

# INDUSTRY REPORT ON NON AUTOMOTIVE PRECISION FORGED AND MACHINED COMPONENTS



30 SEPTEMBER 2026

FINAL REPORT

FROST & SULLIVAN

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## Disclaimer

Fact-finding for this project comprised **secondary/desktop research and primary research**, including discussions with leading market participants and industry experts. The study adopted an **Expert Opinion Methodology**, with quantitative and qualitative information sourced from primary interviews, industry journals, company reports, trusted databases, and publicly available sources. Market estimates and assumptions are subject to changes in prevailing business and market conditions.

Forecasts, estimates, predictions, and other forward-looking statements contained in this report are inherently uncertain and may vary due to changes in underlying assumptions or unforeseen events. Actual results may differ materially from such estimates or forecasts.

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Frost & Sullivan has prepared this study independently and objectively and has exercised reasonable care to ensure its accuracy and completeness. The study presents a fair view of the **Global and Indian Precision Forged and Machined Components for the Non-Automotive Forging Industry**, subject to the limitations of secondary data and primary research. It reflects an overall industry perspective and may not represent the performance of individual companies.

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## Abbreviations

|            |                                               |
|------------|-----------------------------------------------|
| ABS:       | American Bureau of Shipping                   |
| AEW&C:     | Airborne Early Warning and Control            |
| AI:        | Artificial Intelligence                       |
| API:       | American Petroleum Institute                  |
| ASAT:      | Anti-Satellite                                |
| BHP Group: | Broken Hill Proprietary Company               |
| Bn:        | Billion                                       |
| BPCL:      | Bharat Petroleum Corporation Limited          |
| BSI:       | British Standards Institution                 |
| CAD:       | Computer-Aided Design                         |
| CAGR:      | Compound Annual Growth Rate                   |
| CAM:       | Computer-Aided Manufacturing                  |
| CAPEX:     | Capital Expenditure                           |
| CDF:       | Closed die Forging                            |
| CEA:       | Central Electricity Authority                 |
| CETP:      | Common Effluent Treatment Plant               |
| CNC:       | Computer Numerical Control                    |
| COP:       | Conference of the Parties                     |
| COP28:     | 28th Conference of the Parties                |
| COP29:     | 29th Conference of the Parties                |
| CPSE:      | Maharatna Central Public Sector Enterprise    |
| DAQA:      | Defence Aviation Quality Assurance            |
| DEMU:      | Diesel Electric Multiple Unit                 |
| DPSUs:     | Defence Public Sector Undertakings            |
| DRDO:      | Defence Research and Development Organization |
| EASA:      | European Union Aviation Safety Agency         |
| EDM:       | Electrical Discharge Machining                |
| EIA:       | Energy Information Administration             |
| ETP:       | Effluent Treatment Plant                      |
| EU:        | Europe                                        |
| EUR:       | Euro                                          |
| EVs:       | Electric Vehicles                             |

FBR: Fast Breeder Reactor

FDI: Foreign Direct Investment

GAIL: Gas Authority of India Limited

GCC: Gulf Co-operation Council

GDP: Gross Domestic Product

GFCF: Gross Fixed Capital Formation

GST: Goods and Services Tax

GTF: Geared Turbofan

GW: Giga Watt

GWe: Gigawatt Electrical

HAL: Hindustan Aeronautics Limited

HEMM: Heavy Earth Moving Machines

HPCL: Hindustan Petroleum Corporation Limited

HTT-40: Hindustan Turbo Trainer-40

IATA: International Air Transport Association

IATF: International Automotive Task Force

IBR: Indian Boiler Regulations

ICT: Information Technology

IDEX: Innovations for Defence Excellence

IDSA: Institute for Defence Studies and Analyses

IEA: International Energy Agency

IMF: International Monetary Fund

IMO: International Maritime Organization

INR: Indian Rupees

IN-SPACe: Indian National Space Promotion and Authorization Centre

IOCL: Indian Oil Corporation Limited

IPNG: Indian Petroleum and Natural Gas

IRIS: International Railway Industry Standard

IRS: Indian Register of Shipping

ISO: International Organization for Standardization

ISRO: Indian Space Research Organization

JVs: Joint Ventures

KAPP: Kakrapar Atomic Power Project

KBD: Kilo Barrels per Day

KTPA: Kilo tonnes per annum

KWH: Kilowatt-hour

LCA: Light Combat Aircraft

LCC: Low-Cost Carrier

LLTR: Low-Level Transportable Radar

LPG: Liquefied Petroleum Gas

Ltd: Limited

Mbpd: Millions of barrels per day

MEMU: Mainline Electric Multiple Unit

MHI: Mitsubishi Heavy Industries Ltd.

MIG: Metal Inert Gas

MMDR: Mines and Minerals (Development and Regulation)

MMPL: Multi Product Pipeline

MMTPA: Million Metric Tonnes per Annum

Mn: Million

MNRE: Ministry of New and Renewable Energy

Mo: Molybdenum

MoD: Ministry of Defence

MOSPI: Ministry of Statistics and Programme Implementation

MoUs: Memoranda of Understanding

MPR: Multi-Purpose Radar

MRO: Maintenance, Repair, and Overhaul

MRTT: Multi Role Tanker Transport

MSMEs: Micro, Small and Medium Enterprises

MT: Metric Ton

MW: Mega Watt

MWe: Megawatt Electrical

NA: North America

NABL: National Accreditation Board for Testing and Calibration Laboratories

NADCAP: National Aerospace and Defense Contractors Accreditation Program

NAPP: Narora Atomic Power Project

NATO: North Atlantic Treaty Organization

NDE: Non-Destructive Evaluation

NDT: Non-Destructive Testing

NESR: National Energy Services Reunited Corp.

NGHM: National Green Hydrogen Mission

Ni: Nickel

NIS: Israeli New Shekels

NITI Aayog: National Institution for Transforming India

NPCIL: Nuclear Power Corporation of India Limited

ODF: Open Die Forging

OEM: Original Equipment Manufacturer

OEs: Original Equipment

ONGC: Oil and Natural Gas Corporation

PDP8: The Power Development Plan 8

PED: Pressure Equipment Directive

PH: Precipitation Hardening

PIB: Press Information Bureau

PLI: Production Linked Incentive

PM Surya Ghar : Pradhan Mantri Surya Ghar: Muft Bijli Yojana

PM-KUSUM : Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan

PNG: Piped Natural Gas

PPP: Public-Private Partnership

PSUs: Public Sector Undertakings

Pvt: Private

RAPP: Rajasthan Atomic Power Project

RE: Renewable Energy

RES: Renewable Energy Sources

RR: Ring Rolling

SAAW: Smart Anti-Airfield Weapon

SEZ: Special Economic Zone

SIPRI: Stockholm International Peace Research Institute

SM: Standard Missile

SMEs: Small and Medium Enterprises

Solar PV: Solar Photovoltaic

SS: Stainless Steel

STP: Sewage Treatment Plant

TAQA: Industrialization and Energy Services Company

TIG: Tungsten Inert Gas

TN: Tamil Nadu

TWh: Terawatt hours

US: United States

USD: United States Dollar

VTL: Vertical Turning Lathe

YoY: Year-on-Year



**Global & India Macroeconomic  
Overview**

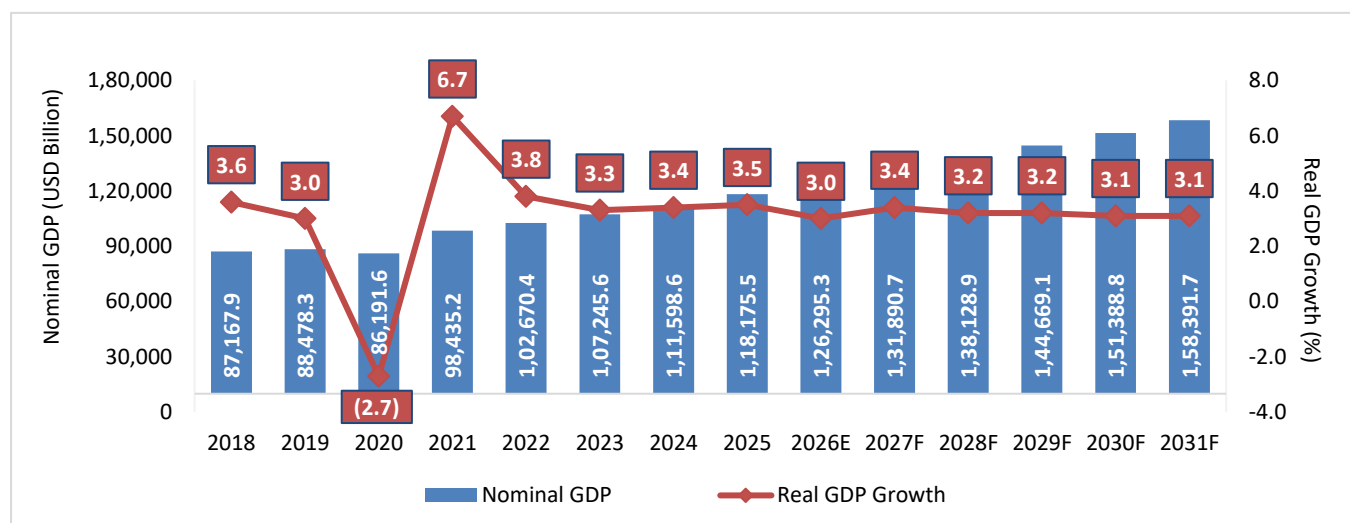
## 1.1 Global Macroeconomic Overview

### 1.1.1 Global Gross Domestic Product (GDP) Growth Outlook

Global growth rebounded in 2021, with real GDP expanding by 6.7%, driven by post-pandemic demand recovery and government fiscal stimulus. However, a high base effect, along with factors such as a surge in inflation amid the Russo-Ukrainian conflict, resulted in growth slowing to 3.3% in 2023. In 2024, growth improved marginally to 3.4%, supported by easing inflation and improving credit conditions. In 2025, escalating US tariff tensions and heightened trade and policy volatility exerted pressure on global activity. However, investments in technology and AI, supportive fiscal and monetary policies, and continued capital expenditure (CAPEX) in infrastructure, renewable energy, and cybersecurity helped cushion the adverse impact of trade disruptions. Consequently, global real GDP growth edged up to 3.5% in 2025.

Global GDP growth is estimated to moderate to 3.0% in 2026. Supply chain disruptions, elevated energy prices, higher freight and insurance costs, and persistent inflationary pressures in H1 2026, amid elevated US-Iran tensions, will weigh on economic activity. These factors will limit household spending, put pressure on business margins, and delay central bank rate cuts. Continued geopolitical tensions, energy-price volatility, freight disruptions, and trade uncertainty could prolong disruptions across global manufacturing and supply chains. This will raise input and transportation costs, thereby weakening business and investment confidence. Higher energy and logistics costs could also sustain inflationary pressures, particularly in energy-importing economies, limiting the pace of the global growth recovery.

**Exhibit 1: Nominal GDP (USD Billion) and Real GDP Growth (%), Global, 2018-2031F**



Note: E: Estimate; F: Forecast; Source: International Monetary Fund (IMF); Frost & Sullivan

Global growth is expected to remain resilient, averaging 3.2% annually between 2027 and 2031. Advanced economies are projected to expand by an average of 1.7% annually over 2026-2031. Growth will remain constrained by aging populations, high debt, inefficient supply chains, and costs associated with transitions to new energy sources. However, strong purchasing power and sustained long-term investments in AI, green energy, and advanced manufacturing will help these economies remain key global players. Emerging markets will drive global growth, averaging 4.1% annually, supported by favorable demographics, strengthening manufacturing capabilities, and investments in digital and green sectors.

### 1.1.2 Key Global Economic Trends

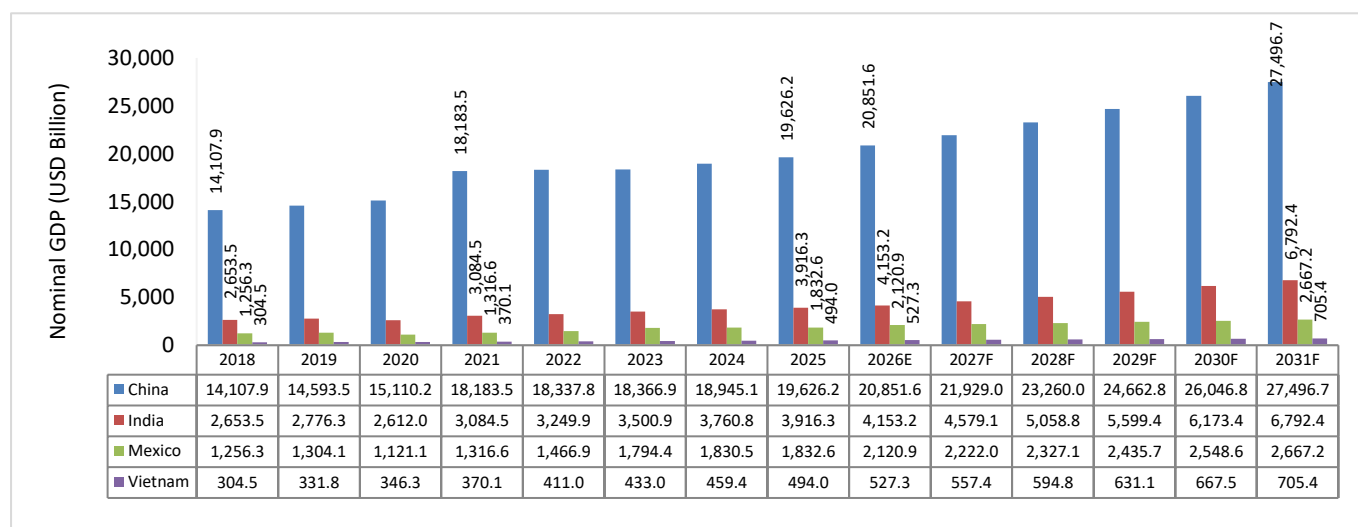
- **Global Growth to Slow with Uneven Regional Recovery:** Global GDP growth is estimated at 3.0% in 2026, a moderation from 3.5% growth in 2025, reflecting the impact of the US-Iran conflict, elevated energy prices, trade uncertainty, and weaker investor sentiment. Continued energy and supply-chain disruptions are expected to keep inflationary pressures elevated and weigh on global demand. Key downside risks include

further geopolitical escalation, slower-than-expected AI-driven productivity gains, and renewed trade tensions.

- **West Asia Conflict and Hormuz Disruptions to Pressure Trade and Inflation:** Prolonged disruption around the Strait of Hormuz is expected to raise energy, freight, and insurance costs and disrupt maritime trade. As of September 2026, shipping traffic through the Strait remains severely constrained amid continued US-Iran escalation, while oil prices have risen above USD 100 per barrel. For India, the disruption will further increase energy, input and logistics costs and pressure export margins.
- **India to Remain Among the World's Fastest-Growing Major Economies:** India is expected to maintain strong growth momentum, supported by robust domestic demand, public CAPEX, manufacturing investment, and resilient services exports. Real GDP grew 7.8% in Q1 FY2027 year-on-year (YoY), with investment, household consumption, and exports also recording strong growth despite global headwinds. Favorable demographics and rising domestic consumption are expected to further support economic growth.
- **Asian and Middle Eastern Emerging Markets to Gain from China+1 Strategies:** As companies seek to reduce geopolitical and supply-chain risks, nearshoring and diversification are expected to support manufacturing and sourcing shifts toward Southeast Asia, India, and selected Middle Eastern economies. Attractive labor markets, government incentives, improving infrastructure, and connectivity are expected to support this realignment. While Gulf Co-operation Council (GCC) economies face near-term investment and logistics challenges from the regional conflict, prospects could improve with a durable resolution and normalization of Strait of Hormuz traffic.

### 1.1.3 Growth Outlook for Key Emerging Markets

**Exhibit 2: Nominal GDP (USD Billion), Select Emerging Markets<sup>1</sup>, 2018-2031F**



Note: E: estimate; F: forecast; India's data are represented in fiscal years. For e.g. FY2019 is the 12-month period between 1 April 2018 and 31 March 2019 and corresponds to 2018 on the chart; Source: IMF; Frost & Sullivan

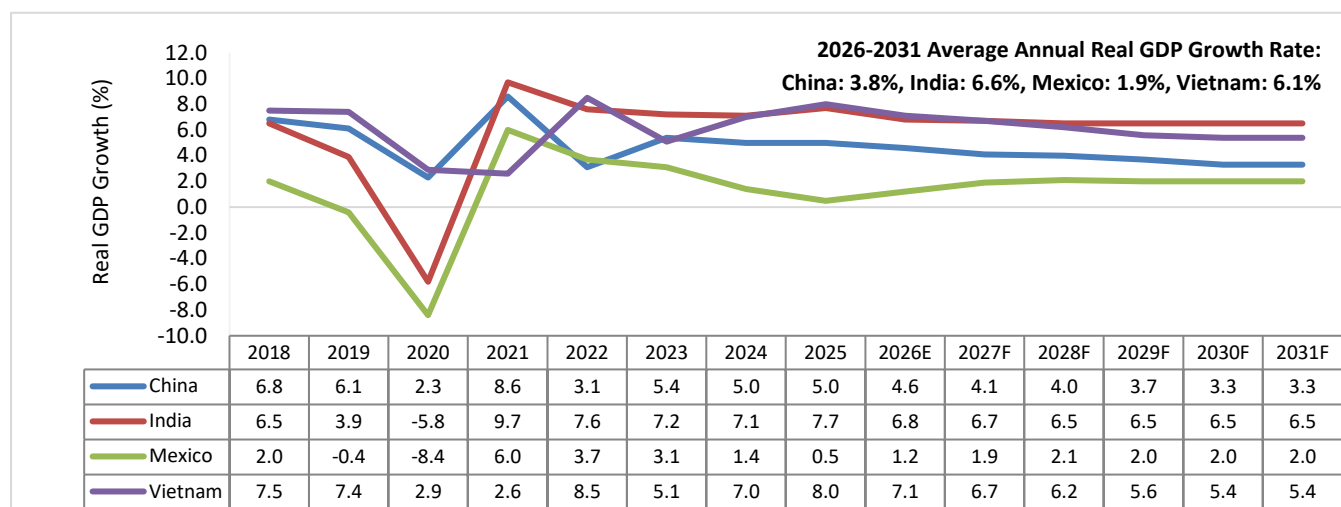
**China:** China's nominal GDP rose at a compounded annual growth rate (CAGR) of 11.8% between 2000 and 2025, reaching USD 19.6 trillion in 2025. However, long-term economic growth in China will see a significant deceleration from 5.7% in the 2015-2025 period to an annual average real GDP growth rate of 3.8% between 2026 and 2031.

**India:** With its real GDP growth in FY2026 (1 April 2025 to 31 March 2026) standing at an estimated 7.7%, India has emerged as a global economic bright spot. FY2027 real GDP growth is pegged at 6.8% and is forecast to average 6.5% between FY2027 and FY2032. By 2031, India is set to become the third largest economy globally, overtaking UK, Germany, and Japan.<sup>1</sup> India's nominal GDP will rise at a CAGR of 6.7% in the 2010-2030 period and will surpass the USD 6.5 trillion mark by 2030. Long-term growth drivers include the demographic dividend, rapidly expanding

<sup>1</sup> IMF

middle class purchasing power, massive CAPEX thrust, and conducive government policies. For instance, the Production Linked Incentives (PLI) scheme, covering 14 key sectors such as automobiles and auto components, pharmaceuticals, electronic products and solar photovoltaic (PV) – helped combined production and sales reach INR 20.4 lakh crore, created around 14.4 lakh jobs, and boosted exports to INR 8.3 lakh crore as of December 2025.<sup>2</sup>

**Exhibit 3: Real GDP Growth (in %), Select Emerging Markets<sup>1</sup>, 2018-2031F**



Note: E: estimate; F: forecast; India's data are represented in fiscal years. For e.g. FY2019 is the 12-month period between 1 April 2018 and 31 March 2019 and corresponds to 2018 on the chart; Source: IMF; Frost & Sullivan

**Mexico:** The economy grew by 0.5% in 2025 amid strong performance in the export, automotive, and services sectors. Mexico's average real GDP growth is forecast to rise to 1.9% during the 2026-2031 period, and nominal GDP is expected to reach USD 2.6 trillion by 2031. The North American nation launched new incentives to attract manufacturing investment. Fiscal incentives and tax breaks will be provided to the electronic and electrical equipment, semiconductor, automotive, medical device, and pharmaceutical sectors.

**Vietnam:** Robust domestic consumption and public investment levels along with strong exports will drive real GDP growth to 7.1% in 2026. Nominal GDP will surpass the USD 705 billion by 2031, posting a CAGR of 6.2% in the 2022-2031 period. Vietnam will establish investment funds for high-tech sectors and train 50,000-100,000 engineers by 2030 to expand the availability of a skilled labor force. Under the Power Development Plan 8 (PDP8), Vietnam's renewable energy sector will attract investments worth USD 134.7 billion between 2021 and 2030.<sup>3</sup>

## 1.2 India Macroeconomic Overview

### 1.2.1 India: GDP Growth and Outlook

India's real GDP growth rate rose to 7.7% in FY2026 from 7.1% in FY2025, supported by strong domestic demand, low inflation, and GST and income-tax reforms that boosted consumption. The GST reforms simplified rates to 0%, 5%, 18%, and 40% and reduced taxes on many goods, while the income-tax reforms raised the exemption threshold to INR 1.2 million and increased the standard deduction to INR 75,000. India's FY2026 growth was also supported by strong exports, particularly as US firms brought forward shipments from India ahead of higher US tariffs on Indian exports.

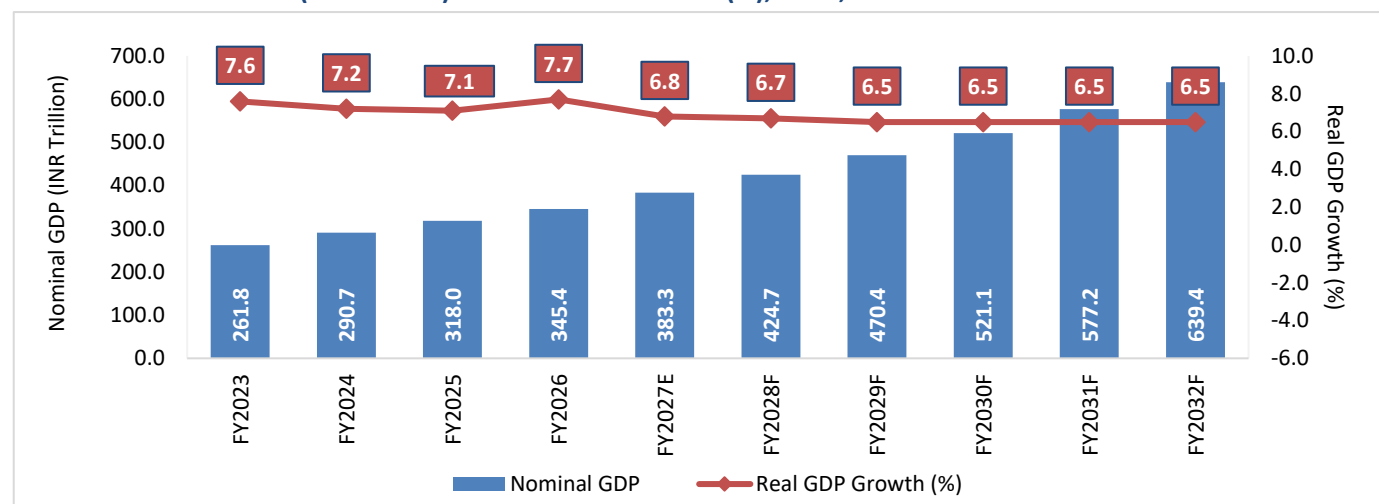
Real GDP growth is projected to moderate to 6.8% in FY2027 as the temporary boost from these reforms fades and elevated global energy prices, amid Middle East supply disruptions, add to inflationary pressures. The moderation also reflects the one-off nature of the consumption boost from the GST reforms and inflationary

<sup>2</sup> Indian Ministry of Commerce and Industry

<sup>3</sup> Vietnam Ministry of Industry and Trade

pressures linked to oil-supply disruptions arising from the US-Iran conflict. In FY2027, growth will continue to be supported by resilient domestic demand and government CAPEX.

**Exhibit 4: Nominal GDP (INR Trillion) and Real GDP Growth (%), India, FY2023-FY2032F**



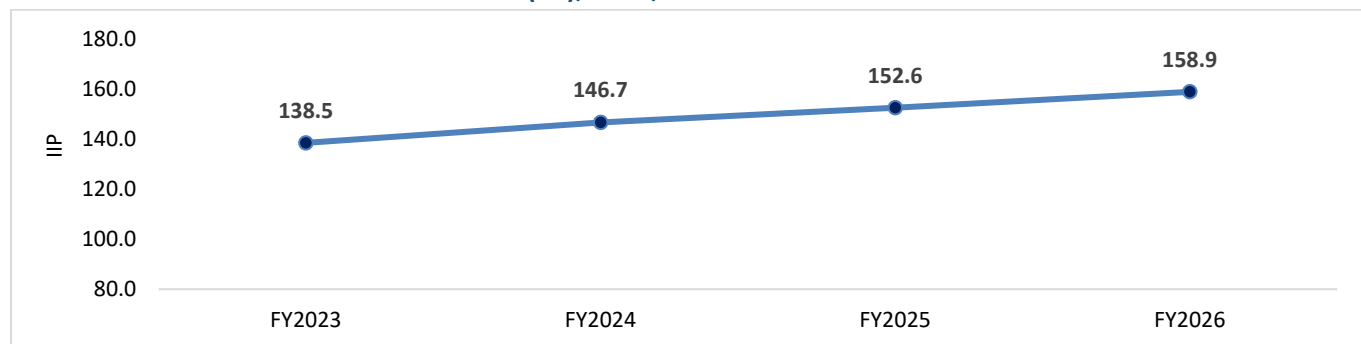
Note: E: Estimate; F: Forecast. Data are presented by fiscal year. For example, FY2023 refers to the period from 1 April 2022 to 31 March 2023.  
Sources: IMF; Ministry of Statistics and Programme Implementation (MOSPI), India; Frost & Sullivan

The 'Make in India' program remains central to India's overall growth story, helping to expand manufacturing and attract global investors. In parallel, the PLI scheme is channeling investment into high-priority sectors such as electronics, pharmaceuticals, and automobiles. Public CAPEX is on a sharp upward trajectory, rising from INR 3.1 trillion in FY2019 to a budgeted INR 12.2 trillion in FY2027, reflecting a CAGR of 18.7%. With a large consumer market, cost-competitive labor, a growing middle class, and ongoing industrial and infrastructure reforms, India, currently the world's sixth-largest economy, is on track to become the third-largest economy globally, surpassing the UK, Japan, and Germany by FY2032 (2031).<sup>4</sup>

### 1.2.2 India: Index of Industrial Production (IIP)

Between FY2023 and FY2026, India's IIP grew at a CAGR of 3.5%, supported by rising domestic demand, government CAPEX, and manufacturing-focused policies, including the Make in India and PLI schemes. Industrial activity remained resilient despite US tariffs imposed in August 2025, supported by strong domestic consumption and export diversification. However, disruptions in the Strait of Hormuz due to the US-Iran conflict are expected to pressure industrial output through higher energy and input costs. Although India's access to the Strait has been restored, continued uncertainty surrounding the conflict could weigh on activity until trade flows fully normalize.

**Exhibit 5: Index of Industrial Production (IIP), India, FY2023-FY2026**



Note: Data are presented by fiscal year. For example, FY2023 refers to the period from 1 April 2022 to 31 March 2023.  
Sources: IMF; MOSPI, India; Frost & Sullivan

Over the longer term, industrial growth is expected to benefit from continued fiscal and infrastructure investment, alongside greater adoption of digitalization, automation, and Industry 4.0 technologies. Improvements in logistics,

<sup>4</sup> IMF

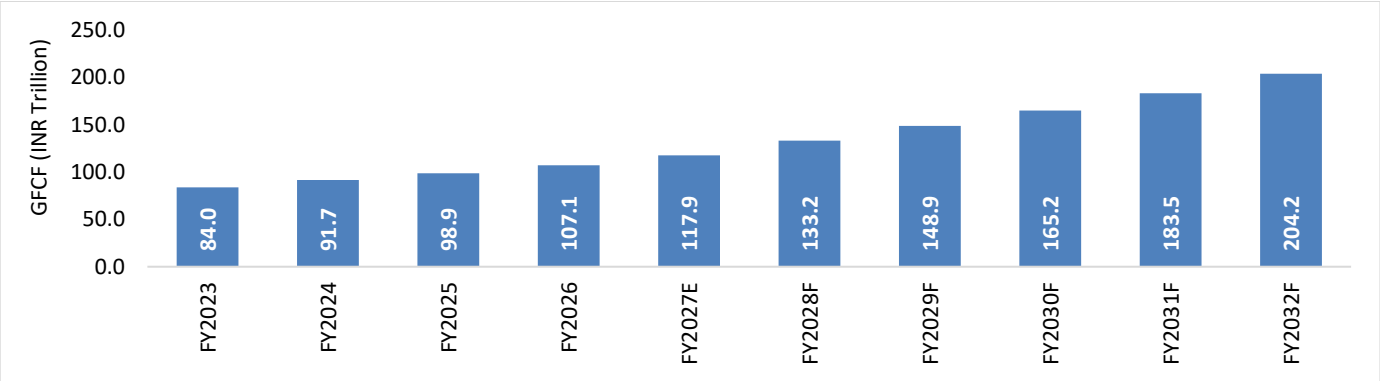
multimodal connectivity, and industrial infrastructure should further enhance productivity and manufacturing competitiveness. Rising investment in renewable energy and sustainable production should also strengthen industrial resilience, supporting sustained growth in industrial output and the IIP through FY2032.

1.2.3 India: Gross Fixed Capital Formation (GFCF)

India’s GFCF has maintained a strong upward trajectory, rising from INR 84.0 trillion in FY2023 to INR 107.1 trillion in FY2026 and projected to reach INR 240.2 trillion by FY2032. GFCF growth is expected to accelerate from a CAGR of 8.4% during FY2023-FY2026 to 11.4% during FY2026-FY2032, supported by continued public- and private-sector investment in infrastructure, manufacturing, and digital connectivity; FDI reforms aimed at improving the ease of doing business; and government CAPEX of INR 12.2 trillion budgeted for FY2027.

Rising GFCF will support demand for industrial components by driving investment in manufacturing, energy, and infrastructure, thereby increasing capacity creation and demand for forgings, rolled rings, precision-machined components, special-alloy components, and other mission-critical engineered components. Investment in manufacturing and logistics will also expand domestic industrial capacity, improve supply-chain efficiency, and strengthen demand for these components across Defense and Aerospace, Energy, Railways, Nuclear, Marine, and heavy equipment.

Exhibit 6: Gross Fixed Capital Formation (GFCF) (INR Trillion), India, FY2023-FY2032F



Note: E: Estimate; F: Forecast. Data are presented by fiscal year. For example, FY2023 refers to the period from 1 April 2022 to 31 March 2023. Sources: IMF; MOSPI, India; Frost & Sullivan

Rising GFCF should support demand for industrial components by driving investment in manufacturing, energy, and infrastructure, thereby increasing capacity creation and demand for forged and machined components. Investment in manufacturing and logistics should also expand domestic industrial capacity, improve supply-chain efficiency, and strengthen demand across sectors such as energy, railways, defense, and heavy equipment.

1.2.4 India: Emergence as the Go-to Manufacturing Destination

**Infrastructure Expansion and Strategic Geographic Positioning:** India benefits from a strategically advantageous location and established maritime connectivity to major markets across Asia, the Middle East, Europe, and Africa. The country has over 200 ports and 137 airports, including 21 international airports and 10 customs airports. India’s major ports handled 915 million tons of cargo, while its airports handled around 3.0 million tons from April to December 2025. Continued government support for infrastructure and logistics development, combined with proximity to key consumer markets, is strengthening India’s attractiveness as a manufacturing and export hub.

**Manufacturing is a Critical Growth Driver:** India has adopted a manufacturing-led growth approach to build a cost-efficient domestic production base, strengthen supply-chain resilience, and expand its export capacity. Policy initiatives such as Make in India, Atmanirbhar Bharat, the Industrial Corridor Development Program, and the PLI schemes will remain central to supporting manufacturing expansion. Increasing localization across Defense and Aerospace, Nuclear Energy, Marine and Shipbuilding, Railways, Energy, and Heavy Engineering is further creating opportunities for domestic component manufacturers. In defense, 75% of the capital acquisition budget, amounting to INR 1.39 lakh crore, has been earmarked for procurement from domestic industries in FY2027. Moreover, the Nuclear Energy Mission targets 100 gigawatts (GW) of capacity by 2047 and at least five indigenous

small modular reactors (SMRs) by 2033. The Government is also strengthening high-precision manufacturing through proposed Hi-Tech Tool Rooms for localized design, testing, and manufacturing of precision components. These initiatives will accelerate import substitution, strengthen domestic supply chains, and support the development of high-value, precision-engineered components.

**Demographic Dividend and Competitive Labor Costs:** India's large and growing young, working-age population continues to be a key driver of manufacturing growth. In 2024, India's median age was 28.8 years, much lower than China's 40.1 years and Vietnam's 33.4 years. Higher fertility rates are also expected to support the expansion of the young and working-age population, with the share of people aged 15-59 projected to rise to over 65.1% by 2030, up from 61.4% in 2011. India's labor force reached 617.6 million in 2025, far exceeding those of peer economies such as Bangladesh, at 74.7 million, and Vietnam, at 57.0 million. Although China's labor force was larger at 767.6 million in 2025, its rapidly aging and declining population limits future labor availability. Beyond labor availability and cost competitiveness, India's expanding engineering and technical talent base, manufacturing-skills ecosystem and growing capabilities in advanced manufacturing are supporting the production of increasingly complex, high-value components. Government initiatives are also strengthening industry-oriented skills in advanced manufacturing, engineering and precision technologies, supporting the development of a deeper domestic manufacturing ecosystem.

**Foreign-Exchange Stability Measures:** The Reserve Bank of India (RBI) continues to use foreign-exchange intervention and reserve management to contain excessive rupee volatility. Foreign exchange reserves rose from USD 668 billion at end-March 2025 to USD 701.4 billion as of 16 January 2026, providing around 11 months of import cover; reserves stood at USD 675.2 billion as of 10 July 2026. In June 2026, the RBI also introduced a USD-INR swap facility that had mobilized USD 73 billion in foreign-currency inflows by August 2026, strengthening external liquidity and reserve buffers. These measures should provide greater exchange rate stability and predictability for exporters while allowing the rupee to remain market determined.

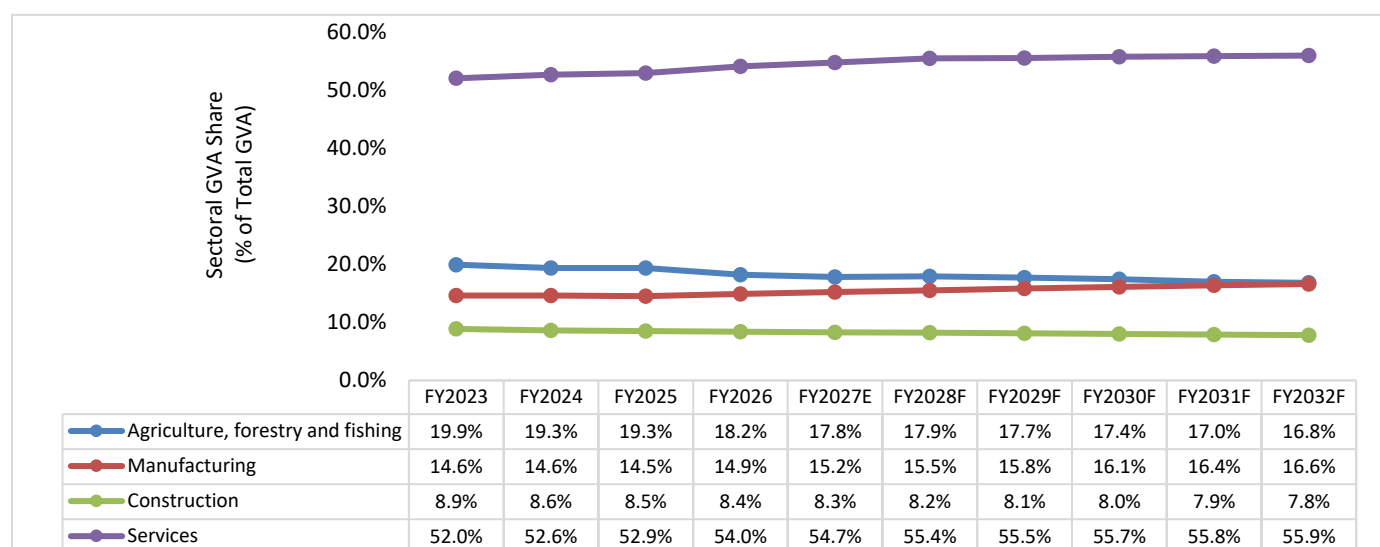
**RBI Regulatory Reforms Supporting Trade Facilitation:** In August 2025, the RBI announced that authorized dealer banks would no longer require prior approval to open Special Rupee Vostro Accounts (SRVAs), which facilitate trade settlement for domestic importers and exporters. The move is expected to streamline cross-border transactions and improve import and export timelines by reducing regulatory bottlenecks. It also forms part of the RBI's broader initiative to promote the use of the Indian rupee in international trade settlements. The Foreign Exchange Management (Export and Import of Goods and Services) Regulations, 2026, introduced in January 2026, further streamlined the regulatory framework for cross-border trade. These measures are expected to facilitate INR-based trade settlement, reduce exchange-rate exposure for exporters and importers, and support the broader internationalization of the Indian rupee.

**Promising Export Potential:** India is targeting USD 2 trillion in total exports by 2030-31, comprising USD 1 trillion each from merchandise and services. The Export Promotion Mission, alongside an expanding network of foreign trade agreements (FTA), is expected to support market diversification, trade finance, export compliance, and access to overseas markets. Continued improvements in multimodal logistics and digital trade infrastructure will further strengthen cost competitiveness and ease of doing business for exporters.

### 1.2.5 India: Sectoral Gross Value Added (GVA) Share

The contribution of agriculture, forestry, and fishing to India's GVA is expected to decline from 19.9% in FY2023 to 16.8% by FY2032, reflecting the economy's gradual transition toward industry- and services-driven growth. As economic development progresses, the services sector is expected to continue expanding, supported by higher private investment, increasing digital adoption, broader financial inclusion, and growth in knowledge-intensive industries.

**Exhibit 7: Sectoral GVA Share (% of Total GVA), India, FY2023-FY2032F**



Note: E: Estimate; F: Forecast. Services include transport, storage, communication and broadcasting-related services; financial services; real estate, ownership of dwellings and professional services; and other services. The shares do not sum to 100% because the chart includes only manufacturing and construction from the industry segment. Data are presented by fiscal year. For example, FY2023 refers to the period from 1 April 2022 to 31 March 2023.

Sources: IMF; MOSPI, India; Frost & Sullivan

Manufacturing subsectors are expected to strengthen their role as long-term growth drivers, supported by policy support, robust domestic consumption, rising investment activity, growing export capabilities, and India's strategic emphasis on self-reliance amid changing global supply chains. Manufacturing GVA is poised to rise from 14.9% in FY2026 to 16.6% in FY2032. Improvements in logistics infrastructure and manufacturing cost competitiveness are also enhancing India's position in higher-value-added manufacturing segments. While global trade uncertainty may weigh on exports in the near term, ongoing supply-chain diversification is encouraging global manufacturers to expand sourcing from India. This is supporting investment in domestic production of non-automotive forged and machined components for critical end markets such as Defense & Aerospace, Nuclear Energy, Marine & Shipbuilding, Railways, Energy, and Heavy Engineering.

The services sector is likely to remain the largest contributor to GVA, driven by rapid digital transformation, increasing adoption of emerging technologies and Industry 5.0 applications, and India's strengthening position in global knowledge-based services. Its share of GVA is expected to rise from 52.0% in FY2023 to 55.9% by FY2032, further establishing services and manufacturing as the key pillars of India's long-term economic expansion.

The construction sector's share of GVA is projected to fall from 8.9% in FY2023 to 7.8% by FY2032 because faster growth in higher-productivity services and manufacturing will gradually reduce construction's relative contribution to overall GVA.



### Global & India Non-Automotive Forging Market

## 2 Market Overview: Global & India

### 2.1 Product Overview & Types

- **Forging:** A manufacturing process that involves shaping and forming metal using compressive forces is called forging. In this process, a metal is shaped through hammering, pressing, or rolling. A hammer or die is used to impart compressive forces on the metal. Carbon, alloy, and stainless steel are frequently used in forging. Aluminum, brass, and copper, which are very soft metals, can also be forged. The method can produce parts in large quantities and can be used to induce desired mechanical properties to the finished product. Typically forging are of four types closed die, open die, ring rolling and radial forging.
- **Closed die Forging:** It is a forging process in which dies move towards each other and cover the workpiece in whole or in part. The heated raw material, which is approximately the shape or size of the final forged part, is placed in the bottom die. The shape of the forging is incorporated in the top or bottom die as a negative image.
- **Open Die Forging:** Open die forging is the process of deforming a piece of metal between multiple dies that do not completely enclose the material. The metal is altered as the die's "hammer" or "stamp" the material through a series of movements until the desired shape is achieved. Products formed through open forging often need secondary machining and refining to achieve the tolerances required for the finished specifications. Open die forging is widely used for the products in small quantity that are simple, rather than complex, such as discs, rings, sleeves, cylinders and shafts. Custom shapes can also be produced with open die forging.
- **Ring Rolling:** Ring Rolled forging is a metal shaping process involving extreme pressure and heat to form seamless circular rings. This technique results in products with superior strength, enhanced grain structure, and better fatigue resistance compared to other manufacturing methods. It is commonly used in the aerospace, automotive, and energy industries for producing high-quality components such as gears, bearings, flanges, and shafts. Unlike traditional machining processes, rolled ring forging allows to produce complex shapes with minimal material waste. In addition to its durability and versatility, this technique offers cost-effectiveness due to its ability to produce large quantities faster than other methods.
- **Radial Forging:** Forging process where the workpiece is subjected to repeated press strokes from several dies mounted around the axis of the workpiece. Several dies usually between two to four are mounted on workpiece linear axis. Each die is radially shaped so that they together form a circular cross section. The workpiece, usually a rod of a reasonably round shape, is heated up and rotated through the dies that through repetitive blows mold workpiece. This way rod is transformed into a circular cross section of predetermined diameter.

