could happen as the cost of battery energy storage systems is projected to keep falling in the coming years. The national laboratory says the BESS costs will fall ~50%, ~30%, and ~15% by end of the decade in its low, mid, and high-cost projections.

4.3.2 Industrial

The industrial sector includes off-highway vehicles, electrical and power equipment, and heavy machinery. DSS & WLW are vital for internal components in off-highway vehicles, such as transaxles, torque limiters, and hydraulic motors. It also has applications in transmission lines, transformers, and elevators. The projected value of the industrial DSS & WLW market is expected to reach ~US$ 113M by the end of FY27P, with a projected CAGR of 5.8% from FY24-27P.

Indian industrial DSS & WLW Market size
(US$ M, FY21-27P*)

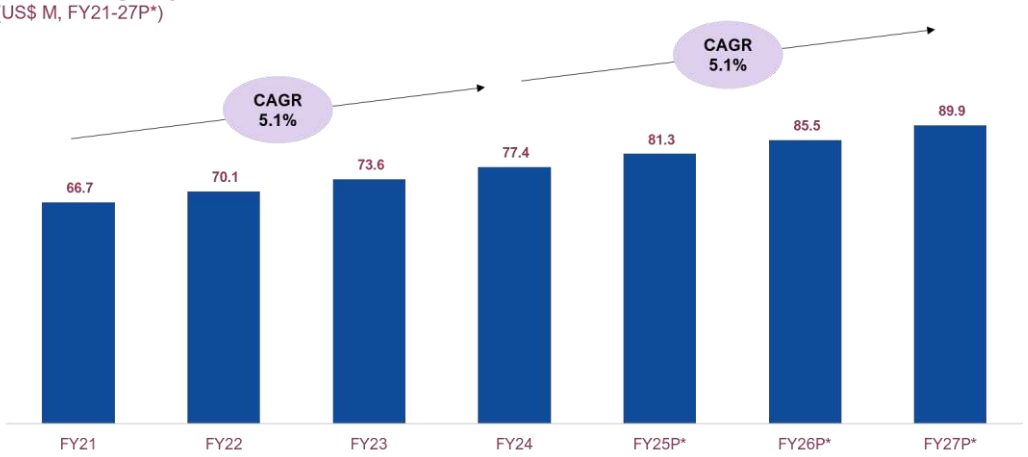


Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

4.3.2.1 Off-Highway Vehicle

Off-highway vehicles include things like tractors, harvesters, excavators, and more, used for jobs like farming and construction. India is expected to see a rise in demand for these vehicles due to increased agricultural and construction activities. DSS & WLW plays a crucial role in internal components like transaxles, torque limiters, and hydraulic motors in these vehicles as mentioned in the application and essentiality part of global. The Indian DSS & WLW market for off-highway vehicle industry was valued at ~ US$ 77M in FY24 witnessing a CAGR of 5.1% during FY21-24.

Indian off-highway DSS & WLW Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The off-highway vehicle industry is set to experience substantial growth due to several factors. The increased investment in infrastructure is anticipated to stimulate the sales of construction vehicles. Worldwide, the demand for agricultural machinery is being fueled by large farms, and the growing awareness of mechanization in emerging economies is expected to further improve the market. Additionally, government policy decisions that prioritize infrastructure development and farmer welfare are fostering a favorable environment for the expansion of off-highway vehicles.

- **Infrastructure spending:** In FY24-30, India is projected to allocate ~INR 140 lakh Cr towards infrastructure, nearly twice the expenditure observed between FY17-23. This surge is anticipated to

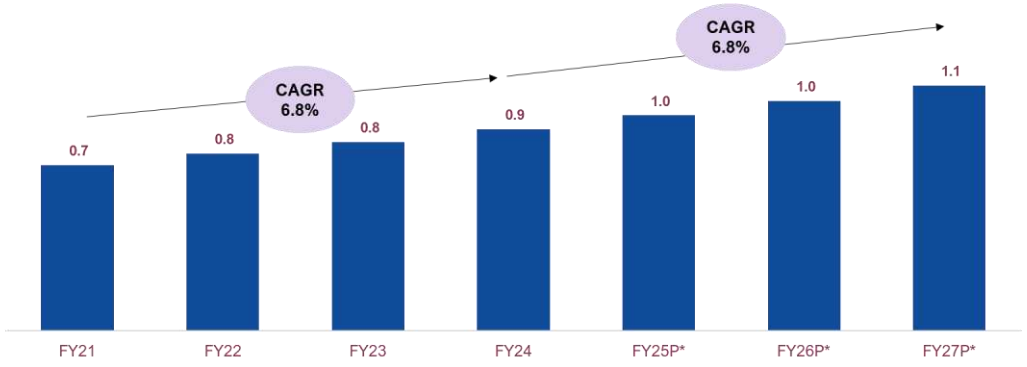
coincide with an increase in the average project size and a rise in the prevalence of mega-scale projects, with roads and power anticipated to spearhead the growth within the infrastructure sector.

- **Agriculture mechanization:** Farm mechanization plays a crucial role in Indian agriculture, accounting for over ~70% of the cultivation of major crops such as cereals, pulses, oilseeds, millet, and more. Additionally, there is significant potential for mechanization in crops like rice and wheat, where the current adoption rate is below ~32%.
- **Government policies:** GoI is taking up initiatives in infrastructure to propel India's growth story.
  - **National Infrastructure Pipeline (NIP):** NIP aims to inject ~INR 110 lakh Cr in investments between FY20-25 to facilitate the development of top-notch infrastructure. Currently, over 8,900 projects, with a cumulative investment exceeding ~INR 100 lakh Cr, are progressing through various stages of implementation.
  - **Increasing expenditure:** The budget for FY24 allocated ~INR 10 lakh Cr (3.3% of GDP) for infrastructure, marking a ~33% increase from FY20. The FY24 budget demonstrated the third consecutive substantial rise in the allocation for infrastructure spending.
  - **Extension of interest-free loans:** 50-year interest-free loans to state governments to encourage infrastructure development & incentivize complimentary policy action.

4.3.2.2 Heavy machinery

Heavy machinery refers to various equipment that enable or power the inner workings of various industries such as manufacturing, infrastructure, and HVAC. DSS & WLW play multifaceted roles in each of these industries as mentioned in global section detail. For instance, disk spring assemblies are used in elevator safety breaks which hold elevators in place in case of failure. The Indian DSS & WLW market for heavy machinery industry was valued at ~ US$ 1M in FY24 witnessing a CAGR of 6.8% during FY21-24.

Indian heavy machinery DSS & WLW Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The heavy machinery industry is set to grow strongly because of key factors. Heavy machinery is essential for steel production, and the increasing demand for steel, driven by construction and urbanization, contributes to this growth. Additionally, energy-efficient solutions for heat exchangers and the demand for HVAC systems due to urbanization further fuel this expansion. Investments in domestic infrastructure are expected to support various industries, including cement, construction equipment, and components like disc springs, both during construction and operations.

- **Steel processing industry:** In FY23, India's consumption of finished steel reached ~120 MT, driven by increased demand for automobiles, infrastructure development, and other sectors. It is projected to

surge to ~230 MT by FY31, with government initiatives like ''Smart Cities'' and ''Affordable Housing'' further contributing to the upswing in steel product consumption.

- **Elevators:** High-rise buildings persist in integrating into urban infrastructure, and as India's urban population is projected to reach ~600 M by end of the decade, the country must unlock buildings designed to accommodate increased population density. India's office real estate market experienced a significant rebound in Q3 FY23, recording the highest office space absorption in 18 months at ~10 M square feet. Gross leasing activity in the top seven cities reached ~16M square feet, a notable ~26% increase from the previous quarter, fueled by robust leasing in the manufacturing sector and a rising demand for flexible workspaces. With increased demand for urban infrastructure such as housing and office facilities, there is a higher need for elevators and escalators to facilitate efficient vertical mobility.
- **Cement industry:** At present, India holds the position of the second-largest cement producer globally, manufacturing ~300 MT annually. The industry is anticipated to experience a growth rate of 7-8%, fueled by investments in infrastructure and large-scale residential projects. The demand for cement in India is expected to reach ~450 MT in FY27.
- **Heat exchangers:** Heat exchangers play a crucial role in regulating system temperatures by transferring heat between different fluids. The increasing population, coupled with rapid urbanization, is anticipated to drive the demand for power. This demand is further fueled by the need to replace outdated heat exchangers and the integration of new heat exchangers into emerging power units.

4.3.2.3 Electrical & Power Equipment

Power equipment, like generators and transmission lines, is crucial for generating and distributing electricity. Due to a rising demand for power and government initiatives, the electrical equipment industry is expected to grow at a rate of ~12%. Dampening vibrations in transformers and acting as spacers between transmission lines are among the various applications of DSS & WLW as previously mentioned in the global section. The Indian DSS & WLW for electrical & power equipment market was valued at ~US$ 18M in FY24 witnessing a CAGR of ~7% during FY21-23.

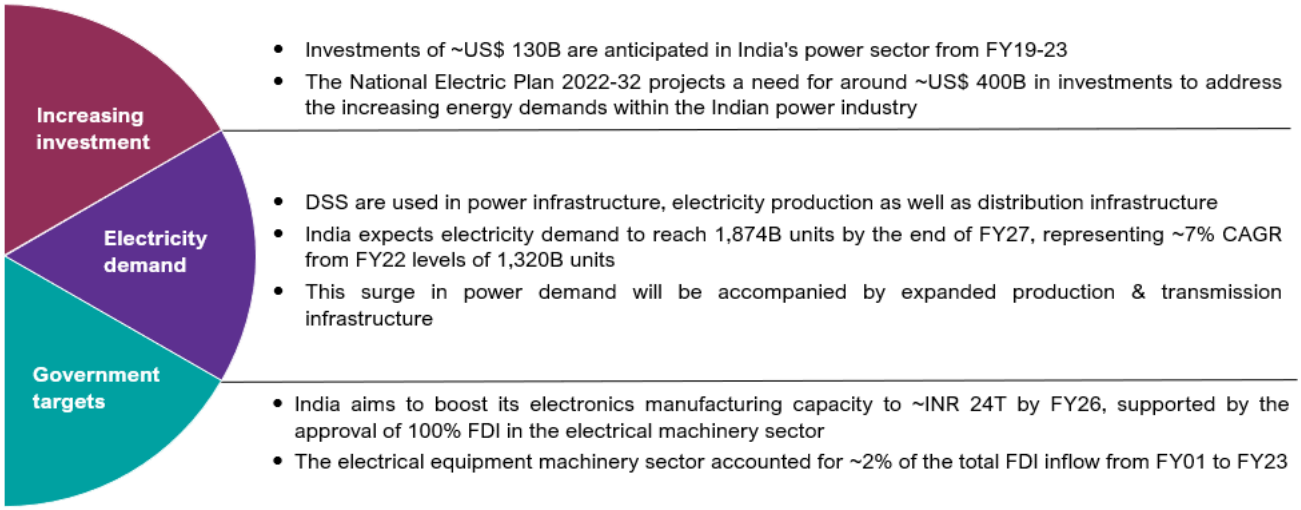
Gala Precision Engineering has played an active role in in the installation of the electrical infrastructure of the new India Parliament house.

Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The electrical and power equipment industry experiences growth from various factors. The rising domestic demand for electricity, increased investments, and government policies aiming to meet targets contribute to

the expansion of the electrical and power equipment sector. This increased growth will also boost the demand for DSS & WLW, which are utilized in electrical and power equipment.



4.3.3 Mobility

Mobility, covering both railways and automobiles, relies heavily on DSS & WLW. DSS & WLW is crucial in the railway domain, applied in rolling stock and infrastructure. It also plays an integral role in 4-wheeled and 2-wheeled vehicles, notably contributing to vehicle clutch and brake mechanisms. The mobility sector has experienced significant expansion, with automobiles playing a substantial role in this development. The main contributors to this growth are proactive government initiatives such as FAME II and AMP, coupled with incentives linked to products. Additionally, the surge in investments is another key driver, leading to an escalating demand for DSS and WLW utilized in vital automobile components. Furthermore, government investments in railways are contributing to the increased demand for mobility.

4.3.3.1 Railway Industry

The Indian railway network is among the largest in Asia and the second largest globally, operating 19,000 trains per day. As mentioned earlier in application and essentiality of global section, within the railway system DSS & WLW are primarily employed in suspension systems to stabilize rolling stock. Infrastructure elements like pull rods, compressors, traction motors, and coaches are also utilized to ensure safety during high vibrations. These components play a crucial role in maintaining the efficiency and longevity of both railways and tracks.

Gala Precision Engineering is the first Indian company to supply WLW to Indian railways for LHB coaches, ICF, MCF, RCF & Vande Bharat coaches. They also supply highly technical springs as import substitute used in various assemblies of metro trains, electric locomotives and other railway parts.

Growth Drivers

The market for DSS & WLW is ready to experience growth, fuelled by government initiatives, increased foreign direct investment, and investments in upgrading tracks and development of new trains. The market's potential for expansion is also enhanced by the growing investments in railway infrastructure and the versatility of railways in meeting various sustainable transportation demands.

- **Government initiatives:** Indian Railways is the world's fourth-largest rail network, running 13,523 passenger trains & 9,146 freight trains daily, as of FY23. Based on changing demographics & income-influenced needs, demand is set to grow in India. To cater to this demand, the government has announced 5,000 km of metro rail network by FY47 in 100 cities.
- **Track upgradation:** For FY24, Indian Railways is targeting the laying of 7,000 km of new railway track. This is accompanied by ~INR 2 Lakh Cr being allotted for capital expenditure in railways, which is an

increase of ~50% over FY23 figures. This investment will drive the demand for DSS & WLW as they have applications both in rolling stock & railway infrastructure.

- **Foreign Direct Investment:** FDI inflows in railway-related components stood at ~US$ 1B from FY01-23. In the railway sector, 100% FDI is allowed under automatic routes for railway infrastructure, along with the operation & maintenance of suburban corridor projects through public-private partnerships. A special cell called Project Development Cell was set up to increase investments & inflow of FDI in the railway industry.
- **Development of new trains**: The development of high-speed and semi-high-speed trains offers new opportunities for future growth prospects with better and more efficient features compared to regular trains. Mumbai-Ahmedabad high-speed rail corridor is expected to operate at a speed of 320 Km/hr covering a distance of 508 Km and 12 Stations. 400 Vande Bharat trains are intended to be introduced by FY26 as per Union Budget FY23.

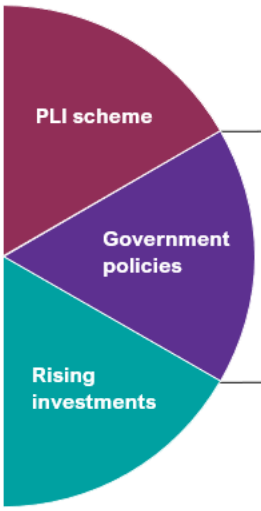
4.3.3.2 Automobile Industry

The Indian automobile industry is experiencing growth, marked by rising exports and production. In FY22, India produced ~23M vehicles annually. The country has a robust market, driven by both domestic demand and exports. In FY23, total sales of passenger vehicles reached ~4M. The automobile industry encompasses both four-wheeled and two-wheeled vehicles, powered by internal combustion engines and electric drivetrains, as well as heavy commercial vehicles. Various types of strip springs, including clip springs, play a crucial role in the operation of a vehicle's clutch and brake mechanisms as mentioned in the previous section of global. The Indian DSS & WLW for automobile market was valued at ~ US$ 18M in FY24 witnessing a CAGR of 10.3% during FY24-27.

Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The automobile industry is set to experience substantial growth in the upcoming years. Thanks to active government policies like FAME II, AMP, and incentives tied to products, there has been notable progress in the automobile industry. Another factor fuelling this growth is increasing investment, which will result in a growing demand for DSS & WLW used in essential automobile components.



- Government of India issued a notification in CY21, initiating PLI schemes for automobile and auto component sectors worth ~INR 26000 Cr
- The scheme aims to drive manufacturing sector development & attract new manufacturing investments

- Government of India has introduced various policies to further the case of a strong and emerging automobile market:
  - **FAME:** It has increased the budget allocation of FAME II by ~80% as compared to FY23. FAME aims to provide financial incentives to consumers for electric & hybrid vehicle adoption.
  - **AMP 2026:** AMP2026 is the collective vision of the government of India & Indian Automotive industry which aims to promote 'Make in India'. It also lays down an expectation for the automotive sector to contribute more than 12% of the country's GDP over the next decade.

- Automotive sector has received a cumulative FDI inflow of ~ US$ 35B between FY01-FY23. With a total investment opportunity of more than US$ 200B over the next 8-10 years, India is expected to become the largest EV market
- Increased investment in automotive has been due to signification cost advantages, Indian auto firms save up to 10-25% on operations as compared to Europe & Latin America

05

Indian market for Coil & Spiral Springs

5. Indian market for Coil & Spiral Spring (CSS)

5.1 Industry overview

CSS consist of coil spring and spiral spring, represented below:

Spiral Springs

Coil Springs

A coil spring is a mechanical device with a helical shape, and it can be either close-wound or open-wound. Spiral springs, on the other hand, are a specific type of spring made from rectangular metal strips that are wound into a flat spiral. While coil springs store mechanical potential energy, spiral springs are designed to store and release rotational energy in the form of torque. These types of springs find applications in various areas such as automotive suspensions, electronic devices, valves, switches, machinery, and more. The effectiveness of coil and spiral springs depends on how and where they are used. The Indian CSS market is valued at ~ US$ 459M in FY24 witnessing a CAGR of 9.8% during FY24-27P.

Gala Precision Engineering is positioning itself as a key import substitution opportunity for European spring suppliers looking to take advantage of government schemes such as the production-linked incentives scheme. It has also entered a new related product category called retractor springs. These springs are a critical component for increasing vehicle safety.

5.2 Manufacturing process

5.2.1 Coil spring

In the production of Coil springs, meticulous attention is given to ensuring precision and quality at every stage. This process begins with a thorough inspection and testing of raw materials, followed by the intricate coiling of spring steel to form the foundational structure. Heat treatment, machining processes, and rigorous quality control measures are then employed to enhance the mechanical properties and dimensional accuracy of the springs. The following process flow chart outlines the step-by-step journey from raw material assessment to the final inspection and packaging, demonstrating the meticulous craftsmanship and adherence to specifications in CSS manufacturing.

Gala is equipped with IATF16949 manufacturing facilities with offices in Germany and China. Gala's coil springs undergo comprehensive testing including microhardness testing, online dimension inspection, load testing & fatigue testing.