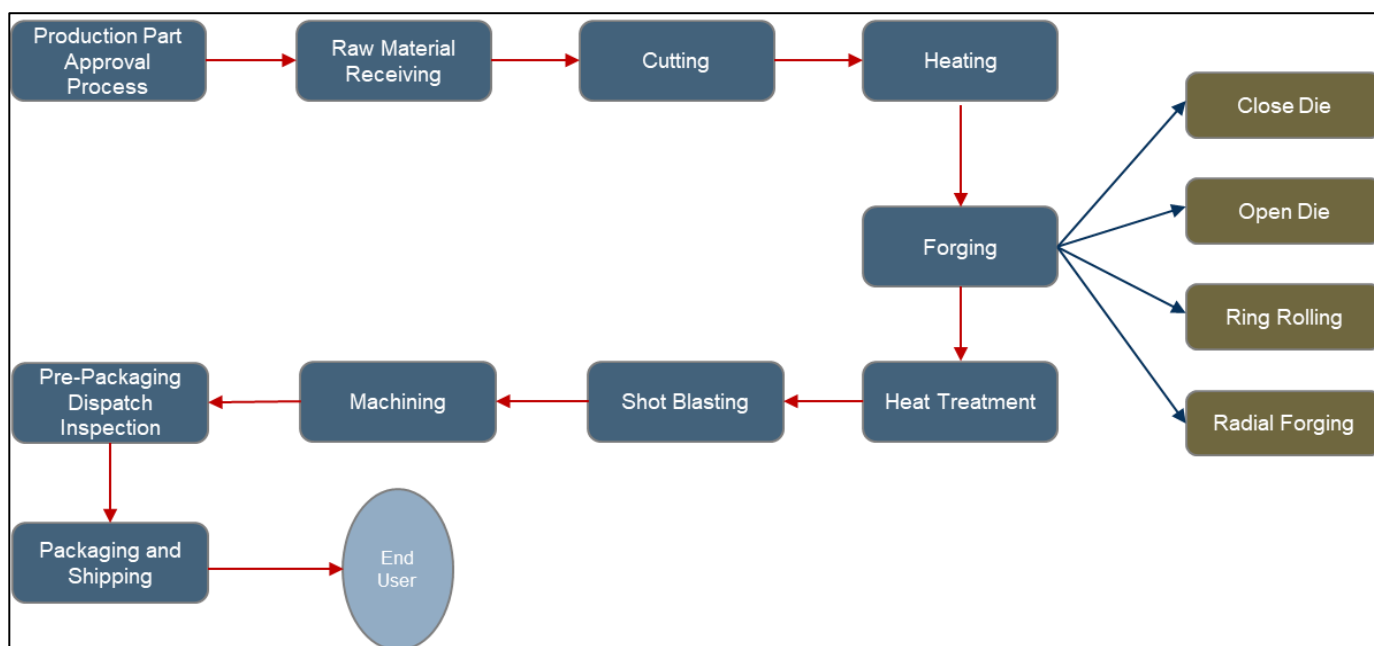
## 2.2 Production Process: Forging

Production of forging parts undergoes a series of operations starting from production part approval, raw material purchase and receiving from the supplier, cutting and sizing it to the desired shape and dimensions to actual forging taking place based on the application and function of the product, forging type is selected whether closed die, open die, ring rolling or radial forging.

General production process flow of the forging is as follows:

- **Production Part Approval Process:** At this stage design of the produced parts is finalized along with the designed mechanical properties and appropriate manufacturing process, grades of the raw materials used are decided keeping in view the economics of the produced parts.
- **Raw Material Procurement, Receiving and Quality Inspection:** Raw material is received from registered suppliers or procured directly. The quality of raw material is inspected with spectrometric and microscope testing facilities either within the plant or from outside testing facilities for proper grade and quality testing.
- **Raw Material Cutting:** At this stage raw material is cut on bandsaw machine and/or shearing machine in the form of billets as per weight required for forged job in desired length.
- **Raw material heating:** The billets are heated in furnaces or in an induction billet heater up to a certain temperature depending on the metal and its grades. It is heated to 1,200–1,270 °C in case of different grades of steel.
- **Forging:** The heated billets are removed one by one from the furnace and placed in hammer for forging. The heated billet is forged in desired shape in one or number of strokes in the hammer. Different forging types could be selected such as closed die, open die, ring rolling, and radial forging based on the application and functionality of the developed product. Also, some units use presses for forging products. Trimming/coining presses are used for removing extra material on the forged job. Visual Inspection, Dimension Check, Nondestructive Evaluation (NDE) or Non-Destructive Testing (NDT) are performed if required.
- **Heat Treatment:** Heat treatment is done on the forged part to obtain the desired properties such as the relieving of internal stresses, the refinement of grain structure, and the attainment of improved mechanical and physical properties. For machinability annealing, normalization, tempering, process annealing, spheroidized or full annealing is performed as per the requirements then quenching and tempering is done to achieve the final properties.
- **Shot Blasting:** After Heat treatment Shot, Blasting is performed to obtain excellent cleaning and surface preparation for secondary finishing operations on the forged part. This process is a highly effective solution for removing contamination on metal substrates or changing the coarseness or smoothness of a surface before coating.
- **Machining:** Forging machining is a manufacturing method that involves cleaning up a metal part to the precise dimensions as per the end user requirements. The finished product is a loosely formed part because of the forging operation. For specific applications, specific dimensions and shapes are needed, which are achieved through machining process. During the machining process, the part is mastered using a range of methods and techniques. Digging, scraping, grinding, milling, and turning tools are suitable for this process.
- **Pre-Packaging Dispatch Inspection:** Final inspection of jobs is done with respect to the dimensions and quality of the product at this stage.
- **Packing and shipping:** Once the product is tested by the quality department then it reaches packing and shipping section for suitable packaging and then shipping section from where it will be sent to the different end users from oil and gas, aerospace and defence, railways, earthmoving, energy and other general engineering sectors.

## Exhibit 8: High Level Forging Production Process Flow



Source: Industry Sources

## 2.3 End Use Sector Wise Key Forging Products

### Exhibit 9: End Use segment wise key products

| End Use Segments                         | Key Products                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Energy</b>                            | Valve body, Gates, Studded Tee, Crosses, Rings, Slip Bowls, Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Valve Casing, Y Block, Flanges, Tube Sheet, Clad Body Valves, Hatch Cover, Bonnet, Frame, Coupling hub, clamp, body, adapters, flange, caps, blocks, Rings, Profile Rings, Round Bar, Spring Plate, Rotor-Pole End Plate, Planet Bucket Ring, Gear Blank, Cross Head, Connect Flange, T Block, Hydro Shaft, Generator Shaft, Crosshead pin, Turbine Shaft, Parts of valve bodies, gate, stem, seat ring, |
| <b>Energy Turbines</b>                   | Rotor Shafts, Gear Box, Low and high-speed drive shafts, Hubs, Turbine discs, Forged bar used in drilling for steam to blades for turbines                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Aerospace</b>                         | Air foils, Unison Rings, Arm Levers, Compressor, Mount, Plate Butterfly, Guide, Poppet, Tees and Elbow Connecting Rod, Road Wheel Arm, Integral Axle arm, Cam shaft, Flange, Caps, Blocks, Rings, Profile Rings and Seamless Rings, Hot Gas Parts, Cam plates, Throttle levers, Mounting flanges, Under carriage Bracketry, Under Carriage Pintles, Regulator Heads, Bearer Beams, Actuator Bodies, Rudder Pedals, Valve bodies, Toggles, Links                                                                                        |
| <b>Defence</b>                           | Crank shaft, Breach Base, Carrier, Crank, Driven Gear, Extractor Lower, Flange, Shoe, Intermediate Gear, Roadwheel Arm, Gear Ring, Planet Wheel, Shoe, Track Link, Sun Gear, Clamp, Handle, Collar, Stopper, Flange, Cam                                                                                                                                                                                                                                                                                                               |
| <b>Mining and Construction Equipment</b> | Rod Eyes, Caps, Trunnions, Spindles, Cam Shafts, Track rollers, teeth's ball stud, Arm Steering, Arm Centre, Rod Head, Caps, Vertical Shafts, Idler Rims, Support Rings, Profile Rings                                                                                                                                                                                                                                                                                                                                                 |
| <b>Railways</b>                          | Gears, Pinions, Couplings, shafts and cylinder heads, Gear Blanks, Pinions and Shafts, Rings, Profile Rings, Bearing Cap, Bevel Pinions, Yoke Forgings, Bush, Connecting Rod, Camshaft                                                                                                                                                                                                                                                                                                                                                 |

|                              |                                                                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Marine &amp; Shipping</b> | Propulsion shafts, Intermediate shafts, Tail shafts, rudder shafts, Propeller hubs, Bearing housings,                           |
| <b>Others</b>                | Sprocket, Spacer Plates, Yokes, Chain links, Shafts, Spindles, Flanges, Tie rods, Universal joints, Steel Structures, Fasteners |

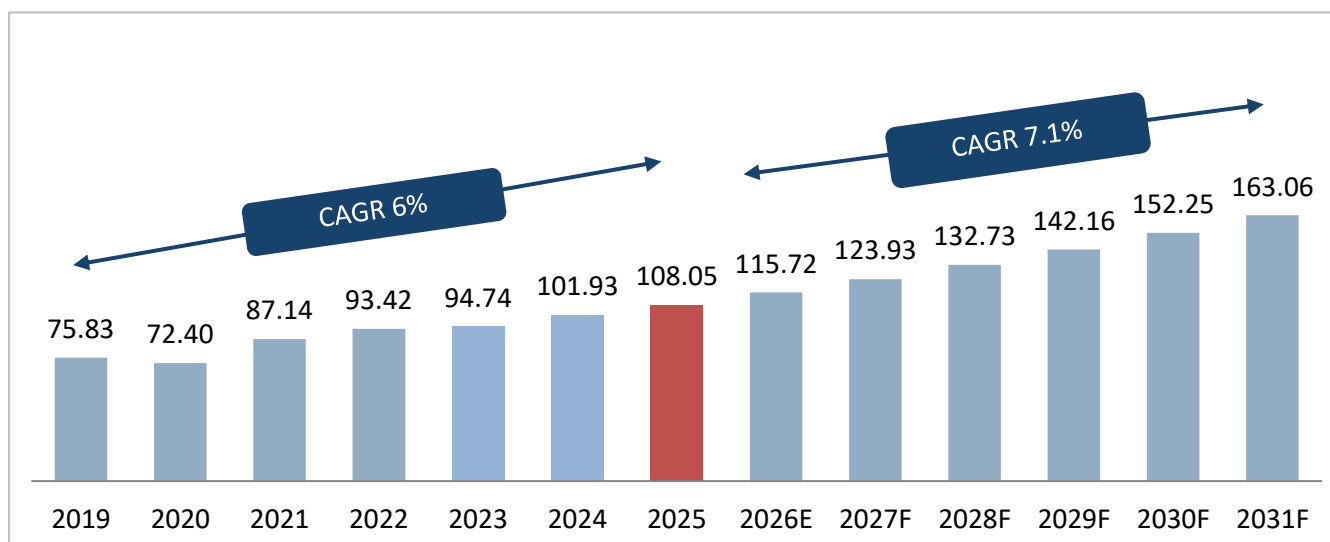
## 2.3 Overview of Global Forging Market

The Global Overall Forging Market is valued at **USD 108.05 Bn in CY 2025**.

- Automotive sector contributes **64% (USD 69.15 Bn)** to the overall global forging demand while remaining **36% (USD 38.90 Bn)** is contributed by the non-automotive sectors such as oil and gas and energy, aerospace and defence, nuclear, mining and construction equipment, railways and other general engineering sectors.

### 2.3.1 Market Size Estimates and Forecasts for Overall Global Forging Market

**Exhibit 10: Global Overall Forging Market Forecast Year CY 2019–2031, USD Bn**



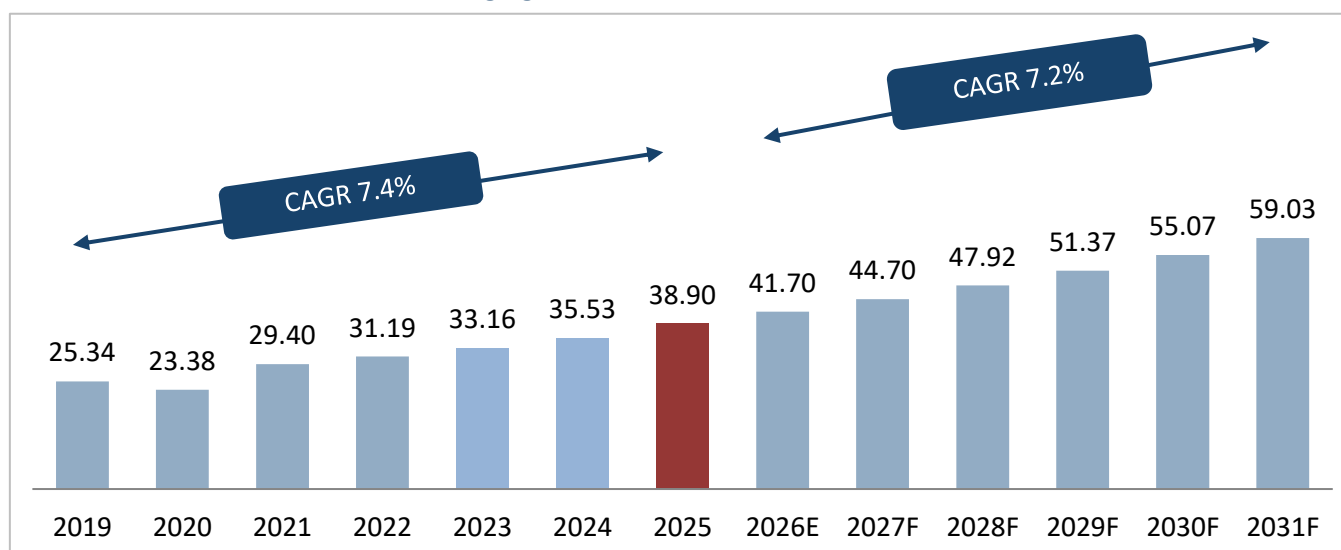
Source: Frost & Sullivan Analysis

The base year is CY 2025, E-Estimated, F-Forecasted

- Overall Global Forging Market was valued at **USD 108.05 Bn in 2025** and is estimated to grow to **USD 163.06 Bn by 2031** at a CAGR of **7.1%** from **2026 to 2030** driven ~**64%** by automotive sector where forged parts such as connecting rods, crankshaft, pistons, injectors, camshafts, chassis parts such as bearings, gears and axles are widely used and remaining **36%** by the growing demand from non-automotive end use sectors such as energy, energy turbines, aerospace and defence, Mining and Construction Equipment, railways and others.
- Historically in 2019 the overall global forging market was valued at **USD 75.83 Bn** and had grown with a CAGR of **6%** till 2025. The global economy was severely impacted by the COVID-19 pandemic. Due to the pandemic, economic activity had drastically decreased, which had a negative demand shock effect on the global forging market.
- In 2020 global overall forging market was valued at **USD 72.40 Bn** and experienced a downfall of **4.5%** from 2019 due to impact of Covid-19 restrictions imposed in movements and transportations. However, as the market started recovering from the pandemic the demand again accelerated and marked **USD 87.14 Bn** in 2021.

## 2.3.2 Market Size Estimates and Forecasts for Non-Automotive Global Forging Market

Exhibit 11: Global Non-Automotive Forging Market Forecast, CY 2019–2031, USD Bn



Source: Frost & Sullivan Analysis

The base year is CY 2025 E-E-Estimated, F-Forecasted

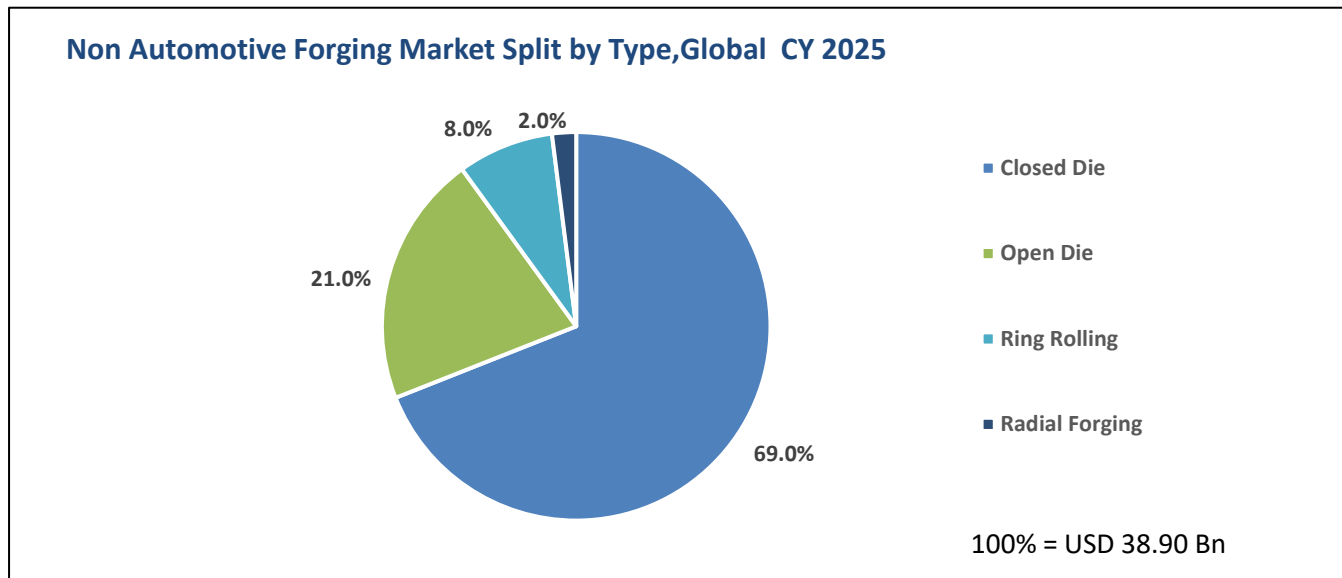
- Historically in 2019 the global non-automotive forging market was valued at **USD 25.34 Bn** and had grown with a CAGR of **7.4%** till 2025 and have marked USD 38.90 Bn market value sustained by the impact of pandemic COVID-19. The global economy was severely impacted by the COVID-19 Pandemic. Due to the pandemic, economic activity has drastically decreased, which had a negative demand shock effect on the global non-automotive forging market.
- In 2020 global non-automotive forging market was valued at **USD 23.38 Bn** and experienced a downfall of **7.73%** due to restrictions imposed in movements and transportation during COVID-19 period. However, as the market started recovering from the pandemic the demand again accelerated and marked **USD 29.4 Bn** in 2021 with a growth of **25.75%** from the previous year.
- Global non-automotive forging market was valued at **USD 38.90 Bn in 2025** which accounts for **36%** of the overall forgings demand and is estimated to grow to **USD 59.03 Bn** by 2031 at a **CAGR of 7.2%** from 2025 to 2031 driven mainly by growth of demand from non-automotive end use sectors such as oil and gas and energy, aerospace and defence, nuclear, mining and construction equipment, railways and other miscellaneous sectors.
- Non-automotive forged parts include valve body, gates, studed Tee, crosses, plate butterfly, guide, poppet, Tees, rod eyes, caps, trunnions, spindles, gears, pinions, couplings, coupling hub, clamp, body, adapters and flanges. China was the leader in this niche segment of forging and witnessed **32% global** forging demand, followed by **Europe (17%), North America (16%), Rest of Asia (excluding China and India) (12%), India (6%), Middle East (1%) and Rest of the world (16%)**. Closed die Forging is the most widely used forging type globally.

## 2.3.3 Global Non -Automotive Forging Market Size by Type & Segment (Open Die, Closed die, Ring Forging and Radial Forging)

- Evolving from ancient blacksmithing techniques to modern, highly sophisticated methods, metal forging continues to play a vital role in producing strong and durable components essential for various industries. The demand for advanced, high-strength components across industries is propelling the metal forging market.

- Maintaining and enhancing reliability in metal forging plants is crucial, requiring regular equipment checks, preventive maintenance programs, and adherence to established safety standards. Globally typical forging types used are closed die forging, open die forging, ring rolling and radial forging.
- Out of the total non-automotive forgings demand Globally, **70% (USD 27.23 Bn)** is met through closed die forging, **20% (USD 7.78 Bn)** by open die forging, **8% ring rolling (USD 3.1 Bn)** and remaining 2% (USD 0.78) by radial forging.
- The major demand driver of forging is economic growth and massive investment in infrastructure, oil gas and focus on aerospace & defence sector across the Globe.

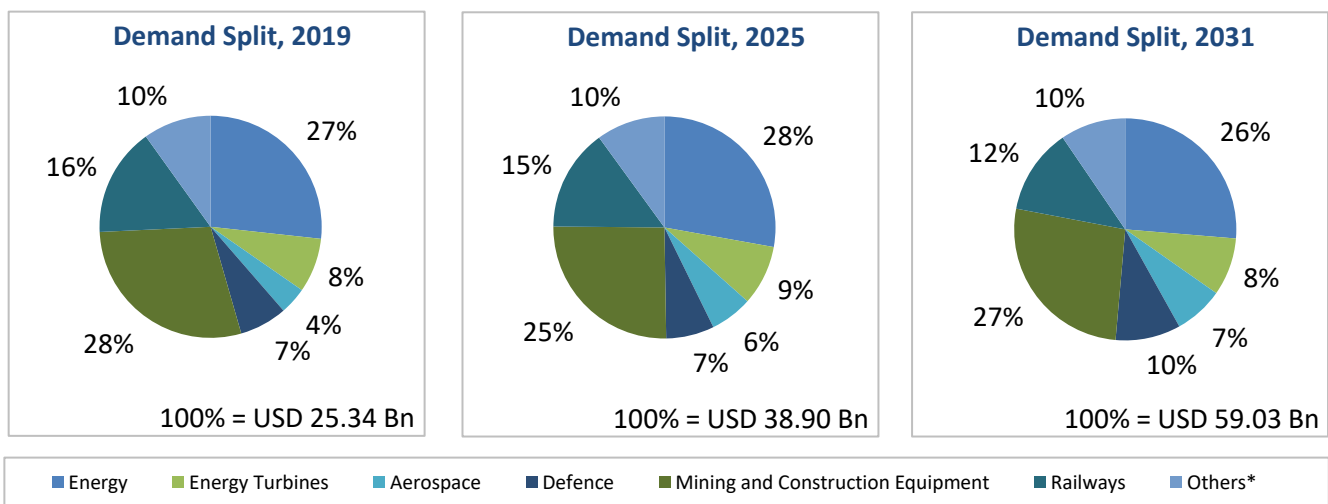
**Exhibit 12: Global Non-Automotive Forging Market Split by Type, CY 2025**



Source: Frost & Sullivan Analysis

### 2.3.4 Global Non-Automotive Forging Market Demand by End Use Industries

**Exhibit 13: Demand Split by End-use segment, USD Bn, CY 2019-31**



Others\* include any general engineering segment such as Marine & Shipping and Agricultural equipment

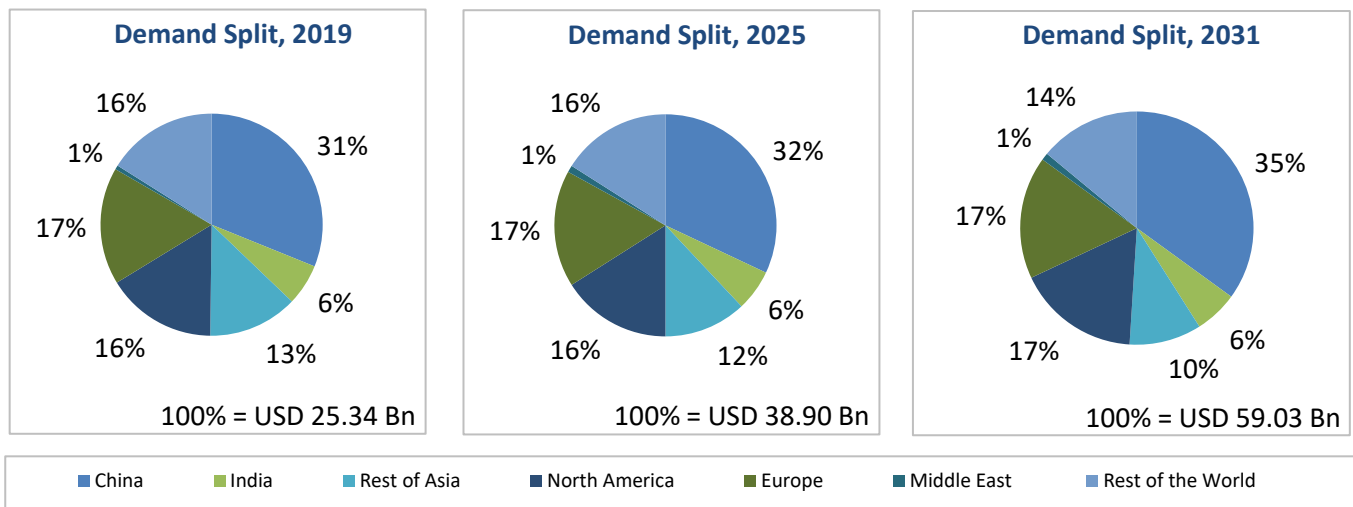
Source: Frost & Sullivan Analysis

**Exhibit 14: Non-Auto Global Forging Market End-use segment wise growth rate, CY 2019-31**

| Year/CAGR Growth | Energy | Energy Turbines | Aerospace | Defence | Mining and Construction Equipment | Railway | Others* |
|------------------|--------|-----------------|-----------|---------|-----------------------------------|---------|---------|
| <b>2019-2025</b> | 8.3%   | 10.2%           | 15.5%     | 7.4%    | 5%                                | 6.1%    | 7.5%    |
| <b>2025-2031</b> | 6.2%   | 6.5%            | 9.9%      | 12.8%   | 8%                                | 4.1%    | 6.2%    |

### 2.3.5 Global Non-Automotive Forging Market Demand by Geography

**Exhibit 15: Demand Split by Geography, USD Bn, CY 2019-31**



Rest of Asia includes all Asian nations excluding China and India

Source: Frost & Sullivan Analysis

Rest of the world include other global nations such as Russia, Australia, African nations and South American nations

**Exhibit 16: Non-Auto Global Forging Market Geography wise growth rate, CY 2019-30**

| Year/CAGR Growth | North America | Europe | Middle East | China | India | Rest of Asia | Rest of the World |
|------------------|---------------|--------|-------------|-------|-------|--------------|-------------------|
| <b>2019-2025</b> | 7.4%          | 7.4%   | 7.4%        | 7.7%  | 8.8%  | 6.0%         | 7.4%              |
| <b>2025-2031</b> | 8.3%          | 6.7%   | 5.3%        | 8.8%  | 7.2%  | 4.0%         | 5.5%              |

- North America and Europe have a well-established market for forged parts due to a mature industrial base.
- China and India are witnessing significant growth in this niche forging market due to rapid industrialization and increasing investments in infrastructure projects.
- Key demand contributors were **China (32%), Europe (17%), North America (16%), India (6%), Rest of Asia (12%), Middle East (1%) and rest of the world (16%)** in 2025.
- India accounts to 6% of the Global share and are largest in Asia after China

## North America:

- The North American non-automotive forging market was valued at **USD 6.22 Bn in CY 2025** and accounts for **16%** of the global non-automotive forging demand and is estimated to reach **USD 10.04 Bn by CY 2031** with a growth rate of **8.3% from CY 2025 to CY 2031**.
- Highly competitive, market is committed towards the adoption of strategic initiatives, such as capacity expansion, product launches, and mergers & acquisitions, to strengthen their presence and position in the industry. North America is among the largest consumers of forged parts due to high product demand from aerospace and defence, oil & gas, energy and construction sectors.
- Further, industry-wide collaborations and joint efforts between forging firms, suppliers, universities, and government laboratories are expected to enable it to leverage its resources in advanced technology implementation and production and implementation.
- Growing use of forged steel in various non-automotive sectors and developments in forging equipment & process are the major factor driving the growth of the North America forging market.
- Key forging manufacturers in this region are **Scot Forge, Ellwood Group, Bharat Forge, Forge Resources Group, Aichi Forge, North American Forgemasters, Trenton Forging, FRISA & HHI Forgings**.
- **Hydraulic fracturing**, propelling the US to become the world's largest producer of oil and natural gas.
- The continued focus on expanding domestic oil and gas production, particularly through increased fracking activity in North America, is expected to support demand for forged components. As drilling and exploration activity expands and more drilling rigs become operational, demand for high-strength forged components used across drilling equipment and associated oilfield applications is likely to increase

## Europe:

- The European non-automotive forging market was valued at **USD 6.61 Bn in CY 2025** and is estimated to reach **USD 9.74 Bn by CY 2031** with a growth rate of **6.7%** from CY 2025 to CY 2031.
- With industries adopting advanced technologies, the Europe Metal forging market is experiencing substantial growth.
- The application of innovative solutions is driving improvements in efficiency and effectiveness. Companies are investing heavily in research and development to maintain a competitive edge and address evolving market requirements.
- This emphasis on technological advancement is anticipated to propel market expansion and create new opportunities. The Europe metal forging market offers promising prospects for continued growth and development.
- The metal forging market is expanding rapidly as industry leaders capitalize on the region's emphasis on innovation and sustainability. Key players are increasingly focusing on developing solutions that cater to the unique needs of European consumers, fostering a highly competitive landscape.
- The market is supported by favorable government policies and substantial investments in technology. As Europe continues to prioritize digitalization and eco-friendly practices, the metal forging market is set to benefit significantly.
- Although there are obstacles such as regulatory compliance and market saturation, the overall trajectory points towards sustained growth and new opportunities. Germany, France and United Kingdom are the top three forging producing nations in the European union and closed die forging is the most preferred

forging type in the region. As France Aerospace hub in Europe, it is driving the forging demand from the Aerospace segment in Europe.

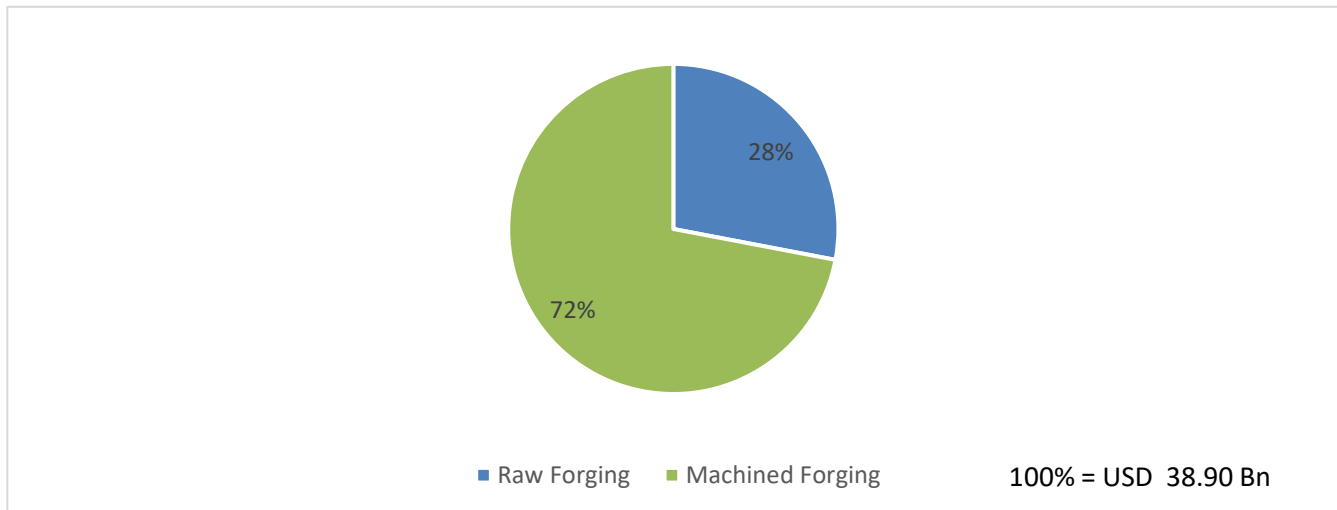
- Key forging manufacturers in Europe are **Precision Castparts Corp. (PCC), Scot Forge, Farinia Group, Otto Fuchs Kg, Lucchini RS, Bharat Forge and Siderforgerossi Group.**

### Middle East

- Middle East non-automotive forging market was valued at **USD 0.39 Bn in CY 2025** and is estimated to reach **USD 0.53 Bn by 2031** with a growth rate of **5.3% from CY 2025 to CY 2031.**
- Metal forgings market in the Middle East region is driven by the increasing use of forged components in oil and gas, industrial machinery and construction applications. Growing automotive aftermarket and easy availability of raw materials (aluminium and steel) are likely to boost metal forgings market. The Middle East region is the world leader in crude oil production.
- Many major countries of the region are dependent on oil business, such as Saudi Arabia, Kuwait, Oman, Bahrain, UAE and Iran. Forged components are used in assemblies of rotary drilling machinery & equipment, field production, and drilling rigs. Carbon steel, alloy steel, aluminium, magnesium, stainless steel, titanium etc are the key materials driving the forging market in the middle east region.
- Key forging manufacturers in the Middle East region are **Steel Forgings Gulf FZC, CD Industries, Precision Metal Industries FZC, ULMA Forja and Galperti Group.**

### 2.3.6 Global Non-Automotive Demand by Raw Forging and Precision Machined Forging

**Exhibit 17: Non-Automotive Demand Split by Raw Forging and Precision Machined Forging, Global CY 2025**

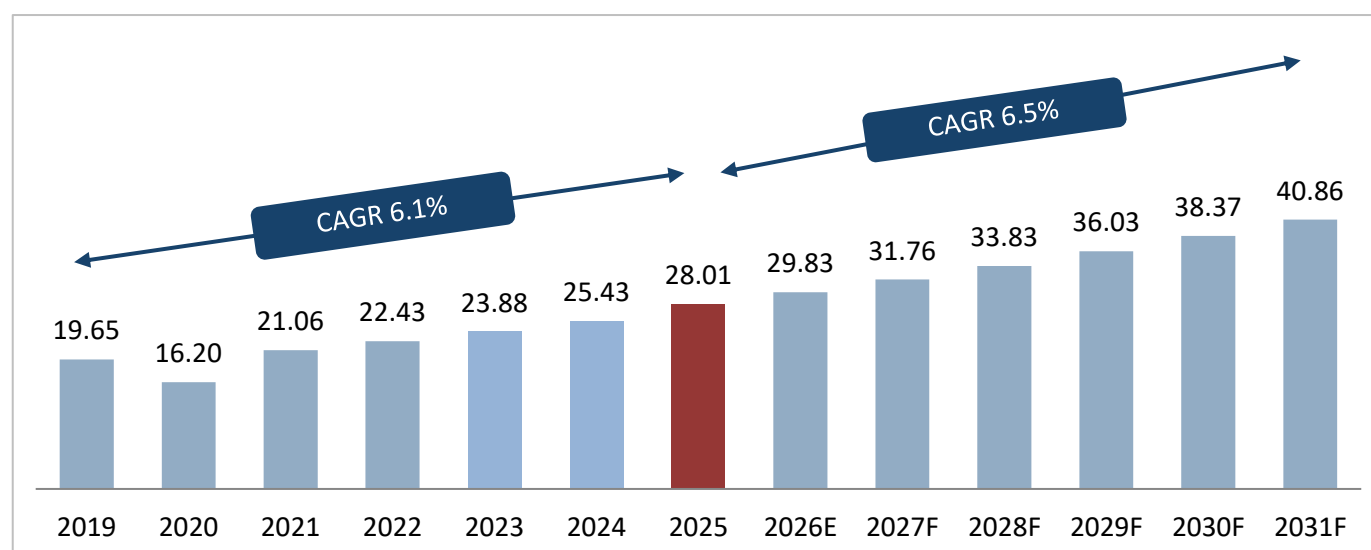


*Source: Frost & Sullivan Primary Research and Analysis*

- Non-Automotive Forging Market was valued at **USD 38.90 Bn** in CY 2025, out of which machined forging is the major contributor with **72% (USD 28.01 Bn)** and used for high precision and close dimensional tolerances becomes crucial while volume wise raw forging is huge but in terms of value raw forgings contribute **28% (USD 10.89 Bn)** to the total market demand and finds applications where high tolerance is not required.

## 2.3.7 Global Non-Automotive Precision Machined Forging Demand Historic Trend and Market Forecast, CY 2019-31

Exhibit 18: Global Non-Automotive Precision Machined Forging Market Forecast, CY 2019-31, USD Bn



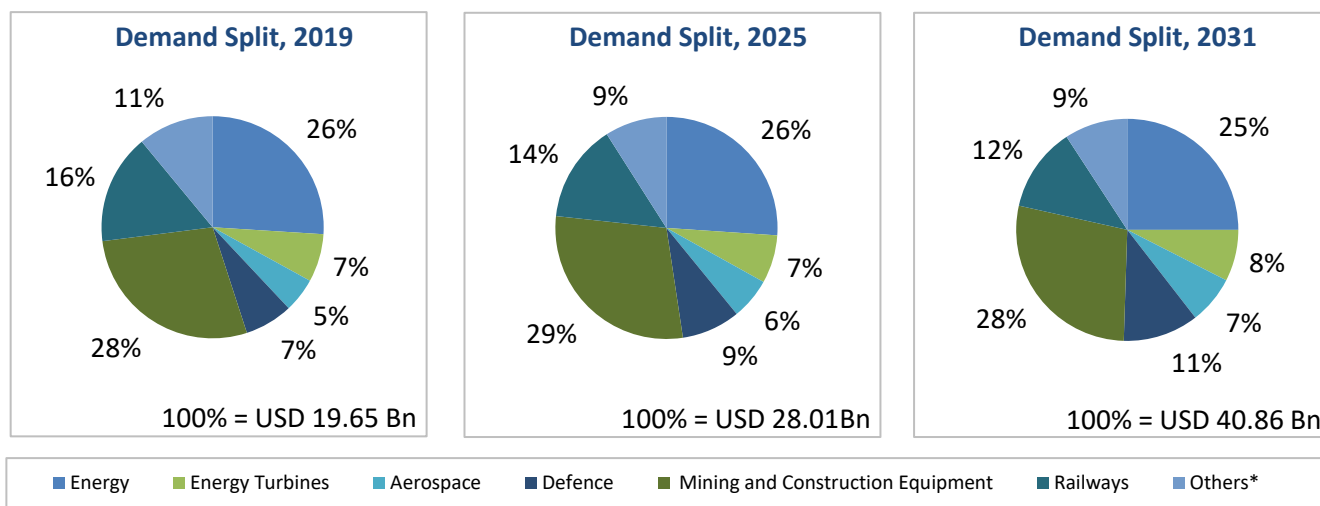
Source: Frost & Sullivan Primary Research and Analysis

E-Estimated, F-Forecasted

- Historically in 2019 the global non-automotive precision machined forging market was valued at **USD 19.65 Bn** and had grown with a CAGR of **6.1%** till 2025 and have marked **USD 28.01 Bn** market value.
- The Global economy was severely impacted by the COVID-19 Pandemic. Due to the pandemic, economic activity had drastically decreased, which had a negative demand shock effect on the global non-automotive forging market.
- In 2020 it was valued at **USD 16.20 Bn** and experienced a downfall of **17.56%** due to restrictions imposed in movements and transportations during COVID-19 period. However, as the market started recovering from the pandemic the demand again accelerated and marked **USD 21.06 Bn** in 2021 with a growth of **30%** from the previous year.
- Global Non-Automotive Precision Machined Forging Market was valued at **USD 28.01 Bn** in 2025 which accounts for **72%** of the overall forgings demand and is estimated to grow to **USD 40.86 Bn** by **2031** at a CAGR of **6.5%** from 2025 to 2031 driven mainly by growth of demand from non-automotive end use sectors such as Oil and Gas and Energy, Nuclear, Aerospace and Defence, Mining and Construction Equipment, Marine and Shipping and Railways and other miscellaneous applications.

## 2.3.8 Global Non-Automotive Precision Machined Forging Market Demand by End Use Industries

Exhibit 19: Demand Split by End-use segment, USD Bn, CY 2019-31



Others\* include any general engineering segment such as Marine & Shipping and Agricultural equipment,  
Source: Frost & Sullivan Analysis

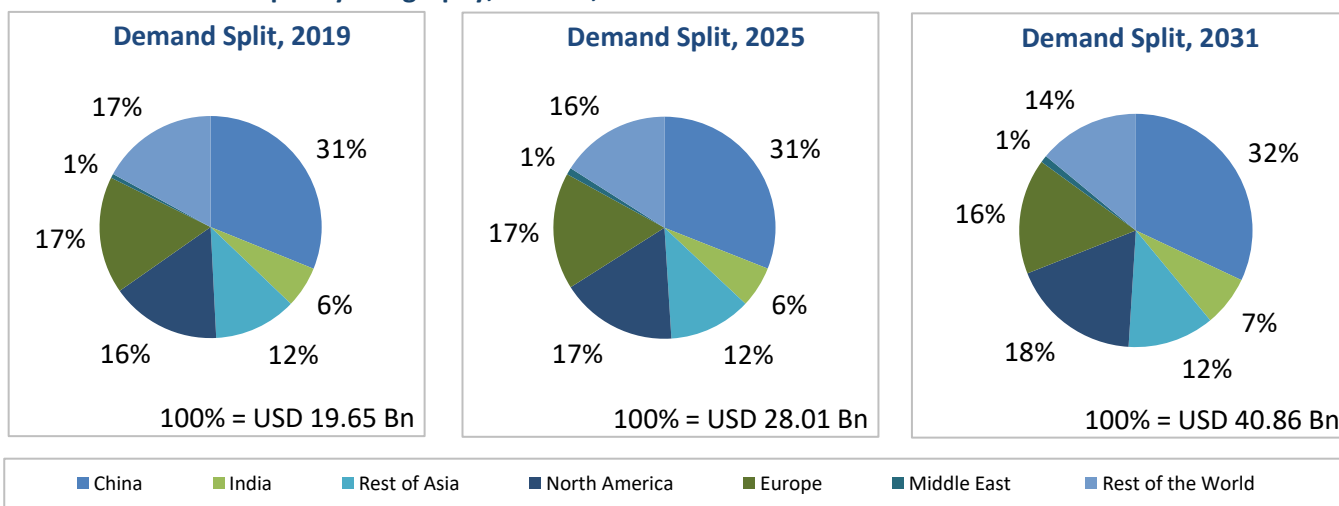
Exhibit 20: Non-Auto Global Precision Machined Forging Market End-use segment wise growth rate, CY 2019-31

| Year/CAGR Growth | Energy | Energy Turbines | Aerospace | Defence | Mining and Construction Equipment | Railways | Others* |
|------------------|--------|-----------------|-----------|---------|-----------------------------------|----------|---------|
| 2019-2025        | 6.1%   | 6.1%            | 9.4%      | 9.6%    | 6.7%                              | 4%       | 3.1%    |
| 2025-2031        | 5.8%   | 7.7%            | 9.3%      | 11.2%   | 5.9%                              | 3.9%     | 6.4%    |

- The Non-Auto Global Precision Machined Forgings market was valued at **USD 28.01 Bn** in CY 2025 where the **Energy** sector accounts for **26%**, **Energy Turbines** (**7%**), **Aerospace** (**6%**), **Defence** (**9%**), **Mining and Construction Equipment** (**29%**), **Railways** (**14%**) and **others** (**9%**).

## 2.3.9 Global Non-Automotive Precision Machined Forging Market Demand by Geography

Exhibit 21: Demand Split by Geography, USD Bn, CY 2019-31



Rest of the world include other global nations such as Russia, Australia, African nations and South American nations

**Exhibit 22: Non-Auto Global Precision Machined Forging Market Geography wise growth rate, CY 2019-31**

| Year/CAGR Growth | North America | Europe | Middle East | China | India | Rest of Asia | Rest of the World |
|------------------|---------------|--------|-------------|-------|-------|--------------|-------------------|
| 2019-2025        | 7.2%          | 6.1%   | 6.1%        | 6.1%  | 7.5%  | 6.1%         | 4.6%              |
| 2025-2030        | 7.5%          | 5.4%   | 6.5%        | 7.1%  | 9.3%  | 6.5%         | 4.2%              |

- Key demand contributors were **China (31%), Europe (17%), North America (17%), India (6%), Rest of Asia (12%), Middle East (1%) and rest of the world (16%) in CY 2025.**

**2.4 Overview of Indian Forging Market****2.4.1 Key Characteristics of Indian Forging Industry**

- India is the 2nd largest Forging producer second to China.
- The industry has an annual output of more **20 lakh metric tonnes** and nearly 380 forging units across the country, located in proximity to its end user customers, Major forging clusters are found in the States of Maharashtra, Punjab, Gujarat, Tamil Nadu, Haryana, Delhi, Karnataka, Jharkhand, West Bengal and Andhra Pradesh. SMEs contribute 30% to forging production, while medium and large-scale units contribute 70%.
- The forging industry provides direct employment to over 300,000 people in India and an additional 60,000 contract laborers.
- The market comprises large integrated forging companies alongside numerous small and mid-sized manufacturers, resulting in a relatively fragmented competitive landscape.
- Shift toward higher-value precision components: Indian manufacturers are moving from conventional forgings toward precision-engineered and machined components, supported by CNC machining, automation and advanced forging technologies.
- In **FY 2025-26** Indian Forging Industry was valued at **INR 51,768 Crores** where in Automotive sector **accounts for 57% share and the remaining 43% for non-automotive sector.**
- India has imported **65.9% of the non-automotive forgings** from various nations of the world to meet the domestic forging demand from sectors such as Oil and Gas, Aerospace and Defence, Earthmoving equipment, Railways and other sectors including construction and farm equipment. High import dependence presents a significant import-substitution opportunity for domestic precision forged machined component manufacturers to capture an increasing share of local demand.
- Indian Non-Automotive Forging Market was valued at **INR 22,502 Crores in FY 2025-26.** The Indian Forgings Industry has made rapid stride in increasing export revenue for better diversification of its product portfolio.

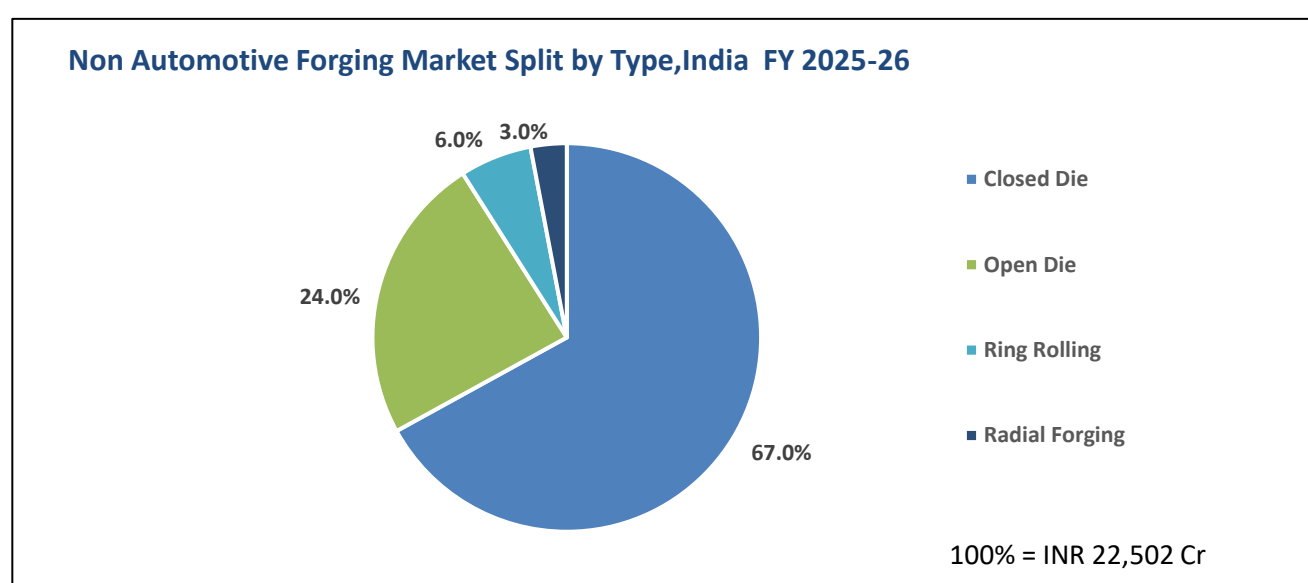
**2.4.2 Forging Market Size by Type & Segment (Open Die, Closed die, Ring Forging and Radial Forging)**

- Forgings are part of seven primary groups of metals/alloy types: carbon, micro alloy and alloy steels, stainless steels, aluminium alloys, copper alloys, iron, nickel, or cobalt-based heat-resistant alloys, titanium, and magnesium alloys. High-strength alloys have better tensile and fatigue strength, making them ideal for load bearing and rotating components in high-pressure environments.
- Steel alloys are primarily forged in hot conditions for industrial applications, while brass, bronze, copper, and precious metals are manufactured for special applications. Aluminium, titanium, and other nonferrous metal

forged parts are mainly used in aerospace, automotive, and other engineering fields for high safety standards against failure due to abuse, shock, or vibratory stresses.

- The domestic forging industry is characterized by fragmented capacities. The unorganized sector has a major presence in the Open Die Forging segment, which has lower capital costs, while the organized players dominate the Closed die Forging segment.
- **Out of the total non-automotive forgings demand in the country, 67% (15,007 Cr) is met through Closed die Forging, 24% (5,313 Cr) by Open Die Forging, 6% Ring Rolling (1,409 Cr) and balance 3% (774 Cr) by Radial Forging.**
- The major demand driver of forgings is the economic growth and massive investment in infrastructure, Energy (Oil Gas) and upcoming Aerospace & Defence sector where India aspires to be self-reliant. Government's thrust on manufacturing sector with initiatives like 'Make in India' and 'Skill India' has created positive economic impact across target sectors.

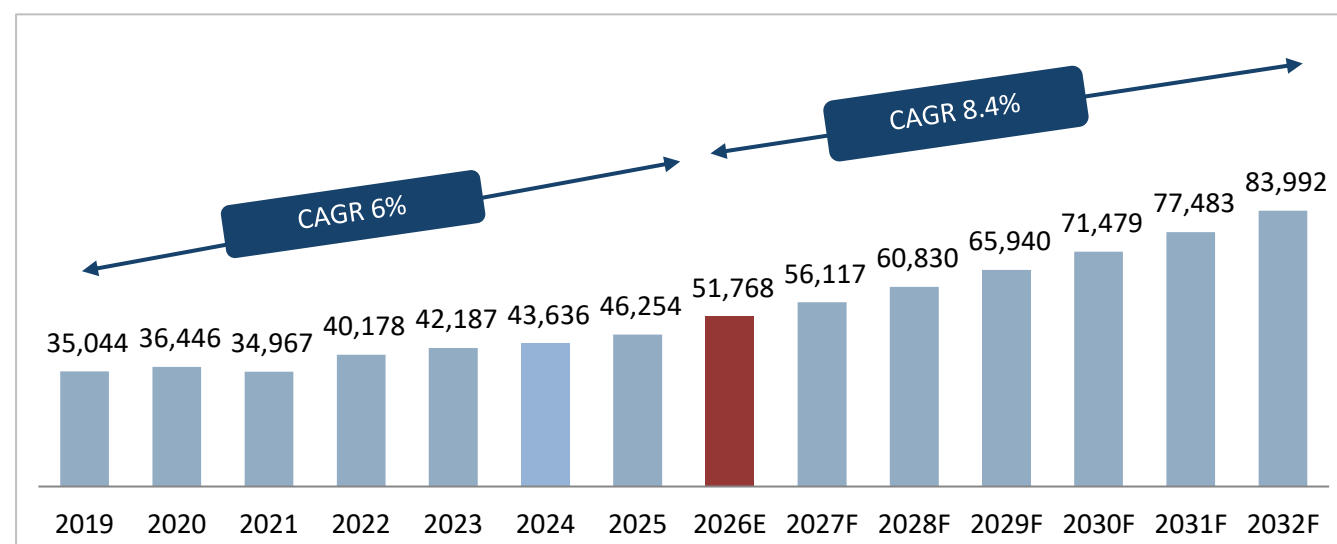
**Exhibit 23: Indian Non-Automotive Forging Market Split by Type, FY 2025-26**



Source: Frost & Sullivan Primary Interviews and Analysis  
E-Estimated, F-Forecasted

## 2.4.3 Market Size Estimates & Forecast for Overall Forging in India

**Exhibit 24: Indian Overall Forging Market Forecast Year FY 2019–2032 (INR Cr)**

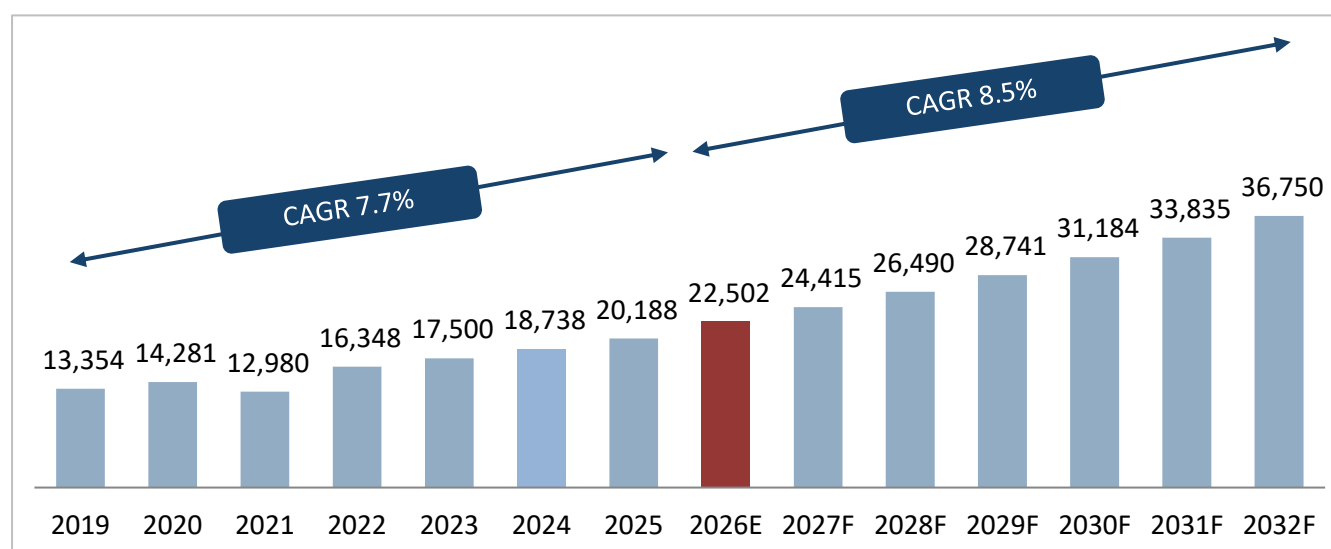


Source: Frost & Sullivan Analysis  
All figures are rounded. The base year is FY 2025-26.

- Indian Overall Forging Market was valued at **INR 51,768 Cr in FY 2026** and is estimated to grow to **INR 83,992 Cr** by FY 2032 at a **CAGR of 8.4% from FY 2026 to FY 2032** driven ~60% by automotive sector where forged parts such as connecting rods, crankshaft, pistons, injectors, camshafts, chassis parts such as bearings, gears and axles are widely used and remaining 40% by the growing demand from non-automotive end use sectors such as Oil and Gas and Energy, Energy Turbines, Nuclear, Aerospace and Defence, Mining and Construction Equipment, Marine and Shipping, Railways and other miscellaneous applications.
- Historically in FY 2019 the Indian Forging Market was valued at **INR 35,044 Cr** and had grown with a moderate **CAGR of 6% till FY 2026** and have marked **INR 51,768 Cr** market value sustained by the impact of pandemic COVID-19. The Indian economy was severely impacted by the COVID-19 Pandemic. Due to the pandemic, economic activity had drastically decreased, which had a negative demand shock effect on the Indian Forging Market. In FY 2020 Indian Forging Market was valued at **INR 36,446 Cr** and it plunged to **INR 34,967 Cr** with a downfall of 4.1% due to restrictions imposed in movements and transportations. However, as the market started recovering from the pandemic the demand again accelerated and marked **40,178 Cr** in FY 2022.

## 2.4.4 Market Size Estimates and Forecasts for Non-Automotive Forging Market in India

**Exhibit 25: Indian Non-Automotive Forging Market Forecast Year FY 2019–2032 (INR Cr)**



Source: Frost & Sullivan Analysis

All figures are rounded. The base year is FY 2025-26.

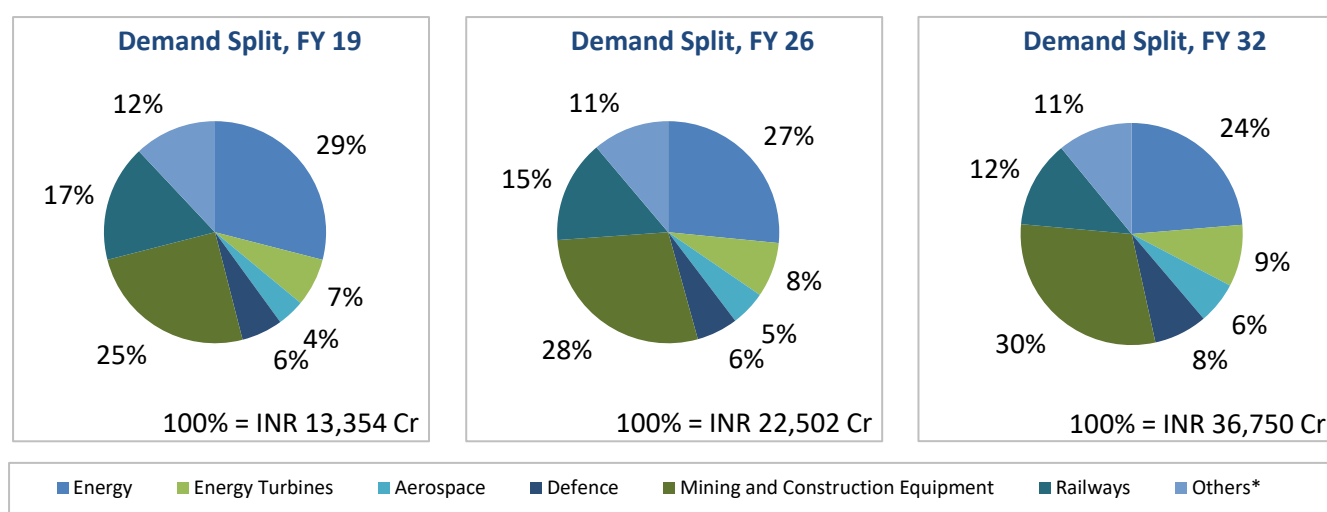
E-Estimated, F-Forecasted

- Non-Automotive forging market was valued at **INR 22,502 Cr in FY 2025-26** which accounts for **43% of the total forgings** demand and is estimated to grow to **INR 36,750 Cr by FY 2032** at a **CAGR of 8.5% from FY 2026 to FY 2032** driven mainly by growth of demand from non-automotive end use sectors such as Oil and Gas and Energy, Nuclear, Aerospace and Defence, Mining and Construction Equipment, Marine and Shipping Railways and others miscellaneous end segments and push for localization and Make in India initiatives by the Government.
- Historically in FY 2019 the Indian Non-Automotive Forging Market was valued at **INR 13,354 Cr** and had grown with a **CAGR of 7.7% till FY 2026** and have marked **INR 22,502 Cr** market value.
- The Indian economy was severely impacted by the COVID-19 Pandemic. Due to the pandemic, economic activity had drastically decreased, which had a negative demand shock effect on the Indian Forging Market. In FY 2020 Indian Non-Automotive Forging Market was valued at **INR 14,281 Cr** and it plunged to **INR 12,980**

Cr with a downfall of **9.1%** due to restrictions imposed in movements and transportations during COVID-19 period. The market started recovering from the pandemic, the demand again accelerated and marked **16,348 Cr** in FY 2022.

## 2.4.5 Indian Non-Automotive Forging Market Demand by End Use Industries

**Exhibit 26: Demand Split by End-use segment, INR Cr, FY 2019-32**



Others\* include any general engineering segment such as Marine & Shipping and Agricultural equipment,

Source: Frost & Sullivan Analysis

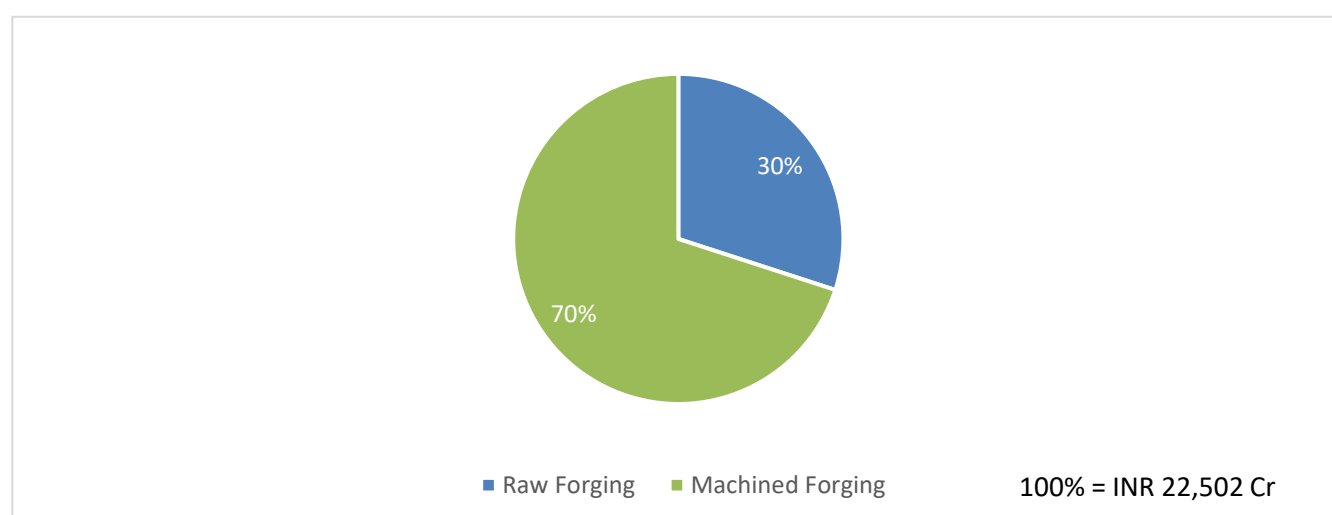
**Exhibit 27: Non-Auto Forgings Sectoral Historic and Projected Growth Rates**

| Year/CAGR Growth | Energy | Energy Turbines | Aerospace | Defence | Mining and Construction Equipment | Railways | Others* |
|------------------|--------|-----------------|-----------|---------|-----------------------------------|----------|---------|
| FY 2019 -26      | 6.4%   | 9.3%            | 11.2%     | 7.3%    | 9.4%                              | 5.7%     | 7.8%    |
| FY 2026 -32      | 6.5%   | 10.7%           | 11.8%     | 13.3%   | 9.6%                              | 5.5%     | 8.1%    |

Others\* any general engineering segment such as manufacturing sector, Construction, Marine & Shipping and Agricultural equipment

## 2.4.6 Indian Non-Automotive Demand by Raw Forging and Machined Forging

**Exhibit 28: Non-Automotive Demand Split by Raw Forging and Machined Forging, India FY 2025-26**

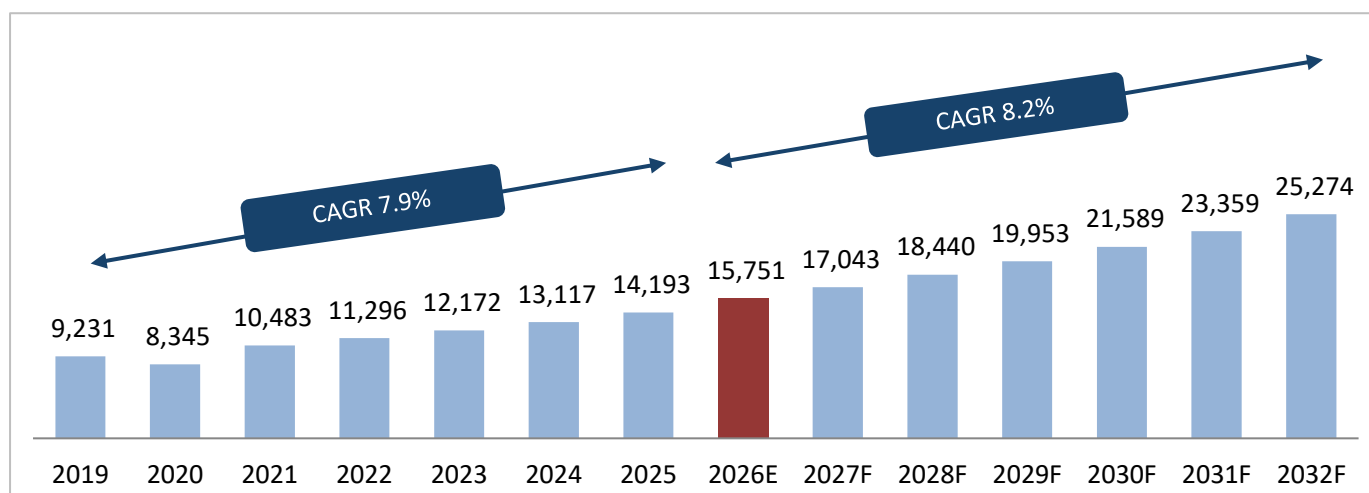


Source: Frost & Sullivan Primary Research and Analysis

- Non-Automotive Forging Market is valued at **INR 22,502 Crores in FY 26** out of which Machined Forging is the major contributor with **70% (INR 15,751.35 Crores)** and used for high precision and close dimensional tolerances becomes crucial while volume wise raw forging is high volume but low value while raw forgings contribute **30% (INR 6,750.58 Crores)** to the total market demand and finds applications where high tolerance is not required.
- Vinir Engineering Limited is present in precision forged and machined components segments with their strong capabilities to meet their customers' demand. Vinir Engineering Limited is positioned as a specialized manufacturer of mission-critical precision forged and machined components, catering to applications where product reliability, dimensional accuracy and stringent quality standards are critical. Its ability to develop highly customized components in close collaboration with customers, coupled with rapid product development and shorter lead times, enables the company to address complex and time-sensitive requirements. This combination of engineering-led customization, manufacturing agility and speed-to-market serves as a key competitive differentiator, particularly across high-value and demanding end-use applications.

#### 2.4.7 India Non-Automotive Precision Machined Forging Demand Historic Trend and Market Forecast, FY 2019-2032

**Exhibit 29: India Non-Automotive Precision Machined Forging Market Forecast, FY 2019-32, (INR Cr)**



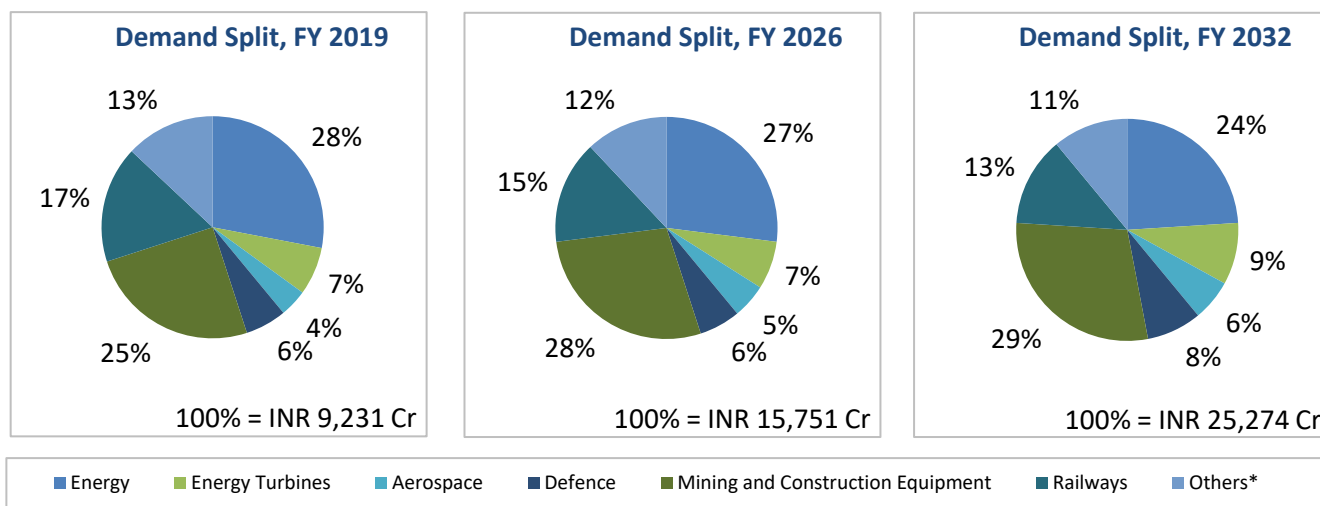
Source: Frost & Sullivan Primary Research and Analysis, all figures are rounded. The base year is FY 2025-26.

E-Estimated, F-Forecasted

- Historically in FY 2019 the Indian Non-Automotive Precision Machined Forging Market was valued at **INR 9,231 Crores** and had grown with a CAGR of **7.9%** till FY2026 and have marked **INR 15,751 Crores** market value sustained by the impact of pandemic COVID-19. The Indian economy was impacted by the COVID-19 Pandemic.
- In FY 2020 it was valued at **INR 8,345 Cr** and experienced a downfall of **9.6%** due to restrictions imposed in movements and transportation during COVID-19 period. However, as the market started recovering from the pandemic the demand again accelerated and marked **INR 10,483 Cr** in FY 2021 with a growth of **25.61%** from the previous year.
- Indian Non-Automotive Precision Machined Forging Market was valued at **INR 15,751 Crores** in FY 2026 which accounts for **70%** of the overall forgings demand and is estimated to grow to **INR 25,274 Cr** by FY **2032** at a CAGR of **8.2%** from FY 2026 to FY 2032 driven mainly by growth of demand from non-automotive end use sectors such as Oil and Gas and Energy, Energy Turbines, Nuclear, Aerospace and Defence, Mining and Construction Equipment, Marine and Shipping and Railways and other miscellaneous applications.

## 2.4.8 India Non-Automotive Precision Machined Forging Market Demand by End Use Industries

Exhibit 30: Demand Split by End-use segment, INR Cr, FY 2019-32



Others\* include any general engineering segment such as Marine & Shipping and Agricultural equipment,  
Source: Frost & Sullivan Analysis

Exhibit 31: Non-Auto India Precision Machined Forging Market End-use segment wise growth rate, FY 2019-32

| Year/<br>CAGR<br>Growth | Energy | Energy<br>Turbines | Aerospace | Defence | Mining and<br>Construction<br>Equipment | Railway | Others* |
|-------------------------|--------|--------------------|-----------|---------|-----------------------------------------|---------|---------|
| FY 2019-26              | 7.1%   | 7.9%               | 11.4%     | 7.5%    | 9.6%                                    | 6%      | 7.7%    |
| FY 2026-32              | 6.1%   | 12.8%              | 12.6%     | 12.9%   | 9.2%                                    | 5.2%    | 5.6%    |

- Non-Auto Indian Precision Machined Forgings market was valued at **INR 15,751 Cr** where the Energy sector accounts for **27%**, Energy Turbines (**7%**), Aerospace (**5%**), Defence (**6%**), Mining and Construction Equipment (**28%**), Railways (**15%**) and others (**12%**).
- Vinir Engineering Limited Operates in this niche segment and are a leading, integrated engineering solutions company engaged in the **manufacturing of specialized, critical and heavy, precision-forged and machined components** for a wide range of industries and applications, including Oil and Gas and energy, aerospace and defence, nuclear, marine and shipping, mining and construction equipment, railways and other miscellaneous industries.

## 2.4.9 Trends in the Usage of Precision Forged Machined Components in India

Exhibit 32a: Trends in the Usage of Precision Forged Machined Components in India

### Trends in the Usage of Precision Forged Machined Components in India

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Adoption of Ring Rollings in Energy (Oil and Gas) Sector</b> | <ul style="list-style-type: none"> <li>Ring Rollings are used in Energy (Oil and Gas Sector) for a range of functions. Ring Rolling is gaining attention in the extraction and storage of Oil and Gas.</li> <li>Fracturing has grown in popularity as a technique of locating and extracting oil from the solid ground, and seamless rolled rings play a crucial part in the fracking process.</li> </ul> |
| <b>Diversification beyond automotive</b>                        | <ul style="list-style-type: none"> <li>While automotive remains the largest forging end market, precision forged and machined components are seeing increasing adoption across aerospace &amp; defence, oil &amp; gas, power &amp; energy, railways and other industrial applications, where strength, reliability and dimensional accuracy are critical</li> </ul>                                       |

## Trends in the Usage of Precision Forged Machined Components in India

|                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aerospace &amp; Defence</b>                                                         | <ul style="list-style-type: none"> <li>Demand of forged components made from various alloys in Aircrafts is in trend. There is rise in commercial aircraft production along with localization of demand for aircraft parts such as engine parts, landing gears, machined parts and turbines. The demand for aerospace forged elements is expected to rise as the number of military-grade aero planes such as helicopters, specialty fighters, and jets increases to improve air defence. Therefore, the increased applications across aerospace sector will further accelerate the heavy forging market in India.</li> <li>Defence Research and Development Organisation (DRDO) has established the near isothermal forging technology to produce all the five stages of high-pressure compressors (HPC) discs out of difficult-to-deform titanium alloy using its unique 2000 MT isothermal forge press. The technology has been developed by Defence Metallurgical Research Laboratory (DMRL), a premier metallurgical laboratory of DRDO at Hyderabad. This is a crucial technology for establishing self-reliance in aeroengine technology. With this development, India has joined exclusive list of global engine developers to have the manufacturing capabilities of such critical aero engine components. These developments will create the opportunities for local forging manufacturers to enhance their capabilities to meet the Defence requirements.</li> </ul> |
| <b>Shift from conventional forgings to finished precision components</b>               | <ul style="list-style-type: none"> <li>OEMs are increasingly seeking tighter tolerances, complex geometries and higher-performance components. This is encouraging forging companies to expand downstream into CNC machining, precision finishing, testing and component-level solutions, increasing value addition per component.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Import substitution and localization</b>                                            | <ul style="list-style-type: none"> <li>India's push toward indigenous manufacturing and lower import dependence is supporting domestic precision-engineering capabilities, particularly in aerospace and defence. This creates an opportunity for Indian manufacturers capable of replacing imported high-specification and difficult-to-manufacture components.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Increasing demand for customization and low-volume/high-mix manufacturing</b>       | <ul style="list-style-type: none"> <li>Unlike traditional high-volume automotive forgings, critical industrial and aerospace applications increasingly require customer-specific engineering, complex geometries and high-precision manufacturing, favouring suppliers capable of combining forging with advanced machining</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Technological Advancements Driving Efficiency, Energy Saving and Cost Reduction</b> | <ul style="list-style-type: none"> <li>Technical advances in product design, manufacturing, and materials are driving efficiency improvements.</li> <li>Forging manufacturers are adopting automation to boost their productivity and efficiency.</li> <li>Green Certification is in trend to reduce the carbon footprint by the forging manufacturers and emphasis on the usage of renewable energy, thereby reducing the energy cost.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**Vinir Engineering Limited's** extensive material capabilities position them strategically to cater to a diverse array of products and industrial applications, enabling them to meet the evolving demands of various sectors.

The firm specializes in producing precision-forged and machined components with Carbon Steels, Alloy Steels, Stainless Steels, Duplex & Super Duplex Stainless Steels, Nickel Alloys, Titanium Alloys, Aluminium Alloys, and other special alloys manufactured to international standards.

### Exhibit 32 b: Insights on Special Metals (Inconel, Monel & Titanium)

| Inconel                                                                                                               | Monel                                                                                                                                                                        | Titanium                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Superalloy composed primarily of nickel, iron, and, to a lesser extent, chromium with <b>advantages of corrosion-</b> | <b>Precipitation-hardened alloy formed by mixing nickel, copper and other metals.</b> Its composition is approximately 65–70% nickel, 20% copper, and 5% iron and manganese, | Extracted from titanium ore using the Kroll Process (magnesium reduction) and emerges as sponge titanium. Key advantages are |

|                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| resistant & structural rigidity with integrity maintained as high as 1390°C – 1425°C                                                                                                                                                                                                                                                                                                               | depending on the piece to be manufactured, key advantages are High corrosion resistance, Resistance to High Temperatures, Good mechanical strength, Non-magnetic, Ease of machining & Fire resistance                                                                                                                                                                                                                                                                                                                          | <b>Enhanced Mechanical Properties: Weight Reduction, Corrosion Resistance, Design Flexibility, Cost Effectiveness</b>                                          |
| <b>Key Applications</b><br><b>Aerospace:</b> Airframe and jet engine components such as turbine seals and exhaust liners are made from Inconel alloys.<br><b>Oil and Gas:</b> Finds application in Extraction being a preferred material of choice for the lining of steel transfer piping commodity<br><b>Marine and Shipping:</b> Propulsion motors, propeller blades, platform risers & hangers | <b>Key Applications</b><br><b>Aerospace:</b> Jet aircraft coatings, aeronautical constructions, and locking wire.<br><b>Marine and Shipping:</b> Pipes, pump shafts, basket strainers, anchor cables, magnetic field measuring equipment, water and fuel tanks, propellers, bolts, valves and even fishing lines.<br><b>Oil and Gas:</b> Crude oil towers, extraction wells, and valves, among many other things. It is commonly used with slurries in the presence of hydrofluoric acid, sulfides and very high temperatures. | <b>Key Applications</b><br><b>Aerospace:</b> Landing gear, engine parts, and structural elements.<br><b>Oil and Gas:</b> Valves, pumps, and piping systems     |
| <b>Alloys:</b><br>600<br>601<br>625<br>718<br>725<br>X750.                                                                                                                                                                                                                                                                                                                                         | <b>Alloys:</b><br>401<br>R-405<br>R-450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Alloys:</b><br>Ti- CP4 (Grade 1)<br>CP3 (Grade 2)<br>CP2 (Grade 3)<br>CP1 (Grade 4)<br>6Al-4V (Grade 5)<br>5Al-2.5 Sn (Grade 6)<br>CP Ti 0.15 Pd (Grade 11) |

Source: Frost & Sullivan Research and Analysis



**End User Overview Global & India**

### 3. End User Overview: Forging

#### 3.1 Energy

##### 3.1.1 Energy Global Overview

Exhibit 33: Global Energy Sector Overview

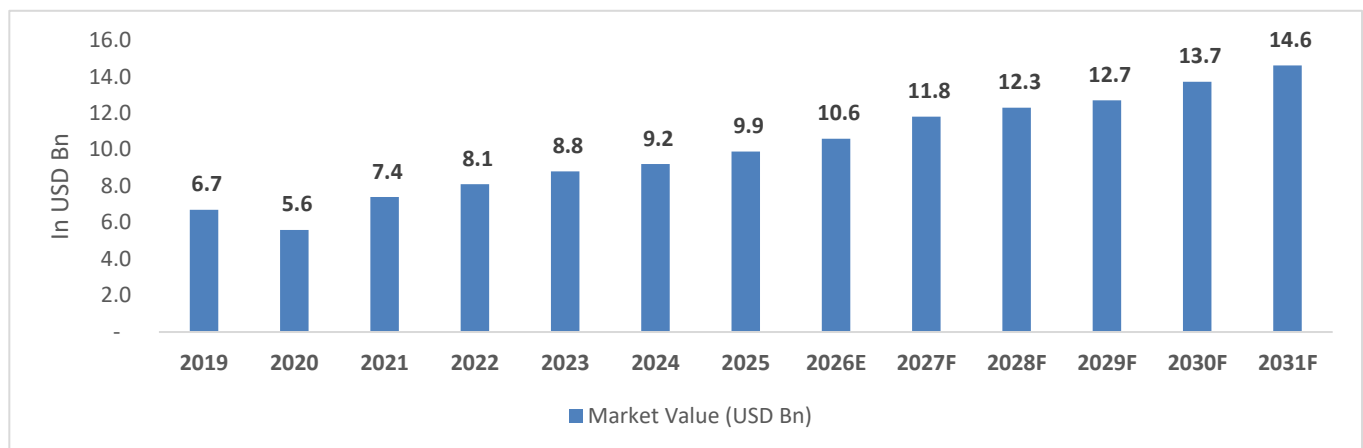
| Overview Parameters                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Market Size and Growth Rate</b> | <ul style="list-style-type: none"> <li>The Overall forging market for Energy sector was valued at <b>USD 10 Bn in 2025</b>.</li> <li>Accounts for <b>27% of the total non-automotive forging global demand</b></li> <li>Projected to reach <b>USD 14.6 Bn by 2031</b> with a growth rate of <b>6.5%</b> from the period <b>2023 to 2030</b>.</li> <li>Global Precision Forged Machined Components market for Energy sector was <b>valued at USD 7.2 Bn in 2025</b>.</li> <li>Projected to reach <b>USD 10.2 Bn by 2031</b> with a growth rate of 5.8% from the period <b>2026 to 2031</b>.<sup>5</sup></li> </ul>                                                                                                                                                                                                                                                                                                    |
| <b>Growth Drivers</b>              | <ul style="list-style-type: none"> <li>The electricity surge is largely driven by rapid industrialization and population growth in emerging economies like India and China.</li> <li>India is expected to see an 8% rise in electricity demand, primarily due to continued economic expansion.</li> <li>China's electricity consumption is anticipated to grow by more than 6%, fueled by intense manufacturing and service activity.</li> <li>The utilization of forged parts in machines within the nuclear power segment which operates under extreme conditions is a significant driver of growth in the forging market.</li> <li>Global annual renewable capacity additions are projected to increase to nearly 935 GW by 2030, driving heavy demand for low-volume, specialized custom forgings (e.g., wind turbine main shafts) that align with a "forge-to-finish" operational model.<sup>6</sup></li> </ul> |
| <b>Energy Crisis Recovery</b>      | <ul style="list-style-type: none"> <li>Global energy markets that were hit particularly hard by the global energy crisis are set to see pressures ease in the next couple of years.</li> <li>Natural gas markets have been dominated by fears about security and price spikes after Russia cut supplies to Europe, and market balances have remained precarious.</li> <li>There is a surge in new liquefied natural gas (LNG) projects coming on stream from 2025 adding an additional capacity of 250+ billion cubic meters per year by 2030, equivalent to around 45% of today's total global LNG supply</li> </ul>                                                                                                                                                                                                                                                                                                |
| <b>Energy sector outlook</b>       | <ul style="list-style-type: none"> <li>Climate change to achieve NetZero target by various economies towards cleaner and more sustainable energy sources, a comprehensive overview of global energy consumption serves as a roadmap for shaping the future of energy production and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

<sup>6</sup> <https://www.iea.org/reports/renewables-2024/electricity>

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | <p>consumption worldwide. Green forged products are in trend and are produced by major players to curb their carbon footprints.</p> <ul style="list-style-type: none"> <li>• The growth of Energy sector Globally is promising and the demand for energy will increase with the growing population, industrialization and urbanization.</li> <li>• The Nuclear power industry extensively uses forged metal parts for various critical applications such as reactors, nuclear waste storage and transportation of raw materials and waste.</li> <li>• Decarbonization pressure within the industry is accelerating a shift toward Electric Arc Furnaces (EAF), largely accelerated by the full implementation of the Carbon Border Adjustment Mechanism (CBAM) in 2026.<sup>7</sup></li> </ul> |
| <b>Marine &amp; Shipping</b> | <ul style="list-style-type: none"> <li>• Decarbonization &amp; Green Ships: Over 50% of global new ship orders in 2024–2025 are for alternative fuel vessels (IMO Net-Zero push). This requires entirely new, custom heavy forgings for dual-fuel engines.<sup>8</sup></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

### Global Overall Forging Market: Energy, 2019-2031

**Exhibit 34: Global Overall Forging Market Trend, Energy, USD Bn, CY 2019-31**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

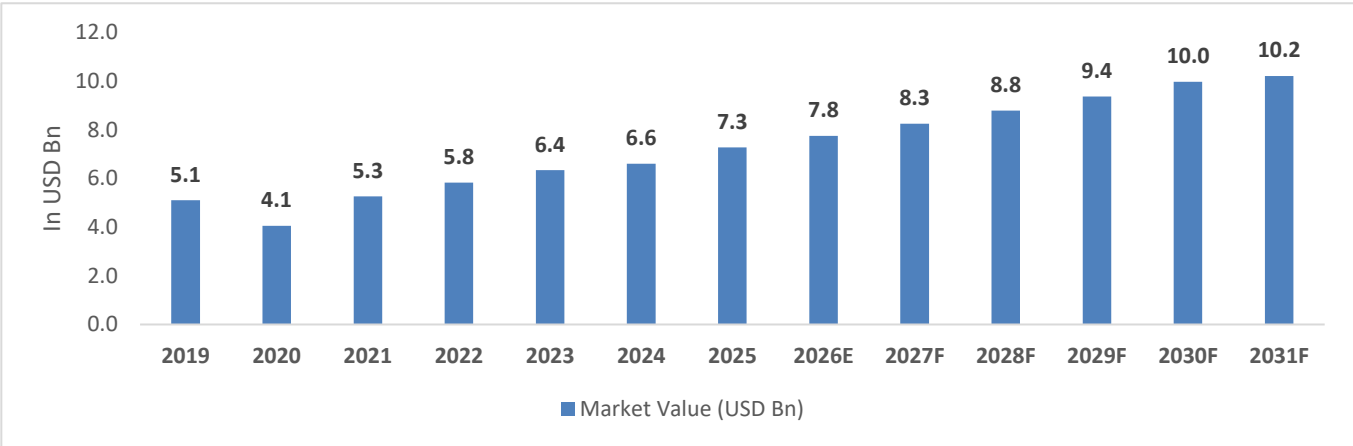
- Global overall forging market for Energy was valued at **USD 10 Bn in CY 2025** and is projected to mark **USD 14.6 Bn by 2031** with a **CAGR of 6.5% from 2025 to 2031** driven by forgings demand from the Oil and Gas, Renewables and Nuclear Energy segments.