S.No.	Process	Description
1.	Raw material inspection & testing	• This is the initial step where the raw materials are inspected for quality and tested to ensure they meet specifications
2.	Coiling	• This step involves winding the raw material into the desired coil or spiral shape, it is a critical step in spring manufacturing, as it determines the spring's overall shape and characteristics
3.	Stress Relieving – I	• After coiling, the springs undergo stress relieving, which is a heat treatment process designed to reduce internal stresses in the material, improving the spring's stability and performance
4.	Grinding	• Grinding is employed at end portions (both end) to achieve precise dimensions on the springs and improve the surface finish. Grinding is employed to achieve precise dimensions on the spring and improve the surface finish
5.	Outer Diameter Chamfering	• Chamfering on the outer diameter of the springs involves cutting or grinding a beveled edge / sloped edge
6.	Shot Peening – I	• Shot peening is a process that bombards the surface of the springs with small particles to enhance strength and fatigue resistance
7.	Shot Peening – II	• Similar to the previous step, this involves a second round of shot peening for additional strengthening
8.	Stress Relieving – II / Warm Scragging	• This step refers to an additional round of stress relieving, possibly at a different temperature or duration
9.	Cold Scragging	• Scragging is a process of compressing the spring to its solid height, it is done to enhance spring's mechanical properties
10.	Length / Load / Solid Sorting & Visual Chamfer Sorting	• Quality control steps involving sorting and visual inspection for length, load, solid features, and chamfer details
11.	Identification marking	• Springs are marked for identification purposes, which can include information about the manufacturer, specifications, strength or other relevant details
12.	Oiling	• Springs are coated with oil to provide corrosion resistance and improve their overall finish
13.	Inner & Outer Diameter & Visual Sorting	• More quality control steps involving sorting and visual inspection of the inner and outer diameters of the springs
14.	Final Inspection	• A comprehensive inspection to ensure that the coil and spiral springs meet all the required specifications
15.	Packaging & Dispatch	• The final step involves packaging the springs for shipment

Operation Inspection

5.2.2 Spiral spring

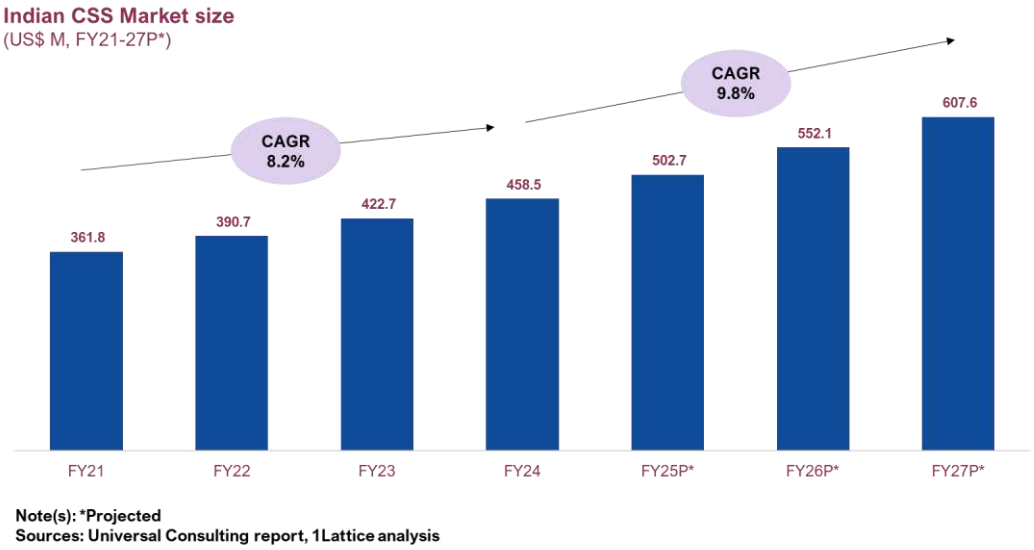
In the manufacturing of spiral springs, the process commences with a comprehensive examination and testing of raw materials, followed by the shaping of springs through forming. Subsequently, it undergoes a stress-relieving process and is coated with sodium and phosphate. Scragging is employed to enhance the mechanical properties of the springs, after which they undergo cleaning and labeling. Finally, a thorough inspection is conducted before the springs are sent for packaging. The accompanying process flow chart illustrates the step-by-step journey from the assessment of raw materials to the final inspection and packaging, showcasing the scrupulous craftsmanship and strict adherence to specifications in the manufacturing of spiral springs.

S.No.	Process	Description
1.	Raw material inspection & testing	• This is the initial step where the raw materials are inspected for quality and tested to ensure they meet specifications
2.	Forming	• Forming, a mechanical manufacturing step, alters the shape of an unfinished product. In the production of spiral springs, a spring former or CNC spring former machine with multiple tooling slides are utilized for bending, creating hoops, and spring coils, resulting in a diverse range of spring shapes
3.	Stress Relieving	• After forming, the springs undergo stress relieving, which is a heat treatment process designed to reduce internal stresses in the material, improving the spring's stability and performance
4.	Bonderlube coating	• Sodium stearate film is applied after phosphate coating, resulting in a lubricating finish for components subjected to cold forming, blanking, or cold drawing
5.	Auto Scragging	• Scragging is a process of compressing the spring to its solid height, it is done to enhance spring's mechanical properties
6.	Cleaning	• While cleaning, springs are placed on a designated mold to prevent deformation. The initial phase involves immersing them in a low-temperature solvent with enhanced cleaning through ultrasonic agitation. The second stage includes a vapor cleaning step for the parts
7.	Pad printing	• Pad printing an indirect offset printing process that uses a silicone pad to transfer a 2-D image onto a 3-D on spiral spring for labeling
8.	Final inspection	• A comprehensive inspection to ensure that the coil and spiral springs meet all the required specifications
9.	Packing	• The final step involves packaging the springs for dispatch & distribution

Operation Inspection

5.3 Market forecast and growth drivers

The end-user industry growth will be the key growth driver for the CSS market. Automobile, construction & agriculture mechanization are some of the key industries showing good growth potential.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

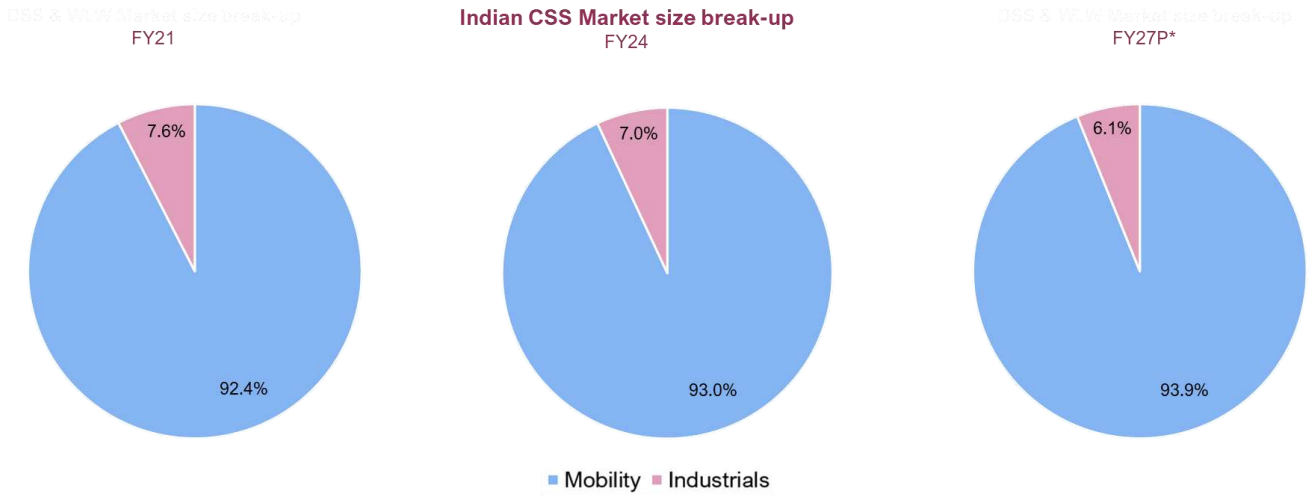
- **Growing automobile industry**: There has been consistent growth in the Indian automobile sector due to increased incomes, accessible financing options & a preference for personal mobility over public transport. This has been further exacerbated by the growing demand for electric vehicles as an affordable & sustainable solution. There also has been an increase in the usage of commercial vehicles, with ~4L units more being sold in FY23 than in FY22. This has led to a proportionate demand in the growth of spiral springs which are a key component of the seat recline & seat belts of various vehicles. Coil springs have also been seeing significant growth as it is an integral part of independent suspension systems.
- **Increased mechanization of agriculture:** Indian agriculture has seen rapid mechanization in recent years due to the expectations of increased output within a shorter period. This has resulted in an increasing demand for farming equipment such as tractors, mowers, deep tillage equipment & spraying equipment. Coil springs have been seeing a proportionate amount increase in demand as they are an integral component in such as clutch and engines.
- **Rapid Urbanisation**: The Indian construction industry is expanding due to factors like population growth, urbanization, and government investments. With an estimated ~600M people expected to reside in urban areas by end of the decade, there is a demand for ~25M additional mid-end and affordable housing units. To address this, the government is investing ~INR 10,000Cr annually in urban infrastructure development in tier 2 & 3 cities. Coil spring growth is proportional, serving as a crucial component in infrastructure for structural support, shock absorption, and movement control.

5.4 Industry-wise application

CSS usage & criticality among different end users		
Industry	**End-user**	**Uses & Criticality**
Mobility	Commercial vehicle	• **Coil springs** are integral components in commercial vehicle (such as light, medium & heavy commercial vehicles) **clutch assemblies**, facilitating the smooth engagement & disengagement of clutch plates; Additionally, they play a **crucial role in cabin shock absorption**, effectively isolating the engine from vibrations & shocks to enhance ride comfort & minimize stress on engine components; They are also a key component of fuel injection systems, braking systems; In light commercial vehicles they are used in suspension systems as well
	Automobiles	• **Coil springs support the weight & absorb shocks in the engine, clutch, & suspension** of both four-wheelers & two-wheelers, minimizing disturbances to the vehicle's frame & body caused by bumps & dips in the road • **Spiral springs** is used in **vehicle seat recline mechanisms** store & release energy, optimizing functions like energy absorption, retraction, flexibility, & durability
	Railway	• **Coil springs** serve various purposes in railway systems, including in **locomotives, wagons, transit, tracks, & signaling**; They are utilized to **absorb shocks & vibrations**, ensuring a comfortable journey for passengers & protecting cargo from potential damage
Industrial	Off-highway	• **Coil springs** in off-highway vehicles serve dual roles: facilitating **smooth clutch operation** in transmissions & are a critical part in the **fuel injection system of the engine**; They absorb shocks from crankshaft vibrations, sudden clutch engagement, & driveline impacts for a smoother overall usage experience
	Industrial infrastructure	• **Coil springs** are **employed in control valves to exert force**, enabling valve movement by overcoming friction & resistance; Additionally, they play a role in actuators by storing energy when compressed & releasing it to activate valves

Indian market size for CSS				
Industry		**Market size (US$ M)**		
		FY21	**FY24**	**FY27P***
Industrials	Off-highway	18.3	21.2	24.5
	Industrial infrastructure	9.1	10.8	12.7
Mobility	Commercial vehicles	19.3	22.6	26.4
	Automobiles	315.1	404.1	544.0
Total		**361.8**	**458.5**	**607.6**

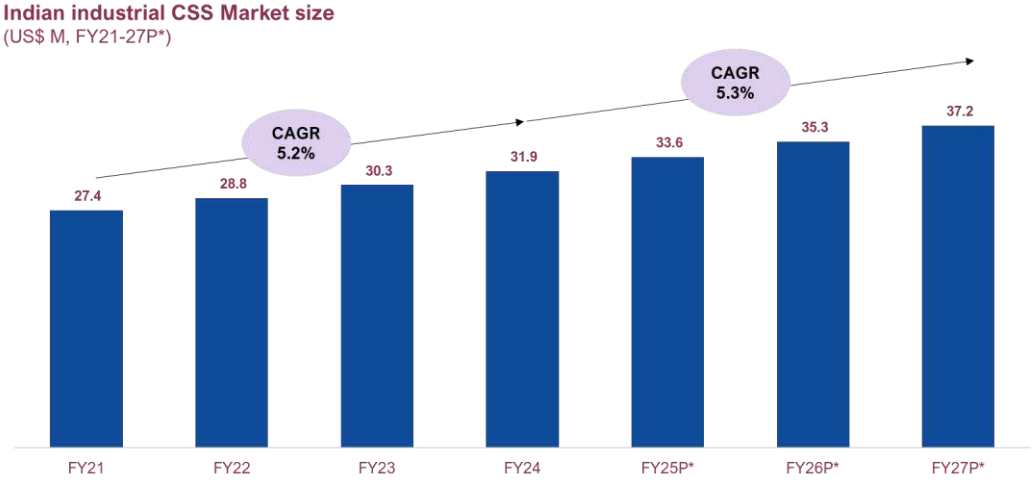
Note(s): *Projected



Note(s): *Projected

5.4.1 Industrial

The industrial sector comprises off-highway vehicles, industrial infrastructure, and railways. In off-highway vehicles, CSS plays a crucial role in the clutch system. In industrial infrastructure coil springs find application in used in valves and actuators, while in railway infrastructure they are used in locomotives, wagons, and transit systems. The collective market for CSS in the industrial sector is anticipated to reach ~ US$ 37M by FY27. This growth is primarily attributed to the rise in mechanized farming, increased construction activities, and government investments in railways. The industrial sector is projected to experience a CAGR of 5.3% from fiscal year FY24-27P.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

5.4.1.1 Off-highway Vehicle Industry

Off-highway vehicles refer to all types of vehicles utilized for non-transportation-related purposes such as agriculture, construction, and mining. Common uses examples are vehicles such as tractors, combine harvesters, excavators, dozers, dump trucks, etc. CSS plays a critical role in various internal components of off-highway vehicles such as the clutch to absorb shocks.

Applications for coil springs in the off-highway vehicle industry (industrials)

Coil springs

- Coil springs serve various roles in off-highway vehicle systems
  - In manual transmission clutches, they help engage and disengage the clutch smoothly by maintaining pressure on the clutch plate
  - In engines, coil springs act as valve springs, ensuring valves open and close at the correct times
  - Additionally, they can be used in engine mounts to isolate vibrations, particularly in off-highway vehicles navigating rough terrains, this enhances the suspension system's flexibility and damping capabilities

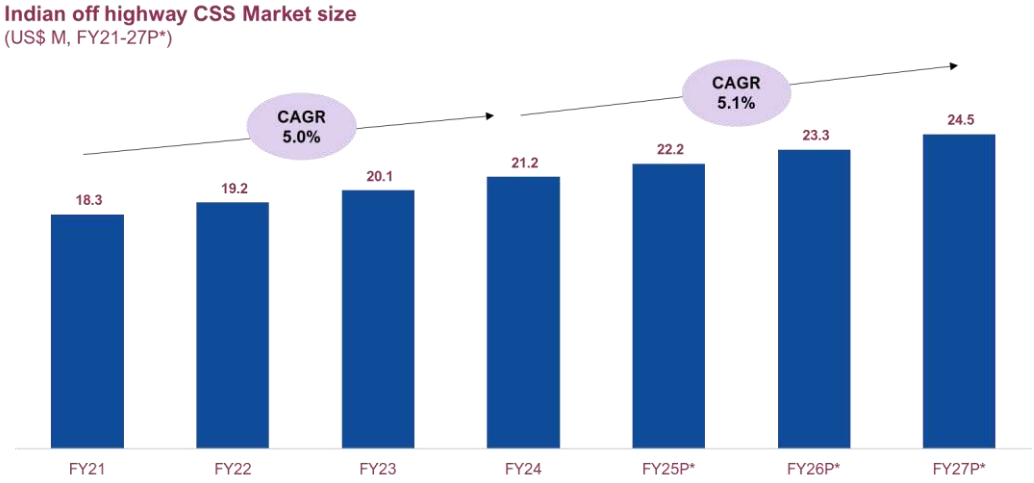
Coil spring: Compression for transmission

Essentiality of coil spring in off-highway vehicle industry (industrials)

Coil springs absorb shock from crankshaft vibration, sudden clutch engagement, and driveline impact. Meanwhile, clutch springs sustain pressure on clutch plates, influencing smooth shifting. These springs also help support the vehicle at the preferred height and ensure proper alignment. By exerting axial force, coil springs establish contact between clutch plates, the flywheel, and the pressure plate. Additionally, they serve as torsional vibration dampers, absorbing variations in the engine's power delivery.

Comparison of coil spring with key select substitutes for off-highway vehicle industry (industrials)

Rubber springs excel at absorbing and damping vibrations, particularly in off-highway vehicles navigating rough terrain. They effectively reduce the transmission of vibrations to crucial components like the clutch or engine. Compared to traditional coil springs, rubber springs are more compact, making them ideal for space-limited applications. Their stiffness can be customized by adjusting material properties or design, providing flexibility to meet specific requirements in clutch or engine systems.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The demand for coil springs, integral for safety and proper utilization in off-highway vehicles, is driven by the growth in agriculture mechanization and the increasing need for construction equipment due to urbanization.

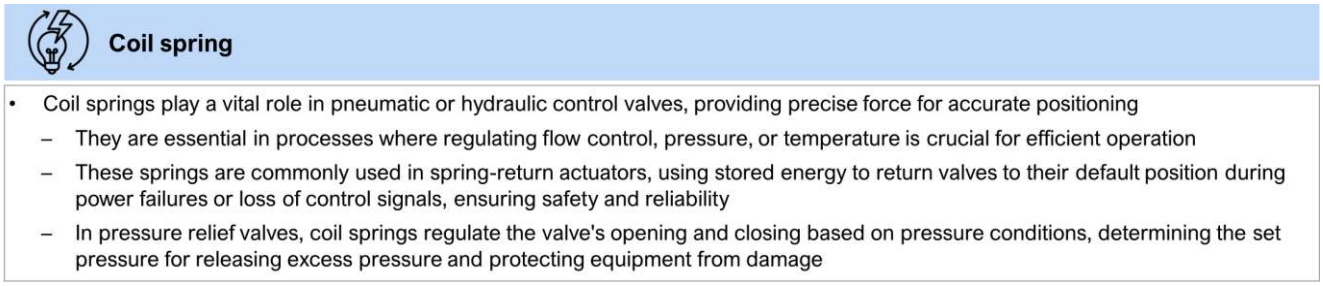
- **Mechanized agriculture:** Indian agriculture has seen an increase in the utilization of machinery due to its effectiveness in boosting productivity, facilitating timely farming operations, and allowing farmers to efficiently rotate crops on the same land. Governmental schemes like Pradhan Mantri Tractor Yojana and SMAM aim at 'reaching the unreached' by making farm machines accessible and affordable for small and marginal farmers. Coil springs find multiple applications in agricultural machinery such as clutch and engine. The growing utilization of tractors in agriculture is leading to a high demand for coil springs.

- **Government initiatives:** Indian Government initiatives like the production-linked incentive and Urban Infrastructure Development scheme in the construction sector are encouraging the use of various construction machinery. These machines include excavators, cranes, bulldozers, pavers, compactors, loaders, and backhoes. Coil springs are used in integral parts of construction equipment such as controlling the arm and bucket in excavators, providing suspension systems in cranes, and serving as shock absorbers in bulldozers. The widespread adoption of these machines in the construction sector is contributing to the growth of the coil springs industry, as they are essential components in these machines.

5.4.1.2 Industrial Infrastructure Industry

Industrial infrastructure encompasses the physical and organizational elements that uphold industrial operations, such as facilities, utilities, transportation networks, and other crucial structures required for manufacturing, processing, and production activities. Coil springs are primarily used in valves and actuators as a part of control valves.

Application for coil springs in industrial Infrastructure industry (industrials)

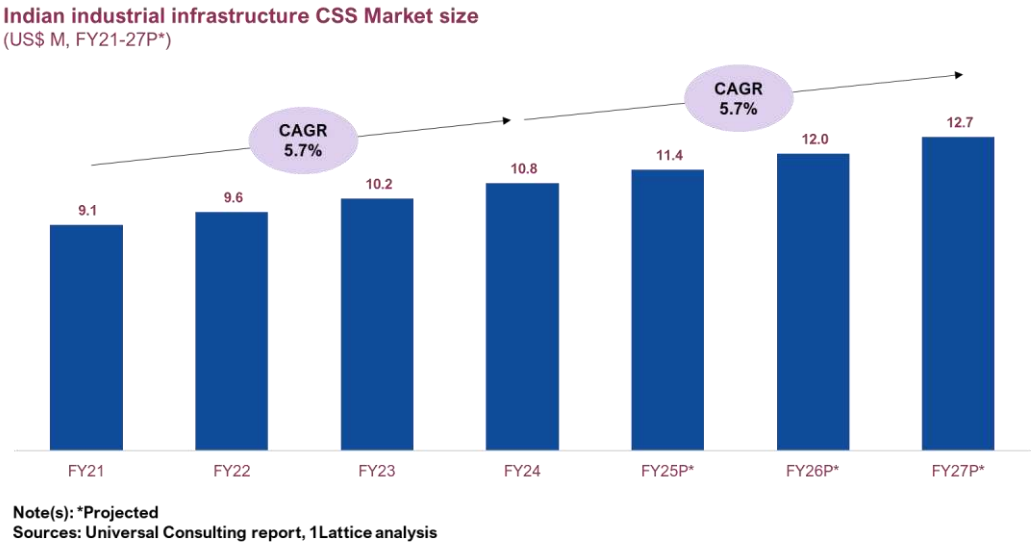


Essentiality of coil springs in industrial infrastructure industry (industrials)

Coil springs in actuators store energy when compressed, releasing potential energy to actuate valves. They provide the force needed to move valves, overcoming friction and resistance. In emergencies or shutdowns, rapid valve closure is crucial. Coil springs enable quick closure, ensuring prompt shutdown during malfunctions. Designed for repeated cycles, they prevent fatigue failure, ensuring long-term reliability in industrial settings.

Comparison of coil spring with key select substitutes for industrial infrastructure industry (industrials)

Rubber springs excel at dampening vibrations, isolating valves or actuators from external vibrations, reducing noise, and preventing structural damage. They absorb shocks, crucial in applications with sudden movements, enhancing equipment protection and reliability. Compared to traditional metal coil springs, rubber springs require less maintenance. However, they may not be suitable for extremely heavy loads due to limitations in load-bearing capacity. Additionally, rubber materials can be sensitive to temperature extremes, degrading in high temperatures and losing flexibility in very low temperatures**.**



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Various government initiatives and increased construction activity have contributed to a growing demand for coil springs used in industrial infrastructure. Coil springs are also employed in bench drilling machines, facilitating the efficient utilization of time in construction projects. The government's "Make in India" initiative is enhancing the demand for industrial infrastructure, thereby increasing the need for coil springs across industries.

- **Industrial growth:** Fuelled by a thriving and advancing economy, India is experiencing a significant surge in process industries, leading to an increased demand for control valves. Various sectors, including the chemical industry with a noteworthy CAGR of ~9%, as well as oil and gas, power, refining, and others, extensively rely on control valves and are undergoing substantial expansion in the country. This expansion serves as a driving force for the growth of the control valve market in India. Consequently, India is emerging as a crucial market for control valve suppliers seeking sustainable long-term growth opportunities.
- **Growing construction activity**: The Indian construction sector is evolving towards mechanization in which various initiatives such as Smart Cities Mission and public-private partnerships are playing a key role. Coil springs find utilization in various machines. One of them are bench drilling machine that is used to create holes in wood and metal material. Coil springs in these machines serve the purpose of bringing the drill to its initial position after the drilling process is completed. The growing demand for increased employment opportunities, driven by a rising population, has led to an increased need for construction activities. This is resulting in driving the demand for the coil spring industry.

5.4.2 Mobility

Mobility encompasses various vehicles, including 4-wheeled automobiles, 2-wheeled vehicles, commercial vehicles, and railways. Within commercial vehicles, CSS plays a crucial role in clutch ensuring smooth operations. In the case of 2 and 4-wheel automobiles, coil springs are pivotal in the proper functioning of the vehicle's clutch and brake mechanisms. The collective market for CSS in the mobility sector is anticipated to achieve significant growth in the coming years. This growth is primarily attributed to the surge in e-commerce, increased adoption of EVs, and government initiatives in the logistics industry. The automobile industry will contribute the majority revenue share for the CSS market.

5.4.2.1 Commercial Vehicle Industry

Commercial vehicles, often referred to as CVs, play a vital role in the transportation and logistics industry. These specialized vehicles are created and fine-tuned to facilitate the efficient movement of goods, serving as a fundamental support for diverse businesses. Commercial vehicles come in various forms, including trucks, vans,

buses, and more. The clutch, equipped with a crucial component called CSS, plays a significant role in ensuring the smooth operation of the vehicle.

Applications for coil springs in commercial vehicle industry (mobility)

Coil springs

- **Coil springs** are commonly used in clutch assemblies to aid the engagement and disengagement of clutch plates
  - These springs, integral to the pressure plate assembly, release pressure on the clutch plate when the pedal is pressed, facilitating smooth transmission disengagement from the engine.
- Coil springs are also used in cabin shock absorption systems to minimize the effects of terrain on the cabin of the vehicle, they are also used in braking system including slack adjusters

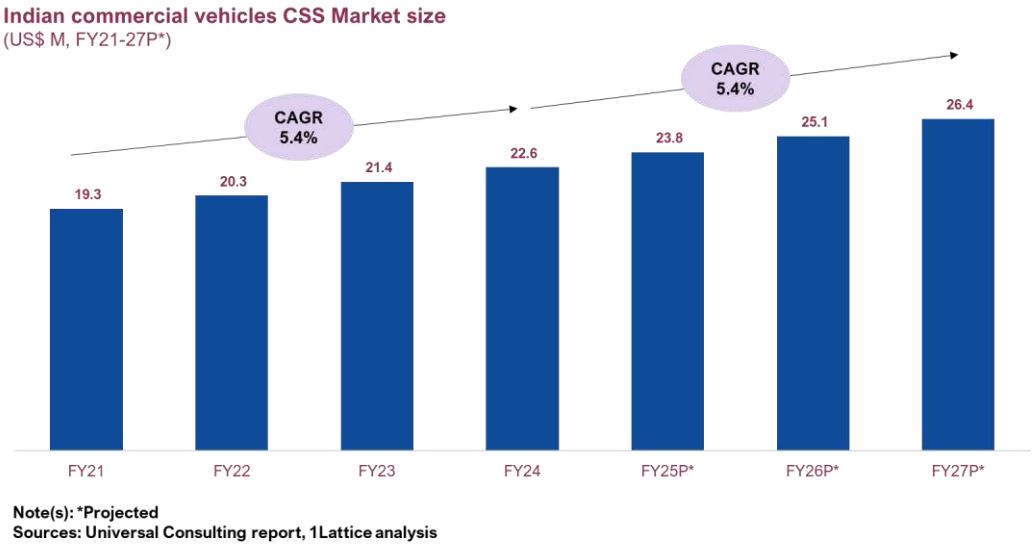
Coil spring: Compression for transmission

Essentiality of coil springs in the commercial vehicle industry (mobility)

Coil springs are crucial for improving the performance and durability of clutch and engine systems in buses and HCVs. They absorb shocks and vibrations during clutch engagement, ensuring smooth operation and protecting components from wear. These springs can also be used in engine mounts or suspension, isolating the engine from vibrations and shocks for a smoother ride and reduced stress on engine parts.

Comparison of coil spring with key select substitutes for commercial vehicle industry (mobility)

An alternative to coil springs is diaphragm springs which can be used in automotive clutches. These springs require alternatively designed clutches which are lighter and more space-efficient compared to traditional coil spring clutches. However, diaphragm-based clutches are not as stable at higher speeds compared to coil spring-based clutches.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The commercial vehicle sector is experiencing an upward trend in the demand for coil springs, as commercial vehicles like buses require a greater quantity of coil springs compared to other vehicles such as cars and bikes. The growth in the logistics market, government norms, and the boom in e-commerce are contributing factors driving the growth of the commercial vehicle industry.

- **Logistics and government norms:** In FY23, India's commercial vehicle wholesale volume increased from ~6L to ~10L units. New product introductions, logistics services, and an expanded network of improved highways along with implementation of BS-VI norms have bolstered growth in the commercial vehicle market in India. This surge in commercial vehicles is fuelling a higher demand for coil springs, given their increased usage in larger vehicles compared to smaller cars.
  - **Global outlook:** In CY18, there were ~120M commercial vehicles globally. Out of the ~14.7M units sold last year, ~11.4M were light commercial vehicles, and ~3.3M were either heavy or medium-duty trucks. Commercial vehicle sales are slowly increasing and are expected to stabilize over the next decade, with an estimated annual growth of ~2% from CY18-30. Growth in major markets like the US, Europe, and China is projected to be minimal. The overall industry expansion will rely on smaller markets worldwide, where ongoing projects for the modernization of road networks and commercial transportation are taking place.
- **E-commerce boom:** Commercial vehicle market, constituting ~4% of India's total domestic automotive production volumes, is projected to experience a CAGR of ~8%. The rapid growth of online shopping has boosted the need for commercial vehicles, especially for delivering goods over short distances. This has led to a higher demand for delivery vans and smaller commercial vehicles to distribute items quickly and efficiently. As the demand for commercial vehicles goes up, so will the need for coil springs, which are a crucial part of their structure.
  - **Global outlook:** E-commerce has shown steady growth, particularly in the aftermath of the pandemic. In CY22, online sales saw a ~3% increase in Europe and a ~7% increase in both the United States and Asia. The global growth trajectory is projected to maintain a ~9% CAGR until CY27, although it falls short of the pre-Covid trend of ~14%. Online purchases accounted for nearly ~20% of total global sales in CY21, and it is anticipated that by CY25, approximately a quarter of all global sales will be conducted online.

5.4.2.2 Automobile Industry

The automobile industry consists of 4-wheeled & 2-wheeled vehicles powered by internal combustion engines and electric drivetrains, along with heavy commercial vehicles. Various types of coil springs play a critical role in the functioning of the vehicle's clutch and & brake mechanism.

Applications for coil & spiral springs in automobile industry (mobility)

Coil springs	Spiral spring
• Coil springs are used in the engine, suspension, clutch & transmission of both 4-wheelers and 2-wheelers in the automobile industry	• **Spiral springs** are also used in reclination of car seats – It performs the basic function of storing & releasing energy spiral & linear springs, stabilizer plate, & lever are used to enable seat reclining • Used in retractor of safety belts, maintaining strength & tension under different environmental conditions or stress levels

Coil spring: Compression for transmission

Spiral spring for seat recline

Spiral spring: Retractor spring for safety belt

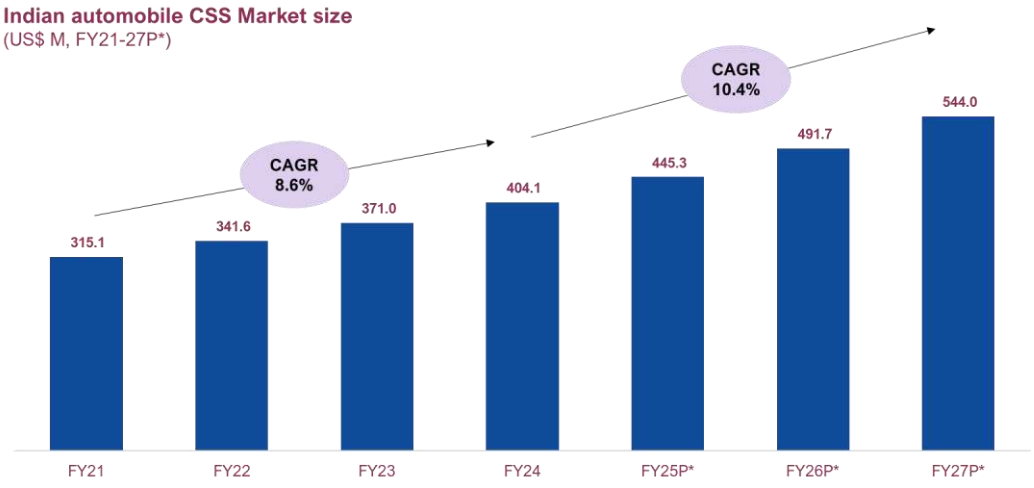
Essentiality of coil & spiral springs in automobile industry (mobility)

Coil springs are a key part of a car's suspension system. They are made of wound metal and are designed to support the vehicle's weight. They absorb shocks from bumps and dips in the road, allowing the frame and body of the vehicle to experience minimal disturbances. They ensure the quality of the ride by providing stability for the vehicle as it travels over uneven surfaces.

Spiral springs are used in seat recline mechanisms to perform the basic function of storing and releasing energy and are used as equalizing springs for smaller angles of rotation in seat recliners. Spiral spring in a car's seatbelt retractor maintains webbing tension. Attached to a spool above the shoulder, the spring winds and stores energy when the seatbelt is unwound. This stored energy retracts the seatbelt tightly against the body when the buckle is secured.

Comparison of coil & spiral spring with key select substitutes for automobile industry (mobility)

As a substitute for Coil springs: Air springs consist of rubber and plastic bags that can be filled or emptied to change the height of a vehicle, serving as an alternative to coil springs. Electronic controls, including air sensors and compressors, manage these inflatable bags, allowing the vehicle's suspension to be adjusted based on its needs, a capability not possible with coil springs. While air springs offer a more comfortable ride, they are prone to wearing out and failing. In contrast, coil springs, especially for front suspension, provide superior ride quality and are a solid choice for off-road manoeuvrability.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The coil springs market is expected to grow in India due to factors such as an increase in vehicle manufacturing and rising demand for EVs as it is an essential factor in automobile industry. Coil springs find utility in EVs to reduce vehicle weight. As of FY23, EV 2-wheelers have a penetration rate of ~5% in the total Indian 2-wheeler market and EV 4-wheelers have a penetration rate of ~1% in the total Indian 4-wheeler market.

- **Rise in vehicle manufacturing:** The automobile industry has seen an expansion in the utilization of light, medium, and heavy-duty vehicles due to factors such as rising income, increasing urbanization, and the introduction of flex-fuel and ethanol fuel vehicles in replacement of petroleum. The commercial vehicle sector is expected to witness an upward trajectory due to rising e-commerce activities, and the implementation of new axle load norms. Coil spring assistance is essential for suspensions, engines, clutch, seat recliners, and in-cabin shock absorbers in vehicles. This has resulted in significant growth of the coil spring market.
- **Increased demand for EVs:** According to NITI Aayog, India's EV finance industry is likely to reach ~INR 4L Cr by the end of the decade. Government initiatives such as Bharat-stage VI emission standards and FAME-II are also expanding the EV market. The increase in demand for electric vehicles and initiatives taken by up government to promote manufacturing and awareness have contributed to the growth of CSS. Coil springs are essential for EVs due to their lightweight suspension requirements, helping reduce the overall vehicle weight crucial for EVs carrying heavy battery loads.

5.4.2.3 Railway Industry

Railway infrastructure includes the physical and organizational components of the railway system, such as tracks, stations, signals, bridges, tunnels, and other facilities required for train operations. It is designed to ensure the safe and efficient movement of trains, providing the essential structure for both passenger and freight transportation. CSS plays a vital role in railway infrastructure, being installed in. It is also used in various aspects of the railway infrastructure, including track construction, and signalling.

Applications for coil springs in railway industry (mobility)

Coil springs

- Coil springs have various applications in locomotives, wagons, and the transit of railways, also utilized in railway infrastructure, including track construction & signaling
  - Primary coil springs establish a connection between the axle box & the bogie frame, while a secondary coil spring system links this frame to the train. Coil springs are used in bogie mounted braking system and in metro track railway fastening system
  - The primary suspension system, consisting of both springs & dampers, is a crucial component for all types of railway rolling stock, including freight wagons. It serves to mitigate forces and vibrations, playing a crucial role in preventing derailments

Essentiality of coil springs in railway industry (mobility)

Coil springs, employed in railway vehicles, serve to absorb shock and vibration, thereby ensuring a smoother ride for passengers and safeguarding cargo from damage. Additionally, coil springs play a crucial role in enhancing safety and ride quality. Coil springs that exhibit resistance to corrosion, along with exceptional durability, demonstrate outstanding longevity, enabling them to withstand the substantial loads of railway transportation systems over extended periods.

Comparison of coil spring with key select substitutes for railway industry (mobility)

Torsion bars serve as replacements for coil springs in the railway sector. Their function involves torsional deformation under the influence of weight, contrasting with the compression observed in coil or leaf springs. Typically, they comprise a solid metal rod or tube attached at one end and twisted at the other end to generate the required force when subjected to a load. Torsion bars are commonly employed in railway systems with limited space requirements but demand substantial load-bearing capacity.

Growth Drivers

Upgradation of Indian railways such as an increase in the production of super-fast trains and various government initiatives to redevelop the existing stations is boosting the need for coil springs since it is an essential factor. Investments by the government in railway infrastructure are enabling an increase in demand for coil springs as they are used in bogies.