<sup>7</sup><https://www.steel-technology.com/index.php/news/europes-steel-industry-confronts-2026-cbam-enforcement-with-decarbonization-challenges-and-import-cost-pressure>

<sup>8</sup> [https://unctad.org/system/files/official-document/rmt2025\\_en.pdf](https://unctad.org/system/files/official-document/rmt2025_en.pdf)

Global Precision Forged Machined Components Market: Energy, 2019-2031

Exhibit 35: Global Precision Forged Machined Components Market Trend, Energy, USD Bn, 2019-31



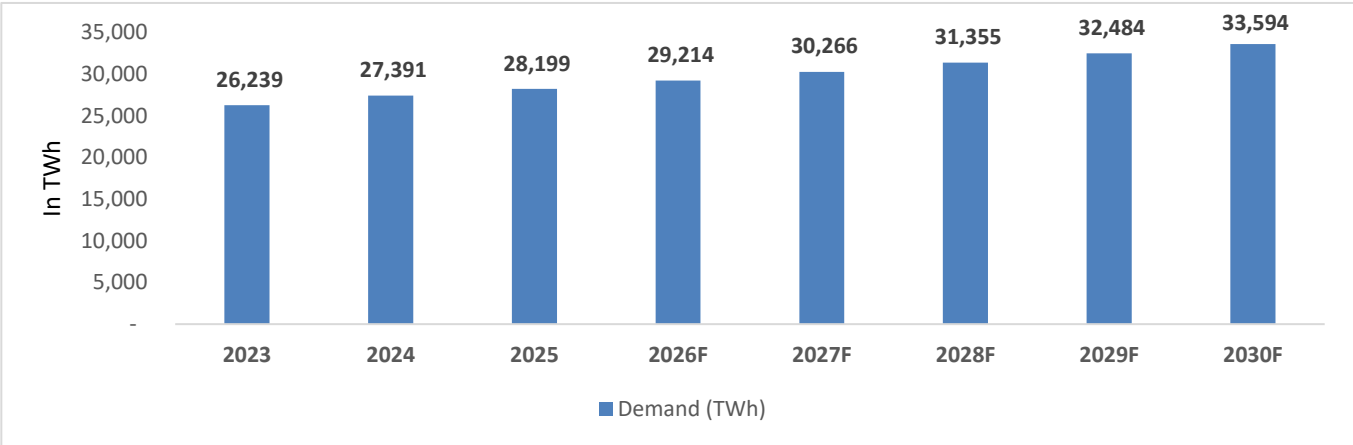
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Energy was valued at **USD 7.3 Bn in 2025** and is projected to mark **USD 10.2 Bn by 2031** with a **CAGR of 5.8% from 2025 to 2031** driven by growth of **precision forged machined components demand from the Oil and Gas, Renewables and Nuclear Energy segments**.

Global Electricity Demand

Exhibit 36: Global Electricity Demand,2023-2030F



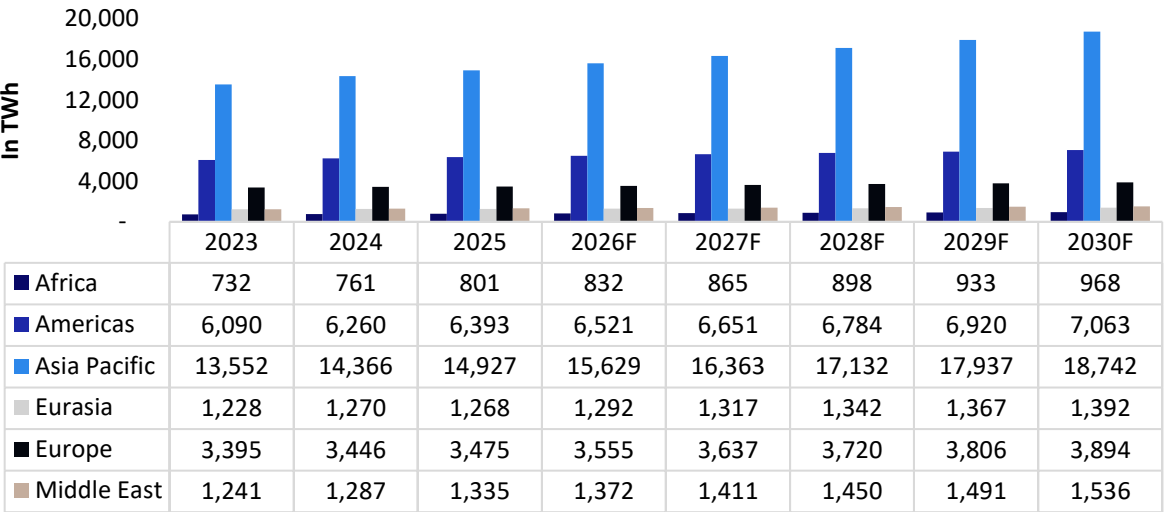
Source: IEA, Electricity Report 2026

F-Forecasted

- Regional energy consumption encompasses various sectors, including transportation, industry, residential, and commercial sectors, each with its unique patterns and drivers
- Key Trends for Electricity demand growth are **population growth, economic development, and increasing electrification** across various sectors coupled with urbanization, industrialization growth in emerging economies, particularly in Asia and Africa.
- This trend is also fueled by the **electrification of transportation** and other systems, as countries strive to reduce and derisk themselves from reliance on fossil fuels and transition to cleaner energy sources.

Overview of Regional Energy Consumption

Exhibit 37: Global Regional Energy Consumption,2023-2030F



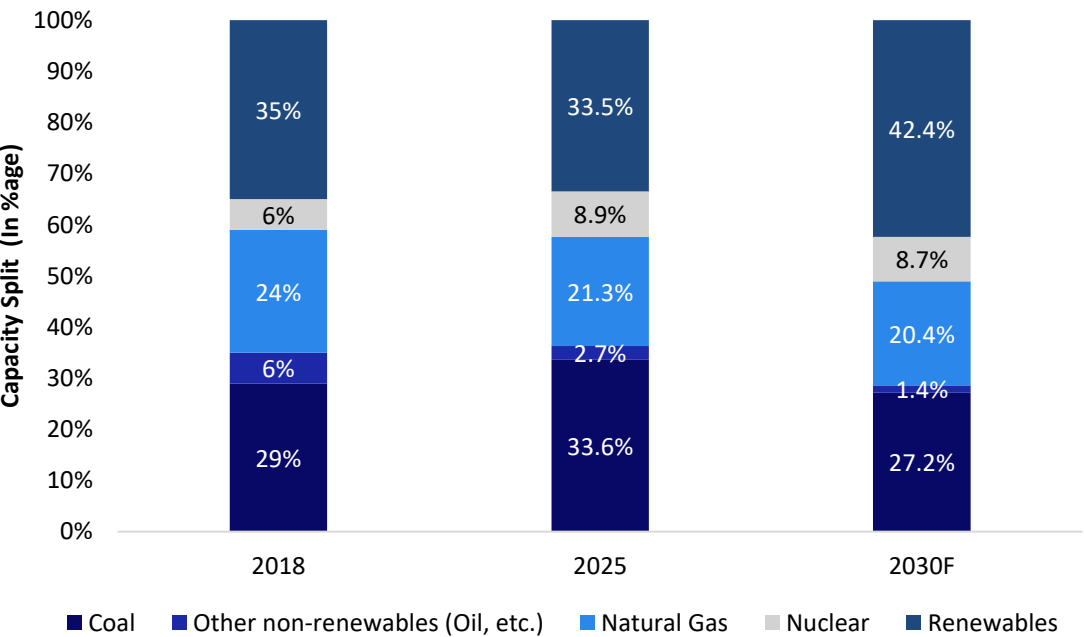
Source: IEA, Electricity Report 2026

F-Forecasted

- **The Americas** are expected to grow at a moderate **CAGR of 2.0% between the period 2026-2030**
- **Emerging economies in Asia Pacific** accelerate at a **CAGR of 4.7%** driven by industrial expansion and urban development.
- **Eurasia & Europe** accelerates at a CAGR of **1.9% & 2.3% from 2026-2030.**
- **Middle East:** accelerates at a CAGR of **2.8% from 2026-2030.**

Global Power Generation and Capacity Overview Across Different Energy Sources

Exhibit 38: Global Energy Capacity, By Source, 2018-2030F



Source: IEA, Electricity Report 2026

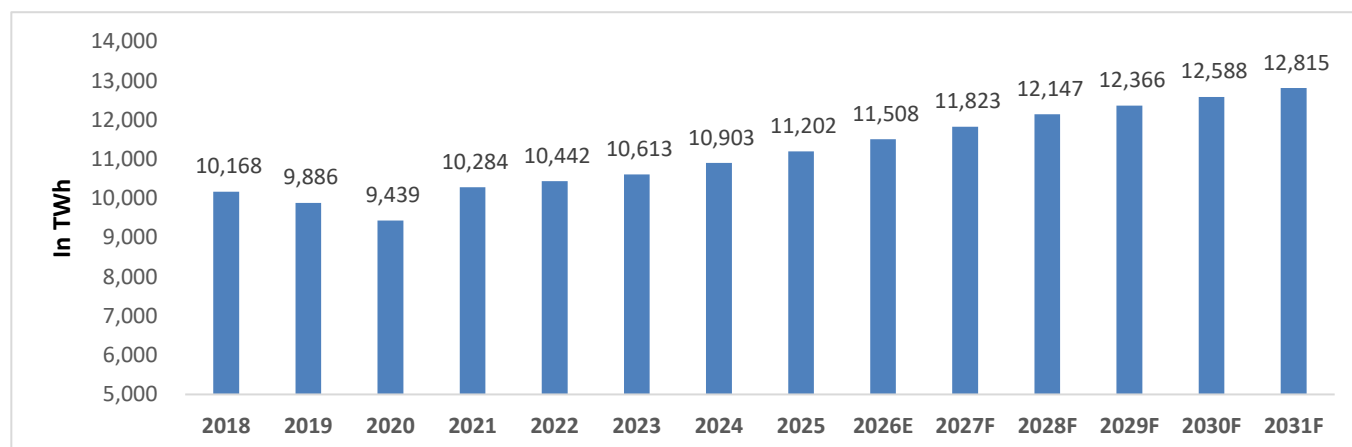
F-Forecasted

- **Coal and natural gas** face a structural **decline** but remain essential for grid reliability, collectively retaining nearly **48% of the global mix by 2030F**.
- **Renewable energy** capacity is driven by environmental concerns and technological advancements, the mix is projected to reach **42.4% by 2030F** contributed by Solar energy which is rapidly growing in China, Europe, North America.
- Nuclear power holds a stable **8.7% share**, providing a vital clean energy baseline supported by new reactor commissions across Asia.

## Fossil Fuels: Coal & Gas

### Global Power Generation and Capacity:

**Exhibit 39: Global Power Generation-Fossil Fuel (In TWh),2018- 2031F**

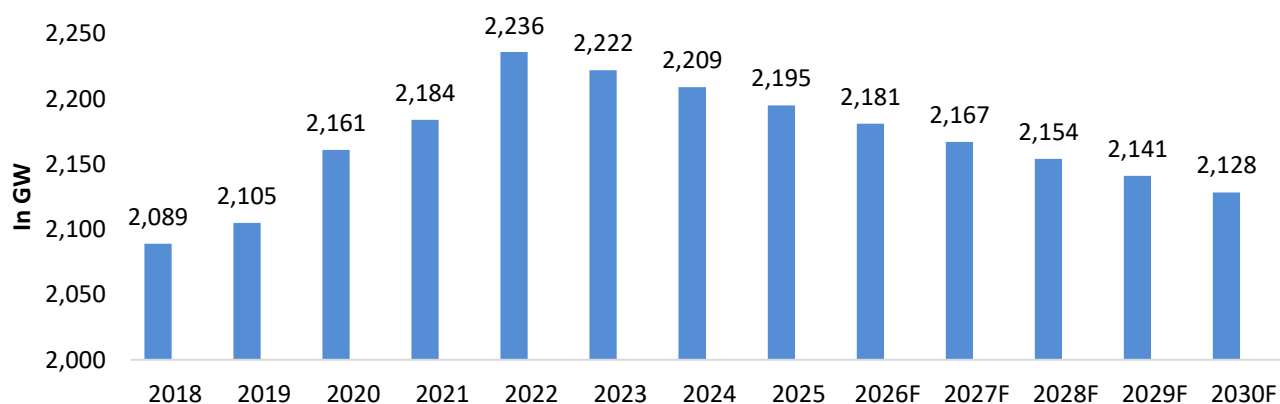


Source: [iea.org](https://www.iea.org)

E-Estimated, F-Forecasted

- **Coal will account for 22% portion of the global power capacity in 2025.** Developing countries continue to invest in coal-fired power infrastructure to meet their growing energy demands.
- As the world strives to achieve carbon neutrality and combat climate change, the future of coal in global power generation remains uncertain.

**Exhibit 40: Global Power Capacity Fossil Fuel (In GW),2018- 2030F**



Source: [iea.org](https://www.iea.org)

E-Estimated, F-Forecasted

## Global Trends in Fossil Fuel

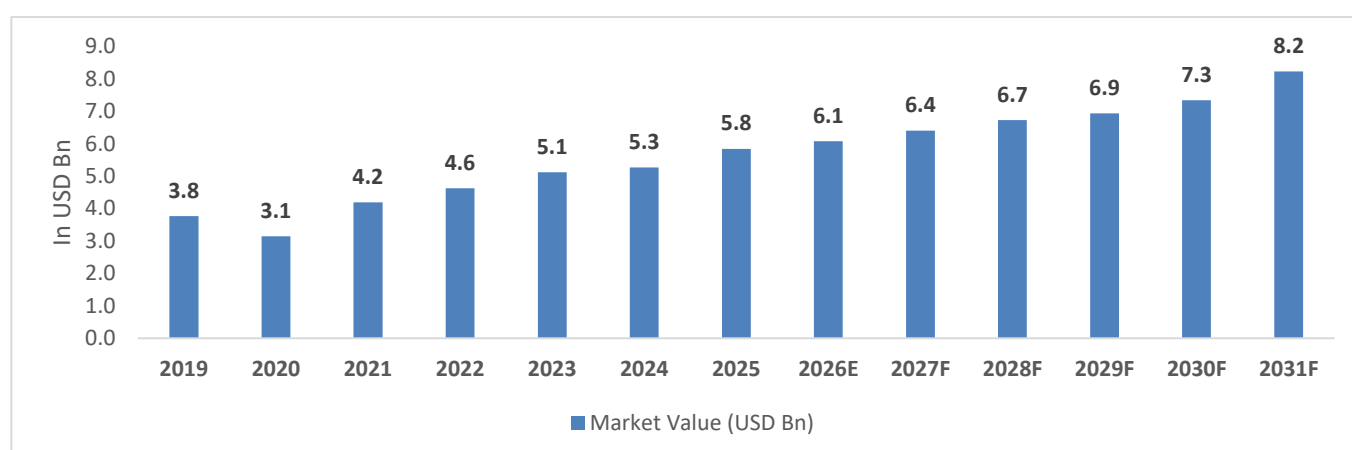
- The fossil fuel generation in **2025 was 11202.00 TWh** and is expected to grow to **12,588.00 TWh in 2030F** at a **CAGR of 2.4%**. The capacity in fossil fuel production is expected to reduce from **2,195 GW in 2025** to **2,128 GW in 2030F**, experiencing a negative **CAGR of 0.6%**.
- Fossil fuels, including coal, oil, and natural gas, have shown an increasing trend over time and are projected to continue rising until 2030.
- The consumption of liquid fuels, such as natural gas plant liquids and crude oil, surpasses that of other fossil fuel types.

### 3.1.1.1 Oil and Gas Sector

- Global oil demand remains on track to grow **from 2.3 mbpd in 2023** and cross the **100 mbpd mark for the first time in history**.
- Global oil demand is projected to rise by **38 million barrels a day to 115 million barrels a day by 2025**. Asian countries will remain the key source of demand increase in the developing world with the China and India at its central.

## Global Overall Forging Market: Oil and Gas 2019-2031

**Exhibit 41: Global Overall Forging Market Trend, Oil and Gas, USD Bn, CY 2019-31**



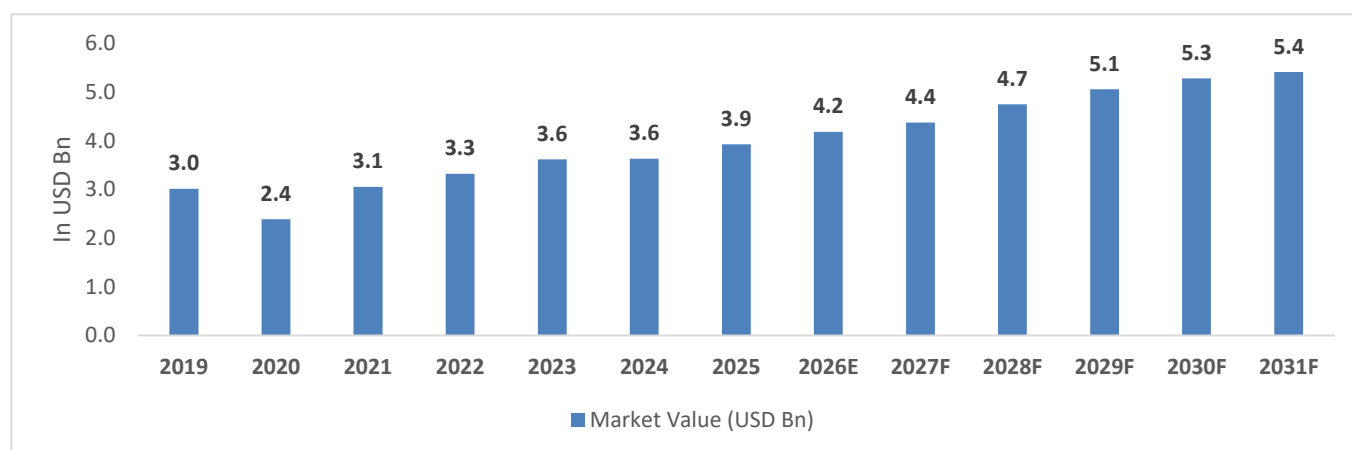
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global overall forging market for Oil and Gas was valued at **USD 5.8 Bn in 2025** and is projected to mark **USD 8.2 Bn by 2031** with a **CAGR of 5.9%** from 2025 to 2031 driven by growth in demand of raw forgings and machined forged components such as Valve body, Gates, Studded Tee, Crosses, Rings, Slip Bowls, Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Valve Casing, Y Block, Flanges, Tube Sheet, Clad Body Valves, adapter bodies and slip bowls.

## Global Precision Forged Machined Components Market: Oil and Gas 2019-2031

**Exhibit 42: Global Precision Forged Machined Components Market Trend, Oil and Gas, USD Bn, 2019-31**



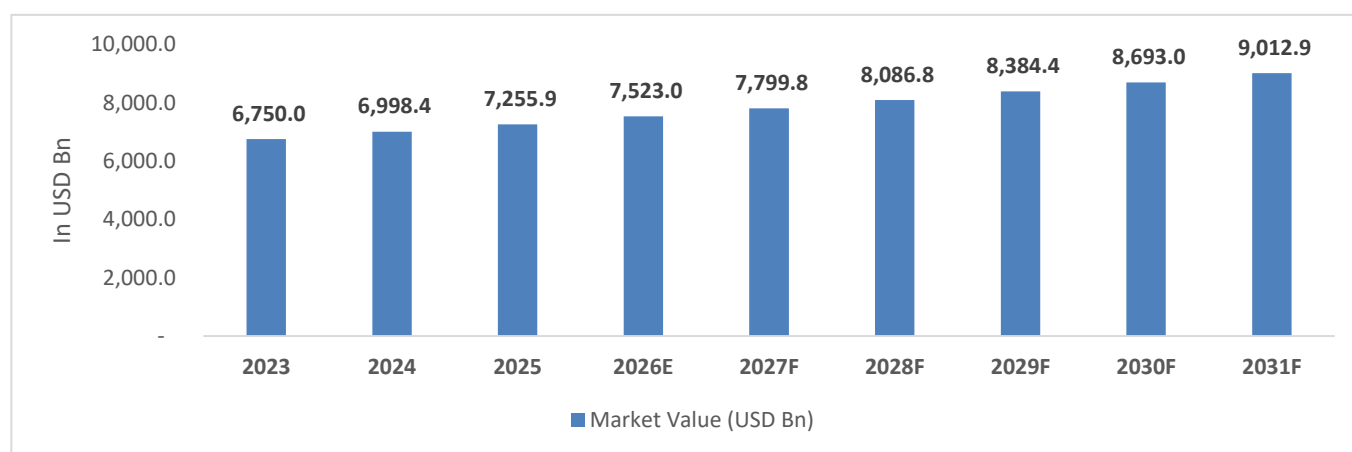
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Oil and Gas was valued at **USD 3.9 Bn in 2025** and is projected to mark **USD 5.4 Bn by 2031** with a **CAGR of 5.5% from 2025 to 2031** driven by growth in demand of components such as Valve body, Gates, Studded Tee, Crosses, Rings, Slip Bowls, Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Valve Casing, Y Block, Flanges, Tube Sheet, Clad Body Valves, adapter bodies and slip bowls

## Global Oil and Gas Overall Market Size, 2023-2031

**Exhibit 43: Global Oil and Gas Market Trend, USD Bn, 2023-2030**



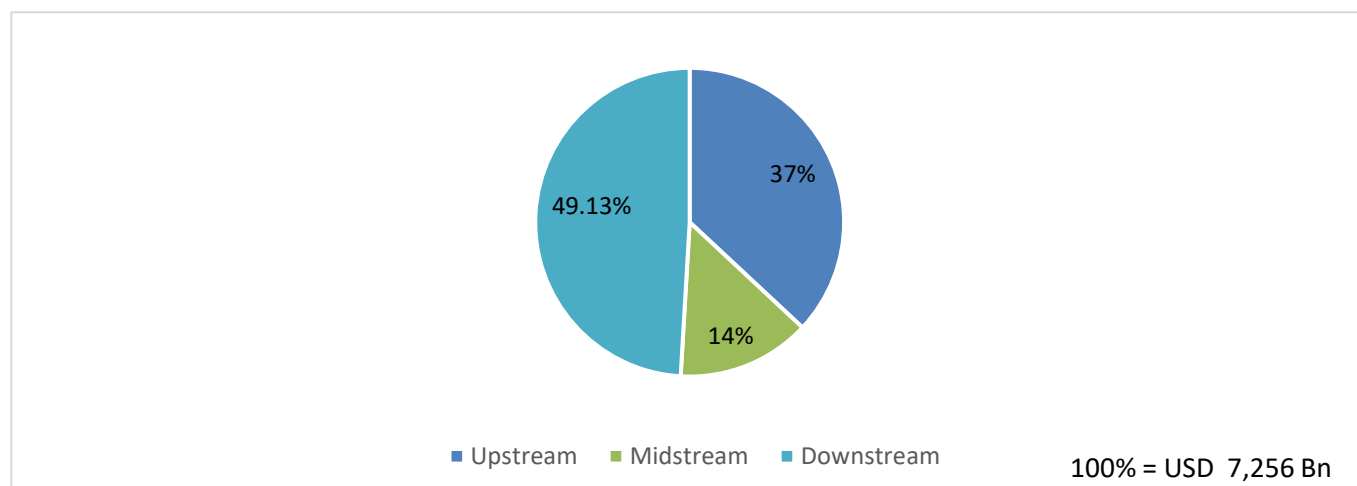
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Oil and Gas market was valued at **USD 7,255.9 Bn in 2025** and is estimated to mark **USD 9,012.9 Bn by 2031** with a **CAGR of 3.68% from 2025 to 2031**.

## Segmentation of Oil and Gas Sector by Type, 2025

Exhibit 44: Segmentation of Oil and Gas by Type, 2025



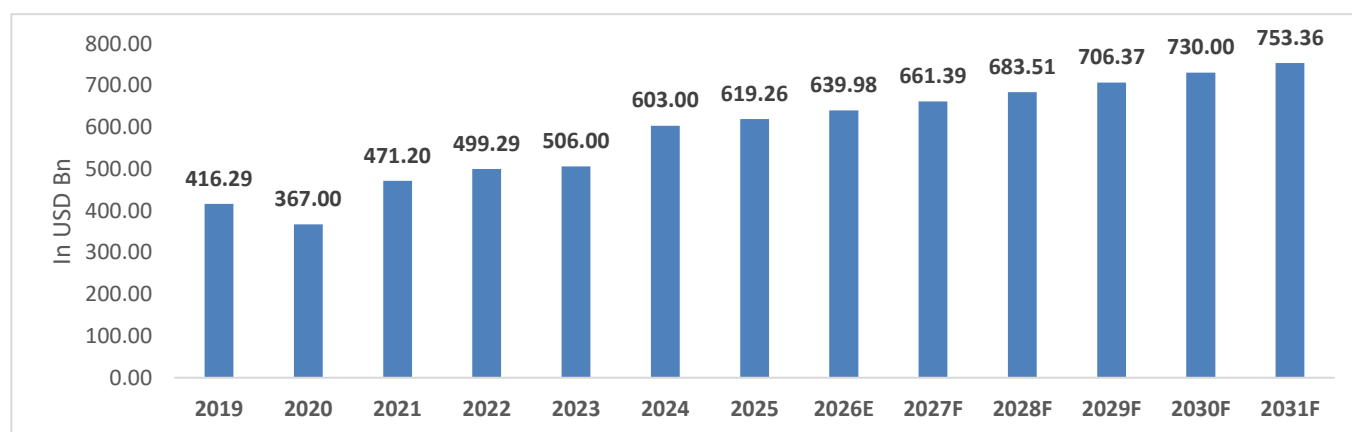
Source: Frost & Sullivan Analysis

Exhibit 45: Segmentation by Stream and Impact on Forging

| Stream     | Remarks                                                                                                                                                                                                                                                       | Impact on Forging |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Upstream   | Underground or underwater crude oil and natural gas fields,<br>Drilling exploration wells that recover and bring the crude oil or raw natural gas to the surface                                                                                              | High              |
| Downstream | Key forging components Valve body, Gates, Studded Tee, Crosses, Rings, Slip Bowls, Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Valve Casing, Y Block, Flanges, Tube Sheet, Clad Body Valves                                             | High              |
| Midstream  | Has minimal impact on forging largely driven by pipes to distribution within refineries, processing plants, pipeline systems, tanker ships for liquefied natural gas (LNG) and crude oil, rail tank cars, and trucking fleets, as well as storage facilities. | Low               |

## Global Historic and Forecasted Upstream Capex, 2019-2031

Exhibit 46: Global Historic and Forecasted Upstream CAPEX, USD Bn 2019-2031



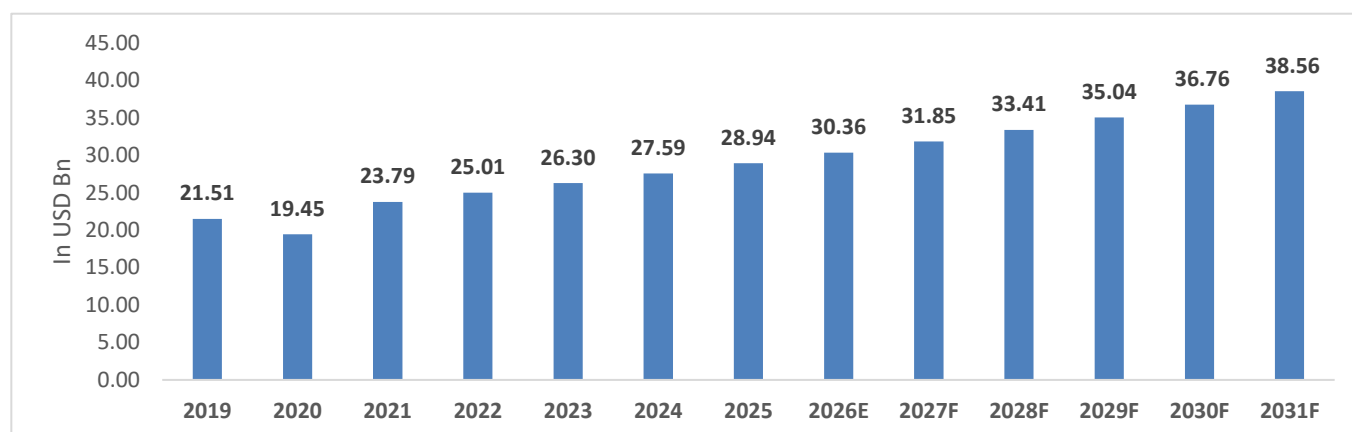
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Oil and Gas Upstream CAPEX was **USD 619 Bn** in 2025 from **USD 416 Bn** in 2019 and is estimated to grow with a **CAGR of 3.2%** from 2025 to 2031 and CAPEX is expected to mark **USD 753 Bn** by 2031.
- Oil and Gas companies have started transitioning to other forms of energy. The demand for fossil fuels will grow and drive Upstream CAPEX investments in the short to mid-term.

## Global Drilling Equipment Market Historic and Forecasted Trend, CY 2019-2031

**Exhibit 47: Global Drilling Equipment Market Trend, USD Bn CY 2019-2031**



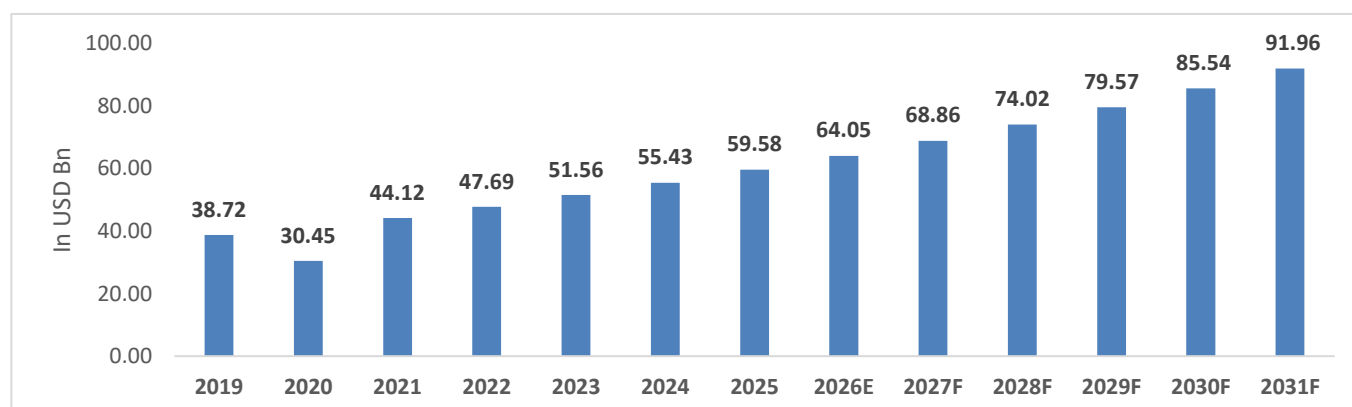
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Drilling equipment market was valued at **USD 28.94 Bn in 2025** poised to grow with a CAGR of **4.9%** from 2025 to 2031 is estimated to reach **USD 38.56 Bn by 2031**.
- **A 5% increase in Oil demand by 2025 was observed** with the support of drilling equipment for exploration, well development, and pipeline construction.
- The growing demand for fabricated metal products and heavy industrial equipment is also propelling the market, as precision drilling is essential for manufacturing and assembly processes.

## Global Hydraulic Fracturing Market Historic and Forecasted Trend, 2019-2031

**Exhibit 48: Global Hydraulic Fracturing Market Trend, USD Bn 2019-2031**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

## Exhibit 49: Region Wise Growth Drivers

| Key components driving demand: Well head connectors, Pressure tubing, Pistons, Cylinder rods, Clevis, End cap & Gland |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Key Regions                                                                                                           | Growth Drivers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Impact      |
| <b>Global Trend</b>                                                                                                   | <p>Innovations such as hydraulic fracturing (fracking) and horizontal drilling have unlocked previously inaccessible reserves, significantly increased supply and changing the global energy market landscape.</p> <p>Global Hydraulic Fracturing market was valued at <b>USD 59.58 Bn in 2025</b> and is estimated to grow with a CAGR of <b>7.5%</b> from <b>2025 to 2031</b> and mark <b>USD 91.96 Bn by 2031</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>High</b> |
| <b>North America</b>                                                                                                  | <p>High market penetration driven by hydraulic fracturing has enabled increased exploration and production activities in unconventional reserves.</p> <p>USA is one of the world's largest producers of shale gas, with abundant availability of prime shale resources. Permian (includes Occidental Petroleum, Chevron, Exxon Mobil), Eagle ford Woodbine, Appalachia (includes Marcellus and Utica shales), Hayneville-Brown Dense are among the key players involved in Hydraulic fracturing.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>High</b> |
| <b>Saudi Arabia</b>                                                                                                   | <p>Investments over <b>USD 100 billion</b> in unconventional gas program, driven by 3 major fields which are Jafurah, North Arabia, South Ghawar</p> <p>From 2018-2022, Saudi Aramco has awarded various contracts to Oil-Field Services companies to execute services covering fracturing, testing, wireline, coiled tubing, slickline services and all associated chemistry, logistics and site services.</p> <p>Saudi Aramco the ultimate end user along with, <b>U.S based Schlumberger, Halliburton Co. and Baker Hughes Co.</b> on the field and to develop the technology to fracture the rock and release the oil and gas it holds, a technology known as fracking.</p> <p>critical components driven by large Oil field entities such as Halliburton, Schlumberger, Baker Hughes, TAQA and NESR</p> <p>Secured an USD 11 billion lease-and-leaseback agreement in 2025 for Jafurah midstream gas processing to rapidly scale infrastructure.<sup>9</sup></p> <p>Halliburton was awarded a multi-billion-dollar contract in 2026 to deploy the Kingdom's first "intelligent fracturing platform" in the Jafurah basin.<sup>10</sup></p> | <b>High</b> |
| <b>Asia Pacific</b>                                                                                                   | <p>Has large technically recoverable shale and CMB reserves in China, Indonesia, and Australia, as well as heavy investment in the hydrocarbon sector through FDI channels in these countries, is expected to boost the market for leading companies to discover the opportunities that exist in these regional markets' unconventional hydrocarbon reserves.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Low</b>  |

<sup>9</sup> <https://www.aramco.com/en/news-media/news/2025/jafurah-midstream-deal>

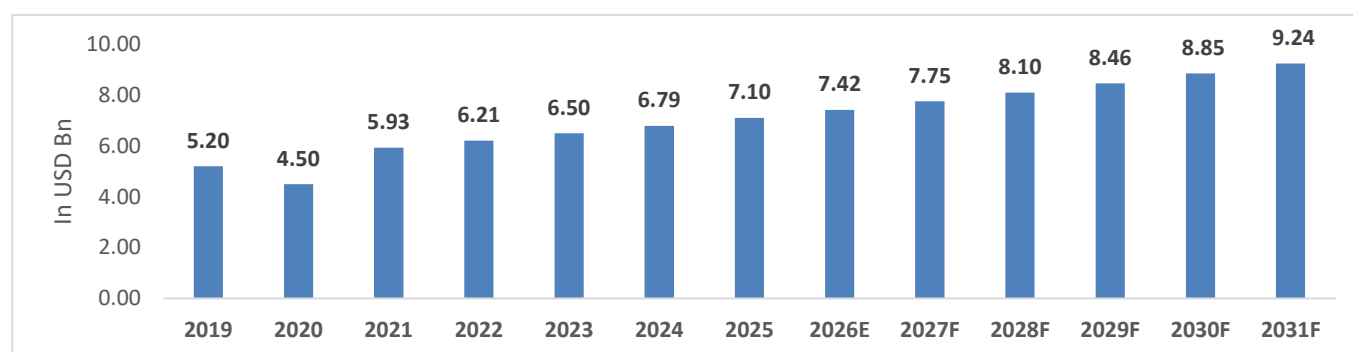
<sup>10</sup> <https://energynewsbeat.co/big-oil-companies/saudi-aramco-awards-halliburton-a-multi-billion-dollar-multi-year-contract-for-jafurah-unconventional-gas-development/>

Australia's Northern Territory opened 50 new unconventional gas exploration blocks in the Beetaloo Sub-basin via the 2026 Petroleum Acreage Release.<sup>11</sup>

Initial commercial shale gas production is targeted for mid-2026 in the Beetaloo basin, marking a definitive shift from discovery to active commercialization.<sup>11</sup>

## Global Wellhead Components Market Historic and Forecast, 2019-2031

### Exhibit 50: Global Wellhead Components Market, USD Bn 2019-2030



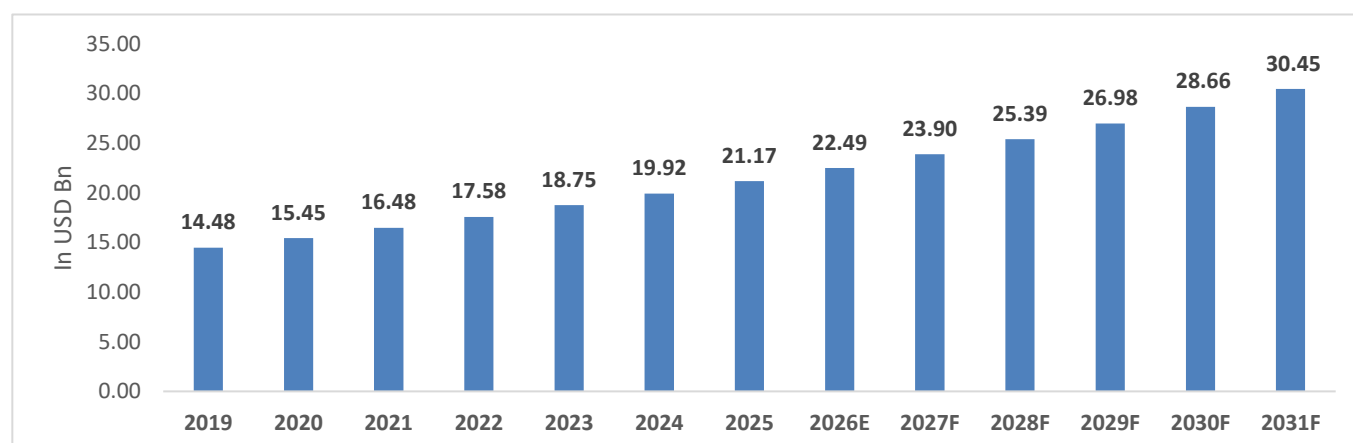
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Wellhead components market was valued at **USD 7.10 Bn in 2025** and is estimated to grow with a CAGR of **4.5%** from **2025 to 2031** and mark **USD 9.24 Bn by 2031**.
- As accessible onshore reserves become depleted, Oil and Gas companies are increasingly turning to offshore fields to meet global energy demands. This shift requires specialized wellhead components that can operate reliably in harsh marine environments and at great depths.
- **North America is driven by US and Canada** are the world's largest producers of oil and natural gas, with extensive onshore and offshore operations.

## Subsea Equipment Market Historic and Forecast, 2019-2031

### Exhibit 51: Subsea Equipment Market, USD Bn 2019-2031



Source: Frost & Sullivan Analysis

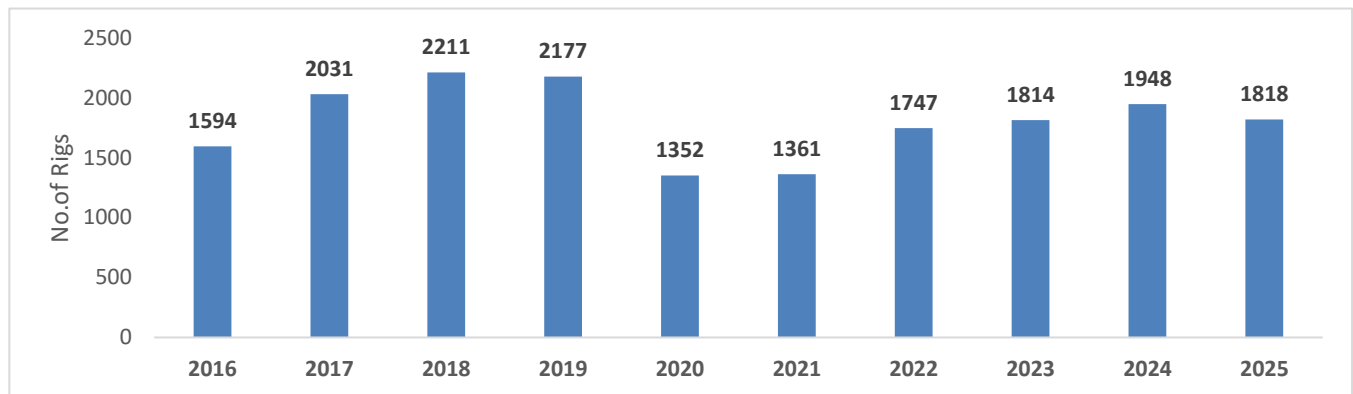
E-Estimated, F-Forecasted

<sup>11</sup> <https://www.ogj.com/general-interest/government/news/55361066/australia-releases-new-beetaloo-sub-basin-acreage>

- Global Subsea Equipment market was valued at **USD 21.17 Bn in 2025** and is estimated to grow with a CAGR of **6.25%** from **2025 to 2031** and mark **USD 30.45 Bn by 2031**, Riser, keel and stress joints, Kelly mandrels, reamer bodies, Drill heads, Tension rings are some of the key Forging components.
- Stringent regulatory requirements regarding safety and environmental protection are driving the demand for advanced subsea equipment.
- Governments and regulatory bodies have implemented rigorous standards to mitigate risks associated with offshore operations.

## Global Rigs Count

**Exhibit 52: Global Rigs Count, 2016-2025**

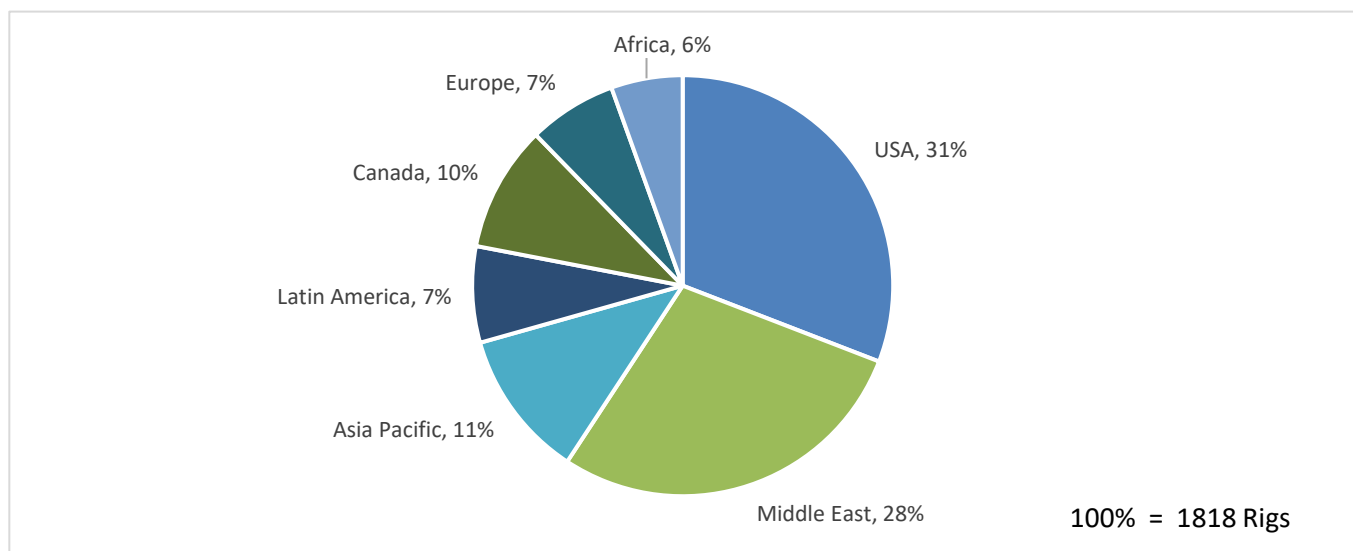


Source: Statista | Baker Hughes Worldwide Rig Count Report (August 2026)

- Global average rig count (including both land and offshore rigs) has grown at a **CAGR of 1.5%** from **2016 to 2025**.
- Following the dip in **2020**, the rig count witnessed a strong recovery, peaking again at **1,948 rigs in 2024** before stabilizing at **1,818 rigs in 2025**.

## Rigs Count by Region, 2025

**Exhibit 53: Global Rigs Count by Region, 2025**

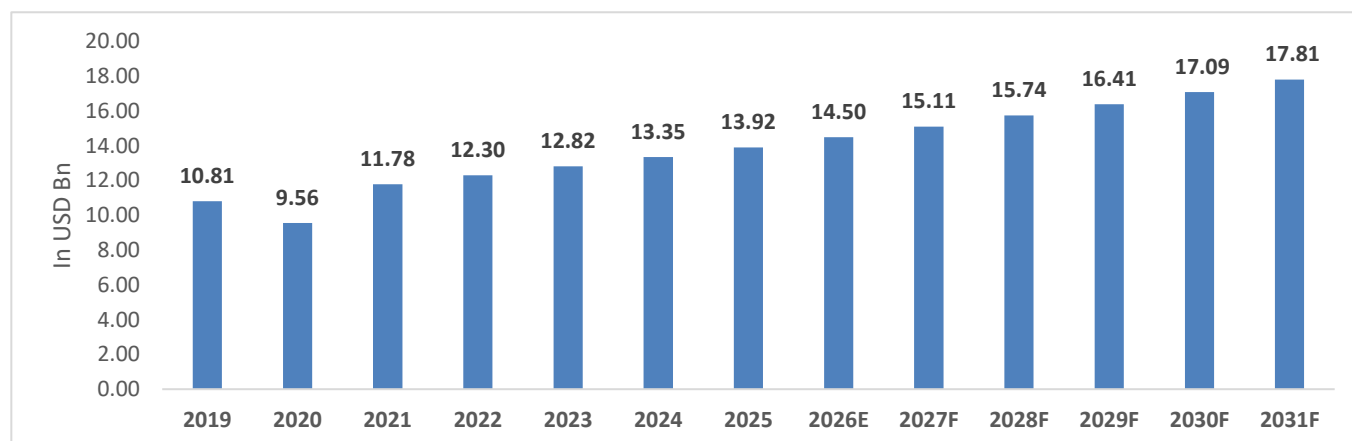


Source: Baker Hughes Worldwide Rig Count Report (August 2026)

- US still leads the average rig count with **30.9% of the Global total**; its overall share has dropped noticeably compared to previous years. In contrast, the **Middle East has surged to 28.4% of the global share** (up from **18% in 2025**).

## Global Oil and Gas Valve Market, 2019-31

Exhibit 54: Global Oil and Gas Valves Market, USD Bn 2019-2031



Source: Frost & Sullivan Analysis

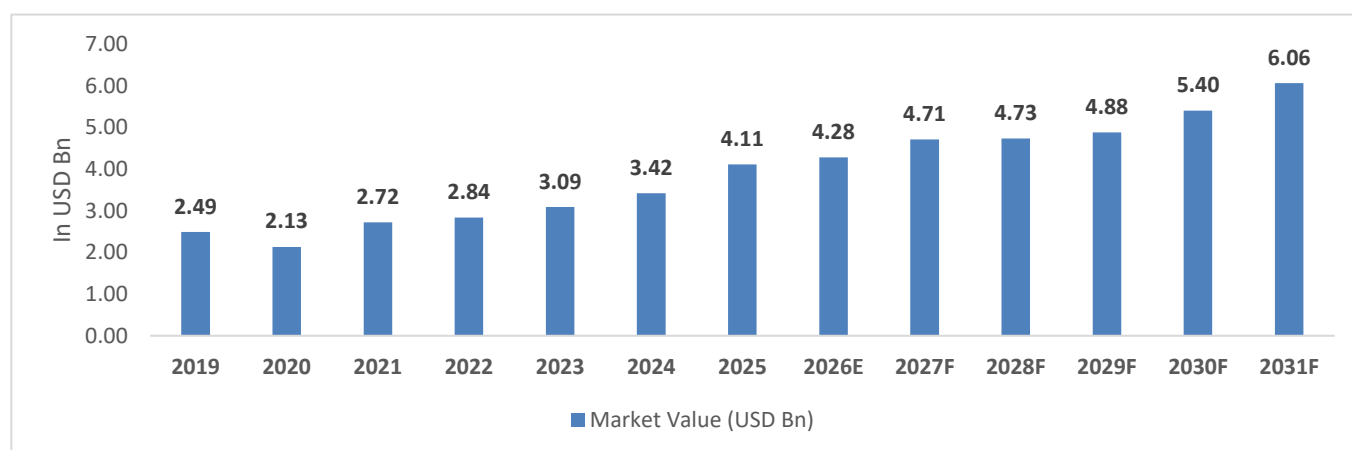
E-Estimated, F-Forecasted

- Global Oil and Gas Valves Market was valued at **USD 13.92 Bn in 2025** and is estimated to grow with a CAGR of **4.2 %** from **2025 to 2031** and mark **USD 17.81 Bn by 2031**, driven by the ever-increasing energy demands of the world, requiring innovative solutions and advanced technologies to ensure efficient and sustainable extraction, distribution, and utilization of oil and gas resources.

### 3.1.1.2 Global Renewable Energy

#### Global Overall Forging Market: Renewables 2019-2031

Exhibit 55: Global Overall Forging Market Trend, Renewables, USD Bn, 2019-31

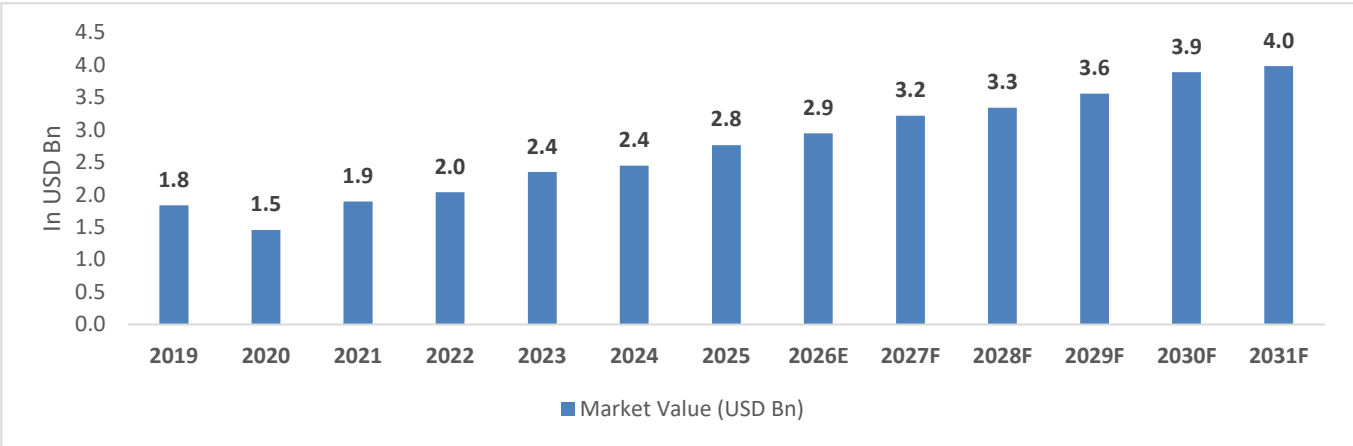


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global overall forging market for Renewables was valued at **USD 4.11 Bn in 2025** and is projected to mark **USD 6.06 Bn by 2031** with a CAGR of **6.7% from 2025 to 2031** driven by demand from wind energy segment, Solar and other segments.

Exhibit 56: Global Precision Forged Machined Components Market Trend, Renewables, USD Bn, 2019-31



Source: Frost & Sullivan Analysis

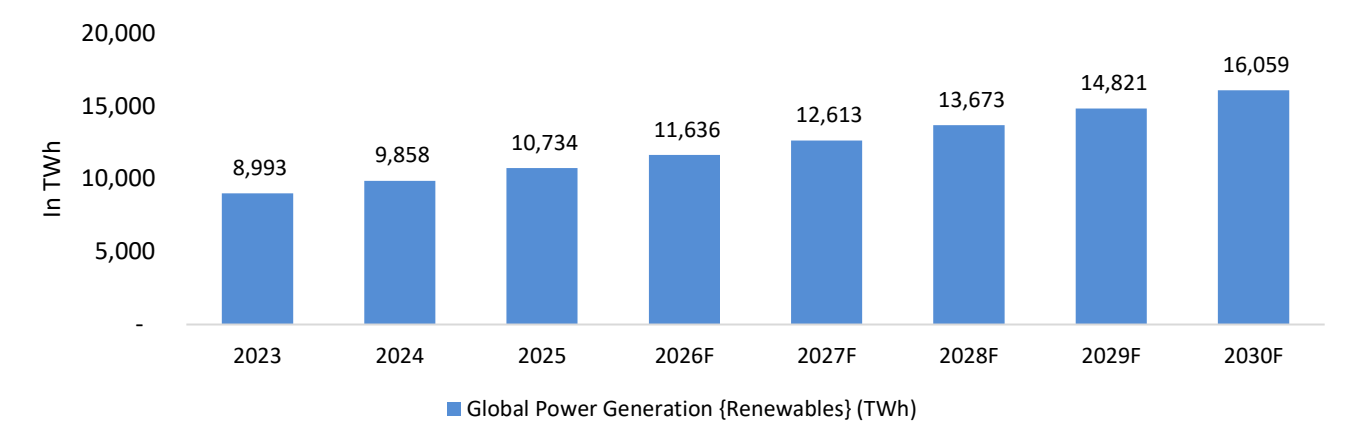
E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Renewables was valued at **USD 2.8 Bn** in 2025 and is projected to mark **USD 4.0 Bn by 2031** with a CAGR of **6.3% from 2025 to 2031** driven by demand from wind energy segment.

Global Renewable Power Generation and Capacity

- Renewable energy, including solar, wind, hydroelectric, and biomass, has gained traction due to declining costs, technological advancements, and increasing awareness of environmental issues such as climate change.
- The renewable power generated increased growing at a **CAGR of 8.4%** from **10,734 TWh** in 2025 to **16,059 TWh in 2030F**.
- Renewable power generation accounted for **34% in 2025** and is expected to grow to **43% in 2030F**.

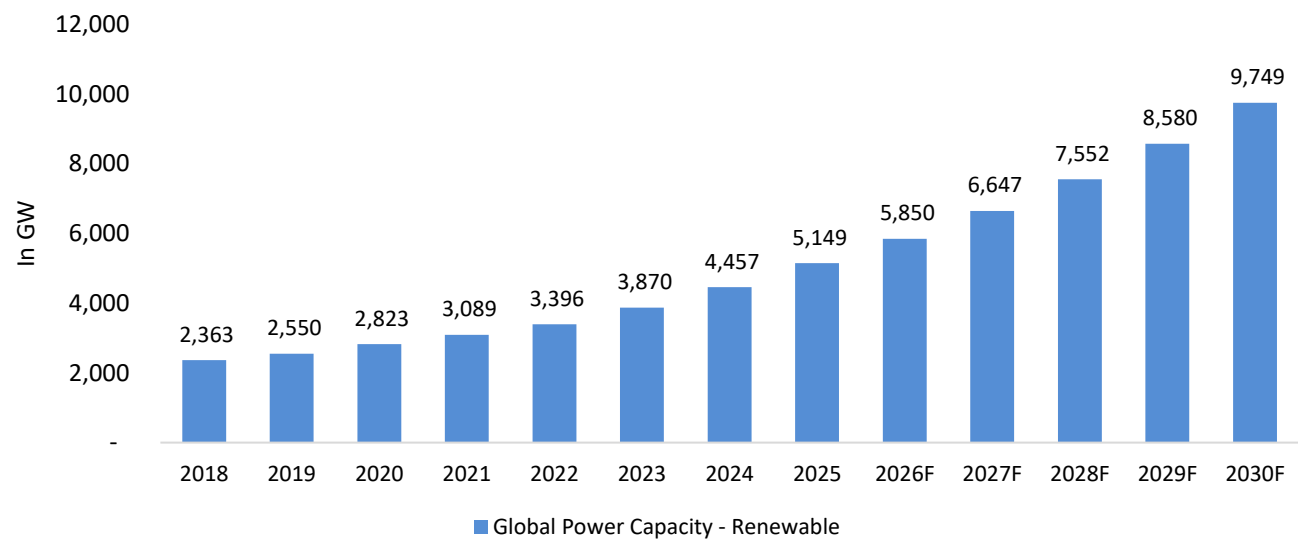
Exhibit 57: Global Power Generation-Renewable (In TWh),2023- 2030F



Source: IEA, Electricity Report 2026

E-Estimated, F-Forecasted

Exhibit 58: Global Power Capacity-Renewable (In GW),2018- 2030F

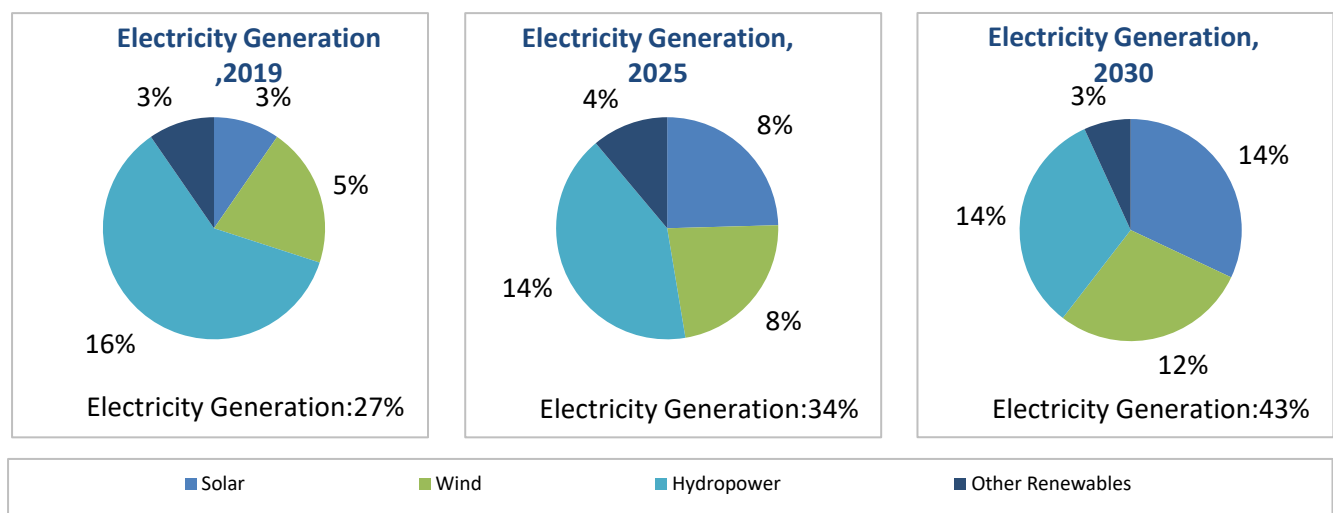


Source: [iea.org](https://www.iea.org)  
E-Estimated, F-Forecasted

Global Trends in Renewables

- Solar PV (Photovoltaic) will see the strongest growth of any generation source, adding over 600 TWh on average annually. It will account for roughly 60% of all new renewable generation growth through 2030.<sup>12</sup>
- Wind generation is forecast to grow at a robust average annual rate of around 10% globally. In the European Union, wind is set to become the single largest source of electricity generation overall, overtaking nuclear.<sup>12</sup>
- Hydropower will not remain the largest renewable source through 2030. Solar PV is officially projected to overtake hydropower globally by 2029 (and will overtake wind and nuclear by 2026).<sup>12</sup>
- Green hydrogen, produced using renewable energy, is gaining traction as a potential clean energy carrier.

Exhibit 59: Global Electricity Generation by Renewable Energy, 2019-2030



Source: IEA

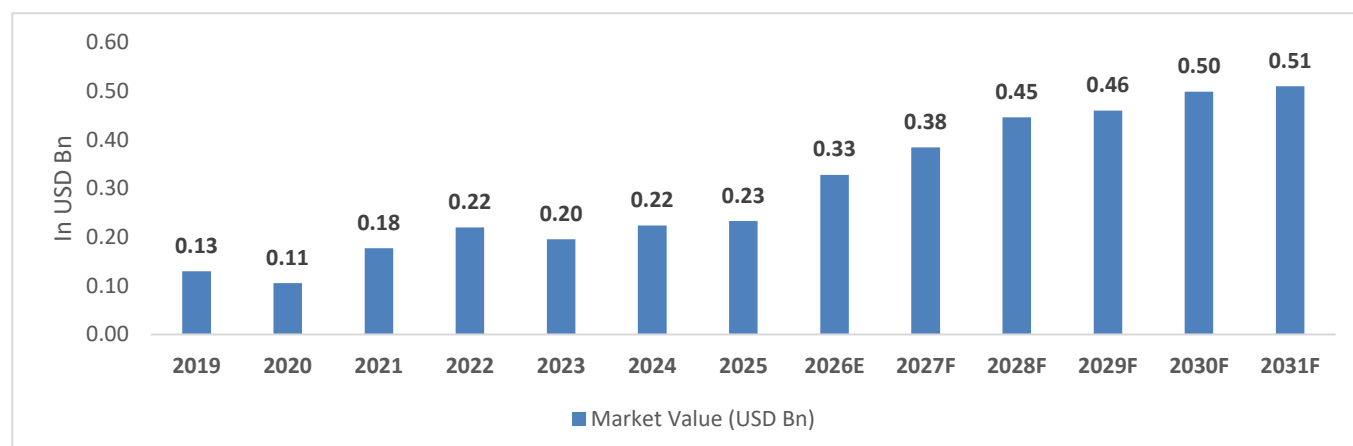
- Electricity Generation by Renewable Energy accounted for **27%** of the total electricity generated globally in 2019.

<sup>12</sup> IEA, Electricity Report 2026 (Page 36-38)

- It witnessed a 34% share of the total electricity generated supported by **Solar (8%), Wind (8%), Hydropower (14%) and others (4%) in 2025.**
- Electricity Generation by Renewables is projected to witness a **43% share** by 2030.

### Global Precision Forged Machined Components Market: Wind Energy 2019-2031

**Exhibit 60: Global Precision Forged Machined Components Market Trend, Wind Energy, USD Bn, 2019-31**



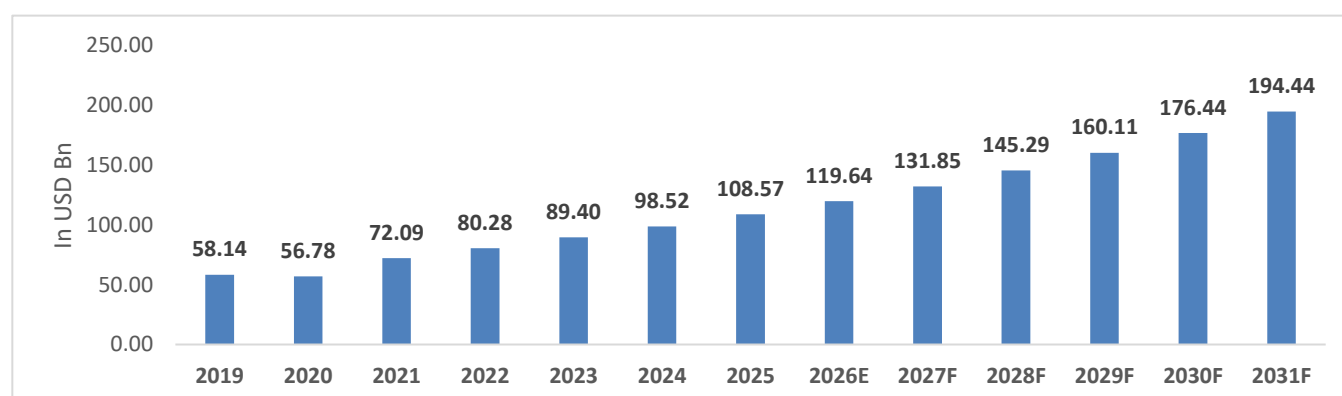
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Wind Energy was valued at **USD 0.23 Bn** in 2025 and is projected to mark **USD 0.51 Bn by 2031** with a CAGR of **13.93% from 2025 to 2031** driven by demand of wind energy components such as **Parts in the nacelle (gearbox, high-speed shaft, low-speed shaft and brake), the yaw drive for upwind turbines (shaft and gear) and tower components** for both downwind and upwind turbines.

### Global Wind Energy Market Trend

**Exhibit 61: Global Wind Energy Market Trend, USD Bn 2019-2031**



Source: Frost & Sullivan Analysis

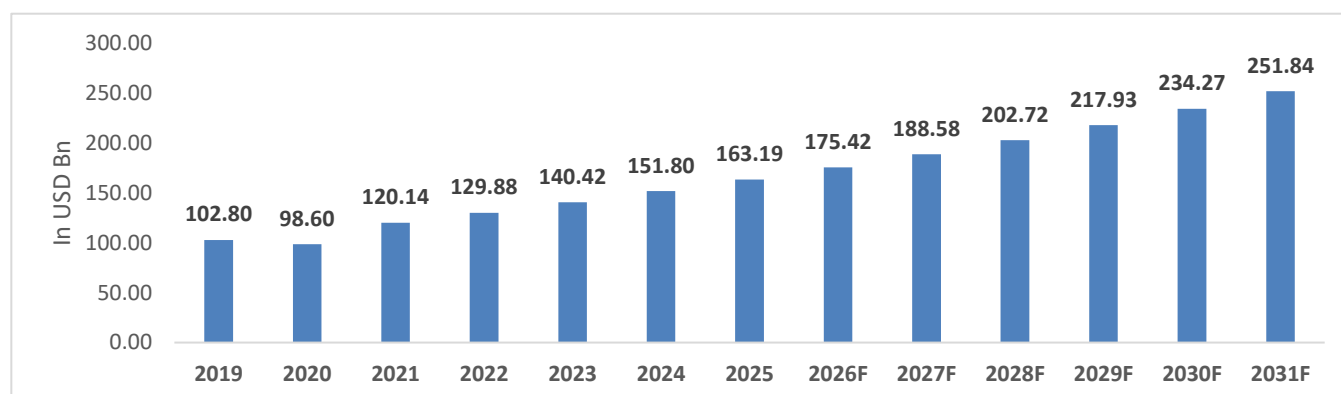
E-Estimated, F-Forecasted

- Globally, a record 165 GW of new wind power capacity was installed in 2025, representing a 40% increase over 2024 and taking cumulative global wind capacity to 1,299 GW. Annual installations are expected to increase to ~212 GW by 2030 under the current market outlook; however, installations need to reach ~320 GW per annum by 2030 to align with the COP28 Consensus target of tripling global renewable energy capacity.
- Global Wind Energy Market was valued at **USD 108.57 Bn in 2025** and is projected to grow at a **CAGR of 10.2% from 2025 to 2031** driven by policy support and to meet COP28 targets across the world.

- In 2025, Asia Pacific accounted for 43% share, North America (28%), Europe (21%), Latin America (5%) and Middle East and Africa (3%) of the Wind Energy Share.
- Asia Pacific contributed 71%, Europe (16%), North America (7%), Latin America (5%) and Africa and Middle East (1%) to the new capacity installations in 2025.

## Global Wind Turbines Market Trend

**Exhibit 62: Global Wind Turbine Market Trend, USD Bn CY 2019-2031**



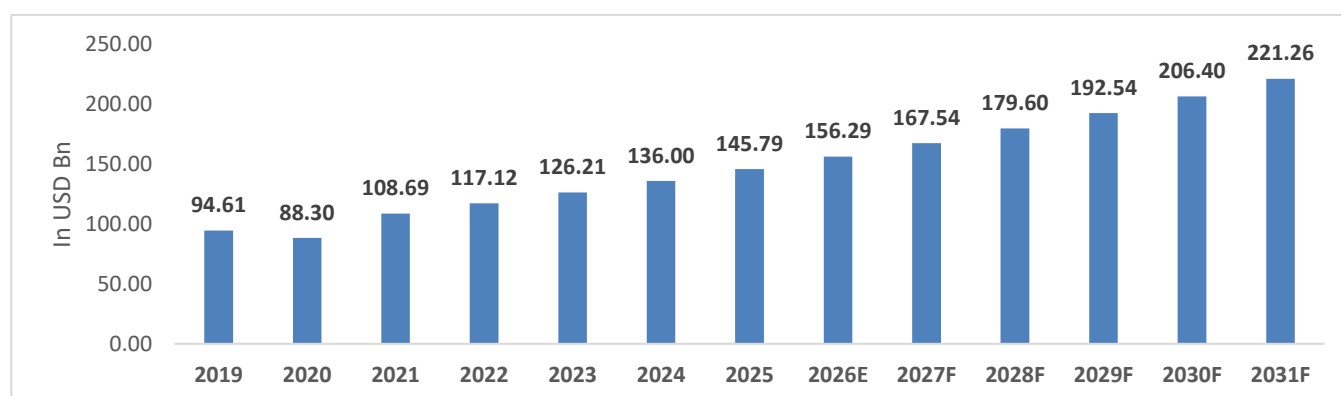
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Wind Turbine Market was valued at **USD 163.19 Bn in 2025** and is projected to grow at a **CAGR of 7.5% from 2025 to 2031** driven by favorable regulatory norms and NetZero emissions targets set by different countries.
- Globally, **28,395 wind turbines** were installed in 2025, representing a 23% increase year-on-year. These installations represented a record 178 GW of mechanically installed wind turbine capacity globally.
- The top five manufacturers by capacity installed in 2025 were all Chinese for the first time: **Goldwind (29.7 GW)**, **Envision (21.8 GW)**, **Windey (19.8 GW)**, **Mingyang (18.6 GW)** and **SANY (15.1 GW)**. Nine of the world's top 15 suppliers were Chinese
- 178 GW of wind turbine capacity was mechanically installed worldwide in 2025, representing a ~40% increase year-on-year. Chinese wind turbine suppliers continued to dominate the global market, accounting for approximately 67% of global installations, with China alone mechanically installing more than 130 GW of wind capacity during the year.

## Global Wind Turbine Components Market Trend

**Exhibit 63: Global Wind Turbine Components Market Trend, USD Bn 2019-2031**



Source: Frost & Sullivan Analysis

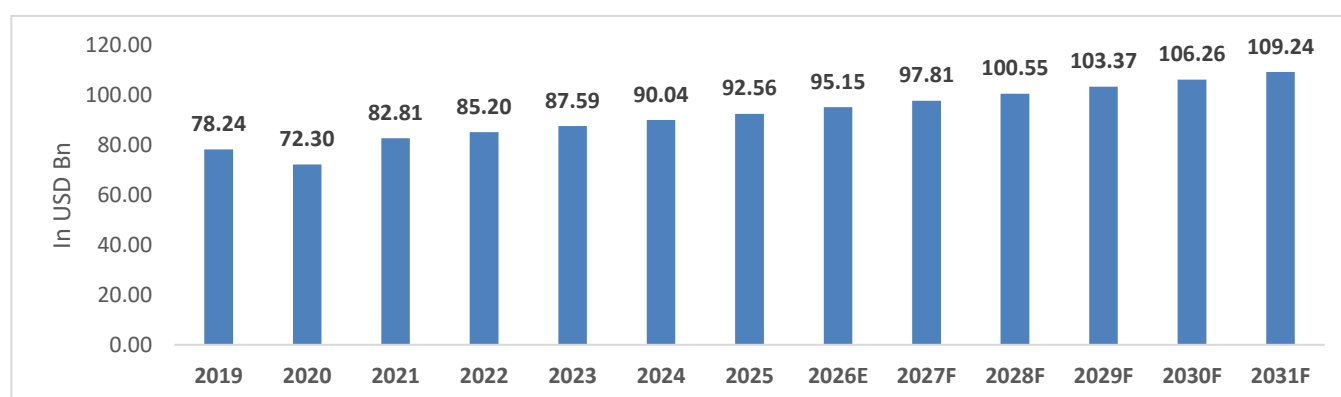
E-Estimated, F-Forecasted

- Global Wind Turbine Market was valued at **USD 145.79 Bn in 2025** and is projected to grow at a **CAGR of 7.2% from 2025 to 2031** driven by growing demand of renewable energy, rising incentives for wind energy projects, technological advancements in turbine design and the commitment to fulfill NetZero emission targets.
- Key components of the wind turbines are **Rotor Blades, Gearbox, Generator, Nacelle and Tower**. Rotor blades account for majority of the market share.

### 3.1.1.3 Global Nuclear Energy

#### Global Nuclear Power Market

**Exhibit 64: Global Nuclear Power Market Trend, USD Bn CY 2019-2031**



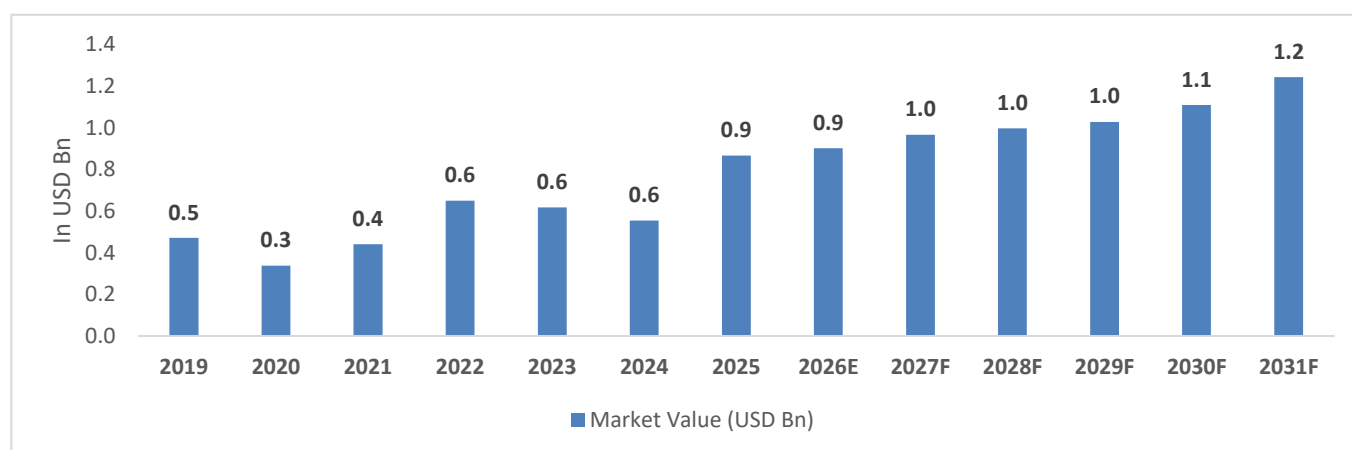
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Nuclear Power market was valued at **USD 92.56 Bn in 2025** and is projected to grow at a **CAGR of 2.8% from 2025 to 2031** driven by advantage of low carbon emission energy sources.

#### Global Overall Forging Market: Nuclear Energy CY 2019-2031

**Exhibit 65: Global Overall Forging Market Trend, Nuclear Energy, USD Bn, CY 2019-31**



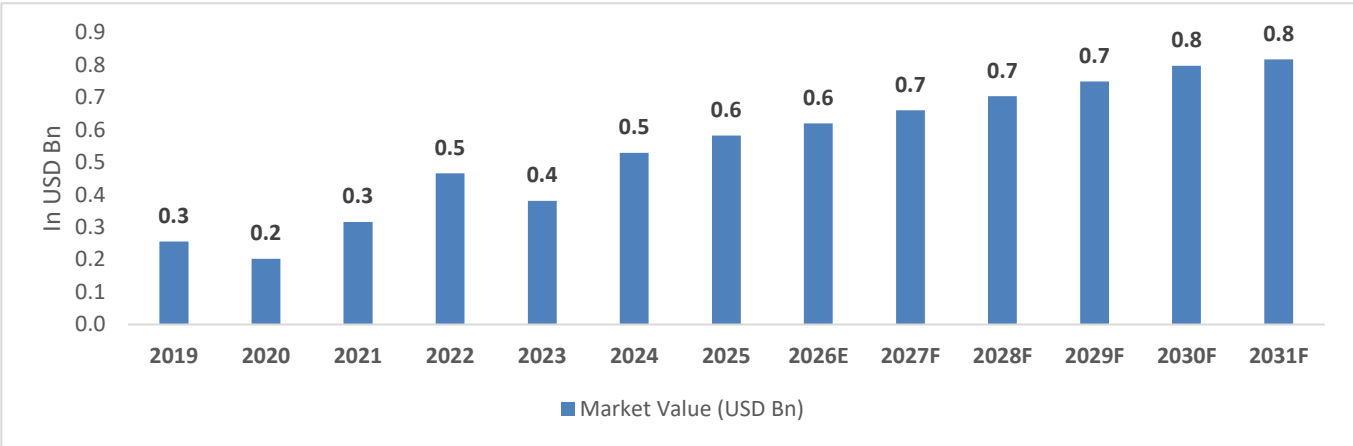
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall Forging Market for Nuclear Energy was valued at **USD 0.9 Bn in 2025** and is projected to mark **USD 1.2 Bn by 2031 with a CAGR of 6.2% from 2025 to 2031** driven by demand of raw forging and machined components such as pump and pump shafts, flanges, gears and tubes, drilling block, tees and bends, connectors, rings, transition cones and discs.

Global Precision Forged Machined Components Market: Nuclear Energy CY 2019-2031

Exhibit 66: Global Precision Forged Machined Components Market Trend, Nuclear Energy, USD Bn, CY 2019-31



Source: Frost & Sullivan Analysis

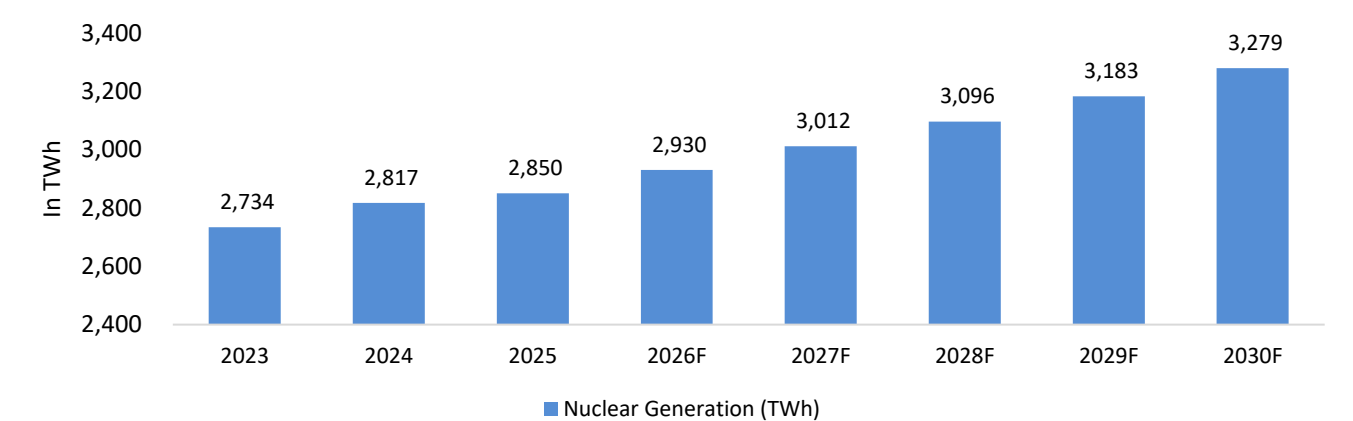
E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Nuclear Energy was valued at **USD 0.6 Bn** in 2025 and is projected to mark **USD 0.8 Bn by 2031 with a CAGR of 5.8% from 2025 to 2031** driven by demand of components such as pump and pump shafts, flanges, gears and tubes, drilling block, tees and bends, connectors, rings, transition cones and discs.