- **Upgradation of Indian railway system to high-speed rail**: The IRSDC has announced various redevelopment projects for existing railway systems, in addition to the launch of new railways such as high-speed trains such as the Vande Bharat Express. The Indian government is expected to manufacture 400 new-generation Vande Bharat Trains during FY23-26. With these new projects and redevelopments, there is anticipated to be a higher demand for coil springs, which play a pivotal role in the rolling stock and infrastructure of high-speed railways.
- **Investments in railway infrastructure:** Investments by the Indian government are playing a key role in developing the railway infrastructure. Indian government has allocated ~INR 50L Cr for infrastructure development by CY30. Indian railways are also aiming to accomplish 100% electrification and become the largest eco-friendly network in the world. This is resulting in increased demand for coil springs as they are essential in different parts of railways such as in wagons, transit, and bogies to increase passenger comfort.
- **Increased investment in metro rail:** India's Metro network is rapidly expanding, with an anticipated ~1700 km of operational lines by FY25. The 2017 Metro Rail Policy enables the Central Government to offer financial support for metro rail projects in cities, subject to feasibility and resource availability. Explore lucrative investment opportunities in India's growing Metro sector and join the revolution reshaping urban transportation. The total budget for all metro projects in FY24 is INR ~19,500 Cr, compared to INR ~19,100 Cr in FY23.

06

Global market for Special Fasteners

6. Global market for Special Fasteners (Studs, Nuts, & Bolts)

6.1 Industry overview

Special fasteners consist of studs, nuts, bolts:

Bolt

Studs

Nut

The fastener industry is crucial across sectors, supplying essential components like screws, bolts, nuts, and rivets for construction, renewable energy, and aerospace. Growth is fueled by increased construction, railway development, and the rising need for electrical equipment. As global infrastructure projects increase, there's a growing demand for fasteners to ensure assembly and structural integrity. The global market size for SFS currently stands at ~US$ 97B as of CY23 and is growing at a CAGR of 6.7% between CY23-26. This market comprises of renewable energy, industrials and mobility industry along with others.

Gala Precision Engineering's global serviceable addressable market (SAM) consists of 9 application segments (agricultural, construction, mining and material handling equipment, renewable energy, railways, warehousing, electrical and general engineering equipment including machine building) and consists of 7 product categories (hex bolt, allen bolt, hex nut, flange bolt, flange nut, self-locking nut, and castel nut). The SAM is valued at US$ 25,613 as of CY23 (as of FY22 it is 22,842M).

6.2 Manufacturing process for Studs

Manufacturing of stud, which is a **special fastening solution** (SFS) begins with a focus on incoming raw materials, where a thorough inspection and testing are conducted to ensure the materials meet the required quality standards and specifications. Following this, the inspected raw materials are carefully stored in a controlled environment to maintain their integrity. The subsequent stages involve precision cutting of materials to desired lengths, chamfering, and machining to attain specific dimensions. Marking procedures contribute to traceability, while thread-rolling techniques are applied at various lengths and sides. Surface treatments, including zinc flake coating, hot-dip galvanizing (HDG), or oiling, are then employed for enhanced corrosion resistance and improved finishing. A final, meticulous inspection ensures compliance with specifications before the assembly of thread protection sleeves, identification labeling, and secure packaging for dispatch. Gala is equipped with ISO 9001:2015 certified manufacturing facilities in India.

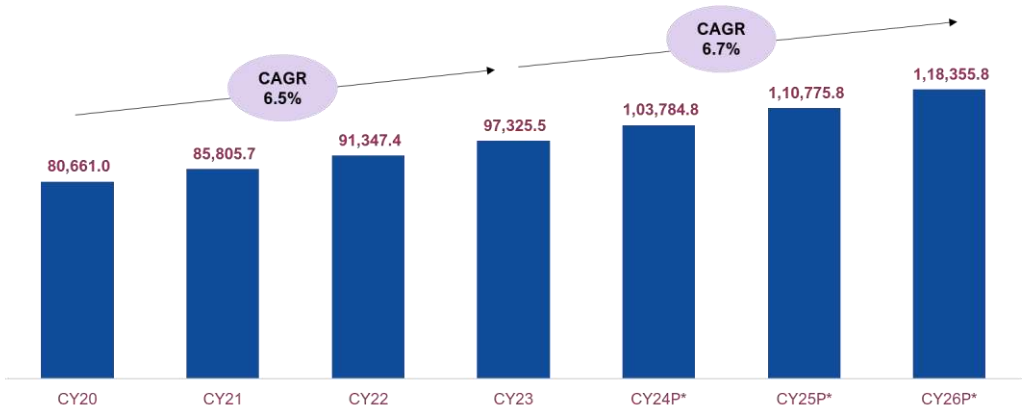
S.No.	Process	Description
1.	Raw material inspection & testing	• This is the initial step where the raw materials are inspected for quality and tested to ensure they meet specifications
2.	Raw material storage	• Storage of the inspected raw materials in a controlled environment to maintain their quality
3.	Cutting	• Material is cut to the desired lengths in preparation for further processing
4.	Chamfering & machining	• Chamfering involves cutting or grinding a beveled edge on the fastening solutions. Machining may include additional processes to achieve specific dimensions
5.	Marking	• Applying marks or identifiers on the fastening solutions for traceability and identification purposes
6.	Thread rolling	• Using a thread rolling process to form threads on the marking & non-marking side of the fastener
8.	Surface treatment	• Applying surface treatments such as zinc flake coating, hot-dip galvanizing (HDG), or oiling to enhance corrosion resistance and improve the overall finish
9.	Final inspection	• A comprehensive inspection of the fastening solutions to ensure they meet all specified requirements before proceeding to the next stage
10.	Thread protection sleeve assembly	• Assembly of thread protection sleeves to safeguard the threads during transportation and handling
11.	Identification labelling	• Applying labels or identification markers on the fastening solutions for clear identification and documentation
12.	Packaging & Dispatch	• The final step involves packaging the final fastening solutions securely for dispatch & distribution

Movement Operation Inspection

6.3 Market forecast and growth drivers

The boom in the renewable energy sector, aging infrastructure, higher investment in the aerospace and defense industry, and post-pandemic recovery in air travel are boosting the need for fasteners to ensure various infrastructures' stability and safety.

Global SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

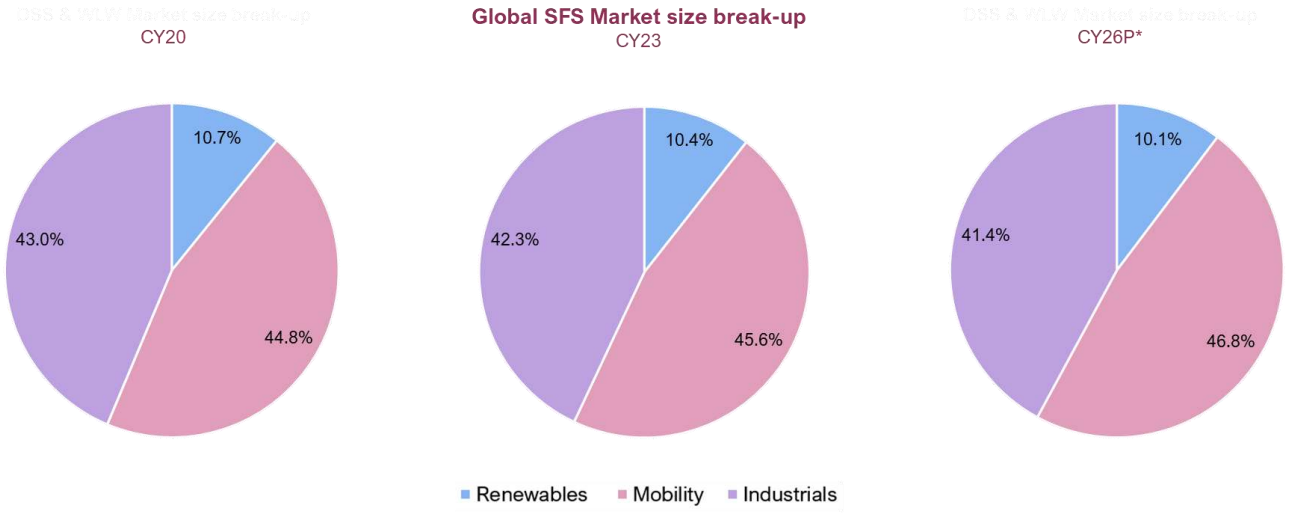
- **Growing renewable energy industry:** Renewable energy sources are projected to contribute ~95% to the increased global power capacity from CY21-26, with solar PV contributing more than half of this growth. Projected growth in renewable energy capacity during CY21-26 is expected to be ~50% higher than that observed from CY15-20. IRA by US offers tax breaks for clean energy, extending the Investment Tax Credit by ~30%. It introduces a US$ 0.0275/kWh Production Tax Credit for eligible wind, solar, and energy storage investments. Aligned with the European Green Deal, the EU has upped its CY30 targets to a minimum of 42.5% renewable energy and a ~45% energy efficiency goal, a ~12% improvement commitment. This increase is driven by increased government support and adopting more ambitious clean energy targets, particularly during the COP26 Climate Change Conference. The rising demand for renewable energy will also lead to an increased need for fasteners used in constructing wind turbines, hydroelectric plants, and solar farms.
- **Ageing infrastructure:** Over the past decade, critical infrastructure hasn't received enough investment for upkeep worldwide. Aging infrastructure brings risks like property damage, business challenges, and interconnected issues. Governments around the world have been investing to improve the aging infrastructure, the US being one of them with the Bipartisan Infrastructure Law which provides ~US$ 8B for the repair of aging water delivery systems to advance drought resilience and expand access to clean water. This boosts the demand for fasteners, crucial for stability and safety in buildings and infrastructure, securing beams, connecting elements, and resisting shear and bending.

6.4 Industry-wise application

SFS usage & criticality among different end users		
Industry	**End-user**	**Uses & Criticality**
Renewable	**Hydroelectricity**	• **SFS** are crucial for hydroelectric plants constructing **dams, penstocks, & turbines;** They **ensure reliable seals, prevent leaks,** & withstand & water, moisture, & intense pressures, offering protection against corrosion, erosion, & fatigue
	Solar	• **SFS secure PV modules** to the mounting structure, protecting electrical components & preventing movement; They are **vital for maintaining structural stability & withstanding significant vibrations** in harsh weather
	Wind turbines	• **SFS** are essential for connecting the **flange, blades, rotor, hub, & tower in wind turbines**. They secure the blades to maintain the tower's strength & durability, **ensuring the structural integrity** of the turbine & preventing damage or disassembly
Mobility	**Railway**	• **SFS** play a vital role in **securing rails to sleepers, attaching bridges & gantry trolleys** to aluminum frames, & connecting intersecting barrier sections in traffic control products. They ensure **stability, alignment, & absorb forces** & vibrations from moving trains
Industrials	**Off-highway**	• **SFS** are essential for maintaining the **stability of a vehicle's suspension system**, securing various components like trim, panels, dashboards, door cards, & wheels. They ensure a **dependable connection between parts**, preventing wobbling or accidental detachment, thereby ensuring safety during vehicle operation
	Electrical & power	• **SFS** play a vital role in **connecting pole line hardware for transmission lines**, securing pipes & equipment in oil & gas plants, & holding together various parts in coal power plants. Their importance lies in **supporting components, facilitating assembly & disassembly**, & ensuring strength, safety, electrical insulation, & overall quality
	Infrastructure & heavy machinery	• **SFS** are essential for heavy machinery, **connecting structural elements like beams & panels** to create a robust framework. These fasteners also play a crucial role in securing components such as gearboxes, engines, & hydraulic systems, **ensuring the durability & structural integrity of industrial settings**

Global market size for SFS				
Industry		**Market size (US$ M)**		
		CY20	**CY23**	**CY26P***
Renewables		8,599.8	10,154.6	12,008.7
Industrials	**Off-highway**	3,440.8	3,953.8	4,549.1
	Electrical & power	1,022.3	1,226.1	1,472.5
	Infrastructure & heavy machinery	30,197.1	36,004.4	43,010.8
Mobility	**Railway**	4,735.9	5,561.1	6,530.0
	Automobiles	31,368.4	38,866.8	48,911.0
Others		1,296.7	1,558.8	1,873.7
Total		**80,661.0**	**97,325.5**	**1,18,355.8**

Note(s): *Projected



Note(s): *Projected

6.4.1 Renewable energy industry

Fasteners are crucial in renewable energy, supporting the assembly and security of structures. In wind energy, they are extensively used in building and maintaining turbines for stability and reliability. Solar projects depend on them to secure panels, ensuring the integrity of installations. High-quality, durable fasteners are essential in both wind and solar applications to withstand environmental conditions and ensure long-term success in renewable energy projects.

Gala Precision Engineering offers high tensile large fasteners sizes M24 to M72, which have applications in renewable energy industry. The renewable energy sector has a strong outlook due to government's focus on non-carbon emissions.

The renewable energy SFS market size stands at ~US$ 10B as of CY23, growing at CAGR of ~6% between CY23-26. The market consists of solar, wind, nuclear and hydroelectricity power generation units.

Application for special fasteners in renewable energy industry:

Fasteners

- Fasteners play a crucial role in linking the flange, blades, rotor, foundation, hub, & tower in wind turbines
- Hydroelectric plants need bolts and fasteners to build dams, penstocks, and turbines, as they are essential to create reliable seals & preventing leaks
- Fasteners affix PV modules to the mounting structure, safeguarding electrical components, & preventing movement

SFS: Tower connects studs & nuts

SFS: Foundation anchor studs

SFS: Nacelle fasteners & blade studs

SFS: High tensile nuts & bolts

Essentiality of special fasteners in renewable energy industry:

Fasteners are crucial in wind turbines and hydroelectricity plants:

- **Wind:** Fasteners are crucial in wind turbines, keeping the blades securely attached to ensure the tower's strength and durability. Well-secured fasteners are essential to maintain the turbine's structural integrity, preventing any damage or disassembly of components. They also help in keeping the blades aligned for efficient wind capture.
- **Hydro:** Fasteners are crucial in hydropower facilities, enduring water, moisture, and intense pressures. Specially designed components provide excellent protection against corrosion, erosion, and fatigue. In hydropower plants, leak-free connections are vital for optimizing energy transmission.
- **Solar:** Fasteners play a crucial role in upholding the structural stability of photovoltaic (PV) systems. PV Tracking Systems refer to solar panel modules that track the sun's movement, fasteners employed for the installation of these systems must possess permanent attributes, exceptional corrosion resistance, and the ability to endure substantial vibrations in extreme weather conditions.

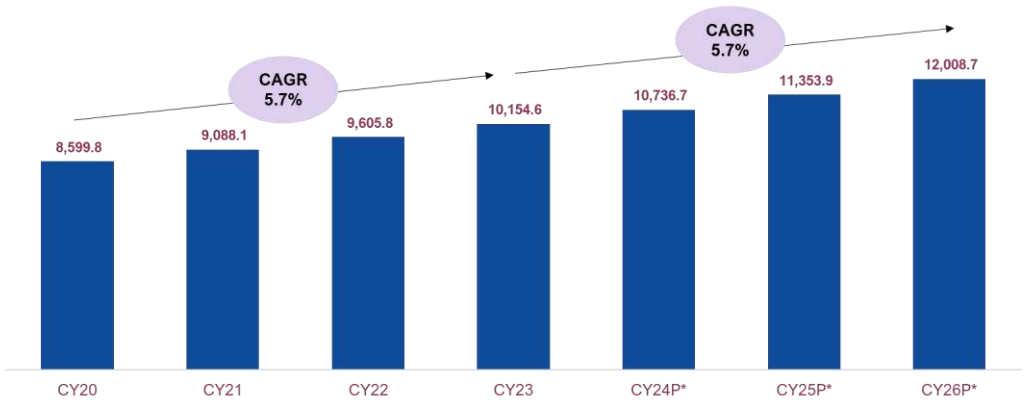
Comparison of special fasteners with key select substitutes in the renewable energy industry:

As substitute of fasteners:

- **Adhesives and Sealants:** Adhesives help spread pressure evenly, decreasing structural risks in solar and wind components. While adhesives and sealants cut production costs by minimizing maintenance, fasteners are durable, cost-effective, and resist movement.

- **Welding**: Welding gives a seamless appearance, watertight joints, and high strength at a low maintenance cost. Fastening, usually cheaper than welding, involves less structural stress and more movement. But, for flexible and easy-to-disassemble needs like solar panels, fasteners are a better option.
- **Snap-Fit or Interlocking Systems:** Snap-fit and Interlocking methods easily work with different solar panel systems, cutting installation time and lowering project costs. For offshore wind farms, valve interlocking systems ensure top-notch safety and reliability. While snap-fit or interlocking options may be cheaper, they still provide durability and resistance to movement for the structure.

Global renewables SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth drivers

Policy support, including measures like tax incentives and carbon trading programs, has significantly driven down costs and accelerated the adoption of renewable energy. Reduction in prices, policy support, and growing familiarity have increased the demand for fasteners used in constructing and operating the renewable energy infrastructure. Gala Precision Engineering has good growth prospects in the European and US wind turbine markets with the global wind turbine market growing at a CAGR of ~8% between CY23-26.

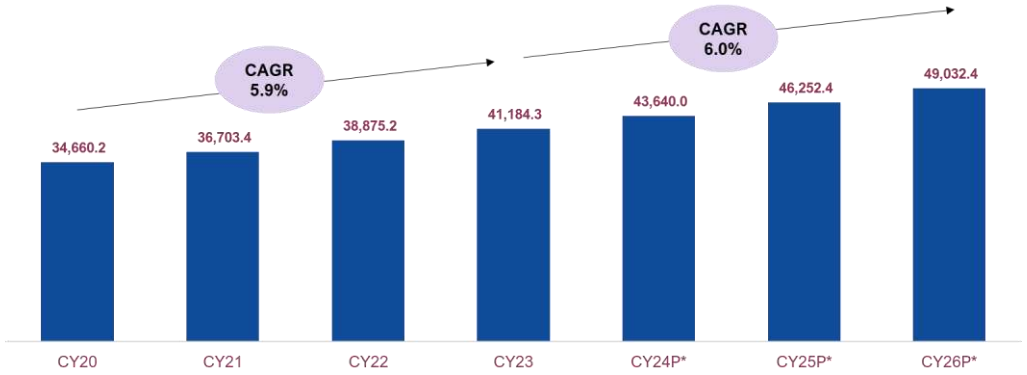
- **Reduction in prices:** The price of solar photovoltaic electricity has dropped by ~85%, while onshore and offshore wind energy fell by ~55% and ~50% respectively, making them economically viable compared to fossil fuels. Consequently, the demand for fasteners is rising as they are essential for constructing and operating wind energy systems and securing various wind turbine components like the rotor and tower.
- **Growing familiarity:** Growing familiarity among financiers with the technical and project risks in renewable energy has led to a reduction in the cost of capital. Moreover, there is evidence indicating that the adoption of renewable energy is socially infectious, when one household installs rooftop solar panels neighbours follow. The demand for fasteners is also increasing in the renewable energy sector, as they are essential for assembling and maintaining renewable energy infrastructure. The global wind turbine market is valued at ~US$ 75B in CY23, growing at a CAGR of ~8% between CY23-26.
- **Policy support:** Policy backing has played a crucial role in advancing the renewable energy sector, further driving the demand for fasteners,
  - **China:** In CY12, the National Development and Reform Commission of China launched a pilot carbon cap and trade program aimed at reducing carbon emissions and fostering a more environmentally sustainable future.