Global Power Generation and Capacity:

- Nuclear energy accounts for around 4% of the total installed capacity, especially as countries seek to transition towards cleaner and more sustainable energy systems to address the challenges of climate change and ensure energy security.
- Remains a key component of the global energy mix, particularly in countries like the **United States, France, China, and Russia**, which host a substantial number of nuclear reactors who rely on nuclear power to meet their electricity demands while reducing greenhouse gas emissions and mitigating climate change

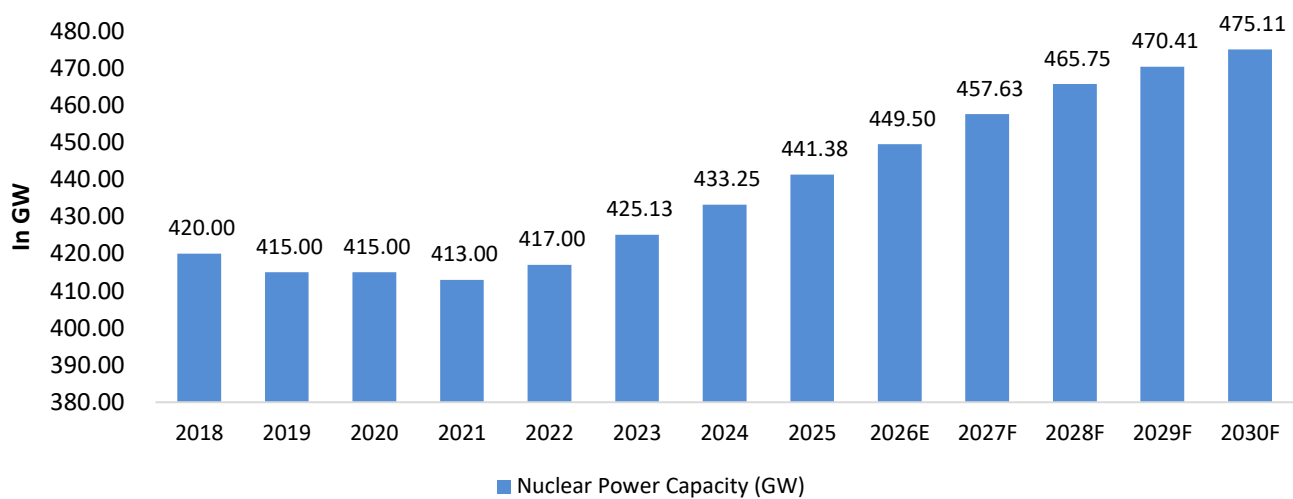
Exhibit 67: Global Power Generation-Nuclear (In TWh), 2023- 2030F



Source: IEA, Electricity Report 2026

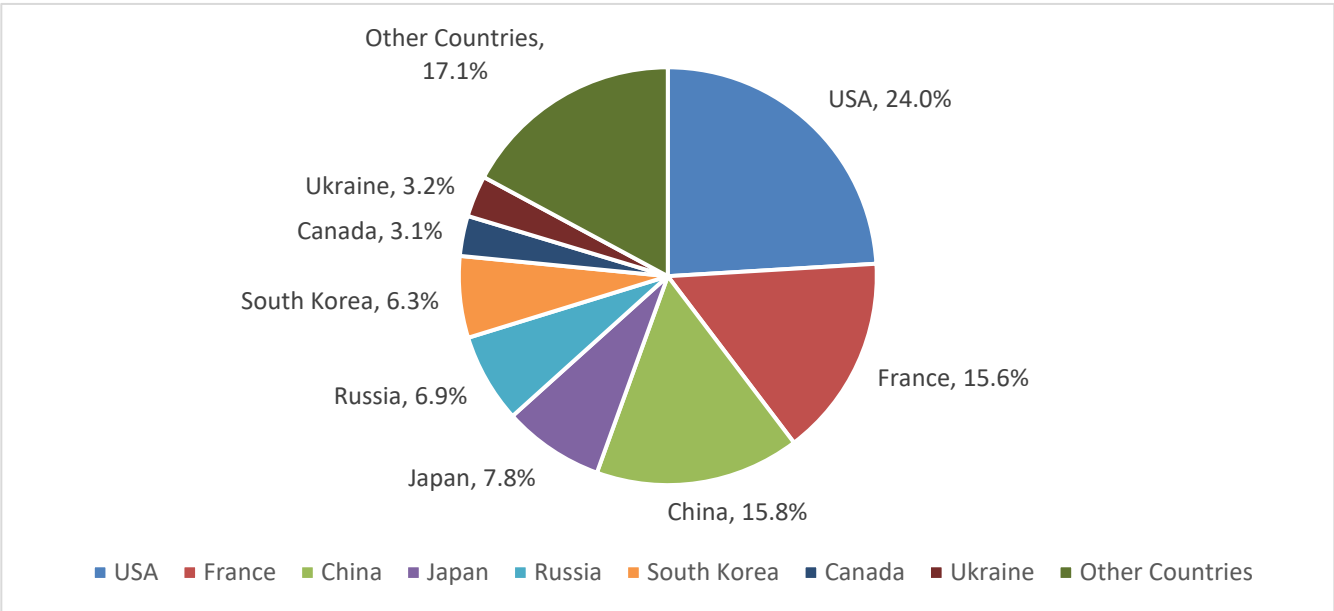
E-Estimated, F-Forecasted

Exhibit 68: Global Power Capacity-Nuclear (In GW),2018- 2030F



Source: *iea.org*  
E-Estimated, F-Forecasted

Exhibit 69: Global Nuclear Power Generation Capacity by Country, 2025



Source: *World Nuclear Association*

- There were **441** nuclear reactors in operation globally in 2025 (totaling ~404.1 GW) with USA leading with 94 reactors, followed by **China (57), France (57), Russia (36), Japan (33), South Korea (26) and India (21)** are among the key nations.
- **The global expansion pipeline is massive: 80 reactors are actively under construction** (set to add ~87 GW of gross capacity), and another **123 reactors are planned** (~112.4 GW) worldwide.
- The **USA** maintains the highest installed capacity, representing **24.0%** of the global mix. Notably, **China (15.8%) has now officially surpassed France (15.6%)** as the second-largest nuclear capacity holder globally.
- **China dominates the new-build pipeline**, aggressively adding to its fleet with **38 reactors currently under construction** (~43.3 GW) and an additional **43 planned** (~49.2 GW).
- **India and Russia** are also driving significant regional expansion. **India has 8 reactors under construction and 14 planned**, while **Russia has 7 under construction and 23 planned**.

## Exhibit 70: Nuclear Capacity Panned by Countries

| Country        | No. of Reactors | Capacity (Gross MW) |
|----------------|-----------------|---------------------|
| China          | 43              | 49,235              |
| Russia         | 23              | 21,000              |
| India          | 14              | 8,275               |
| Poland         | 7               | 4,950               |
| Uzbekistan     | 4               | 2,110               |
| United Kingdom | 3               | 3,830               |
| Czech Republic | 3               | 2,570               |
| Sweden         | 3               | 1,500               |
| Others*        | 23              | 18,913              |
| <b>World</b>   | <b>123</b>      | <b>1,12,383</b>     |

Source: World Nuclear Association

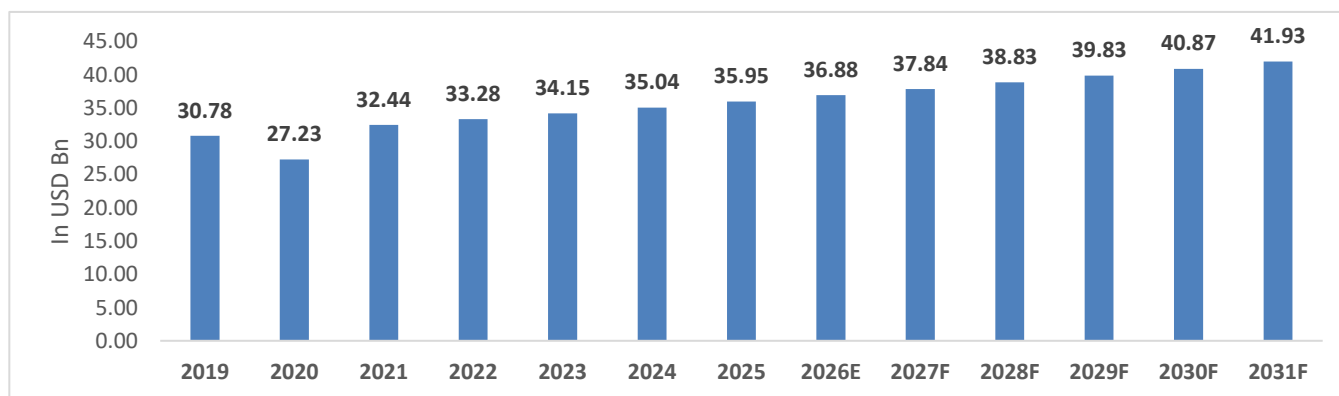
Others\* includes Bulgaria (2), France (2), Iran (2), Kazakhstan (2), Romania (2), Ukraine (2), Vietnam (2), Belarus (1), Canada (1), and Hungary (1).

### Global Trends in Nuclear:

- There are **over 160 nuclear plants operating in Europe**, with another **13 currently under construction**. **France** remains a massive proponent, generating **68.1% of its domestic electricity** from nuclear power sources.
- Following the inaugural Nuclear Energy Summit and COP29, **31 countries have officially endorsed a declaration to triple global nuclear capacity by 2050** to reduce fossil fuel reliance and meet climate targets.<sup>13</sup>

### Global Nuclear Power Equipment Market

#### Exhibit 71: Global Nuclear Power Equipment Market Trend, USD Bn CY 2019-2031



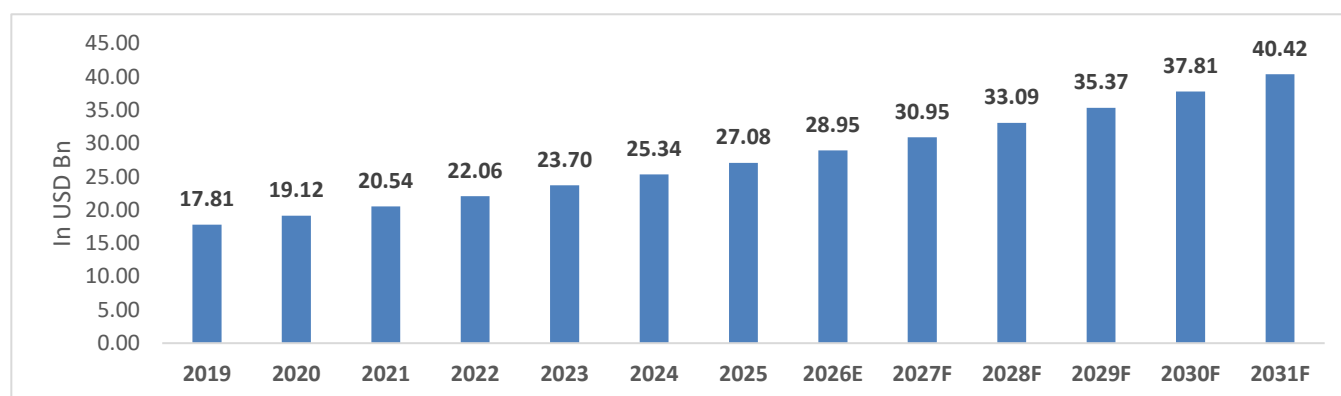
Source: Industry Report

E-Estimated, F-Forecasted

- Global Nuclear Power Equipment Market was valued at **USD 35.95 Bn in 2025** and is projected to grow at a **CAGR of 2.6% from 2025 to 2031** driven by rising energy demand production of clean electricity.

<sup>13</sup> IAEA Annual Report 2024

**Exhibit 72: Global Cryogenic Equipment Market Trend, USD Bn CY 2019-2031**



Source: Industry Report

E-Estimated, F-Forecasted

- Global Cryogenic Equipment Market was valued at **USD 27.08 Bn in 2025** and is projected to grow at a **CAGR of 6.9 % from 2025 to 2031** driven by its unique properties of cryogenic technology for metallurgy and in automotive segments.
- Cryogenic Equipment is used for **Storage and Distribution applications. The storage application segment led the market and accounted for a share of 57.3% in 2025 while distribution applications witnessed 42.7% share.**
- Globally, the metallurgy sector is seeing a sharp increase in demand for cryogenic equipment, which is essential for enabling advanced processing methods.
- In metallurgical applications, cryogenic equipment is essential, especially when it comes to treating and working with metals at very low temperatures.
- The demand for cryogenic equipment market is driven by increasing demand for natural gas and the expanding energy industry. As more countries shift towards cleaner energy sources, the need for liquefied natural gas is rising, which in turn requires extensive cryogenic equipment for storage and transportation.

### 3.1.2 Energy India Overview

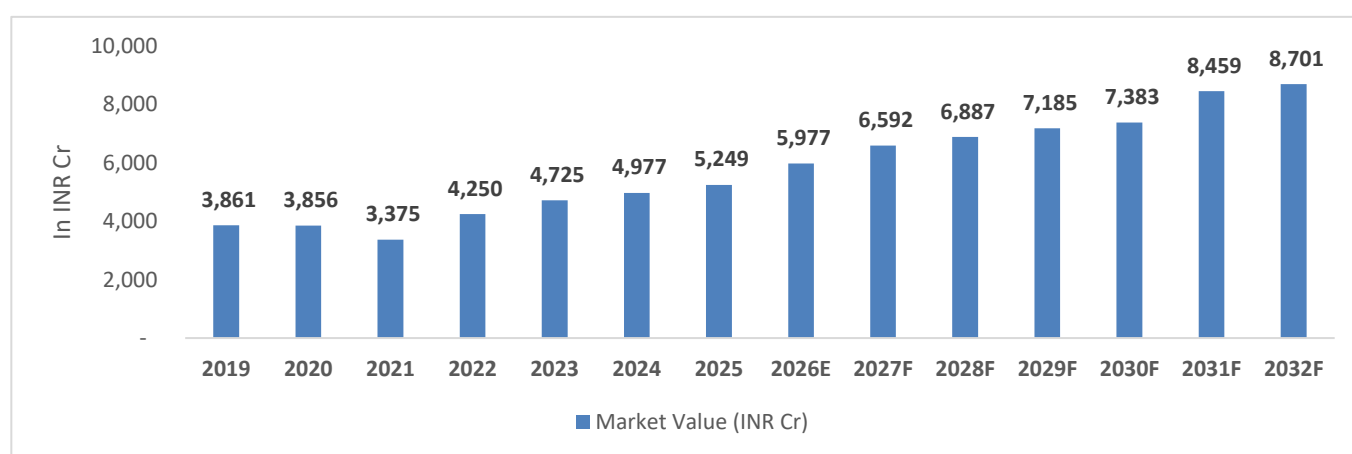
#### 3.1.2.1 Energy:

- The Demand for Energy in India is mostly met by fossil fuels where in Coal accounts for **55.1%**, Crude Oil **27.6%**, Renewables **5.9%**, Natural Gas **5.7%**, Hydroelectricity **4.5%** and nuclear energy **1.2%**.
- The increasing adoption of nuclear power** as an alternative to conventional energy sources further contributes to expanding the forging industry.
- Overall Forging market for Energy sector was valued at **INR 7,776 Crores in FY 2025-26** which accounts for **35%** of the total non-automotive forging demand in India.
- The demand of forgings in Energy sector, including energy turbines, is projected to grow at a **CAGR of 7.5%** from **FY 2026 to FY 2032**.
- Forged products such as **Valve body, Gates, Studded Tee, Crosses, Rings, Slip Bowls, Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Valve Casing, Y Block, Flanges, Tube Sheet and Clad Body Valves** will experience a boost with the growth of Energy sector in India.
- The Nuclear power industry extensively on forged metal parts for various critical applications such as **reactors, nuclear waste storage and transportation** of raw materials and waste.

- **Precision Forged components** are crucial in manufacturing pressure vessels due to their ability to withstand high temperatures and pressures. The utilization of forged parts in machines within the nuclear power segment which operates under extreme conditions is a significant driver of growth in the forged market.
- The Indian Government has set a highly ambitious, long-term target to scale civil nuclear capacity to **100 GWe by 2047**. This expansion requires a massive transformation of the domestic heavy precision forging supply chain.<sup>14</sup>
- The government's approval of **10 indigenous 700 MWe Pressurized Heavy Water Reactors (PHWRs) to be built in "fleet mode"** has generated a consolidated, bulk procurement pipeline for domestic forging companies capable of manufacturing critical components like reactor pressure vessels, steam generators, and primary piping.<sup>15</sup>

## India Overall Forging Market: Energy, FY 2019-2032

**Exhibit 73: India Overall Forging Market Trend, Energy, INR Cr, FY 2019-32**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

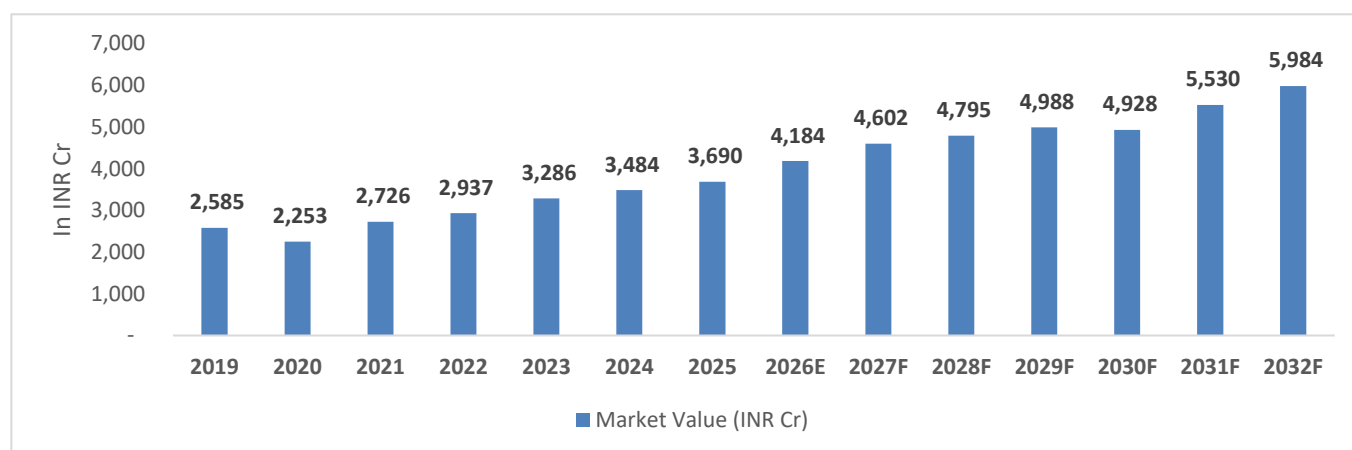
- Indian Overall forging Market for Energy was valued at **INR 5,977 Crores in FY 2026** and is projected to mark **INR 8,701 Crores by FY 2032** with a **CAGR of 6.5% from FY 2026 to FY 2032** driven by demand of **raw forgings and forged machined components** from the **Oil and Gas, Renewables and Nuclear Energy segments**.

<sup>14</sup> <https://world-nuclear.org/information-library/country-profiles/countries-g-n/india>

<sup>15</sup> <https://www.pib.gov.in/PressNoteDetails.aspx?Noteld=159731&ModuleId=3&reg=3&lang=1>

## India Precision Forged Machined Components Market: Energy, FY 2019-2032

**Exhibit 74: India Precision Forged Machined Components Market Trend, Energy, INR Cr, FY 2019-32**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

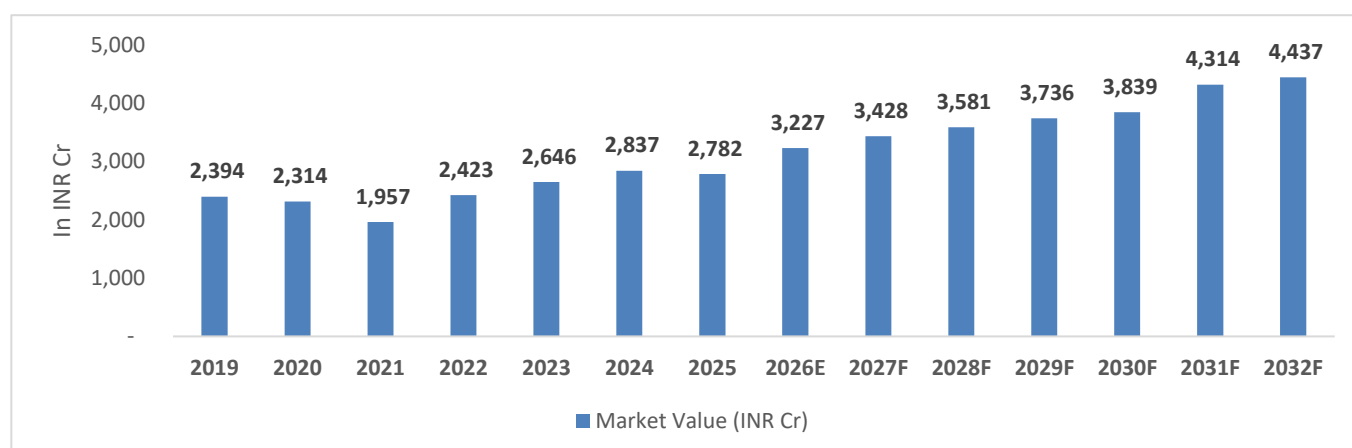
- Indian Precision Forged Machined Components Market for Energy was valued at **INR 4,184 Crores in FY 2026** and is projected to mark **INR 5,984 Crores by 2031** with a **CAGR of 6.1% from FY 2026 to 2032** driven by growth of precision forged machined components demand from the Oil and Gas, Renewables and Nuclear Energy segments.

### 3.1.2.2 Oil and Gas

- India is the world's 3<sup>rd</sup> largest oil importer and consumer.
- India's economic growth is closely related to its energy demand; it retained its spot as **the third-largest consumer** of oil in the world as of 2023.
- India has set a target to raise the share of natural gas in the energy mix to **15% by 2030** from about 5.7% now. India is expected to be the largest driver of global oil demand between 2024 to 2030 taking a lead from top importer China.
- The Government has allowed **100%** foreign direct investment (FDI) in natural gas, petroleum products and refineries.

## India Overall Forging Market: Oil and Gas, FY 2019-2032

**Exhibit 75: India Overall Forging Market Trend, Oil and Gas, INR Cr, FY 2019-32**



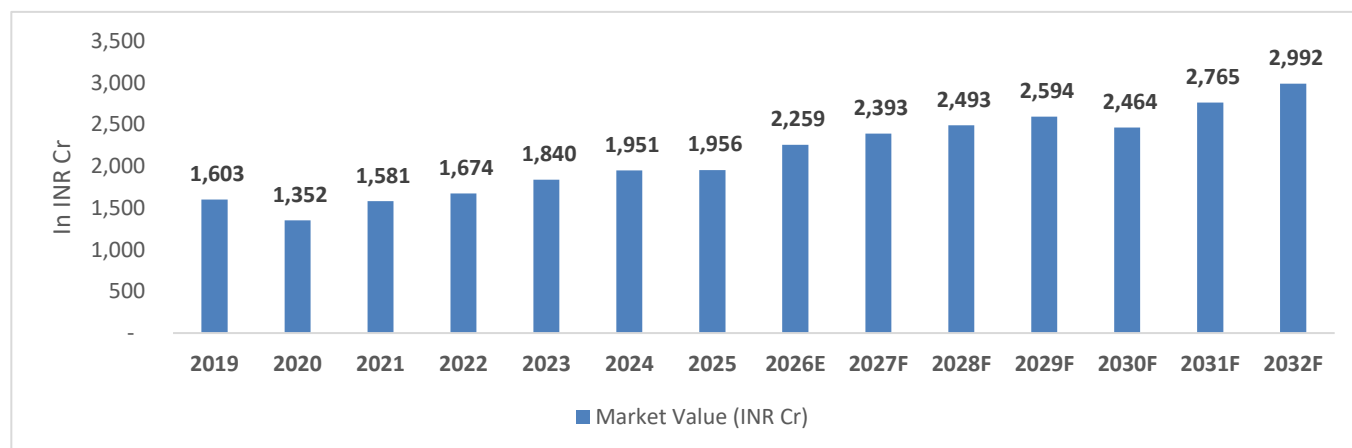
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forging Market for Oil and Gas was valued at **INR 3,227 Crores in FY 2026** and is projected to mark **INR 4,437 Crores by FY 2032** with a **CAGR of 5.4% from FY 2026 to 2032** driven by growth in demand of raw forgings and machined components such as flanges, bonnet forgings, valve bodies, stems and impellers.

#### India Precision Forged Machined Components Market: Oil and Gas, FY 2019-2032

**Exhibit 76: India Precision Forged Machined Components Market Trend, Oil and Gas, INR Cr, FY 2019-32**

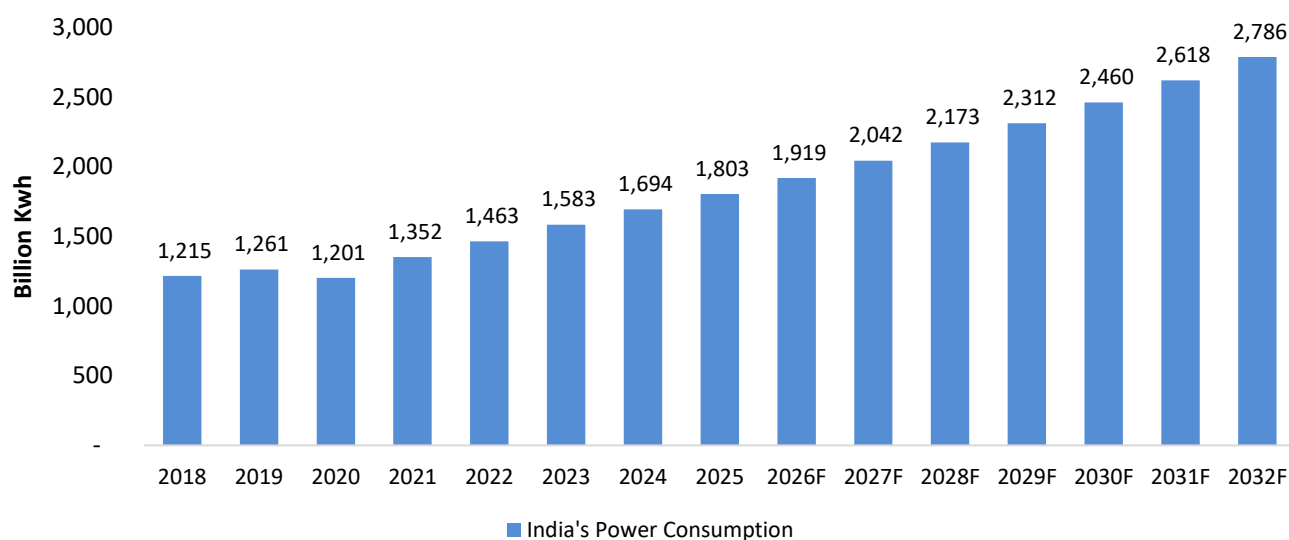


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision Forged Machined Components Market for **Oil and Gas** was valued at **INR 2,259 Crores** in FY 2026 and is projected to mark **INR 2,992 Crores by FY 2032** with a **CAGR of 4.8% from FY 2026 to FY 2032** driven by growth in demand of components such as flanges, bonnet forgings, valve bodies, stems and impellers.

#### Exhibit 77: India's Power Consumption, FY 2018-FY 2032F

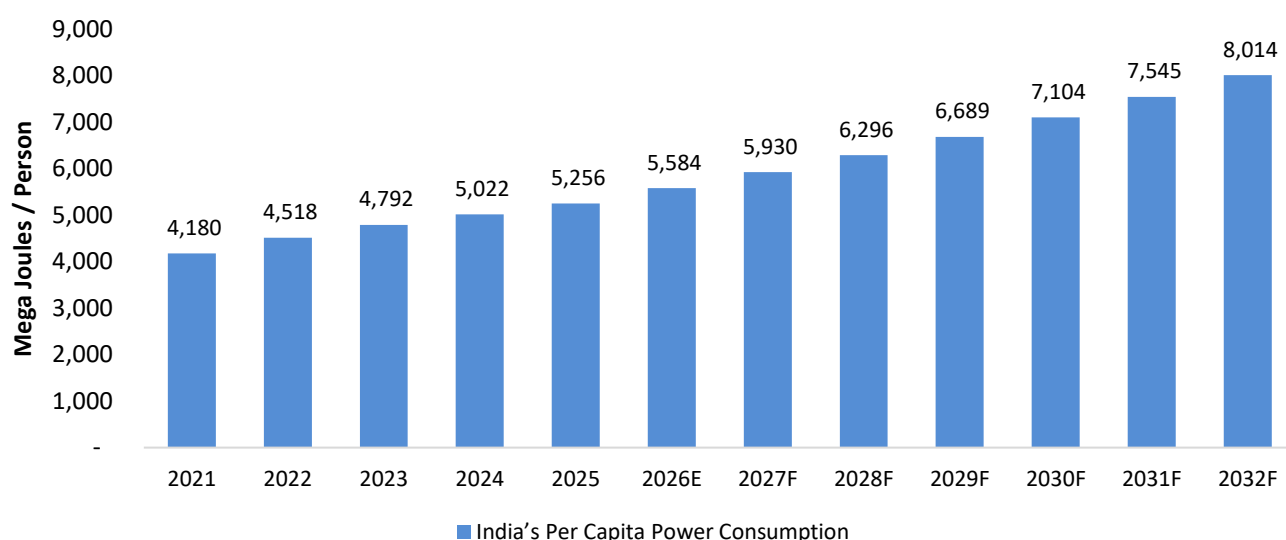


Source: CEA, EIA, Electricity Data, India

E-Estimated, F-Forecasted

- India's power consumption is on a steep climb, fueled by a booming economy, rising living standards, and rapid urbanization. The Indian power consumption has increased from **1,215.00 billion KWh in 2018** to **1,909 billion KWh in 2026** and is expected to further grow to **2,786 billion KWh by 2032F**.

## Exhibit 78: India's Per Capita Power Consumption



Source: PIB

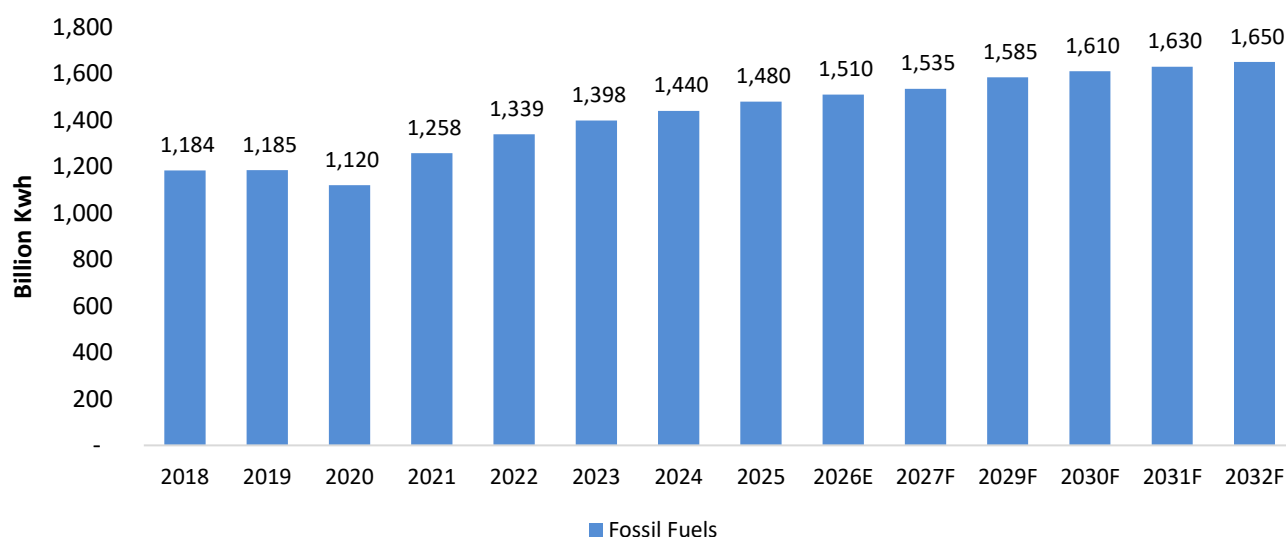
E-Estimated, F-Forecasted

### Indian Per capita power consumption

- The average electricity consumption per person was around **4,180 Mega Joules/ Person in FY21**, which increased to **5,256 Mega Joules/Person in FY 2025** and for FY 2026 it is estimated to reach **5,584 Mega Joules/Person**.

### India Power Generation and Capacity- Fossil Fuel (FY 2018-2032F)

#### Exhibit 79: India Power Generation-Fossil fuel (Billion KWh) FY 2018-2032F



Source: Energy Information Administration, India

E-Estimated, F-Forecasted

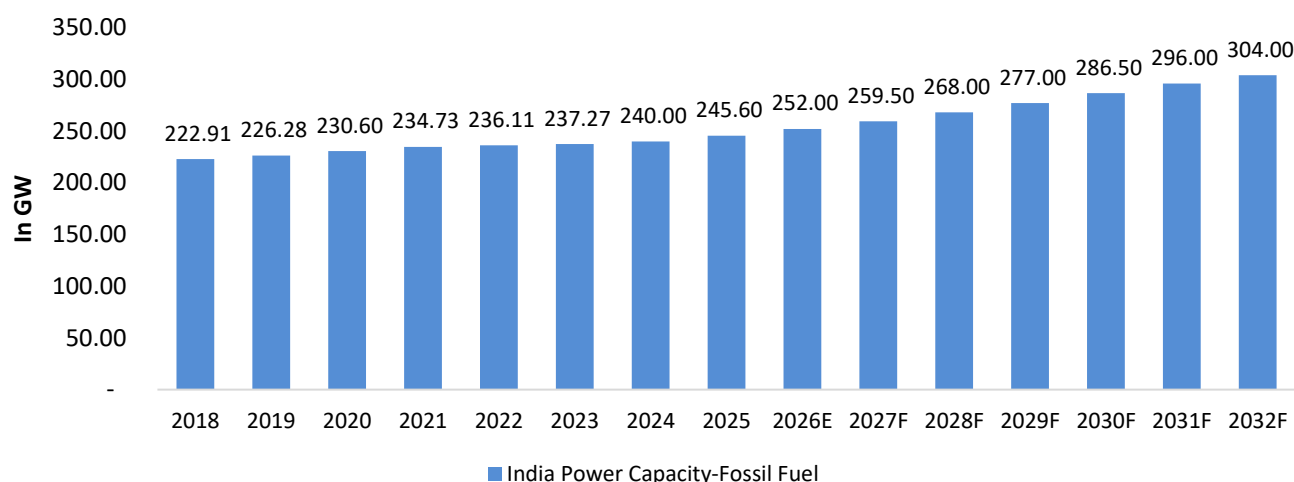
### India Power Generation-Fossil Fuel

- India relies heavily on Thermal generation, the other fossil fuels which are used are natural gas, lignite and diesel.
- Fossil fuels accounted for ~75% of India's electricity generation in 2025, down from ~79.5% in 2018, reflecting the increasing penetration of renewable energy sources, particularly solar and wind, in the

country's power generation mix despite coal's abundance and domestic availability, it poses significant environmental challenges of greenhouse gases, exacerbating air quality and climate change issues.

- The power generation in India from fossil fuel was 1,480 billion KWh in 2025 and this is expected to grow to **1,650 billion KWh by FY 2032F**. The government aims to augment the proportion of cleaner energy sources like solar and wind in the energy matrix. However, due to their cost-effectiveness and established infrastructure, fossil fuels are anticipated to remain the primary source of power generation in India during the forecast period.

**Exhibit 80: India Power Capacity-Fossil Fuel (GW) FY 2018- 2032F**



Source: Central Electricity Authority, Installed Capacity Report

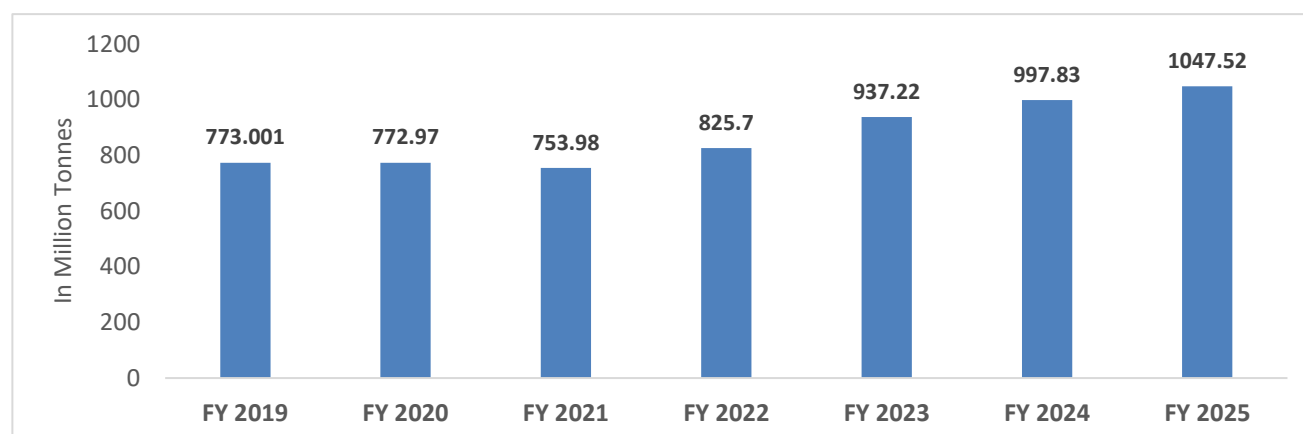
E-Estimated, F-Forecasted

#### India Power Capacity-Fossil Fuel:

- Coal contributes **55%** of the total capacity. Despite being abundant and reliable, these sources pose environmental challenges, contributing to pollution and climate change.
- The capacity of fossil fuels is expected to increase from **245.60 GW in 2025 to 304 GW in 2032F** at a **CAGR of 3.1%**. Despite environmental apprehension, coal continues to be favored for its affordability and domestic abundance.
- Initiatives to incorporate cleaner options like solar and wind are progressing, but fossil fuels are poised to retain their prominence in India's energy generation due to established infrastructure and economic viability.

#### Coal Production Trend in India (in Million Tonnes), FY 2019-25

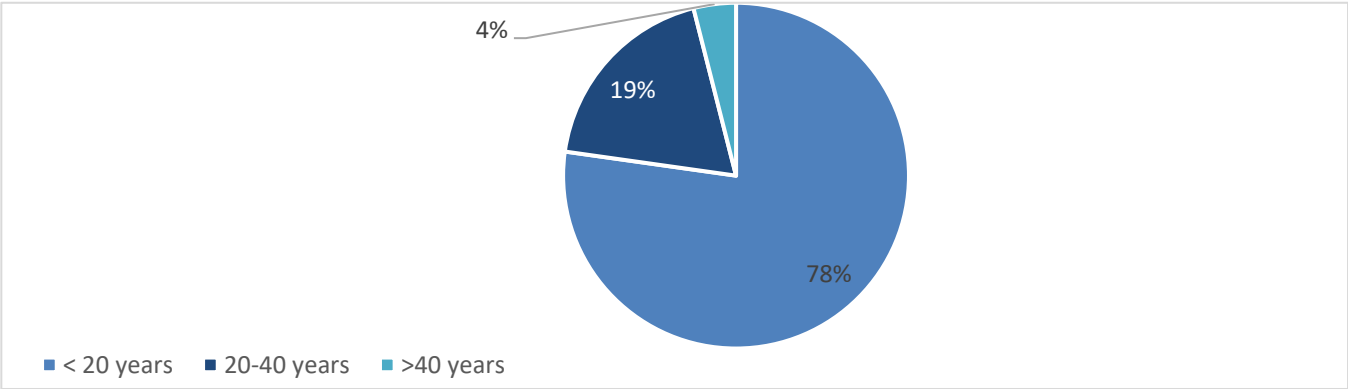
**Exhibit 81: Coal Production Trend, India FY 2019-25**



Source: NITI Aayog, India Climate & Energy Dashboard

- Coal production of India marked **1,047.52 million tonnes in FY 2025** which is highest of all times and the production has grown with a **CAGR of 5.2% from FY 2019 to FY 2025**, this accounted for 12% of global demand, second after China, which accounted for **52% of global coal consumption**. The Ministry of Coal reported 619.4 MT during April-November 2025, versus 628.37 MT in the corresponding prior-year period, a decline of 1.43%. The official FY2025-26 production target is 1,157 MT.
- **Coal India** is the major producer of Coal in India which produced **~75% of** the total coal production in India. India is dependent on electricity generated from coal-based power plants. To meet the growing demand, a greater number of coal blocks need to explore and mined which generates the demand of machinery and eventually the demand for forged products will increase.
- India is accelerating domestic coal mine development, with 45 new PSU coal projects/mines planned over five years, including 36 by CIL, seven by SCCL and two by NLCIL. The allocated coal-block base has expanded to 209 mines under the CMSP and MMDR frameworks, with 74 receiving mine-opening permission and 60 already under production

Exhibit 82: Coal Power Generation Capacity in India, by Age



Source: Global Energy Monitor

Age of Coal Power Generation Capacity in India

In India similar to China, over 75% of the coal power generation capacity in India is within 20 years age group with roughly 20% of the capacity between 20 to 40 years age group.

Key companies in the oil and gas industries in India are **Oil and Natural Gas Corporation (ONGC)**, **Gas Authority of India Limited (GAIL)**, **Bharat Petroleum Corporation Limited (BPCL)**, **Hindustan Petroleum Corporation Limited (HPCL)**.

Exhibit 83: Key Company Insights

| Country | Key Insights                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ONGC    | <ul style="list-style-type: none"> <li>• Leading oil drilling companies in India. Drilling services account for more than 55% of ONGC’s capex.</li> <li>• Operates 105 drilling and 74 work over rigs.</li> <li>• There has been major progress in terms of technology infusion introduction of Under-Balanced Drilling, use of Advanced Hybrid Bits, resource optimization through Batch Drilling in Offshore &amp; Pad Drilling in Onshore.</li> </ul> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <ul style="list-style-type: none"> <li>ONGC implements the Government's Make in India/local-content procurement framework across its supply chain, supporting greater domestic participation in oilfield equipment and services.<sup>16</sup></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>GAIL</b> | <ul style="list-style-type: none"> <li>Owns and operates a network of around 16,240 km of natural gas pipelines spread across the length and breadth of country. It is also working concurrently on execution of multiple pipeline projects to further enhance the spread.</li> <li>Commands 66% market share in gas transmission and has a Gas trading share of over 54% in India. GAIL and its Subsidiaries, JVs also have a formidable market share in City Gas Distribution. In the Liquefied Natural Gas (LNG) market, GAIL has significantly large portfolio.</li> <li>Pioneer in using gas for producing petrochemicals and has an integrated 810 KTPA gas based petrochemical complex in Uttar Pradesh.</li> </ul>                                                                                                                                                                  |
| <b>BPCL</b> | <ul style="list-style-type: none"> <li>India's second-largest government-owned downstream oil producer. The firm develops strategic pipeline networks connecting refineries to key markets.</li> <li>Mumbai refinery's access to Northern markets via pipelines to Kota, Mathura, Piyala</li> <li>Bina refinery's connection to key markets via Bina-Kota-MMPL &amp; Bina-Kanpur pipelines</li> <li>Kochi refinery's access to TN market via pipeline to Karur</li> <li>They have significantly reduced logistics costs due to pipeline network.</li> </ul>                                                                                                                                                                                                                                                                                                                                 |
| <b>HPCL</b> | <ul style="list-style-type: none"> <li>Engaged in the business of refining Crude Oil and marketing of various petroleum products like Asphalt, Diesel, Kerosene, LPG, Lube Oils, Petrol, branded products like ATF (Aviation Turbine Fuel), Power, Turbojet, Naphtha, throughout India and at select foreign countries.</li> <li>HPCL owns and operates two refineries situated at Mumbai (West coast of India) and Visakhapatnam (East Coast of India).</li> <li>The Visakhapatnam refinery has successfully ramped up to its expanded capacity of 15 MMTPA (300 kbd) to meet rising regional fuel demand. Initiated under the Visakh Refinery Modernization Project (VRMP) in <b>2016</b>, the core capacity expansion was physically completed in <b>2023</b>, with the plant achieving full operating utilization at the 15 MMTPA scale in <b>January 2025</b>.<sup>17</sup></li> </ul> |

Source: Company Websites

<sup>16</sup><https://tenders.ongc.co.in/o/com.ongc.tender/static/businessPartner/Procurement%20Policy%20Initiatives%20by%20ONGC-PMC.pdf?>

<sup>17</sup>[https://www.hindustanpetroleum.com/documents/pdf/Earnings\\_Concall\\_Transcript\\_Q3\\_FY\\_2025.pdf](https://www.hindustanpetroleum.com/documents/pdf/Earnings_Concall_Transcript_Q3_FY_2025.pdf)

## India's Gas Energy Industry

- As more development initiatives are carried out, India's electricity requirements continue to rise. The nation's gas power capacity, which comprises both natural gas and LNG-based power plants, is essential to its energy landscape. Natural gas is the main fuel used by these facilities, and they have a number of advantages for the environment over coal and oil, including reduced emissions and increased efficiency. These gas-based power plants are a good fit for the nation's peak load requirements and renewable energy mix.

Exhibit 84: Gas Reserves in India (in billion cubic meters), FY 19-25

| Gas Reserves in India (in billion cubic meters) |         |         |         |         |         |         |
|-------------------------------------------------|---------|---------|---------|---------|---------|---------|
| FY19                                            | FY20    | FY21    | FY22    | FY23    | FY24    | FY25(P) |
| 1384.04                                         | 1373.56 | 1372.37 | 1149.45 | 1141.74 | 1094.19 | 1073.01 |

Source: NITI Aayog, India Climate & Energy Dashboard | MoSPI Energy Statistics 2026

India's gas reserves are quite small, and no significant discoveries have been made in the past five years.

Exhibit 85: Natural Gas Production in India (in billion cubic meters), FY 19-25

| Natural Gas Production in India (in billion cubic meters) |       |       |       |       |       |         |
|-----------------------------------------------------------|-------|-------|-------|-------|-------|---------|
| FY19                                                      | FY20  | FY21  | FY22  | FY23  | FY24  | FY25(P) |
| 32.87                                                     | 31.18 | 28.67 | 34.02 | 34.45 | 36.44 | 36.11   |

Source: IPNG Statistics Report 2024-25

Natural Gas production in India stood at 36.11 BCM in FY 2024-25, demonstrating sustained output compared to the 36.44 BCM produced in FY 2023-24.

## LNG Terminal and Plans for Gas Production

- LNG is crucial to India's energy mix with the ever-increasing demand of the country & need to reduce carbon emissions. Plan of developing LNG terminals in India along with formulation of plans for gas production has been in the forefront with increased need to diversify energy sources & promotion of sustainability. India has made considerable progress in establishing LNG terminals along its coastline, facilitating the import and distribution of LNG across the country. Some notable LNG terminals in India include:

Exhibit 86: Operational LNG Terminal in India, As of March 2025

| Terminal Location   | Promoters                        | Capacity (MMTPA) |
|---------------------|----------------------------------|------------------|
| Chhara, Gujarat     | HPCL LNG Limited (HPLNG)         | 5                |
| Dhamra, Odisha      | Adani LNG Pvt Ltd                | 5                |
| Dahej, Gujarat      | Petronet LNG Ltd (PLL)           | 17.5             |
| Kochi, Kerala       | Petronet LNG Ltd (PLL)           | 5                |
| Hazira, Gujarat     | SHELL                            | 5.2              |
| Dhabol, Maharashtra | GAIL(KLPL)                       | 5                |
| Ennore, Tamil Nadu  | Indian Oil LNG Pvt. Ltd. (IOLPL) | 5                |

|                               |                    |      |
|-------------------------------|--------------------|------|
| <b>Mundra, Gujarat</b>        | GSPC LNG Ltd (GLL) | 5    |
| <b>Total Capacity (MMTPA)</b> |                    | 52.7 |

Source: IPNG Statistics Report 2024-25

#### Exhibit 87: Planned/Under Construction LNG Terminals

| Terminal Location               | Promoters              | Capacity (MMTPA) | Status                                         |
|---------------------------------|------------------------|------------------|------------------------------------------------|
| <b>Jafrabad, Gujarat</b>        | Swan Energy            | 5                | Planned / Under Construction                   |
| <b>Dahej Expansion, Gujarat</b> | Petronet LNG Ltd (PLL) | 5                | Planned / Under Construction<br>(New Addition) |
| <b>Gopalpur, Odisha</b>         | Petronet LNG Ltd (PLL) | 4                | Planned / Under Construction<br>(New Addition) |
| <b>Proposed Total Capacity</b>  |                        | <b>14 MMTA</b>   | -                                              |

Source: IPNG Statistics Report 2024-25

#### India's Gas Power Generation Capacity

- In recent years, India has witnessed a surge in gas power capacity additions with existing gas-based power plants being modernized and new projects being initiated to enhance the country's energy infrastructure. Notable projects include the expansion of existing LNG terminals, the establishment of new regasification facilities, and the introduction of advanced gas turbine technology for improved efficiency.

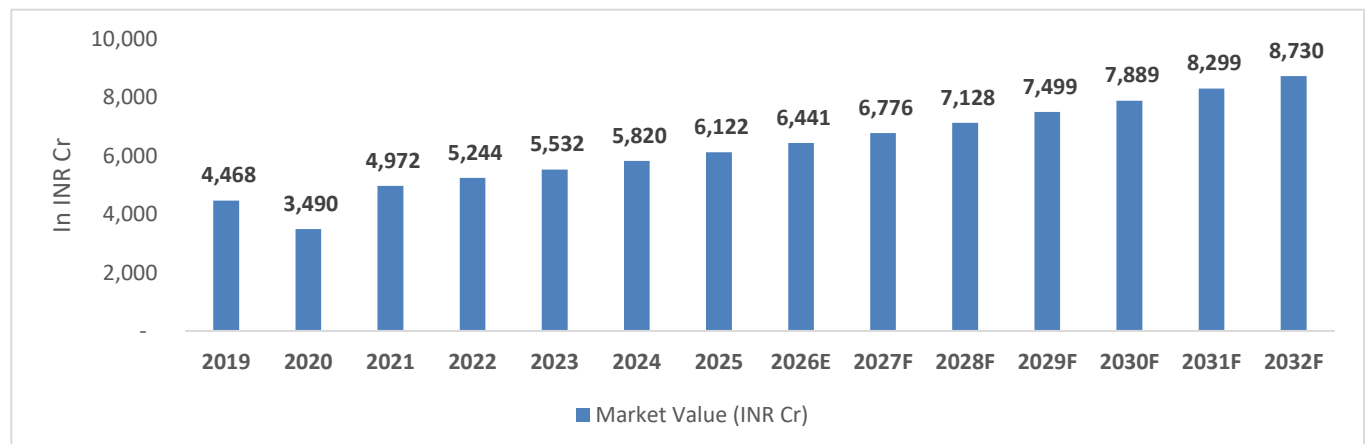
#### Exhibit 88: India's Gas Power Generation Capacity

| Region    | Sector       | Capacity in MW   |
|-----------|--------------|------------------|
| ALL INDIA | State        | 6,497.61         |
|           | Private      | 5408.50          |
|           | Central      | 7,237.91         |
|           | <b>Total</b> | <b>19,144.02</b> |

Source: CEA Installed Capacity Report, Aug 2026

#### India Oil and Gas Valves Market Trend, FY 2019-2032

#### Exhibit 89: Market Trend, Oil and Gas Valves, India, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

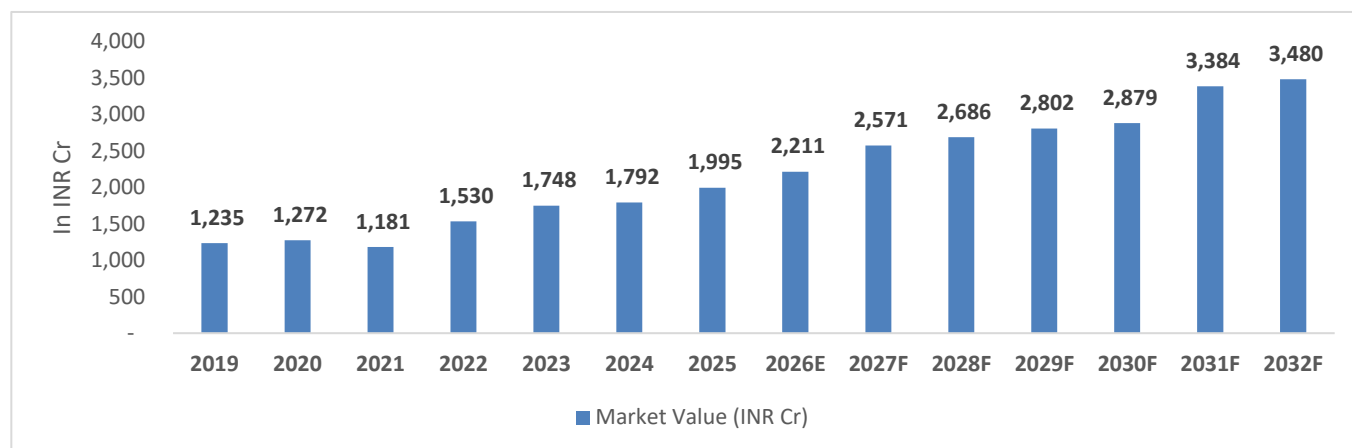
E-Estimated, F-Forecasted

- Oil and Gas Valve market was valued at **INR 6,441 Crores in FY 2026** and is projected to mark **INR 8730 Crores by 2032** with a **CAGR of 5.2% from FY 2026 to 2032** driven by increasing population, urbanization, increase in energy demand and technological advancement for more efficient valves.

### 3.1.2.3 India Renewable Energy

#### India Overall Forging Market: Renewables, FY 2019-2032

Exhibit 90: India Overall Forging Market Trend, Renewables, INR Cr, FY 2019-32



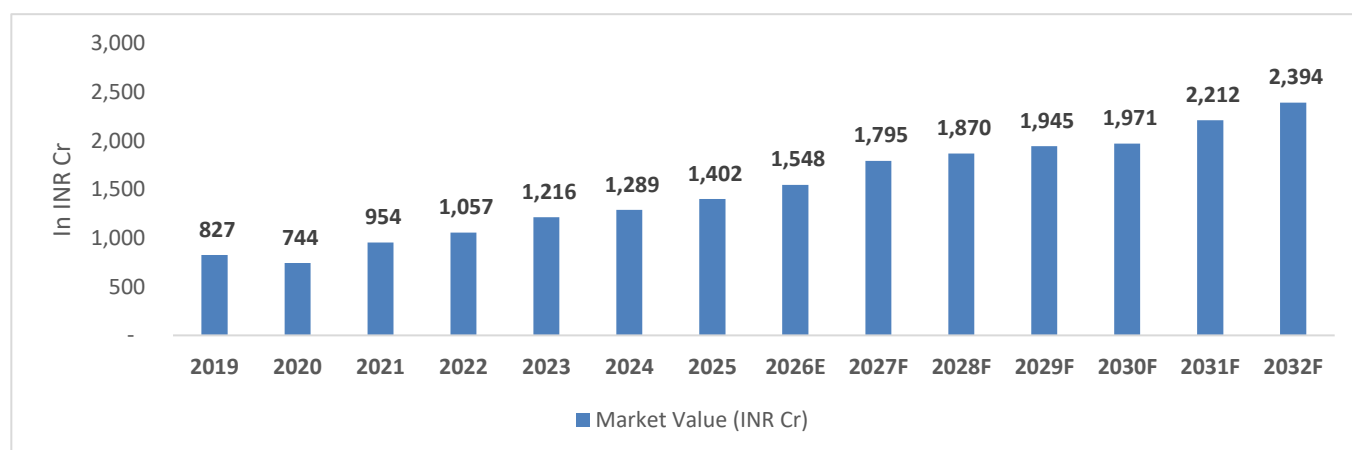
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forging Market for Renewables was valued at **INR 2,211 Crores in FY 2026** and is projected to mark **INR 3,480 Crores by 2032** with a **CAGR of 7.9% from FY 2026 to 2032** driven by growth in demand of raw forgings and precision forged machined components from wind segment, solar and other segments.

#### India Precision Forged Machined Components Market: Renewables, FY 2019-2032

Exhibit 91: India Precision Forged Machined Components Market Trend, Renewables, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

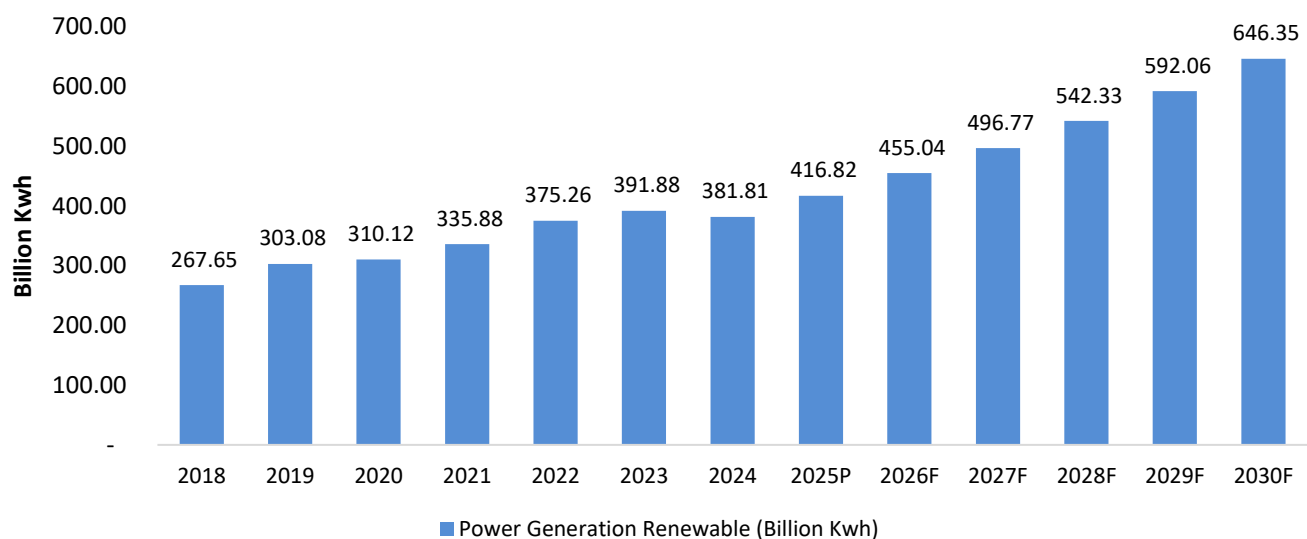
F-Forecasted, (P)- Provisional

- Indian Precision forged machined components market for Renewables was valued at **INR 1,548 Crores in FY 2026** and is projected to mark **INR 2,394 Crores by FY 2032** with a **CAGR of 7.5% from FY 2026 to 2032** driven by growth in demand of precision forged machined components from wind segment.

India Power Generation-Renewable:

- **Renewable sources** have increased from 267.65 billion KWh in 2018 to 416.82 billion KWh in 2025.
- India is exploring emerging technologies such as tidal and geothermal energy to further diversify its renewable energy sources.
- India's commitment to renewable energy remains unwavering, as it strives to achieve its targets for clean, affordable, and accessible electricity for all while mitigating the impacts of climate change. The overall power generation from renewable sources is expected to reach **646.35.70 billion KWh in 2030**.
- Government's targets for solar power installation have been driving growth in the sector, supported by favorable policies and incentives.
- **Wind energy** contributes substantially to India's renewable energy mix, with wind farms dotting the landscape in states with favorable wind conditions.
- **Hydropower** plays a crucial role in India's renewable energy portfolio, leveraging the country's rivers and water resources for clean electricity generation.
- Driven by the 'Panchamrit' climate goals, India is accelerating its renewable infrastructure to achieve 500 GW of non-fossil fuel-based capacity by 2030, aiming to meet 50% of the nation's total power demand via renewable sources.<sup>18</sup>
- Solar power heavily dominates the recent renewable expansion, independently accounting for 30.30% (168.04 GW) of the nation's total installed capacity as of August 2026.<sup>18</sup>
- Total non-fossil fuel capacity has already reached 54.88% (304.33 GW) of India's installed power base as of August 2026, showcasing a rapid structural shift in the overall power mix.<sup>18</sup>

Exhibit 92: India Power Generation Renewable (Billion KWh) 2018-2030F



Source: MoSPI, Energy Statistics India Publication 2026

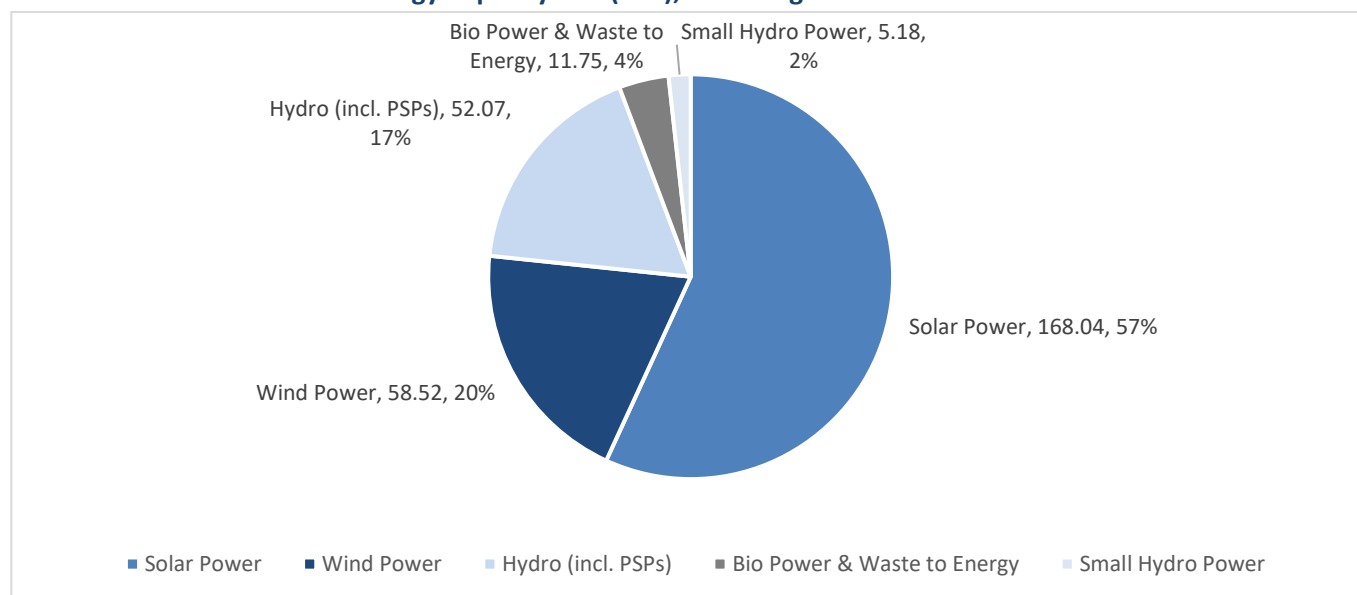
E-Estimated, F-Forecasted

<sup>18</sup> MoSPI, Energy Statistics India Publication 2026

## India Power Capacity- Renewable

- As of August 2026, renewable energy-based electricity generation capacity (including hydro) stands at **295.55 GW**, accounting for **53.30%** of the country's total installed capacity.
- India's total electricity generation capacity has reached **554.54 GW**, with renewable energy contributing a significant portion of the overall power mix.

### Exhibit 93: India Renewable Energy Capacity Mix (GW), As of August 2026



(Note: Bio Power includes 10.87 GW of Biomass/Bagasse and 0.88 GW of Waste to Energy).

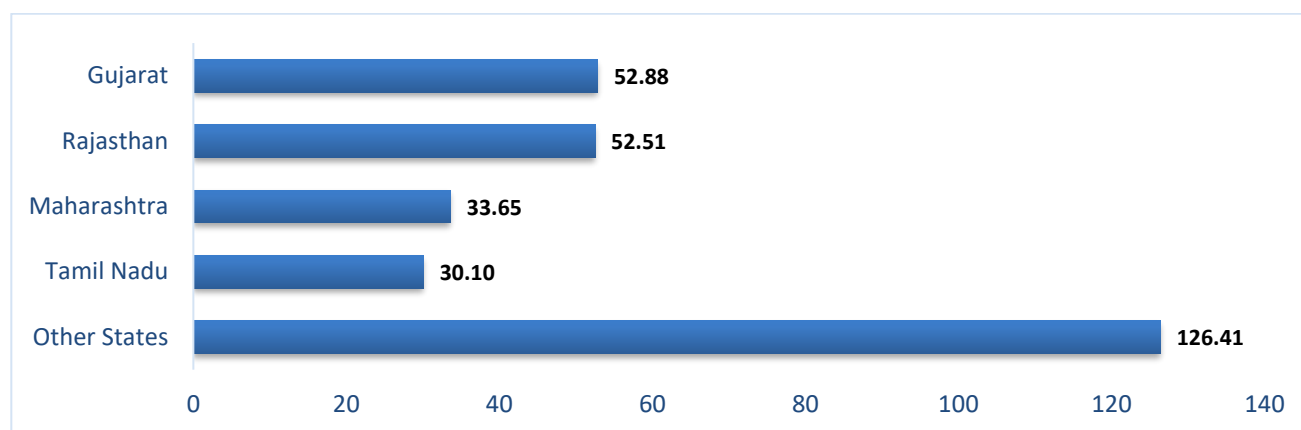
Source: CEA Installed Capacity Report August 2026

- Solar Energy dominates the renewable segment** in India, surging to **168.04 GW (56.86%)** and playing a crucial role in harnessing abundant sunlight. **Wind power follows with 58.52 GW (19.80%)**, driven by vast coastal and inland wind corridors.
- Hydroelectric power is another key contributor**, with large hydro (including Pumped Storage Plants) generating **52.07 GW (17.62%)** and small hydro adding **5.18 GW (1.75%)**, offering a reliable and sustainable source of energy from India's rivers and water systems. Bio-power and waste-to-energy add another **11.75 GW (3.97%)** to the mix.

### Leading States in Renewable Energy Capacity

- Gujarat** tops the list with a total of **52.88 GW** of installed renewable energy capacity (51.84 GW from RES and 1.04 GW from Hydro), driven by its strong focus on solar and wind energy projects.
- Rajasthan** closely follows at second with **52.51 GW** (50.31 GW from RES and 2.20 GW from Hydro), continuing to benefit from its vast land and abundant sunlight.
- Maharashtra** ranks third with **33.65 GW** of total renewable capacity (30.23 GW from RES and 3.42 GW from Hydro).
- Tamil Nadu** stands at fourth with a capacity of **30.10 GW** (27.90 GW from RES and 2.20 GW from Hydro), leveraging its favorable wind patterns to generate substantial energy.
- Karnataka** follows at fifth with a capacity of **27.82 GW** (24.18 GW from RES and 3.63 GW from Hydro), supported by a robust mix of hydro, solar, and wind initiatives.

#### Exhibit 94: Top States Driving India's Renewable Energy Capacity (GW), As of August 2026

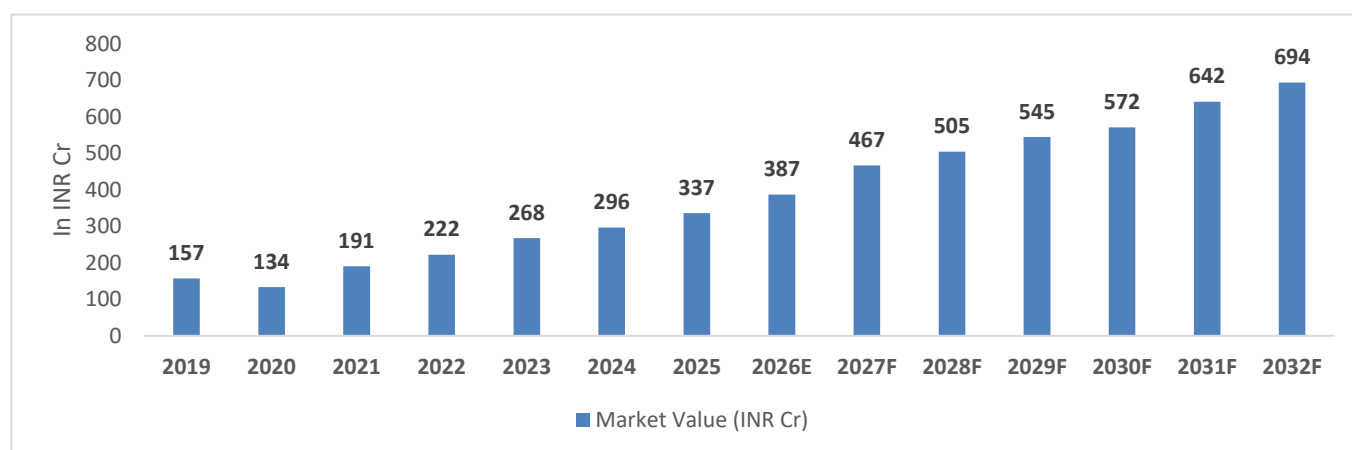


Source: CEA Installed Capacity Report, August 2026

\*Other States include Karnataka, Andhra Pradesh, Madhya Pradesh, Telangana, Uttar Pradesh, Punjab, Himachal Pradesh, etc.

#### India Precision Forged Machined Components Market: Wind Energy, FY 2019-2032

#### Exhibit 95: India Precision Forged Machined Components Market Trend, Wind Energy, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision forged machined components market for Wind Energy was valued at **INR 387 Crores in FY 2026** and is projected to mark **INR 694 Crores by FY 2032** with a **CAGR of 10.2% from FY 2026 to 2032** driven by growth in demand of precision forged machined components from wind segment such as Parts in the nacelle (gearbox, high-speed shaft, low-speed shaft and brake), the yaw drive for upwind turbines (shaft and gear) and tower components for both downwind and upwind turbines.

#### Key Schemes and Programs

- The Government of India has implemented a range of measures and initiatives aimed at promoting and accelerating renewable energy capacity across the nation, with an ambitious target of achieving 500 GW of installed electric capacity from non-fossil sources by 2030.
- Key programs include the National Green Hydrogen Mission, PM-KUSUM, PM Surya Ghar, and PLI schemes for solar PV modules.

### National Green Hydrogen Mission

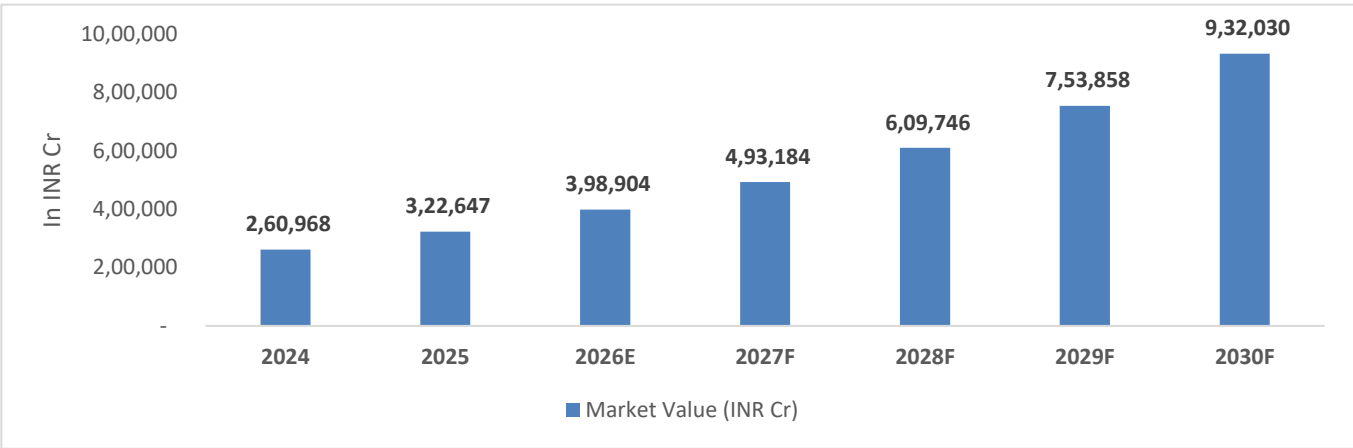
The key objective of this mission is to make India the Global Hub for production, usage and export of Green Hydrogen and its derivatives. This will contribute to India’s aim to become Aatmanirbhar through clean energy and serve as an inspiration for the global Clean Energy Transition.

- **Exports:** This mission will facilitate export opportunities through supportive policies and strategic partnerships.
- **Domestic Demand:** The Government of India will specify a minimum share of consumption of green hydrogen or its derivative products such as green ammonia and green methanol by designated consumers as energy or feedstock. The year-wise trajectory of such minimum share of consumption will be decided by the Empowered Group (EG).
- **Competitive Bidding:** Demand aggregation and procurement of green hydrogen and green ammonia through the competitive bidding route will be undertaken.
- **Certification framework:** MNRE will also develop a suitable regulatory framework for certification of Green Hydrogen and its derivatives as having been produced from RE sources.

### 3.1.2.4 India Nuclear Energy

#### Business Potential in Nuclear Energy in India (INR Cr), FY 2024-2030

Exhibit 96: Business Potential in Nuclear Energy in India, INR Cr, FY 2024-30



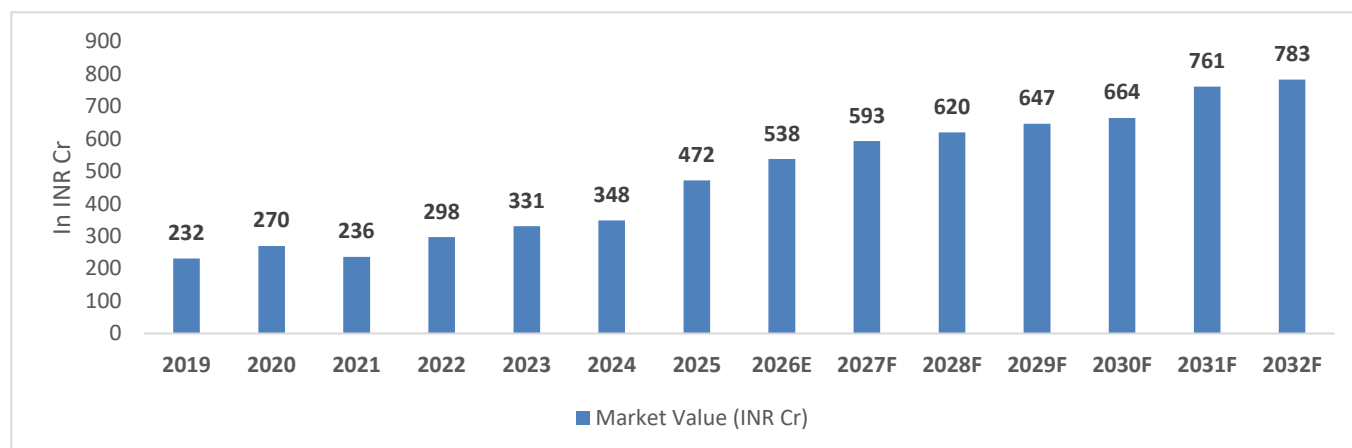
Source: Nuclear Business Platform and Frost & Sullivan

E-Estimated, F-Forecasted

- It is estimated that Nuclear Energy segment in India holds a business opportunity of **INR 3,98,904 Crores in FY 2025** and is projected to create a business opportunity of **INR 9,32,030 Crores by FY 2030** with a growth rate of **23.63% from FY 2024-30** driven by the construction of **20 nuclear projects** currently under construction and those with financial sanctions, with an anticipated completion date by 2031.

## India Overall Forging Market: Nuclear Energy, FY 2019-2032

### Exhibit 97: India Overall Forging Market Trend, Nuclear Energy, INR Cr, FY 2019-32



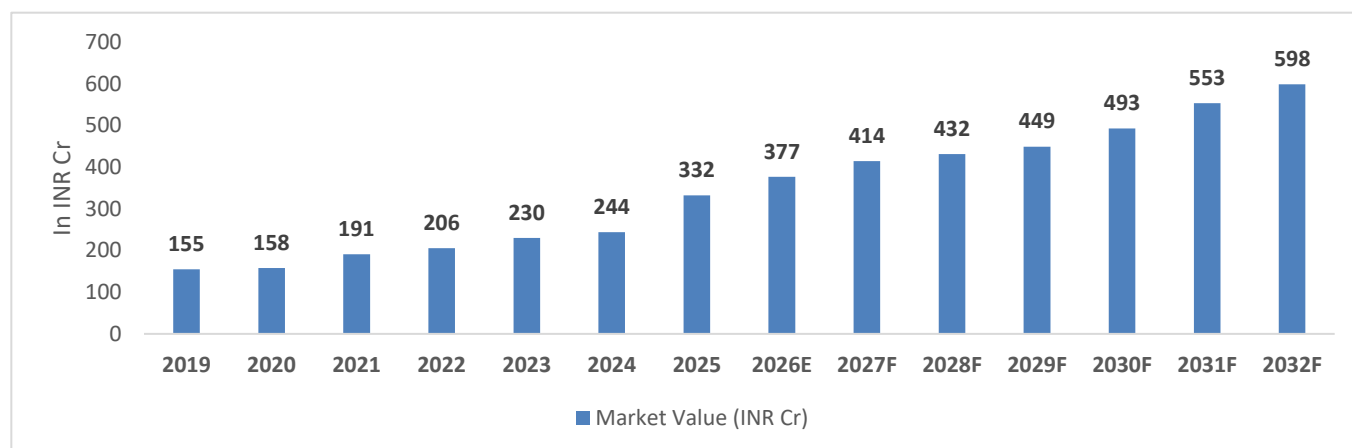
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forging Market for Nuclear Energy was valued at **INR 538 Crores in FY 2026** and is projected to mark **INR 783 Crores by FY 2032** with a **CAGR of 6.5% from FY 2026 to 2032** driven by demand of raw forgings and forged machined components such as pump and pump shafts, flanges, gears and tubes, drilling block, tees and bends, connectors, rings, transition cones and discs and global shift towards clean and sustainable form of energy.

## India Precision Forged Machined Components Market: Nuclear Energy, FY 2019-2032

### Exhibit 98: India Precision Forged Machined Components Market Trend, Nuclear Energy, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

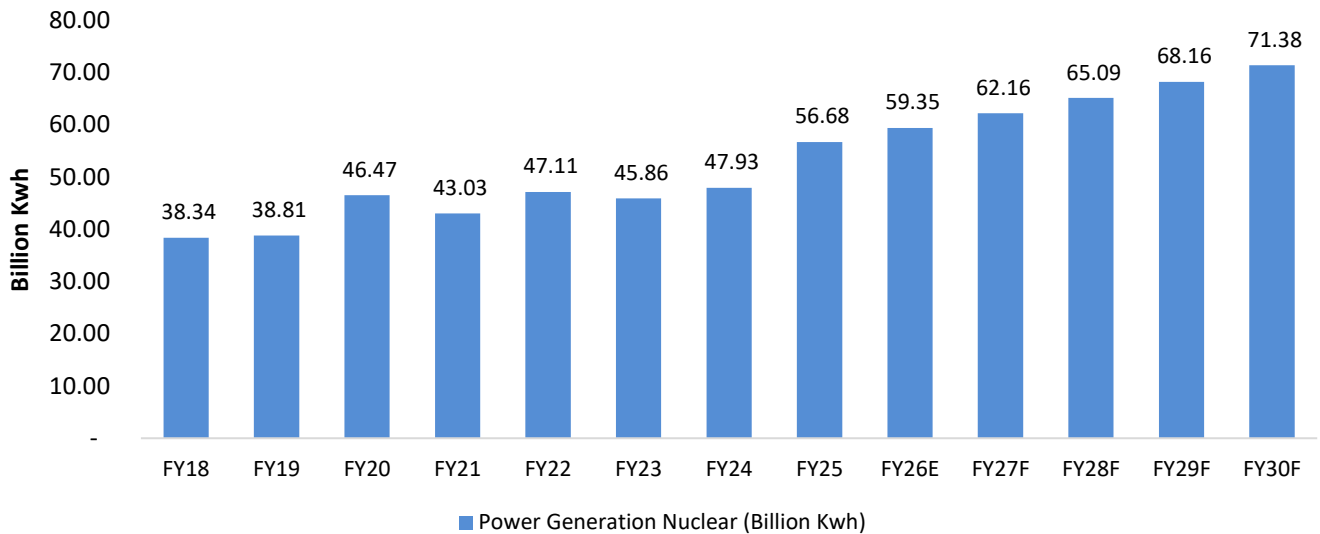
- Indian Precision forged machined components market for Nuclear Energy was valued at **INR 377 Crores in FY 2026** and is projected to mark **INR 598 Crores by 2032** with a **CAGR of 8% from FY 2026 to 2032** driven by demand of precision forged machined components such as pump and pump shafts, flanges, gears and tubes, drilling block, tees and bends, connectors, rings, transition cones and discs.

## India Power Generation and Capacity-Nuclear: FY 2018-2030F

- India's nuclear power source constitutes to **3.1% of the total power generation** in India.
- Generation has grown to an official actual of **56.68 billion KWh in FY 2025 (P)** and is projected to reach **71.38 billion KWh by 2030**. India uses a three-stage program for power generation with a combination of

Pressurized Heavy Water Reactor (PHWR) and Fast Breeder Reactor (FBR). This gives the capability to grow multi-fold capacity through the uranium-plutonium route.