- **EU:** In July CY21, the commission proposed to increase the binding target of renewable energy sources in the EU's energy mix to ~40% by CY30 and promoted the uptake of renewable fuels such as hydrogen in industry and transport, with additional targets.
- **US:** RPS mandates a specific percentage of a state's electricity to come from renewable energy, fostering energy diversity, supporting local production, and boosting economic growth. These policies drive the US$ 269B market for renewable energy in the U.S. as of 2022.

6.4.2 Industrial

Industrials encompass off-highway vehicles, electrical and power equipment, and heavy machinery. In off-highway vehicles, fasteners are utilized in key areas such as chassis, engines, and suspension. These components play a crucial role in connecting and securing various parts, including panels, cabinets, and motors within electrical systems. Their significance extends to critical applications in construction, mining, and other heavy industries. The overall market for SFS in the industrial sector is projected to achieve a value of ~US$ 41B in CY23. This growth is primarily attributed to increased investments from regions such as Europe, the US, and China, coupled with heightened construction activity. Anticipated growth in the mobility industry is forecasted, with a CAGR of ~6.0% expected during the period from CY23-26P.

Global industrial SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

6.4.2.1 Off-highway vehicle

Fasteners are crucial in off-highway vehicles, performing vital functions by securely connecting and holding parts together. They play a key role in the structural integrity and performance of these vehicles, used widely in areas like chassis, engines, suspension, and other systems. Properly selecting and applying fasteners is essential for ensuring the reliability, safety, and efficiency of off-highway vehicles in demanding conditions.

The off-highway market consists of agricultural vehicles, mining, and construction

Application for special fasteners in off-highway vehicle industry (industrials)

Fasteners
• Fasteners play a crucial role by keeping the suspension system intact, linking it to the vehicle or trailer • They are also used to secure trim, panels, dashboards, and door cards in position • Fasteners are employed within the realm of off-highway vehicles to secure the wheels onto the hub

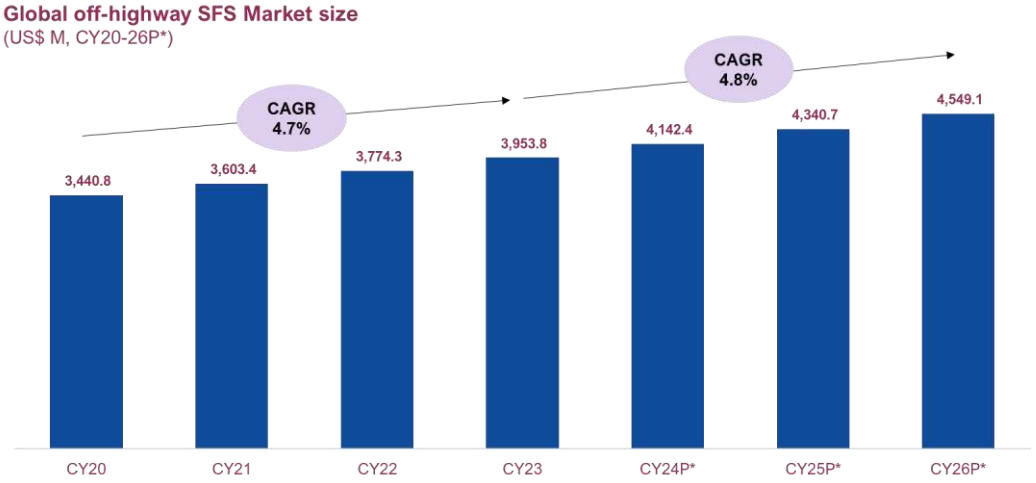
Essentiality of special fasteners in off-highway vehicle industry (industrials)

Fasteners are used in various parts of off-highway vehicles such as:

- **Engine and steering**: Engine fasteners play a crucial role in uniting components, guaranteeing stability and structural integrity. Steering system fasteners play a crucial role in stabilizing the weighty engine components and securing suspension.
- **Body and Interior Trim**: Fasteners play a crucial role in maintaining a dependable connection among different parts, ensuring their stability while the vehicle is in operation. Moreover, they contribute to preventing potential leaks in automotive components.
- **Wheels**: Fasteners are essential for attaching wheels to a vehicle, preventing wobbling or accidental detachment, and ensuring safety. Wheel fasteners not only secure the connection but also make it easy to assemble and disassemble different components.

Comparison of special fasteners with key select substitutes in the off-highway vehicle industry (industrials)

- **Welding:** Welding is a simpler method to permanently join parts in off-road vehicles. It's easier and faster, but it's costly because it needs special equipment and trained professionals. On the other hand, fasteners offer flexibility with lower structural stress but may loosen up due to vibrations.
- **Adhesives:** Adhesives spread stress across the whole bonding surface, being much lighter than fasteners and cutting weight by ~15%. Fasteners are relatively simple to install, can be disassembled, and require less maintenance. On the other hand, adhesives provide advantages like corrosion reduction and vibration dampening.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

The rising interest in battery-operated electric vehicles (EVs) due to environmental concerns, is boosting the demand for fasteners. Additionally, the resurgence in construction activity, fuelled by the return to office work, is spurring the need for construction materials and off-duty vehicles like forklifts, cranes, and backhoes, further increasing the demand for fasteners to ensure structural stability and safety.

- **Increased demand for BEV:** The demand for battery-powered vehicles like tractors, excavators, forklifts, dirt bikes, and cranes has significantly increased due to growing awareness of climate change and sustainability. In CY22, the demand for automotive lithium-ion (Li-ion) batteries rose by about ~65%, reaching 550 GWh, compared to 330 GWh in CY21. This increased demand also applies to fasteners, crucial for safety and maintaining proper clamping force in electric vehicle batteries.
- **Construction activity:** The return-to-office mandate, after pandemic restrictions eased, has increased the demand for office space, boosting construction in the Asia Pacific. High rental growth is expected in

Hong Kong due to tenant shifts, and Singapore sees a strong demand with tenants mostly back in offices. Singapore office real estate investment trusts have ~75% occupancy in downtown central business districts. Along with this, there has been initiative from governments to boost the construction industry. US administration has unveiled nearly $400B for public infrastructure and clean energy investments, backing 40,000 ongoing projects and boosting the construction industry. EU construction industry, contributing ~9% to GDP, aims to improve competitiveness, resource efficiency, and sustainability, emphasizing upgrades in existing buildings and renovations to spur demand. This surge in construction activity will drive up demand for off-duty vehicles like forklifts, backhoes, and cranes.

6.4.2.2 Electrical & power equipment industry

In the electrical and power equipment industry, fasteners are crucial for connecting and securing components like panels, cabinets, motors, and more. Properly choosing and using fasteners is vital to uphold structural integrity and performance, ensuring the overall safety and efficiency of systems. The electrical and power equipment industry consists of electrical transmission and distribution equipment.

Application for special fasteners in electrical & power equipment industry (industrials)

Fasteners

- Fasteners play a vital role in connecting and securing pole line hardware to transmission lines
- They are also used in fastening onshore & offshore oil & gas connection pipes, electrical panels, and control cabinets, attaching motors and conveyor systems, connecting wires and cables, and contributing to electricity generation and storage
- Critical fasteners are crucial in foundation of electrical towers, providing overall strength

SFS: Stud bolts used for transmission lines, towers, structures & transformer

Essentiality of special fasteners in electrical & power equipment industry (industrials)

Fasteners: Fasteners play a crucial role in the electrical and power equipment sector by supporting components, facilitating efficient machine assembly and disassembly, and ensuring high levels of strength, safety, electrical insulation, and overall quality. They are employed to prevent loose connections, mitigate electrical hazards, minimize the risk of short circuits and potential accidents, and create contact points with minimal transition resistance. Within the energy industry, critical fasteners are relied upon in essential systems to support electricity generation. In both renewable and non-renewable power generation segments, specialized material fasteners that adhere to stringent design and manufacturing standards are a fundamental requirement.

Comparison of special fasteners with key select substitutes in the electrical & power equipment industry (industrials)

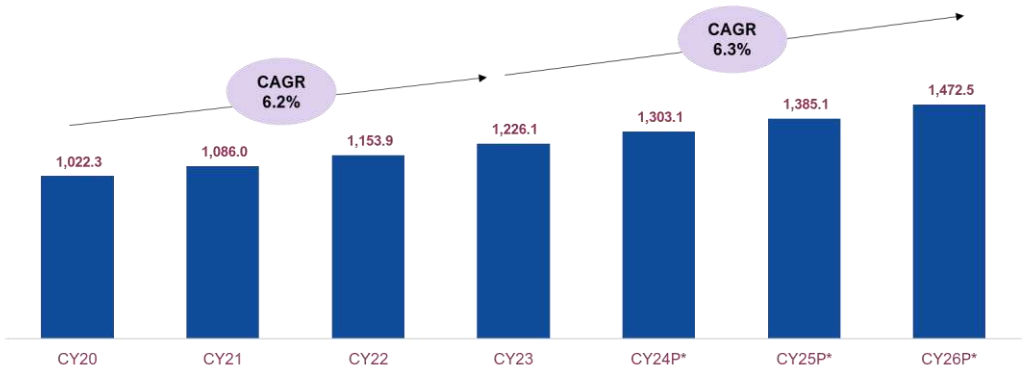
Welding: Welding creates strong and lasting bonds between metal parts without the need for piercing materials, improving structural stability. Welded connections are permanent, while bolted ones can be taken apart. Inspecting welded joints is more expensive and intricate compared to bolted connections.

Adhesives: Using adhesives instead of mechanical fasteners cuts down on the number of tools and components needed. Adhesives replace traditional methods like riveting and welding, saving costs. Fasteners are better for

tasks requiring removal and adjustments, addressing maintenance and repair needs, and minimizing waste during assembly.

Interlocking: Interlocking simplifies assembly and disassembly of components, streamlining the process and reducing the number of required parts. Fasteners can be removed without damaging the joining components offering improved consistency, reliability, and holding power.

Global electricals SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

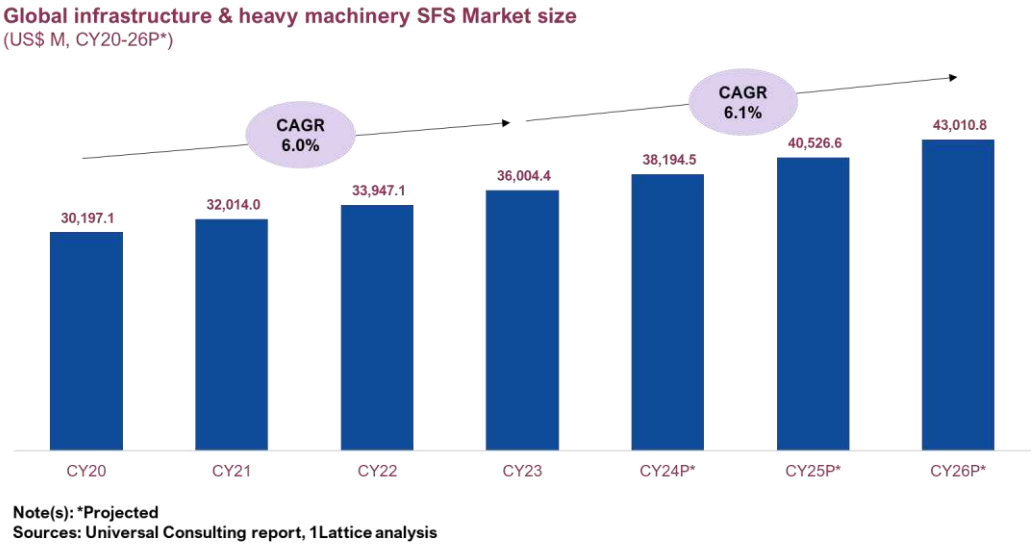
Smart grid and energy infrastructure advancements fuel growth in the electrical and power equipment industry. Fasteners, crucial for grid connectivity and assembly, are in higher demand due to the improved electricity supply from smart grids. Government and private investments supporting energy infrastructure development are boosting the need for fasteners to enhance the performance and reliability of electrical equipment.

- **Smart grid implementation:** Smart grids use advanced technology to improve the balance of electricity supply. To achieve Net Zero Emissions by CY50, investments in smart grids must increase by 100% by CY30. The U.S. has allocated ~$3B for 58 projects across 44 states under the President's Bipartisan Infrastructure Law to strengthen the resilience and reliability of the electric grid. Europe has decided to install ~510 GW of new renewable energy capacity (~70% connected to distribution grids), which implies an estimated 940 GW of renewable energy installed capacity by CY30. This growing investment in smart grids is driving demand for advanced electrical equipment and control systems, consequently increasing the need for fasteners, which play a crucial role in grid connectivity, assembly, and structural linkage.
- **Energy infrastructure development:** Energy infrastructure development drives growth in the electrical and power equipment industry due to increased demand from residential and commercial sectors. Government and private investments in infrastructure support economic development and urbanization. Battery storage investment is set to reach ~US$ 40B in CY23, nearly double the CY22 level. Rising demand for energy infrastructure will boost the need for fasteners, essential for enhancing performance, reliability, and durability in electrical equipment, turbines, motors, exhaust systems, pumping systems, and storage vessels.

6.4.2.3 Infrastructure & heavy machinery

Heavy machinery relies on essential fasteners to maintain structural integrity and reliability. These connectors securely join parts, ensuring stability and safety in heavy machinery used in industrial settings. Properly selecting, installing, and maintaining fasteners is crucial to prevent equipment failures and ensure safety for operators and bystanders. The infrastructure & heavy machinery market consists of roadways, ship building, warehousing,

airports, ports, lifts and elevators, general engineering and equipment, machine building, commercial and residential buildings, material handling equipment, electronics market, oil and gas maintenance market and aerospace.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Heavy machinery is booming with automation, smart tech, and innovations like robotics and AI. The US$2.5 Tt industrial machinery sector is shifting to sustainable solutions. Rapid industrialization in Asia and Africa drives demand, while developed economies modernize for competitiveness. Sectors like renewable energy and healthcare are set to boost demand for specialized machinery solutions.

Technological advancements

- Automation, driven by smart machinery with sensors & analytics, enhances efficiency, productivity, & safety.
- Robotic material handling, autonomous guided vehicles, 3D printing technology, and AI-driven predictive maintenance are providing flexibility and customization in machinery parts, reducing production time and waste.
- Industrial machinery sector, valued at $2.5T, is undergoing a fundamental transformation due to the shift from products to solutions, rapid digital technology adoption, and sustainability imperatives.

Industrial sector dynamics

- Asia and Africa's growing economies drive rapid industrialization, spurring demand for machinery in construction, automotive, and food processing.
- Developed economies invest in modernizing and replacing outdated machinery to maintain competitiveness.
- Robust growth is anticipated in sectors such as renewable energy, pharmaceuticals, and healthcare, boosting demand for specialized machinery solutions.

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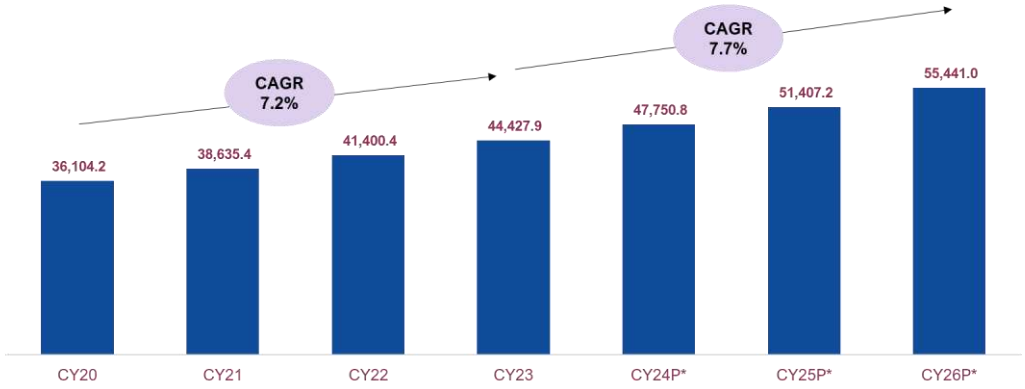
6.4.3 Mobility

Mobility involves railway infrastructure, where fasteners play a crucial role in ensuring the stability and integrity of railway tracks. These components are also employed in the construction of bridges, contributing to their strength. The comprehensive market for fasteners in the mobility sector is expected to see significant growth primarily attributed to increased investments from countries such as Europe, the United States, and China, coupled with a heightened emphasis on sustainability. Mobility market also refers to the automobile market where SFS have applications in ICE and electric vehicles.

Global mobility SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

6.4.3.1 Railway industry

Fasteners are vital for railway infrastructure, connecting components to ensure safety. They are used extensively in railway tracks, ensuring the stability and integrity of the entire rail system. These fasteners are also used in building bridges, contributing to strength. Properly choosing and applying fasteners is crucial for efficient, safe, and durable railway infrastructure.

Application for special fasteners in railway industry (mobility)

Fasteners

- Fasteners are crucial for securing the rail to the sleeper, distributing pressure evenly to the ballast and sleepers
- Fasteners serve the purpose of securing the bridges and gantry trolleys to an aluminum frame and connecting the intersecting barrier sections in traffic control products

SFS: Fish bolts to connect rail track

SFS: Shear connectors for bridges, high tensile nuts & bolts

Essentiality of special fasteners in railway industry (mobility)

Fasteners are pivotal in ensuring structure integrity of railway infrastructure:

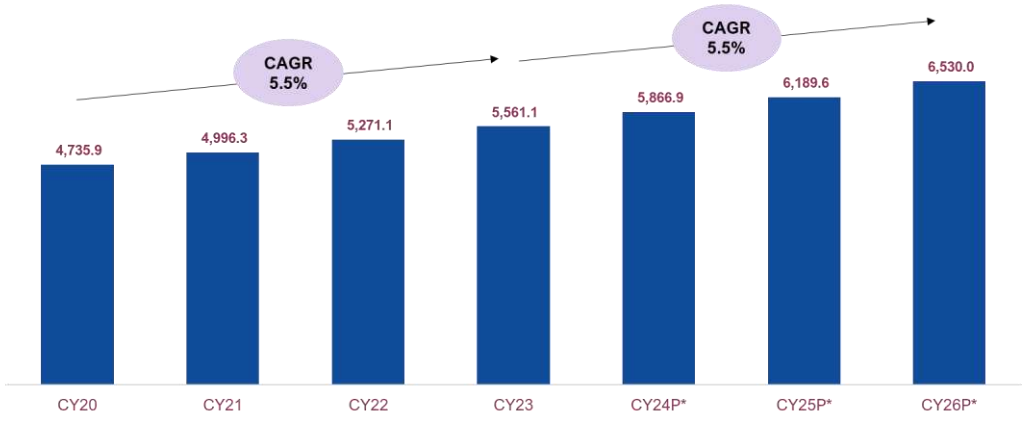
- **Tracks:** Rail fasteners keep the rails in place on the sleeper, preventing them from moving vertically or horizontally, which could lead to train derailment. These fastenings help maintain stability, and alignment, and absorb forces and vibrations from moving trains. This reduces the need for track maintenance and extends the lifespan of the railway infrastructure.
- **Infrastructure:** Fasteners play a crucial role in signal and crossing systems by imparting the essential strength and stability required to endure external forces, vibrations, and various stressors. They are pivotal in upholding the stability and dependability of traffic control equipment, ensuring that barriers can withstand the impact of a collision.

Comparison of special fasteners with key select substitutes in the railway industry (mobility)

As substitute of fasteners:

- **Welding:** Welding provides a durable connection, reducing noise and wear on railway tracks and wheels, and is stronger than fastened connections. Welds are tougher to dismantle, replace, or repair and are more prone to fatigue. Fasteners are cost-effective, resist loosening from vibrations, and handle rail motion better than welding.
- **Adhesives:** Sealants and adhesives play a crucial role in both the interior and exterior of rail vehicles, from design to maintenance. Advanced structural adhesives offer stronger bonds and greater corrosion resistance compared to mechanical fasteners. Fasteners are essential in securing running rails during railroad construction, providing durability, affordability, and minimal waste generation.

Global railways SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Sustainable practices, such as transitioning to alternative fuels and promoting greener transport, are gaining momentum. Increased investment in railway infrastructure, like the recent examples in the US, and EU is driving demand for fasteners, crucial for rail safety and long-term sustainability.

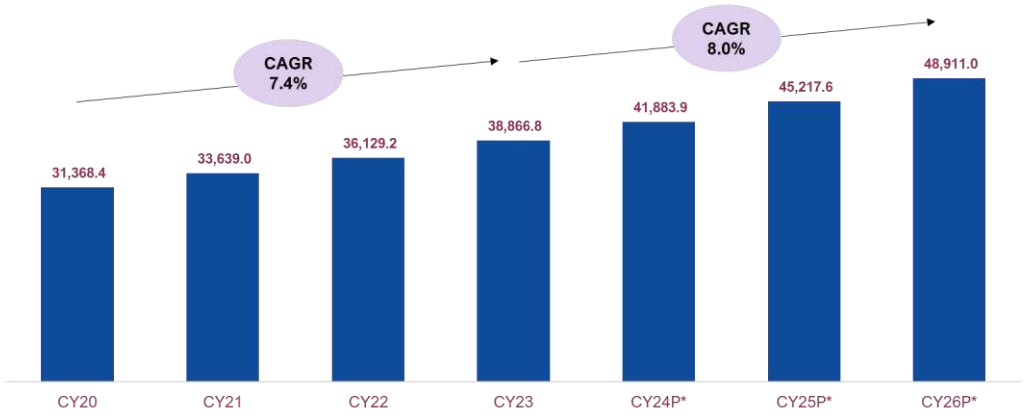
- **Sustainability:** To promote sustainability, countries are transitioning from diesel-powered trains to those utilizing hydrogen or alternative fuels. Ethiopia-Djibouti's 753 km rail line, powered by hydro-generated electricity, Germany started operating 14 hydrogen trains to serve passenger transit over a 100 km track in CY22. France ordered 12 hydrogen trains that will soon start test runs, while the Italian Ministry of Infrastructure and Transport assigned EUR 300M for the purchase of hydrogen-powered rolling stock. With a global focus on sustainability, innovations in railway infrastructure will drive the demand for fasteners crucial in building and securing rails for sleepers and supports.
- **Increased investment:** The upsurge in investments in railway infrastructure is poised to generate greater demand for fasteners, especially as new railroads are set to be established. A few examples of these investments are.
  - **US:** In September CY23, the FRA of the U.S. DOT announced that it has invested more than ~US$ 1B from President Biden's Bipartisan Infrastructure Law into 70 rail improvement projects in 35 states and Washington, D.C.
  - **EU:** In June CY23, the EU invested ~US$ 6B in sustainable, safe, and efficient transport infrastructure. The Commission has selected 107 transport infrastructure projects to receive over ~US$ 6B in EU grants from the CEF.

- **China:** In CY22, China Railway Co invested ~US$ 105B in fixed-asset investment. This investment built 4,100 km of new railways, including 2,082 km of high-speed lines**.**

6.4.3.2 Automobiles

The global SFS automobiles market currently stands at ~US$ 39B and is growing at a CAGR of 8.0% between CY23-26. The automobile market consists of ICE vehicles and EVs.

Global automobiles SFS Market size
(US$ M, CY20-26P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

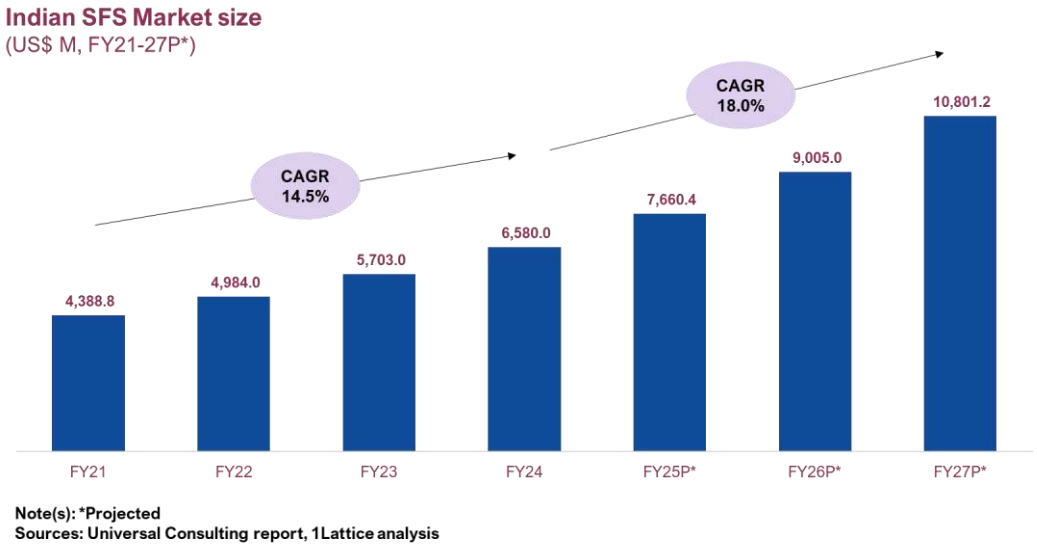
07 Indian market for Special Fasteners

7. Indian market for Special Fasteners (Studs, Nuts, & Bolts)

7.1 Industry overview

The fastener industry in India is vital for renewable energy, construction, and electrical equipment. As the economy grows and industrialization increases, there's a rising demand for fasteners. Indian manufacturers serve both domestic and international markets, contributing to exports. Fasteners are crucial in the expanding renewable energy sector, and the construction boom drives the need for reliable solutions. Challenges like fluctuating raw material prices and global quality standards persist, but the industry's resilience positions it as a key player in India's manufacturing.

The Indian SFS market size stands at ~US$ 6.6B as of FY24, growing at a CAGR of 18.0% between FY24-27. This market consists of renewable energy, mobility, industrials & others.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

7.2 Market forecast and growth drivers

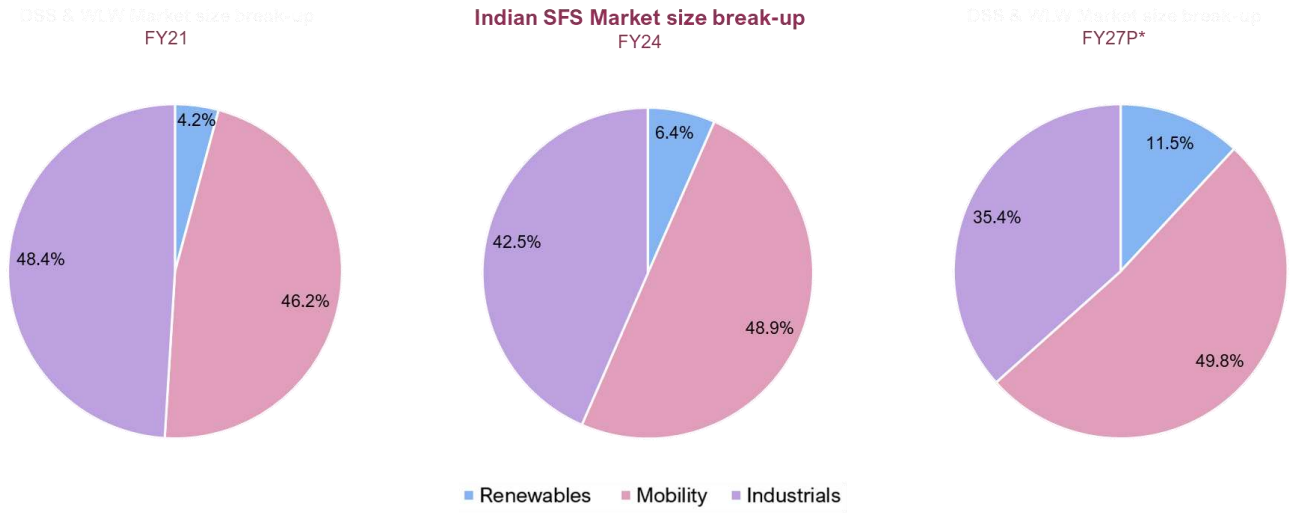
India's construction & mining industries are booming due to the increased investment, leading to more government support and project budgets. The renewable energy sector is also on the rise, with ambitious expansion plans, driving demand for specialized fasteners in green energy infrastructure construction.

- **Construction & mining activity:** In FY23, road construction averaged 30 km/day, railway construction reached 14 km/day, driving demand for construction machinery. Increased urban population led to more housing projects, boosting construction activities and the need for equipment. The construction equipment industry had a record year, selling over 1 lakh units with a ~26% YoY growth, driven by expanded construction and mining, especially in road construction. The rise in coal production to ~73M metric tons, a ~9% increase from FY22, fuelled demand for fasteners in construction and coal mining sector.
- **Renewable energy:** Renewable energy capacity surged by ~34%, reaching 33 GW, comprising over ~85% of new installations. The prime minister has set ambitious goals for, targeting 500 GW of renewable energy capacity and a ~45% reduction in the country's economic emissions intensity by the end of the decade. This capacity increase reflects market expansion, a significant move towards a greener future. With the expanding green energy market, there's an increasing need for specialized fasteners essential in building wind turbines, hydroelectric plants, and solar farms, ensuring the long-term stability and security of these structures.

7.3 Industry-wise application

Indian market size for SFS				
Industry		Market size (US$ M)		
		FY21	FY24	FY27P*
Renewables		182.6	424.4	1,243.1
Industrials	Off-highway	465.5	539.5	626.8
	Electrical & power	49.9	61.7	76.2
	Infrastructure & heavy machinery	1,609.1	2,197.8	3,118.7
Mobility	Railway	588.1	1,236.1	2,598.3
	Automobiles	1,439.0	1,981.2	2,782.8
Others		54.6	139.3	335.2
Total		**4,388.8**	**6,580.0**	**10,801.2**

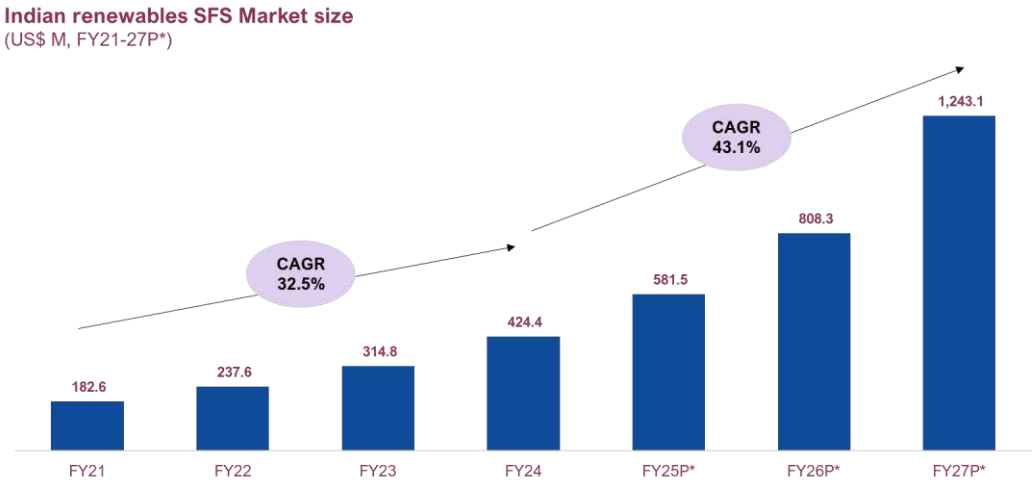
Note(s): *Projected



Note(s): *Projected

7.3.1 Renewable energy industry

India's renewable energy industry relies heavily on the fastener sector. As the country aims for a 500GW renewable energy capacity by FY39, there's an increasing need for top-notch fasteners to build and maintain projects like wind turbines and solar panels. This highlights the crucial role of a strong and dependable fastener industry in fostering the growth and sustainability of India's renewable energy sector. The Indian fastener for the renewable energy market was valued at ~ US$ 424M in FY24 witnessing a CAGR of 32.5% during FY21-24. The market includes solar, nuclear, wind and hydroelectricity energy generation applications.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Government policies, foreign investments, and decreasing costs of solar and wind power have played a significant role in driving growth in the renewable energy sector, with solar power becoming more economical than coal-based power. These factors are driving the demand for fasteners used in renewable energy ensuring structural integrity.

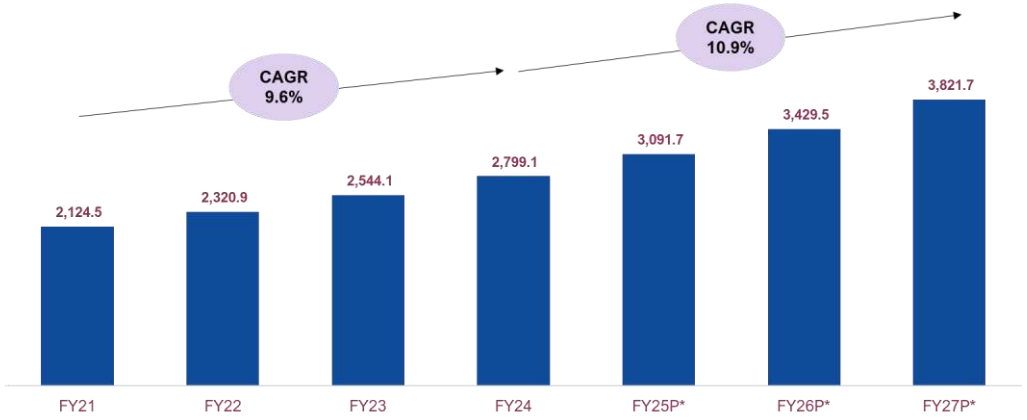
- **Decreasing cost:** Renewable energy in India is booming thanks to significantly lower costs of solar and wind power. According to a report by the Institute for Energy Economics, solar power costs have dropped by ~84%, making it cheaper than coal-based power in most of the country. Similarly, wind power costs have gone down by ~49% in the past decade, making it one of the most economical energy sources in India. This surge in renewable energy has led to an increased demand for fasteners, crucial in building and operating wind energy systems by securing various turbine components like the rotor and tower.

- **Increased investments:** Foreign companies have shown substantial interest in India's renewable energy sector, channelling investments into solar and wind power projects within the nation. In the Q3 of FY23, the Ministry of Commerce and Industry reported that FDI in India's renewable energy sector reached ~US$ 251 M. Key investing countries include Singapore, Mauritius, the Netherlands, and Japan. This influx of investment is expected to stimulate greater demand within the industry to produce fasteners, leading to further expansion and the establishment of additional manufacturing facilities.

7.3.2 Industrial

The Industrials include off-highway vehicles, electrical & power equipment, and heavy machinery. Fasteners play a vital role in connecting and securing components in off-highway vehicles, electrical equipment, and heavy industries like construction and mining. The overall market for fasteners in the industry is projected to reach ~US$ 3.8B by FY27P, driven by increased construction and mining activities and government initiatives. The mobility industry is expected to experience a CAGR of 10.9% from FY24-27.

Indian industrial SFS Market size
(US$ M, FY21-27P*)

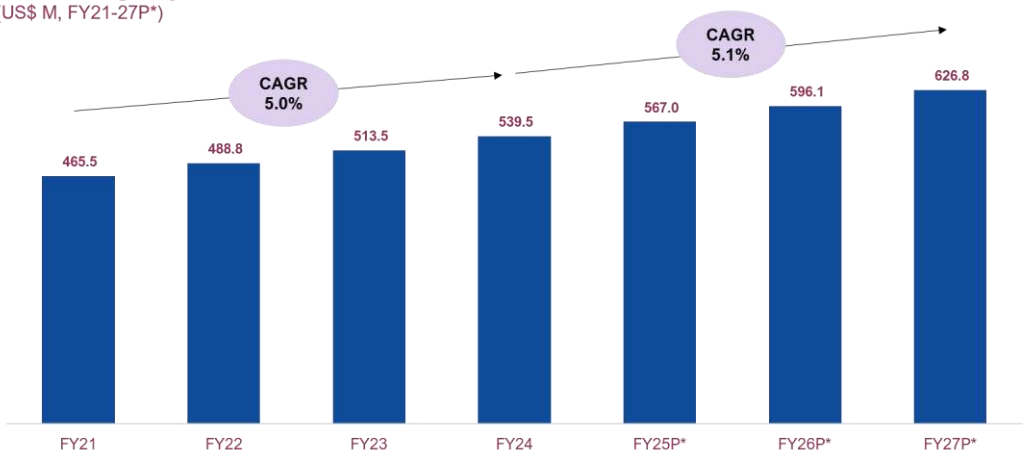


Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

7.3.2.1 Off-highway vehicle

The off-highway vehicle industry in India heavily depends on fasteners, essential for connecting and securing components in construction, agriculture, and heavy-duty vehicles. With the sector expanding due to infrastructure development and increased mining (up by ~9%), the demand for top-notch fasteners remains high, fueled by a rise in foreign direct investment. The Indian fastener for off-highway vehicle market is valued at ~ US$ 540M in FY24 witnessing a CAGR of 5.0% during FY21-24.

Indian off-highway SFS Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

In FY23, India experienced a notable rise in coal production, significantly impacting the mining industry. The surge in coal mining plays a crucial role in the country's mineral sector output. Simultaneously, the construction sector is rapidly expanding due to increased public and private projects. This growth in mining and construction is boosting demand for equipment and fasteners to ensure equipment stability.

- **Mining activities:** In FY23, coal production rose to ~73M metric tons, a ~9% increase from FY22 ~67 M metric tons. This accounted for ~78% of the total mineral sector output. The coal mining sector, which propels ~80% of India's need for mining equipment in open-pit mines, is thriving. India allows 100% FDI in mining and exploration of non-core minerals, and ~50% FDI through joint ventures with public-sector

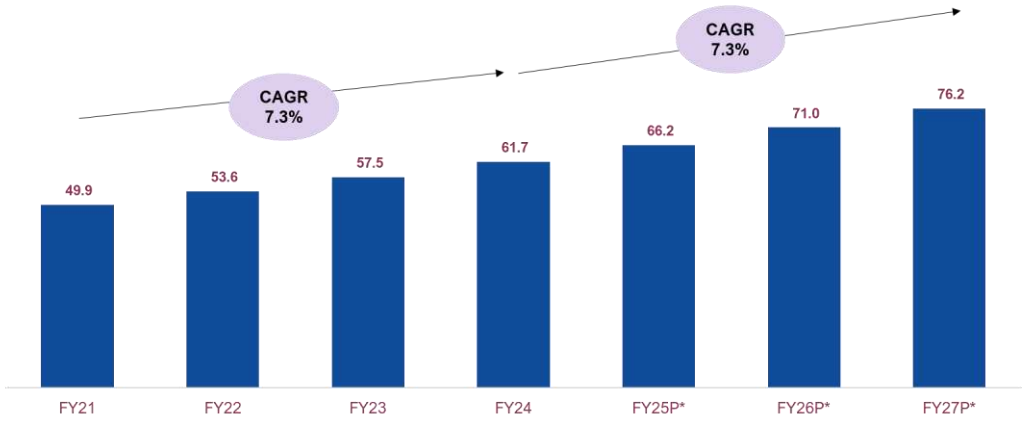
units. The surge in mining activities and equipment demand is expected to drive the need for fasteners, connecting machine parts, mounting equipment, and ensuring stability.

- **Rising construction activities**: In FY23, road construction averaged 30 km/day, and there was a significant rise in railway construction, reaching 14 km/day. This surge increased demand for machinery such as excavators, motor graders, crushers, and screeners. The growing urban population has increased the demand for housing projects, leading to a surge in construction activities and the need for related equipment. As a result, there will be a higher demand for fasteners used in construction equipment such as excavators, loaders, trucks, and more.

7.3.2.2 Electrical and power equipment

In India, the electrical and power equipment industry depends on the fastener sector. Fasteners are vital for connecting and securing components in this sector. With a yearly ~12% growth in demand for electricity and power equipment, there's a corresponding need for top-notch fasteners for construction and maintenance. This highlights the importance of a strong fastener industry in ensuring the efficiency and reliability of electrical and power systems in India.

Indian electrical and power equipment SFS Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Governments strategically use CBET to cut costs, enhance reliability, and reduce emissions. India's rising power demand due to factors like heatwaves, COVID-19 restrictions, unpredictable weather, and increased agriculture has boosted the need for power and electrical equipment, driving up demand for construction fasteners.

CBET

- Governments have recently started CBET to cut costs, improve reliability, and reduce emissions in participating countries
- India sees CBET expansion as a chance to harness Nepal's hydroelectric potential, aiding the development of a unified South Asian Power Market
- This initiative boosts the electric equipment market and increases the demand for construction fasteners
- The Indian electrical equipment market is expected to grow at ~12% annually, driving the demand for fasteners

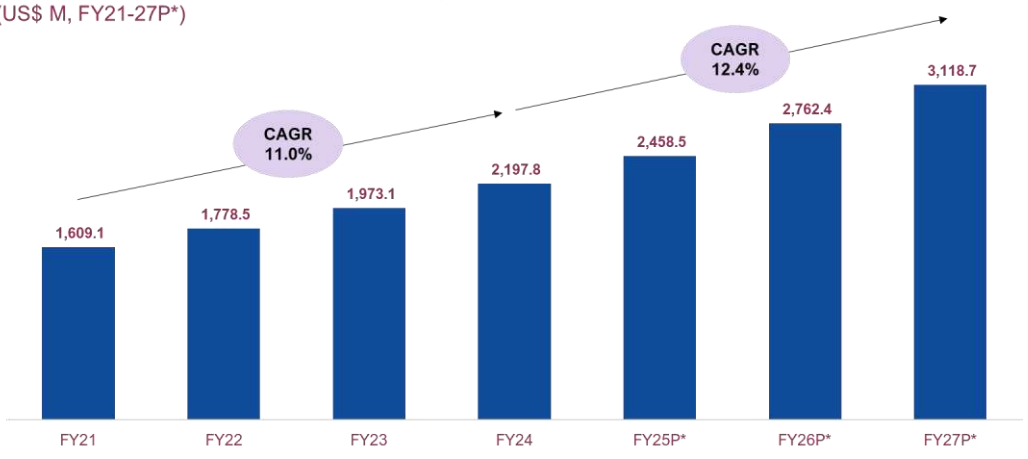
Surge in power demand

- Industrial and commercial operations make up over ~50% of annual power consumption, households contribute a quarter, and agriculture adds more than a sixth
- The surge in demand in the first half of last year was due to a heatwave and eased COVID-19 restrictions
- Federal power ministry reports cited erratic weather and increased agricultural activity as major factors for substantial growth in the second half of last year
- The return to office requirements and free power provision further boosted demand for power and electrical equipment, leading to an increased need for fasteners used in construction

7.3.2.3 Infrastructure & heavy machinery

The infrastructure & heavy machinery industry includes roadways, ship building, warehousing, airports, ports, commercial & residential buildings, lifts and elevators, general engineering and equipment, machine building, material handling equipment, electronics market, oil & gas maintenance market and aerospace. This industry relies on the fastener sector. Fasteners are crucial for connecting and securing components in heavy machinery. With the construction industry booming and infrastructure investment reaching ~US$ 122B, there's a rising demand for top-notch fasteners to guarantee the structural integrity and safety of these machines. The close connection between heavy machinery and fasteners emphasizes the need for reliable fastening solutions to ensure the effective operation of heavy machinery in India. The Indian fastener for heavy machinery market was valued at ~ US$ 2B in FY24 witnessing a CAGR of 11.0% during FY21-24.

Indian infrastructure & heavy machinery SFS Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

In FY23, the construction equipment industry saw impressive growth due to a rise in construction and mining. Road, highway, and railway projects expanded significantly, increasing demand for construction equipment and the fasteners that connect parts for structural integrity.

- **Growing construction and mining activity:** In FY23, the construction equipment industry had its best year ever, with a remarkable ~26% YoY growth, exceeding 1L units in sales. This surge is due to increased

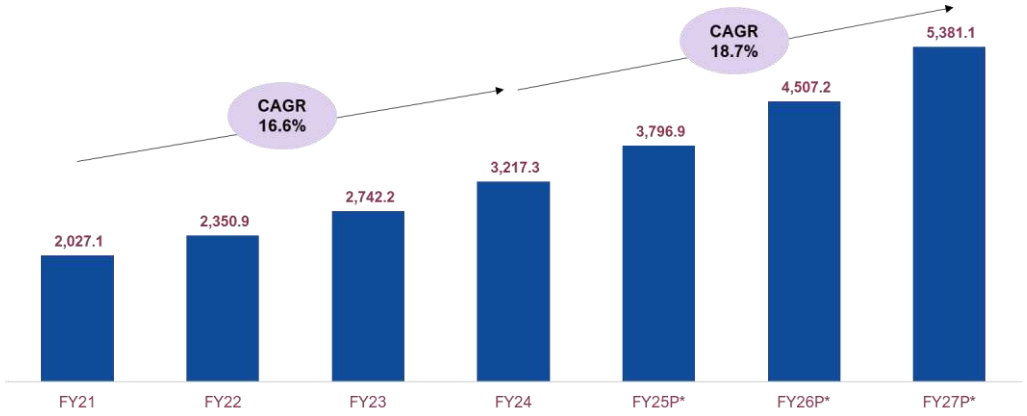
construction and mining activities, notably achieving a road and highway construction rate of ~30 km per day. This boost in demand for equipment like excavators and crushers is also expected to drive an increased need for fasteners to ensure structural integrity and durability.

- **Railway infrastructure:** In FY23, the railway construction sector experienced notable growth, laying tracks at a rate of 14 km/day. This surge was fuelled by new railway lines, doubling and gauge conversion projects, and a focus on traditional infrastructure by state governments. Additionally, a ~15% increase in coal production led to higher sales of mining equipment like high-capacity excavators, motor graders, and dozers. The expanding railway infrastructure and increased mining activities have elevated the demand for heavy machinery, consequently boosting the need for fasteners in the industry.
- **Government investments:** The government and private sector's increased investment in infrastructure is a key driver of growing demand for construction equipment. In the FY23-24 Union Budget, the capital investment for infrastructure is set to rise by ~33% to US$ 122 B. The government is also extending the 50-year interest-free loan to state governments for another year to spur more infrastructure investment. This boost in infrastructure spending is anticipated to increase the demand for construction equipment, leading to a higher need for essential fasteners that ensure strength, stability, and reliability.

7.3.3 Mobility

The stability of railway infrastructure and the strength of bridges depend on fasteners. These crucial components play a vital role in advancing railway infrastructure by connecting and securing tracks, sleepers, bridges, and signaling equipment. The fasteners market in the mobility sector is anticipated to experience significant growth, propelled by government investments, the expansion of high-speed rail, increased funding, and the electrification of the railway network. Mobility also includes automotive applications in ICE vehicles and EVs.

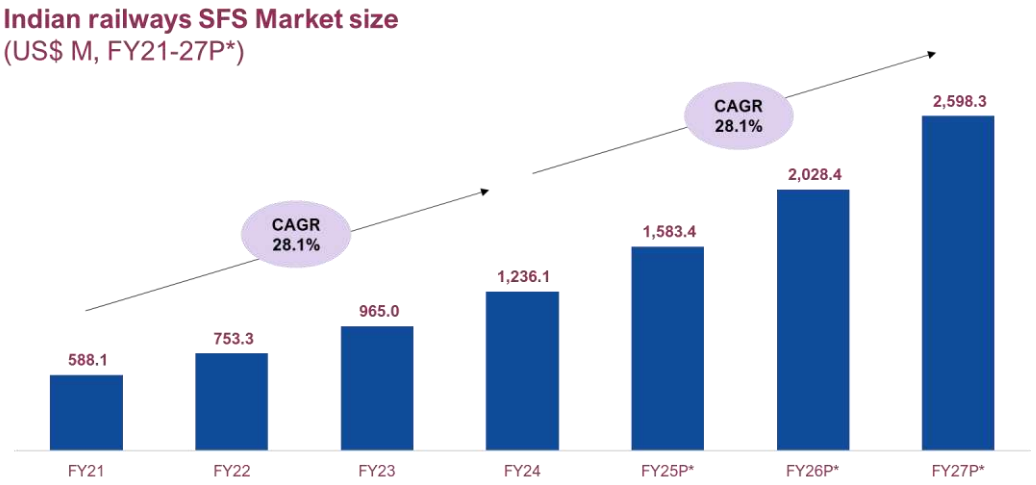
Indian mobility SFS Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

7.3.3.1 Railway Industry

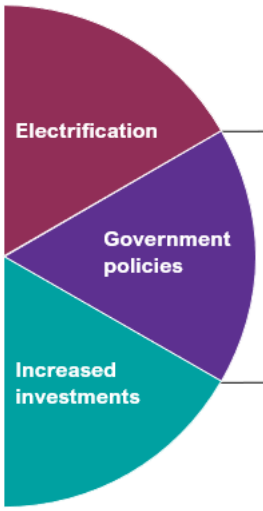
Fasteners are vital for the growth of railway infrastructure, connecting and securing tracks, sleepers, bridges, and signaling equipment. Reliable and durable fasteners are crucial for safe and efficient train operations. With a government investment of around US$ 5B and increasing foreign direct investment, the railway infrastructure industry is expected to further expand. As the Indian railway network grows and modernizes, there's a rising demand for top-notch fasteners.



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

Growth Drivers

Indian government is taking significant steps to improve its railway infrastructure, as outlined in the National Rail Plan (NRP) and backed by substantial budget allocations. With a focus on high-speed rail, increased investments, and electrification of the railway network, there is a growing demand for fasteners in the industry, crucial for ensuring the structural integrity of railway infrastructure.



- By February 2023, ~85% of India's Broad-Gauge network has been electrified
- Indian Railways achieved complete electrification for 6 zonal railways and aims for 100%, making it the world's largest eco-friendly railway
- Vision 2024, part of the NRP, includes measures like budgeting for 3000 electric locomotives and getting 55,000 wagons through PPP.
- The increased electrification and locomotive production will lead to heightened demand for fasteners used to secure running rails into various components, ensuring stability and proper alignment.

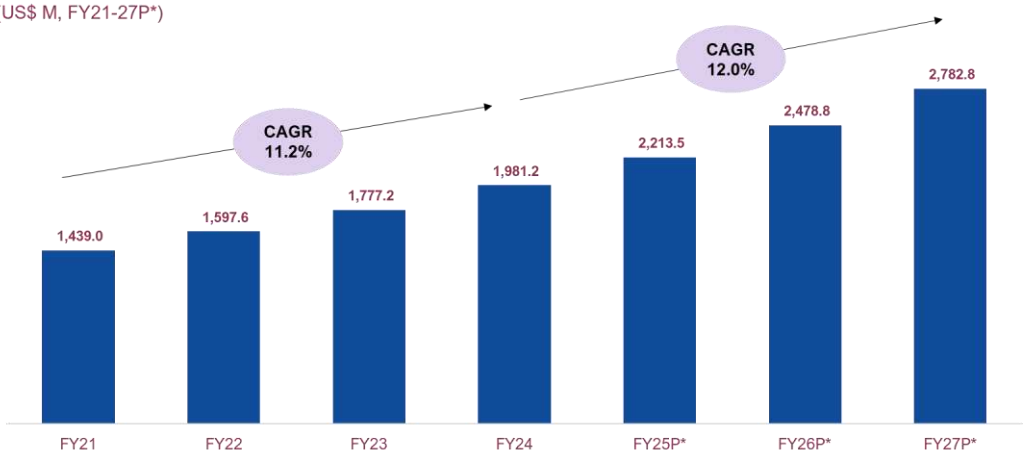
- The government is boosting railway infrastructure in India for a more efficient transportation system
- The NRP aims to make the railway system 'future-ready' by the end of the decade. ~US$ 5B is allocated to the NHSRC for the flagship project, a high-speed rail line from Mumbai to Ahmedabad
- The budget also covers 1000 smaller eight-car Vande Bharat EMUs, 25 hydrogen-powered trains, and 150 air-conditioned EMUs for mainline duties, called the Vande Metro
- With increased funding, there will be a rising demand for fasteners to ensure structural integrity in railway infrastructure

- Indian government's investor-friendly policies have boosted FDI in railways, reaching ~US $1B from FY01-23. The (NIP) foresees investments of ~US$ 200B by FY25, constituting ~12% of total planned investments
- Projects valued at ~US$ 23M will operate under the PPP model
- This increased investment will create opportunities and manufacturing demands in railway infrastructure, particularly for fasteners crucial in securing rails to sleepers, bearers, or other supports, playing a vital role in railroad construction

7.3.3.2 Automobiles

The Indian SFS automobiles market currently stands at ~US$ 2B and is growing at a CAGR of 12.0% between FY24-27. The automobile market consists of ICE vehicles and EVs.

Indian automobiles SFS Market size
(US$ M, FY21-27P*)



Note(s): *Projected
Sources: Universal Consulting report, 1Lattice analysis

08 Competitive benchmarking

8. Competitive Benchmarking

8.1 Gala Precision Engineering overview

Gala Precision Engineering is a key Indian manufacturer of high tensile fasteners and technical springs. Gala Precision Engineering also offers disc springs under the Gala brand & wedge lock washers under the Gallock brand. These products are as per German DIN standards and can be customized to meet the requirements of 175+ active global customers. Gala Precision Engineering has a strong global presence across 25+ global export countries with an office in Frankfurt Germany to better service their European clientele.

Gala Precision Engineering has 30+ years of experience in understanding spring material behavior and has tie ups with global research institutes in Germany and India for new product testing and process validation.

Gala Precision Engineering has alliances with steel mills in India, Europe, Brazil, Korea, etc. from which it acquires ~30% of its raw materials. Such alliances are key for maintaining consistency in quality and delivery.

Product development takes 3 to 9 months, followed by a 3 to 12-month testing and validation phase incurring significant costs. Plant audits by clients occur during this period. The process concludes with a 12 to 18-month supply ramp-up and quality stabilization, showcasing Gala's meticulous and time-consuming operations that prioritize thorough testing, validation, and quality assurance for reliable product delivery to clients. In addition to its facilities in India, Gala Precision Engineering maintains an office in Germany as well. Gala Precision Engineering is adding new customers for disc springs in high-value markets such as Europe and USA and is mainly competing with German producers to improve its market share.

With a global clientele, Gala's exports reach 25+ countries, encompassing major markets such as Germany, Denmark, China, Italy, Brazil, USA, Sweden, Switzerland and others contributing ~40% to total sales.

Gala is setting up a new facility in Chennai dedicated to the production of special fastening solutions.

Gala specializes in Strip Springs designed for high fatigue applications in two-wheelers, four-wheelers, and off-highway vehicles. Their product range also includes disc springs conforming to DIN 2093 standards, Bearing Series, and customized variants featuring a variety of raw materials and surface coating options. Gala is a supplier for global and Indian players like Brembo Brake India Pvt Ltd., Bufab India Fasteners Pvt Ltd., Vestas Wind Technology India Pvt. Ltd., Endurance Technologies Ltd., Exedy Clutch India Pvt Ltd., Larsen & Toubro Electrical Automation (L&T Electrical Automation), Schneider Electric SE, MSL Driveline Systems Ltd. (formerly Mahindra Sona Limited), Wuerth Industrial Services Pvt Ltd., General Electric Vernova (GE Vernova), Enercon Global GmbH, Senvion S.A., Schaeffler Technologies AG & Co. KG, Hitachi Astemo Ltd., Altra Industrial Motion, Webtec Products Limited, LPS Bossard Pvt. Ltd. And Legrand India Pvt. Ltd.

Gala Precision Engineering has a significant presence in the disc spring market for renewable energy industry with ~80% share in the Indian market as of FY23 and ~3% share in the global market as of CY22*.

Gala Precision Engineering has ~15% market share in the Indian SFS market for wind turbines as of FY23.

(Note: *Gala Precision Engineering's revenue taken for FY23)

Products

Disc & strip springs and wedge lock washers (DSS & WLW)

Gala Precision Engineering offers disc springs as per DIN 2093 standard or as per custom requirements to the client needs. Within groups of DIN 2093, standard sizes as per series A, B and C are provided. Gala Precision Engineering has built-up in-house expertise and cooperates with German universities to develop high performance disc springs which offer high fatigue life at high stress levels. Furthermore, the size of the disc

springs can be reduced while meeting the same load / deflection requirements due to Gala Precision Engineering's improved manufacturing technology. Other advantages of Gala Precision Engineering's disc springs include 100+ standard sizes available ex-stock, ISO 9001:2015 / IATF16949 certified manufacturing facilities and the availability of disc spring selection software online. Gala Precision Engineering is competing domestically with International Industrial Springs, while internationally with Muhr und Bender KG, Schnorr GmbH & Christian Bauer GmbH + Co. KG.

Gala Precision Engineering manufactures an extensive range of strip springs for Indian and global OEMs across automotives, off-highway vehicles, and more industries. Some key applications for these strip springs are two wheelers, four wheelers and off highway vehicles. Gala is the partner of various notable OEMs such as Brembo Brake India Pvt Ltd., and Endurance Technologies Ltd.

Coil & spiral springs (CSS)

In 2015, Gala Precision Engineering commenced the production of CSS, drawing upon its extensive manufacturing expertise to provide springs tailored for diverse critical applications. The company boasts IATF16949 and ISO 9001:2015 certified manufacturing facilities, ensuring high-quality standards.

Gala Precision Engineering has various advance manufacturing processes in the manufacturing of coil springs, including the usage of CNC Wafios machine from Germany, Wheelabrator shot peening machine, spring grinding and chamfering CNC machine & multi station automatic scragging and load testing machine. They even offer various types of surface coatings.

Gala Precision Engineering's spiral springs offer high durability, optimum design for space saving, capability to offer variety of surface treatments and coatings which are capable of meeting stringent tolerances.

Gala Precision Engineering's CSS solutions have found adoption across numerous industries such as automobiles, off-highway vehicles, commercial vehicles & industrial infrastructure.

Within the CSS category, Gala faces competition from industry players like Stumpp Schuele & Somappa Springs Pvt. Ltd., NHK Springs India Ltd., and Muhr und Bender KG.

Special fastening solutions (SFS)

Gala Precision Engineering manufactures special fastening solutions such as anchor bolts and studs from various materials such as alloy steel / high tensile steel (as per ISO 890-1, DIN & ISO series standard), and structural steel. These come with various coatings such as zinc flake coating, delta tone, geomet, magni, mechanical zinc plating (Cr 6 free), and hot dip galvanizing.

Gala Precision Engineering is mainly competing with Randack Fasteners India Pvt. Ltd., Sundram Fasteners Ltd. &, Hiten Fasteners Pvt. Ltd. in the Indian SFS market. In the global segment they are competing with Cooper & Turner Ltd., Rose Holm A/S, & August Freidberg GmbH.

Gala Precision Engineering's SFS are used across various applications such as wind energy, hydro electricity generation, railways, off highway vehicles, heavy machinery & electricals.

8.2 Financial & operational benchmarking with global players

Global competitive benchmarking				
Parameters	Gala Precision Engineering	Schnorr GmbH	Cooper & Turner Ltd.	Christian Bauer GmbH + Co. KG
Year of analysis	FY23	CY22	CY22	CY21
Founding year	2009	1908	1912	1880
Location	India	Germany	United Kingdom	Germany
Revenue from Operation (USD M)	20.60	52.71	47.83	45.45
Total Income (USD M)	20.80	53.50	47.83	47.18
EBITDA (USD M)	3.60	4.51	2.59	3.18
Profit after Tax before Exceptional items	1.80	3.12	2.06	(1.44)
Profit after Tax after Exceptional items	3.01	-	-	-
EBITDA Margin (%)	17.32	8.43	5.42	6.74
Profit after Tax Margin before Exceptional items (%)	8.65	5.83	4.31	(3.05)
Profit after Tax Margin after Exceptional items (%)	14.49	-	-	-
Debt/Equity	0.70	0.08	1.42	0.48
ROCE excluding exceptional items (%)	16.07	33.12	8.39	(3.25)
RoE before Exceptional items (%)	17.28	24.81	16.17	(7.52%)
RoE after Exceptional items (%)	28.94	-	-	-

Source: Financial information for Gala has been derived from restated audited financial statements for the financial years ended March 31, 2023

Cooper & Turner Ltd.'s financials for the calendar year ended December 30, 2022, are taken from official UK government website GOV.UK, which is a website for company details and financials

Schnorr GmbH's financials for for the calendar year ended December 30, 2022, are taken from the company register, a central platform for company data by German government

Christian GmbH + Co. KG Bauer's financials for the calendar year ended December 30, 2021 are taken from company register, a central platform for company data by German government

Notes:

Below mentioned formula are used for international players only

For Schnorr GmbH *& Christian Bauer GmbH + Co. KG, total debt is calculated by considering the liabilities to credit institutions*

For Cooper & Turner Ltd, total debt is calculated by considering the amount owned to group undertaking

For companies without exceptional items, line items calculated after exceptional items have been indicated with a "-"

EBITDA: Profit after tax + Interest & similar expense + Depreciation & amortization + Total tax expense

Profit after tax before exceptional times = Profit before tax before exceptional items - total tax expense

Profit after tax after exceptional times = Profit before tax and after exceptional items - total tax expense

EBITDA Margin: EBITDA / Total income

Profit after tax margin before exceptional items = Profit after tax before exceptional items / Total income

Profit after tax margin after exceptional items = Profit after tax and after exceptional items / Total income

Debt/Equity: Total debt / Total Equity

ROCE excluding exceptional items: EBIT (Profit after tax + Total tax expense + Interest & similar expense) / Capital employed (Total equity + Total debt)

RoE before exceptional items = Profit after tax before exceptional items / Total equity

RoE after exceptional items = Profit after tax after exceptional items / Total equity

8.3 Financial & operational benchmarking with Indian players

- In FY23, Rolex Rings Limited offers the strongest EBITDA margin among all players (23.6%), followed by SKF India Limited (18.62%), and Gala Precision Engineering (17.5%)
  In FY23, SKF India is notably debt free with a debt-to-equity ratio of 0.0.

Financial benchmarking for FY23

Domestic competitive & peer benchmarking						
Parameters	**Gala Precision Engineering**	**Sundaram Fasteners Limited**	**SKF India Limited**	**Harsha Engineers International Limited**	**Rolex Rings Limited**	**Sterling Tools Limited**
Year of analysis	FY23	FY23	FY23	FY23	FY23	FY23
Founding year	2009	1962	1923	1986	1975	1979
Location	Thane, Maharashtra	Chennai, Tamil Nadu	Bengaluru, Karnataka	Ahmedabad, Gujarat	Rajkot, Gujarat	Haryana, India
Revenue from Operation (INR M)	1,654.65	56,627.50	43,049.30	13,640.20	11,789.53	7,719.78
Total Income (INR M)	1,670.82	57,076.00	43,567.90	13,938.10	11,982.45	7,748.78
EBITDA (INR M)	289.40	8,983.20	8,013.70	2,190.80	2,800.17	1,004.36
Profit after Tax before Exceptional items (INR M)	144.52	5,003.50	5,248.80	1,232.80	1,980.92	444.35
Profit after Tax after Exceptional items (INR M)	242.12	-	-	-	-	478.78
EBITDA Margin (%)	17.32	15.74	18.39	15.72	23.37	12.96
Profit after Tax Margin before Exceptional items (%)	8.65	8.77	12.05	8.84	16.53	5.73
Profit after Tax Margin after Exceptional items (%)	14.49	-	-	-	-	6.18
Debt/Equity	0.70	0.23	0.00	0.17	0.11	0.33
ROCE excluding exceptional items (%)	16.07	18.73	31.37	14.65	30.70	12.89
RoE before exceptional Items (%)	17.28	16.59	22.42	11.50	26.66	11.10
RoE after exceptional Items (%)	28.94	-	-	-	-	11.96

Financial benchmarking for H1FY24

Domestic competitive & peer benchmarking						
Parameters	Gala Precision Engineering	Sundaram Fasteners Limited	SKF India Limited	Harsha Engineers International Limited	Rolex Rings Limited	Sterling Tools Limited
Year of analysis	H1FY24	H1FY24	H1FY24	H1FY24	H1FY24	H1FY24
Founding year	2009	1962	1923	1986	1975	1979
Location	Thane, Maharashtra	Chennai, Tamil Nadu	Bengaluru, Karnataka	Ahmedabad, Gujarat	Rajkot, Gujarat	Haryana, India
Revenue from Operation (INR M)	956.81	28,325.80	22,748.10	6,874.50	6,321.03	4,307.76
Total Income (INR M)	966.53	28,443.90	23,176.10	6981.00	6,382.86	4,343.55
EBITDA (INR M)	188.33	4,689.20	3,667.80	877.10	1,436.00	544.05
Profit after Tax before Exceptional items (INR M)	100.72	2,617.90	2,443.90	449.70	954.00	251.34
Profit after Tax after Exceptional items (INR M)	95.97	-	-	-	-	255.31
EBITDA Margin (%)	19.48	16.49	15.83	12.56	22.50	12.53
Profit after Tax Margin before Exceptional items (%)	10.42	9.20	10.54	6.44	14.95	5.79
Profit after Tax Margin after Exceptional items (%)	9.93	-	-	-	-	5.88
Debt/Equity	0.63	0.18	0.00	0.15	0.05	0.32
ROCE excluding exceptional items (%)	10.23	9.53	13.82	5.37	14.80	6.87
RoE before exceptional Items (%)	10.85	8.14	10.23	4.04	11.38	6.00
RoE after exceptional Items (%)	10.34	-	-	-	-	6.10

Source: Financial information for Gala Prescision Engineering has been derived from restated audited financial statements for the financial years ended March 31, 2023. Along with half-yearly restated unaudited financial statements ending September 30, 2023.

Sundaram Fasteners Ltd. financials has been derived from official company website which are unaudited financial statements for the financial years ended March 31, 2023. Along with half-yearly data ending September 30, 2023.

SKF India Ltd. financials have been derived from official company website which are unaudited financial statements for the financial years ended March 31, 2023. Along with half-yearly data ending September 30, 2023.

Harsha Engineers International Ltd. financials has been derived from official company website which are unaudited financial statements for the financial years ended March 31, 2023. Along with half-yearly data ending September 30, 2023.

Rolex Rings Ltd. financials have been taken from NSE, BSE, and Rolex Rings official financial statements. statements for the financial years ended March 31, 2023. Along with half-yearly data ending September 30.

Sterling Tools Ltd. finacials have been derived from the official company website which are audited financial statements for the financial year ended March 31, 2023. Along with half-yearly unaudited financials ending September 30, 2023.

Notes:

For companies without exceptional items, line items calculated after exceptional items have been indicated with a "-"

EBIDTA= Profit after tax before exceptional items + finance cost + depreciation & amortization + total tax

Profit after tax before exceptional times = Profit before tax before exceptional items - total tax expense

Profit after tax after exceptional times = Profit before tax and after exceptional items - total tax expense

EBITDA margin = EBITDA / Total income

Profit after tax margin before exceptional items = Profit after tax before exceptional items / Total income

Profit after tax margin after exceptional items = Profit after tax and after exceptional items / Total income

Debt/Equity = Total debt (current borrowings + non-current borrowings) / Total equity

ROCE excluding exceptional items = EBIT (Profit before exceptional items and tax + finance costs) / Capital employed (total equity + total debt)

RoE before exceptional items = Profit after tax before exceptional items / Total equity

RoE after exceptional items = Profit after tax after exceptional items / Total equity

For SKF India Limited, all profitability figures are inclusive of the share of profit and loss of associates

For Gala Precision Engineering, profit after tax after exceptional times is net of non-controlling interest in H1FY24

Figures for H1FY24 have not been annualized

8.4 Global competitive landscape

Global competitive landscape				
Company	**Description**	**Strengths**	**Industries serviced**	**Products**
Gala Precision Engineering	Gala Precision Engineering serves the global markets with high-end technology solutions in the area of **high-tensile fasteners & technical springs**	• Established **manufacturer of precision components** with a diverse global product portfolio, catering to various markets and geographies • **Strong and enduring customer relationships with Indian and global OEMs**, Tier 1 entities, and distributors, high entry barriers for products supplied to OEMs and Tier 1 customers • Integrated **manufacturing facilities with in-house design, experienced & skilled workforce, and automation capabilities**, contributing to scale, flexibility, and holistic solutions	• Automotive • Railways • Off-highway vehicles • Renewables • Commercial vehicle • Electrical • Heavy machinery • Industrial infrastructure	• Disc spring • Strip spring • Coil spring • Spiral spring • Wedge lock washers • Special fasteners (nuts, anchor bolts & studs) • Bearing disc springs
Schnorr GmbH	Schnorr is an international solution provider in the field of **disc springs & screw-locking devices** across a global network	• It offers deep drawing parts, stamped & fine-blanked disc springs & precision parts for industrial companies • It has expertise in material & surfaces engineering, **in-house toolmaking, & prototyping** • It is equipped with multiple quality certificates such as **IATF 16949: 2016, ISO 14001:2015,** & more	• Renewable • Aerospace • Energy • Marine • Electronics • Medical engineering • Transportation • Industrial brakes • Power tools • Metal production • Defence • Furniture • Valves & fittings • Semiconductor • Construction • Machinery & plant engineering	• Disc spring • Safety washers • Load washer • Wave spring • Special spring
Cooper & Tuner Ltd.	Cooper & Turne manufactures hot & cold formed - **high strength fasteners**	• It merged with Beck Industries in CY19 & is exploring new products & safety-critical markets, including oil & gas, petrochemical & subsea(submerged ocean equipment, operations, or applications) • It patented the **'Coronet' Direct Tension Indicator** ensuring correct torque tensioning for high-strength bolts • It is equipped with multiple quality standard certificates such **as ISO 9001, UKCA, RISQS, TUV** & more	• Renewable Energy • Railway • Tunnelling • Construction • OEM	• Fasteners (nuts, bolts & studs)
Christian Bauer GmbH + Co. KG	Christian Bauer GmbH + Co. KG specializes in manufacturing **disc springs & precision component**	• It is equipped with multiple certificates including **ISO 9001, IATF 16949, KTA 140**1 & more • It offers grinding, stamping/ fine blanking technology along with vanes, rotors and rollers	• Automotive • Energy • Renewable • Aerospace • Mechanical engineering • Shipbuilding & offshore industry	• Disc spring • Disc spring stacks • Slotted disc springs • Ball bearing disc springs • Conical spring washers • Wave & special springs

8.5 Domestic competitive & peer comparison landscape

Domestic competitive & peer landscape				
Company	**Description**	**Strengths**	**Industries serviced**	**Products**
Gala Precision Engineering	Gala Precision Engineering serves the global markets with high-end technology solutions in the area of **high-tensile fasteners & technical springs**	• Established **manufacturer of precision components** with a diverse global product portfolio, catering to various markets and geographies • **Strong and enduring customer relationships with Indian and global OEMs**, Tier 1 entities, and distributors, high entry barriers for products supplied to OEMs and Tier 1 customers • Integrated **manufacturing facilities with in-house design, experienced & skilled workforce, and automation capabilities**, contributing to scale, flexibility, and holistic solutions	• Automotive • Railways • Off-highway vehicles • Renewables • Electrical • Commercial vehicle • Heavy machinery • Industrial infrastructure	• Disc spring • Strip spring • Coil spring • Spiral spring • Wedge lock washers • Special fasteners (nuts, anchor bolts & anchor bolts) • Bearing disc springs
Sundaram Fasteners Limited	Sundaram Fasteners is a manufacturer of **high-precision & critical component**s for automotive, infrastructure, wind energy & aviation sectors	• It offers a **wide range of products** such as fasteners, power train components, sintered metal products, iron power, cold extruded parts, radiator caps, water pumps, oil pumps & wind energy components	• Renewables • Automotive • Industrials	• High tensile fasteners • Cold extruded parts • Hot forged parts • Power metallurgy • Pumps & assemblies • Radiator caps • Power train components
SKF India Limited	SKF India is a provider of **automotive & industrial engineering solutions** with a focus on processing involving rotation	• It **focuses on processing involving rotation** with a key focus area being the reduction of friction in these processes • It is positioned as an engineering company that **allows clients to improve friction reduction**, energy efficiency and reliability	• Aerospace • Agriculture • Automotive • Construction • Food & beverage • General machinery • Wind energy • Marine • Material handling • Mining, mineral processing & cement • Oil & gas • Pulp & paper • Railways	• Bearing • Seals • Lubrication • Maintenance products • Power transmission
Harsha Engineers International Limited	Harsha Engineer is a precision engineering company manufacturing **ball bearing cages & stamped components**	• Manufacturing equipment **includes hard milling & turning machines, computerized numerical control, wire-cut &** electrical discharge machines, & more • For product development, they use **pro engineers for 3D modelling & detailing**, numerically controlled tool paths, etc. • It was awarded the **TPM consistency award** in 2019 by Japan Institute of Plant Maintenance	• Automotive • Industrial • Electrical	• Brass cages • Steel cages • Polyamide cages • Stamped components
Rolex Rings Limited	Rolex Rings designs & manufactures **hot forged rolled rings**	• It used multiple **high-precision measuring instruments** spectrometer, electronic microscope, CMM, contour measuring, machine profile projector, surface roughness tester etc. to ensure product quality • It is equipped with multiple industries certifications such as **ISO 9001, TS 16949, OHSAS18001** & more	• Automotive • Industrial • Railways • Off-highway • Renewable • Textile • Electrical • Defence • Power • Aerospace • Marine • Oil & natural gas	• Transmission component • Engine component • Chassis component • Bearing rings • Exhaust system components
Sterling Tools Limited Fasteners	Sterling Tools Limited Fasteners manufactures critically fabricated high tensile cold forged fasteners	• Produces fasteners to fit Indian, German, Japanese, American and British standards • Offers various surface finishes such as **Zinc Phosphating, Zinc Plating** and **Dip Spin Coating** on fasteners • Has achieved various quality certifications such as **ISO 9001**, TS16949, ISO 14001, **ISO 17025**, and OHSAS 18001	• Passenger vehicles • Two-wheelers • Commercial vehicles • Agri-equipment • Construction equipment	• Standard fasteners • Chassis fasteners • Special fasteners • Engine fasteners • Nuts

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