**Exhibit 99: India Power Generation -Nuclear (Billion KWh) 2018-2030F**



Source: MoSPI, Energy Statistics India Publication 2026

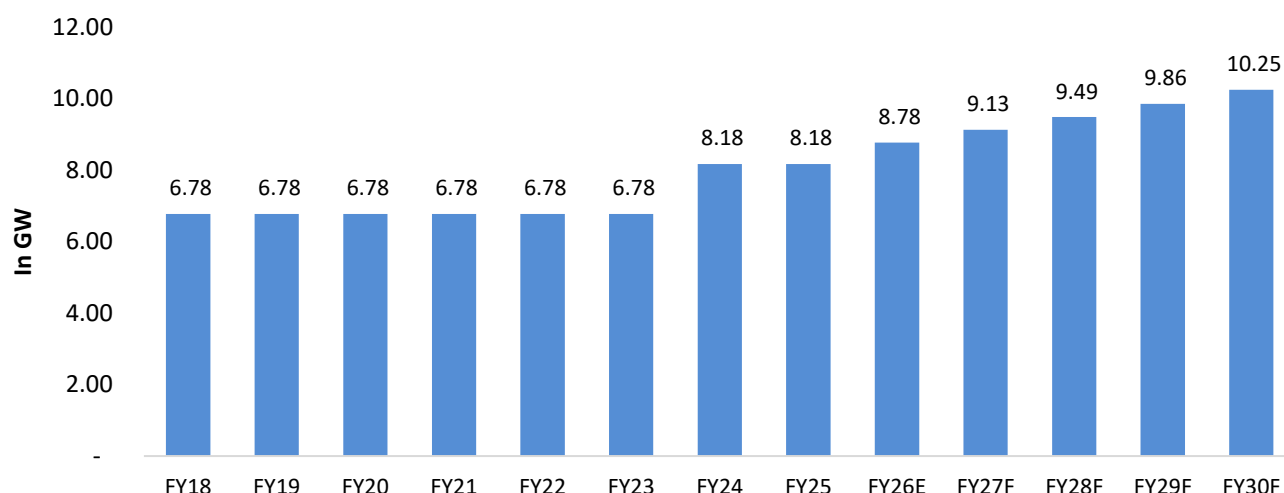
(P)- Provisional, F-Forecasted

#### India Power Capacity-Nuclear:

- India's nuclear power has a total operational installed capacity of **8,780 MW (8.78 GW)** as of August 2026, accounting for **1.58%** of the country's total power grid.
- Two more reactors of 1,000 MWe** have been approved and are expected to be ready by 2030. These two reactors are expected to be in Kudankulam, this would increase the nuclear capacity capability to **22,480 MWe by 2030**. There are around 24 operational nuclear reactors in India and another 9 under construction.<sup>19</sup>
- India has plans to increase nuclear power generation mix of nuclear from 3% to 10% in the future. Shifting to the nuclear energy sector, large tenders are expected from the energy and power sector for the construction of 10 new reactors within the next 8 years.
- India maintains a long-term strategic target to achieve **100 GW of nuclear capacity by 2047** under the Nuclear Energy Mission to ensure round-the-clock clean baseload power and support net-zero objectives.<sup>19</sup>

<sup>19</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2291078&utm&reg=48&lang=2>

## Exhibit 100: India Power Capacity -Nuclear (GW) 2018-2030F



Source: MoSPI, Energy Statistics India Publication 2026

E-Estimated, F-Forecasted

## Exhibit 101: Major Nuclear Installations in India, As of December 2025

| Name                                      | State         | Capacity                                           | Highlights                                                                                                                                                                                                                       |
|-------------------------------------------|---------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Kudankulam Nuclear Power Plant</b>     | Tamil Nadu    | 2,000 MW (2 units of 1,000 MW each)                | This plant uses VVER-1000 reactors supplied by Russia and is the largest nuclear power station in India. <b>Current State:</b> Units 1 and 2 are fully operational, while Units 3, 4, 5, and 6 are currently under construction. |
| <b>Tarapur Atomic Power Station</b>       | Maharashtra   | 1,400 MW (2 units of 540 MW and 2 units of 160 MW) | It is the oldest nuclear power plant in India, with its first units commissioned in 1969. <b>Current State:</b> Fully operational.                                                                                               |
| <b>Rajasthan Atomic Power Station</b>     | Rajasthan     | 1,180 MW (6 units of varying capacities)           | The first unit of this plant was commissioned in 1973, and it now has multiple reactors in operation. <b>Current State:</b> Fully operational; Units 7 and 8 (700 MW each) are currently in advanced stages of construction.     |
| <b>Kaiga Atomic Power Station</b>         | Karnataka     | 880 MW (4 units of 220 MW each)                    | Known for its indigenous pressurized heavy water reactors (PHWR). <b>Current State:</b> Fully operational; development for Units 5 and 6 (700 MW each) is planned/ongoing.                                                       |
| <b>Madras Atomic Power Station (MAPS)</b> | Tamil Nadu    | 440 MW (2 units of 220 MW each)                    | Located at Kalpakkam, it uses PHWR and was among the first reactors in India to be constructed indigenously. <b>Current State:</b> Fully operational.                                                                            |
| <b>Narora Atomic Power Station</b>        | Uttar Pradesh | 440 MW (2 units of 220 MW each)                    | This plant is located on the banks of the Ganges River and uses PHWR technology. <b>Current State:</b> Fully operational.                                                                                                        |

|                                      |                |                                                              |                                                                                                                                                                                                                     |
|--------------------------------------|----------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Kakrapar Atomic Power Station</b> | Gujarat        | 1,840 MW (2 units of 220 MW and 2 units of 700 MW)           | It uses PHWRs.<br><b>Current State:</b> Expansion complete; the newly added indigenous 700 MW units (KAPP-3 and KAPP-4) are now fully operational.                                                                  |
| <b>Kalpakkam PFBR</b>                | Tamil Nadu     | 500 MW (under construction, expected to be operational soon) | This plant will be a significant step for India's fast breeder reactor program.<br><b>Current State:</b> Core loading achieved; currently undergoing final commissioning and power-raising phases.                  |
| <b>Bhimpur Nuclear Power Plant</b>   | Madhya Pradesh | 1,400 MW (proposed)                                          | This plant is in the planning stage and will significantly boost nuclear capacity upon completion.<br><b>Current State:</b> Currently in the pre-project stage (land acquisition and statutory clearances ongoing). |
| <b>Chutka Nuclear Power Plant</b>    | Madhya Pradesh | 1,400 MW (proposed)                                          | Another planned project expected to add to India's nuclear power generation capability.<br><b>Current State:</b> Currently in the pre-project/planning stage.                                                       |

Source: Nuclear Power Corporation of India Limited (NPCIL) | Press Information Bureau (PIB) Releases

## Nuclear Reactors Planned in India

### Exhibit 102: Nuclear Reactors Planned

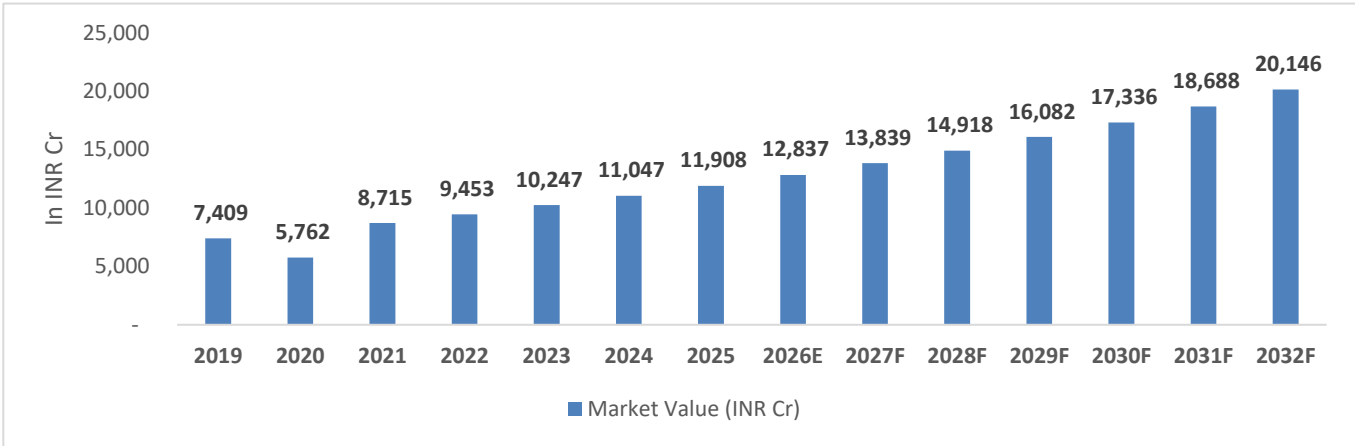
| State          | Reactor Name             | Capacity (MW) each | Current Status & Expected Timeline                |
|----------------|--------------------------|--------------------|---------------------------------------------------|
| Haryana        | Gorakhpur 1 & 2          | 700                | Under Construction (Expected by 2029–2031)        |
| Haryana        | Gorakhpur 3 & 4          | 700                | Pre-project / Early Stage (Expected by 2031)      |
| Madhya Pradesh | Chutka 1 & 2             | 700                |                                                   |
| Rajasthan      | Mahi Banswara 1&2        | 700                | Under Construction (Expected by 2031–2032)        |
| Rajasthan      | Mahi Banswara 3&4        | 700                | Pre-project / Early Stage (Expected by 2031-2032) |
| Karnataka      | Kaiga 5 & 6              | 700                |                                                   |
| Gujarat        | KAPP-5 & 6 (Kakrapar)    | 700                | Newly Planned by 2035 (NEM Roadmap)               |
| Rajasthan      | RAPP-9 & 10 (Rawatbhata) | 700                | Newly Planned by 2035 (NEM Roadmap)               |
| Uttar Pradesh  | NAPP-3 & 4 (Narora)      | 700                | Newly Planned by 2035 (NEM Roadmap)               |
| Tamil Nadu     | FBR 1 & 2 (Kalpakkam)    | 500                | Pre-project approved (post-PFBR phase)            |

Source: World Nuclear Association, Press Information Bureau (PIB), Parliament Question: Nuclear Energy Projects (March 12, 2026) detailing the KAPP, RAPP, NAPP expansions and FBR 1&2 pre-project approvals.

- To achieve the **100 GW target by 2047**, three new twin-unit PHWR projects (KAPP-5&6, RAPP-9&10, and NAPP-3&4) have been officially mapped out for completion by 2035.
- Following the first criticality of the 500 MW Prototype Fast Breeder Reactor (PFBR) in April 2026, the government has officially accorded approval for pre-project activities for twin commercial Fast Breeder Reactors (FBR 1 & 2) at Kalpakkam.

India Cryogenic Equipment Market

Exhibit 103: India Cryogenic Equipment Market Trend, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

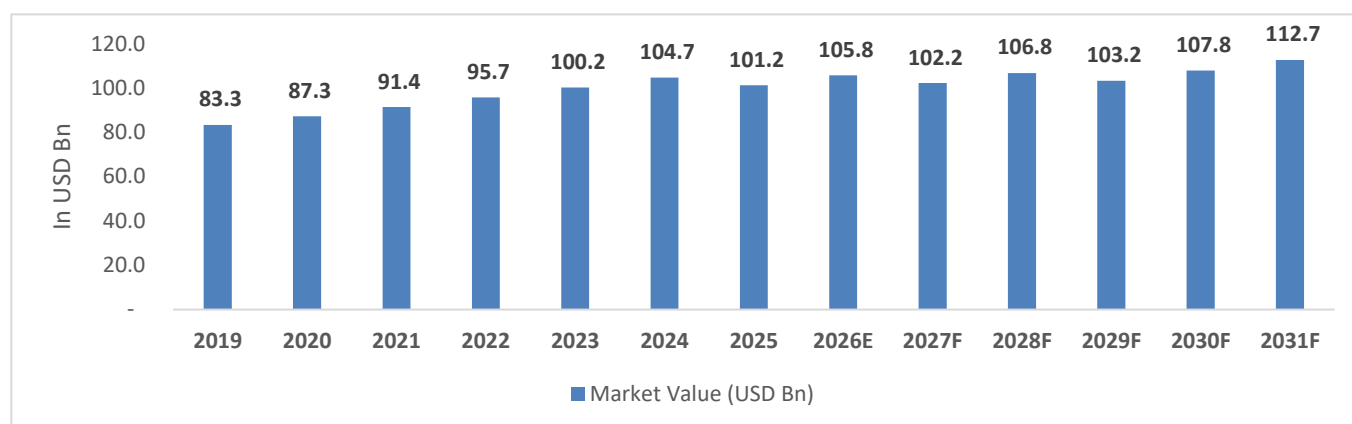
- Indian Cryogenic Equipment Market for was valued at **INR 12,837 Crores in FY 2026** and is projected to mark **INR 20,146 Crores by FY 2032** with a **CAGR of 7.8% from FY 2026 to FY 2032**.
- Key drivers are government initiatives and policies promoting the adoption of cleaner fuels, enhancing healthcare infrastructure and strengthening industrial capabilities, incentivization for the cryogenic technology.
- **Cryogenic Tankers** are widely used in India particularly in the transportation of liquefied natural gas (LNG). Cryogenic tankers enable the safe and efficient transportation of LNG from production facilities to distribution hubs and end users. **Forged valves are crucial components** used for regulating gas flow within the cryogenic tankers ensuring safety.

## 3.2 Energy Turbine Overview:

### 3.2.1 Global Energy Turbine Market Overview

#### Global Energy Turbine Market Trends, CY 2019-2031

Exhibit 104: Global Energy Turbines Market Trend, USD Bn, CY 2019-31



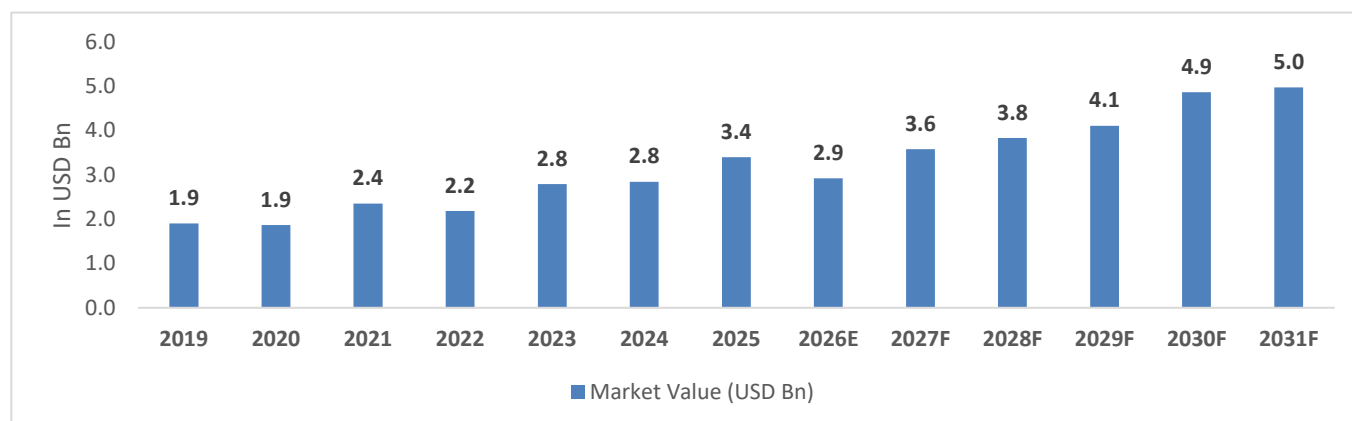
Source: Industry Report

E-Estimated, F-Forecasted

- Global Energy Turbine market was valued at **USD 101.2 Bn in 2025** and is projected to mark **USD 112.7 Bn by 2031** with a **CAGR of 4.5 % from 2025 to 2031** driven by increasing energy demand, advancements in turbine technology, and a global shift towards sustainable energy sources.
- The factors driving market growth include the rise in investments in power infrastructure and focus on cleaner energy solutions

#### Global Overall Forgings Market: Energy Turbines, CY 2019-2031

Exhibit 105: Global Overall Forgings Market Trend, Energy Turbines, USD Bn, CY 2019-31



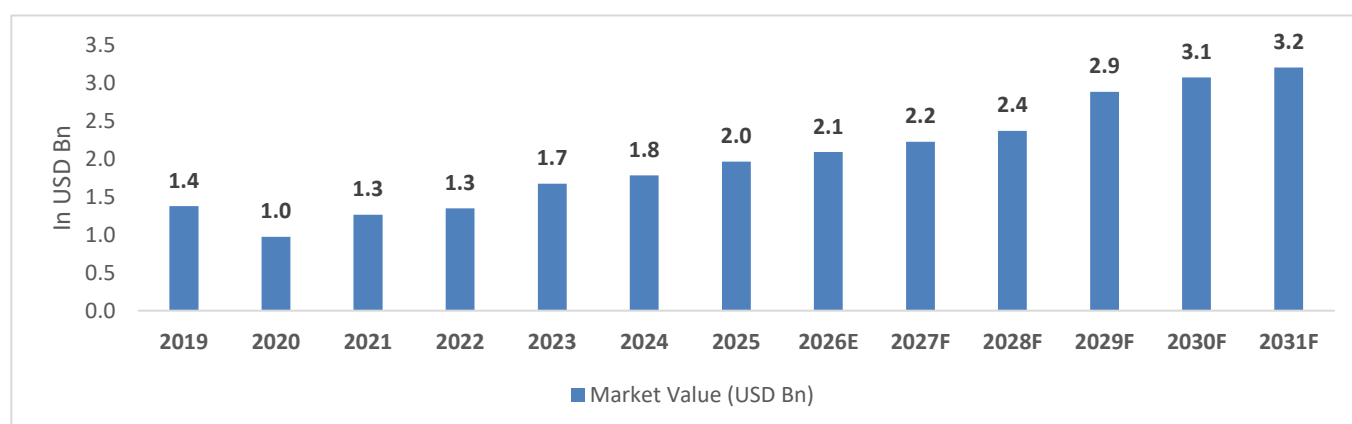
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall Forgings market for Energy Turbines was valued at **USD 3.4 Bn in 2025** and is projected to mark **USD 5.0 Bn by 2031** with a **CAGR of 6.5% from 2025 to 2031** driven by growth of demand of forgings and forged machined components from the gas turbines and steam turbines segments.

## Global Precision Forged Machined Components Market: Energy Turbines, CY 2019-2031

### Exhibit 106: Global Precision Forged Machined Components Market Trend, Energy Turbines, USD Bn, CY 2019-31



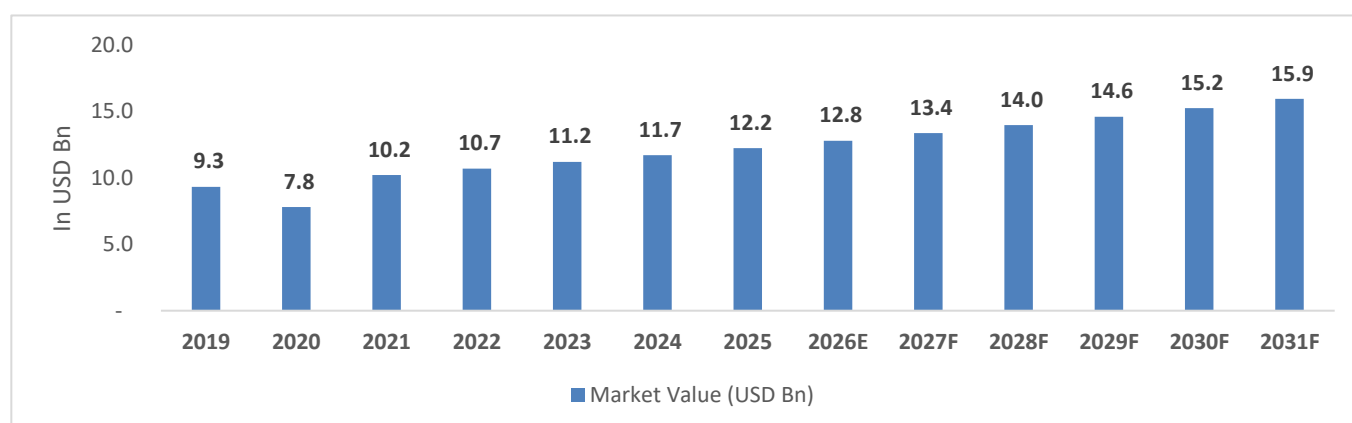
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Energy Turbines was valued at **USD 2.0 Bn** in **2025** and is projected to mark **USD 3.2 Bn by 2031** with a **CAGR of 8.5% from 2025 to 2031** driven by growth of precision forged machined components demand from the gas turbines and steam turbines.

## Global Gas Turbine Market Trends, CY 2019-2031

### Exhibit 107: Global Gas Turbines Market Trend, USD Bn, CY 2019-31



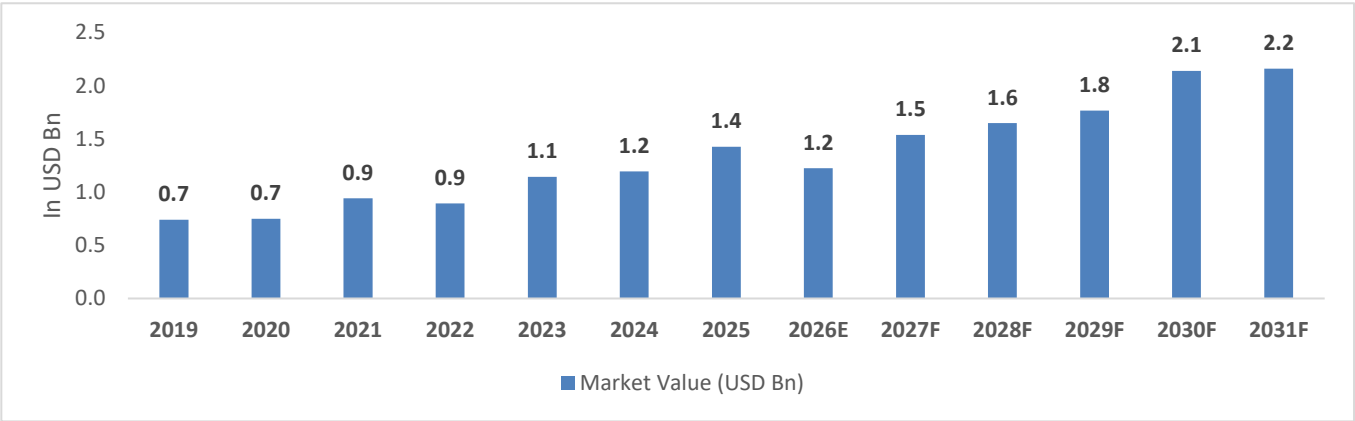
Source: Industry Report

E-Estimated, F-Forecasted

- Global Gas Turbine market was valued at **USD 12.2 Bn in 2025** and is projected to mark **USD 15.9 Bn by 2031** with a **CAGR of 4.5 % from 2025 to 2031** driven by **rapid technological advancements in energy industry combined with a shift towards distributed power production technologies**.

Global Overall Forgings Market: Gas Turbines, CY 2019-2031

Exhibit 108: Global Overall Forgings Market Trend, Gas Turbines, USD Bn, CY 2019-31



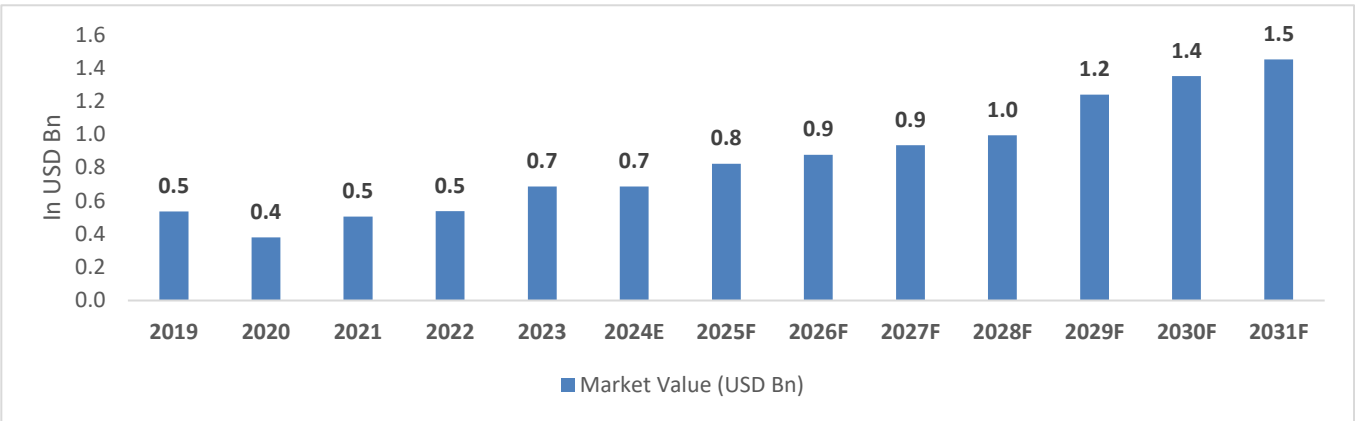
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global overall forgings market for Gas Turbines was valued at **USD 1.4 Bn in 2025** and is projected to mark **USD 2.2 Bn by 2031** with a **CAGR of 7.2% from 2025 to 2031** driven by growth of raw forgings and forged machined components **such as drive shaft, Rotor Shaft, blades and vanes, impellers and retainer rings.**

Global Precision Forged Machined Components Market: Gas Turbines, CY 2019-2031

Exhibit 109: Global Precision Forged Machined Components Market Trend, Gas Turbines, USD Bn, CY 2019-31



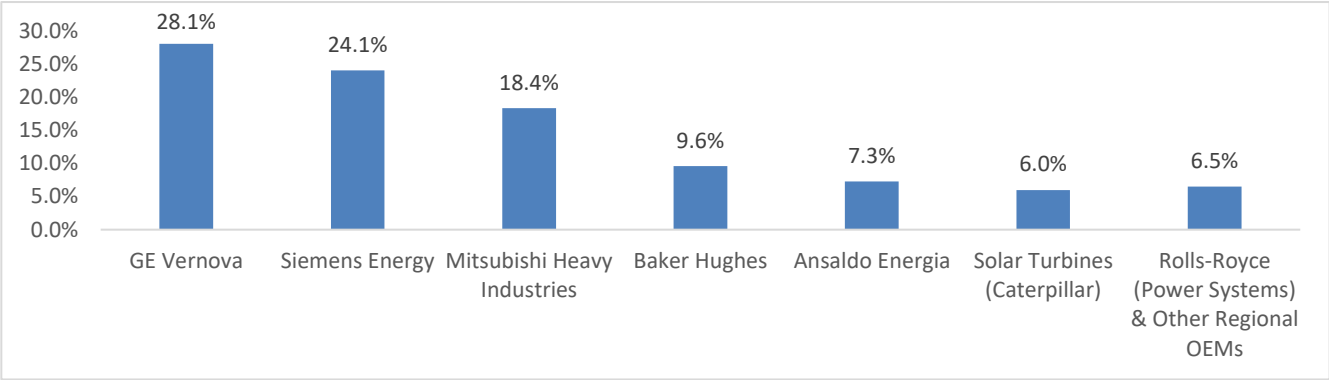
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision forged machined components market for Gas Turbines was valued at **USD 0.8 Bn in 2025** and is projected to mark **USD 1.5 Bn by 2031** with a **CAGR of 9.8% from 2025 to 2031** driven by growth of precision forged machined components **such as drive shaft, Rotor Shaft, blades and vanes, impellers and retainer rings.**

## Gas Power Turbines Ordered (2025)

Exhibit 110: Market Share of Gas Power Turbines manufacturers based on Orders in 2025

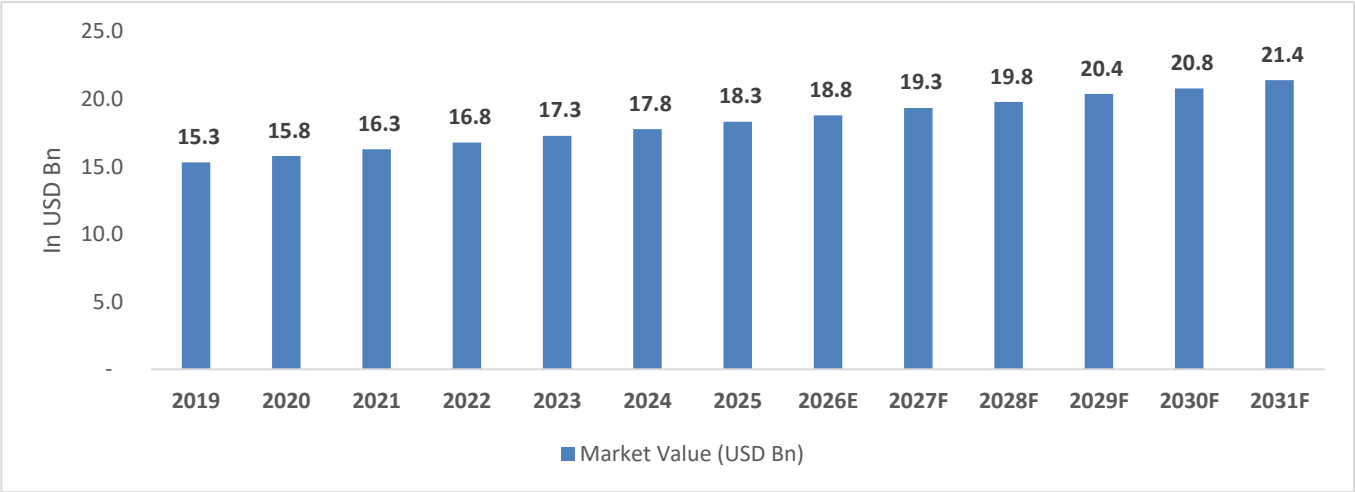


Source: Industry Report

- In 2025, global gas turbine sales were around 469 units, and the market is expected to grow at a CAGR of 3.6% from 2026 to 2035.<sup>20</sup>
- The gas turbine manufacturing market remains highly consolidated, with the top four players (**GE Vernova, Siemens Energy, Mitsubishi, and Baker Hughes**) contributing to approximately **80%** of the global market share in 2025.
- **GE Vernova** and **Siemens Energy** command over half of the market (combined 52.2%), driven by demand for advanced control systems, rapid load adjustments to support renewables, and compatibility with diverse fuels like hydrogen.**Error! Bookmark not defined.**
- The global gas turbine market size was valued at **USD 23.27 billion in 2025** and is experiencing significant momentum propelled by a "dual drive": the low-carbon transition (coal-to-gas) and the massive AI-driven data center boom requiring reliable, uninterrupted baseload power.

## Global Steam Turbine Market Trends, CY 2019-2031

Exhibit 111: Global Steam Turbines Market Trend, USD Bn, CY 2019-31



Source: Industry Report

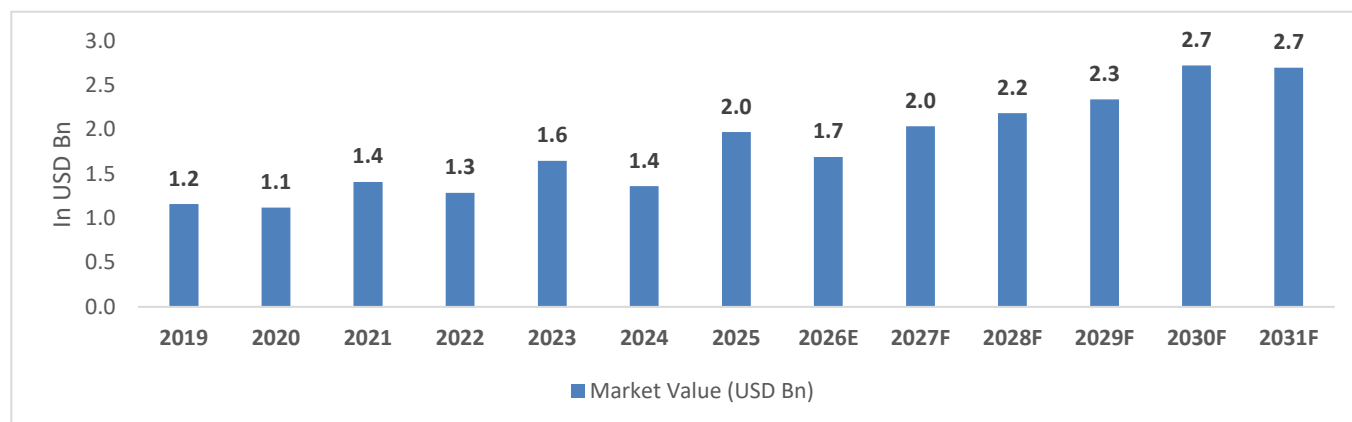
E-Estimated, F-Forecasted

<sup>20</sup> <https://www.pharma-geek.com/gas-turbine-market/>

- Global Steam Turbine Market was valued at **USD 18.3 Bn in 2025** and is projected to mark **USD 21.4 Bn** by 2031 with a **CAGR of 3% from 2025 to 2031** driven by rising demand of electricity and dependency on coal-based power plants for electricity generation.

#### Global Overall Forgings Market: Steam Turbines, CY 2019-2031

**Exhibit 112: Global Overall Forgings Market Trend, Steam Turbines, USD Bn, CY 2019-31**



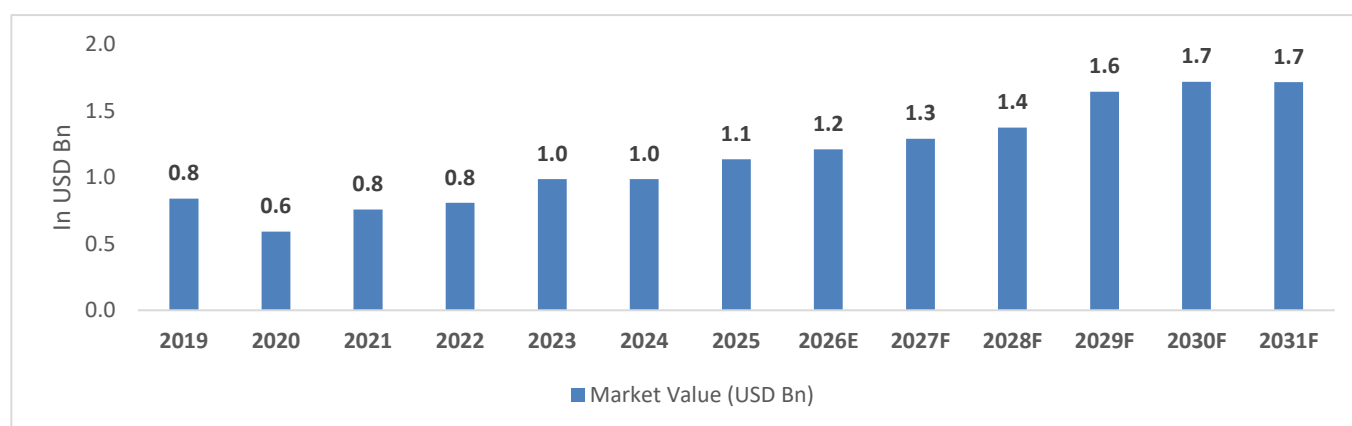
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall Forgings Market for Steam Turbines was valued **at USD 2.0 Bn in 2025** and is projected to mark **USD 2.7 Bn by 2031** with a **CAGR of 5.5 % from 2025 to 2031** driven by growth of raw forgings and forged machined components such as drive shaft, Rotor Shaft, blades and vanes, impellers, Turbine wheel components and retainer rings.

#### Global Precision Forged Machined Components Market: Steam Turbines, CY 2019-2031

**Exhibit 113: Global Precision Forged Machined Components Market Trend, Steam Turbines, USD Bn, CY 2019-31**

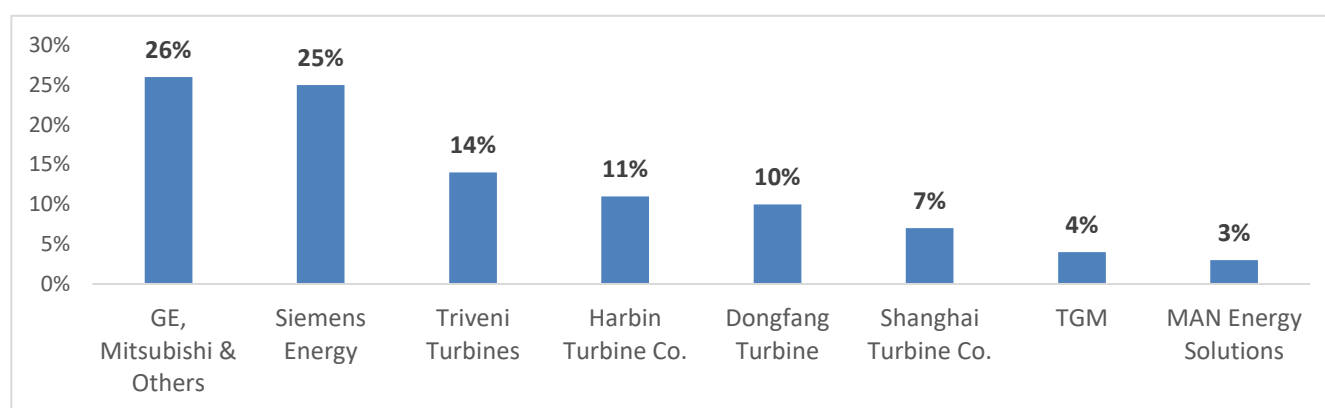


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Steam Turbines was valued **at USD 1.1 Bn in 2025** and is projected to mark **USD 1.7 Bn by 2031** with a **CAGR of 7.1% from 2025 to 2031** driven by growth of precision forged machined components such as drive shaft, Rotor Shaft, blades and vanes, impellers, Turbine wheel components and retainer rings.

**Exhibit 114: Market Share of Steam Power Turbines manufacturers based on Orders in 2025**



Source: McKoy Reports

### Steam Power Turbines Orders

- Siemens remains the leading individual OEM by unit orders. Siemens Energy recorded 132 steam-turbine orders in 2025, more than the next two OEMs combined, making Siemens the most active individual supplier by unit orders.
- Chinese OEMs dominate when measured by MW rather than units. Chinese manufacturers captured approximately 47.9% of global steam-turbine capacity ordered in 2025. Large turbines of  $\geq 150$  MW represented only 38.3% of order units but 90.8% of ordered MW, which disproportionately benefits Harbin, Dongfang and Shanghai in MW-based rankings.
- Triveni focuses on turbines up to 100 MW and produces roughly 300-350 machines annually. Turbines above 100 MW represent more than 90% of the overall global market by capacity

With the growth of the Renewable Energy segment demand for forged components from various segment such as Wind, Solar, Hydropower, Biomass and Geothermal is increasing.

- **Forged Products for Wind Power Segment:** Parts in the nacelle (gearbox, high-speed shaft, low-speed shaft and brake), the yaw drive for upwind turbines (shaft and gear) and tower components for both downwind and upwind turbines.
- **Forged Products for Hydropower:** Rings, discs and shafts are ideal for components such as blades, wheels and driveshafts for both turbines and generators.
- **Forged Products for Solar Energy Segment:** Solar energy harvesting employs turbines, and solar panels frequently require gearing in the manufacturing process, which are great applications for forgings.
- **Forged Products for Biomass Segment:** Kiln Components
- **Forged Products for Geothermal Power Segment:** Forged bar used in drilling for steam to blades for turbines, shafts for generators and blanks for gearboxes.

Key Global Manufacturers of Gas and Steam Turbines are **General Electric Company, Siemens AG, Mitsubishi Hitachi Power Systems (MHPS), Shanghai Electric Group Company Limited, Dongfang Electric Corporation Limited, Bharat Heavy Electricals Limited (BHEL), Ansaldo Energia S.p.A, Toshiba Corporation, Doosan Group, Harbin Turbine Company Limited and Triveni Turbines Limited.**

**Exhibit 115: List of Turbine Manufacturers and Description**

| Turbine Manufacturer                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>GE Vernova (Formerly General Electric Company)</b> | Global market leader. Following its spin-off from GE in April 2024, GE Vernova is entirely focused on the energy transition. It dominates the aeroderivative and advanced heavy-duty gas turbine markets and is aggressively advancing hydrogen-ready technologies.                                                                                                                                                                                                                                      |
| <b>Siemens Energy</b>                                 | A top player in the global gas and steam turbine business following its spin-off from Siemens AG. As an independent entity, its primary focus is on hydrogen co-firing, grid stabilization, and renewable integration, maintaining a strong presence in the Middle East and Europe.                                                                                                                                                                                                                      |
| <b>Mitsubishi Power (Formerly MHPS)</b>               | Following the exit from the Hitachi joint venture, it operates wholly under Mitsubishi Heavy Industries (MHI). It is a market leader in North Asia and globally for JAC-class (advanced heavy-duty) gas turbines, meeting decarbonization demands with >64% efficiency.                                                                                                                                                                                                                                  |
| <b>Shanghai Electric Group Company Limited</b>        | One of the big three in the Chinese turbine market. Shanghai Electric has traditionally been strong in steam turbines, but the company acquired a 40% stake in Ansaldo that has expanded its gas turbine capabilities. Ansaldo's technology is now being leveraged in the Chinese market. Shanghai Electric is also continuing to target projects across Asia.                                                                                                                                           |
| <b>Dongfang Electric Corporation Limited</b>          | Company is another of the big three in the gas and steam turbine market. The model is largely the same as Shanghai Electric: preserve a strong stake in the local Chinese market and then focus on expanding across Asia                                                                                                                                                                                                                                                                                 |
| <b>Bharat Heavy Electricals Limited (BHEL)</b>        | Market leader in India and increasingly moving to compete with Chinese players in other parts of Asia. BHEL has traditionally had a close working relationship with Siemens but rejected a formal relationship in 2014. BHEL still relies on Siemens for certain key components.                                                                                                                                                                                                                         |
| <b>Ansaldo Energia S.p.A</b>                          | Strong ties and market access in China with part ownership by Shanghai Electric. Traditionally very strong in southern Europe, although new equipment sales in this region have been very weak since the start of the decade. Also, traditionally strong in North Africa again that market has been weak during this decade due to political issues. Turbine technology is derived for Siemens as the company used to have a licence agreement in the early 2000s.                                       |
| <b>Toshiba Corporation</b>                            | Toshiba has historically had a strong footprint in North Asia and North America. Supplies the entire turbogenerator for coal-fired projects. For CCGT plants, Toshiba has traditionally worked in partnership with GE on many projects (GE supplies the gas turbine, Toshiba the steam turbine). Relationship is under considerable pressure as GE has made a move to service Toshiba turbines, prompting Toshiba to target GE equipment.                                                                |
| <b>Triveni Turbines Limited</b>                       | Triveni Turbines caters to diverse sectors through a wide range of steam turbine products that are built to suit the customer's requirements. Their commitment to offer cost effective, energy-efficient and environment-friendly solutions have led to substantial investment in undertaking extensive research and development. This dedication yields to producing innovative and robust product offerings tailored to meet the demands of customers from over 20 industries and across 80+ countries |
| <b>Doosan Enerbility (Formerly Doosan Group)</b>      | Following a corporate rebranding, Doosan has transitioned into a dedicated energy transition company. Alongside developing in-house large gas turbines, they are aggressively expanding globally in Small Modular Reactors (SMRs) and offshore wind markets.                                                                                                                                                                                                                                             |

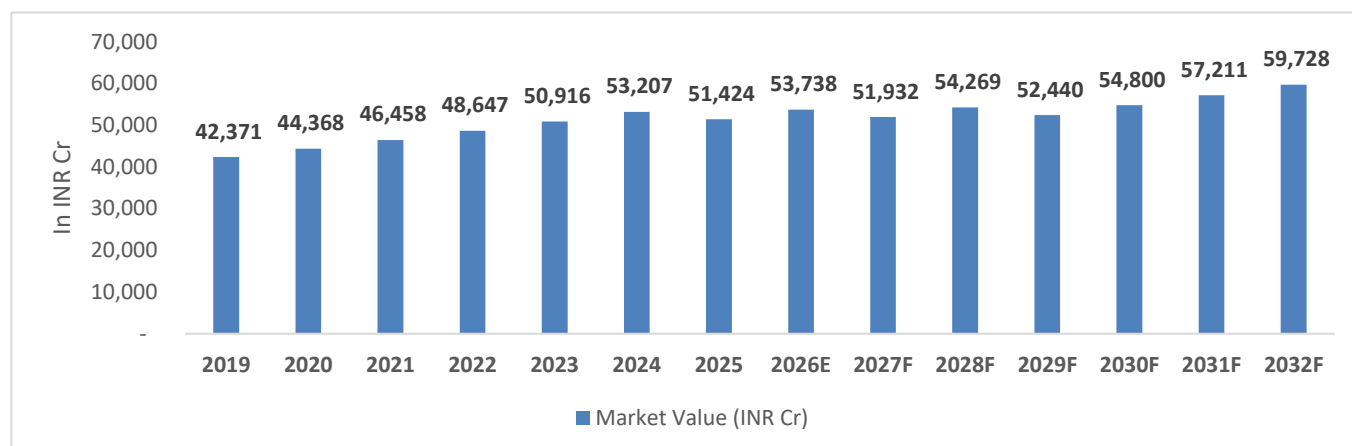
| Turbine Manufacturer                  | Description                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Harbin Turbine Company Limited</b> | Harbin is expected to benefit from China's expansion of power projects under its One Belt One Road (OBOR) initiative as Chinese equipment makers would be preferred for power projects. With strong domestic presence in steam turbine technology, the company is moving towards manufacturing gas turbines, which could benefit it in China's growing gas market as well as international markets |

Source: Frost & Sullivan Research

### 3.2.2 India Energy Turbine Market Overview

#### India Energy Turbine Market Trend FY 2019-2032

Exhibit 116: India Energy Turbine Market Trend, INR Cr, FY 2019-32



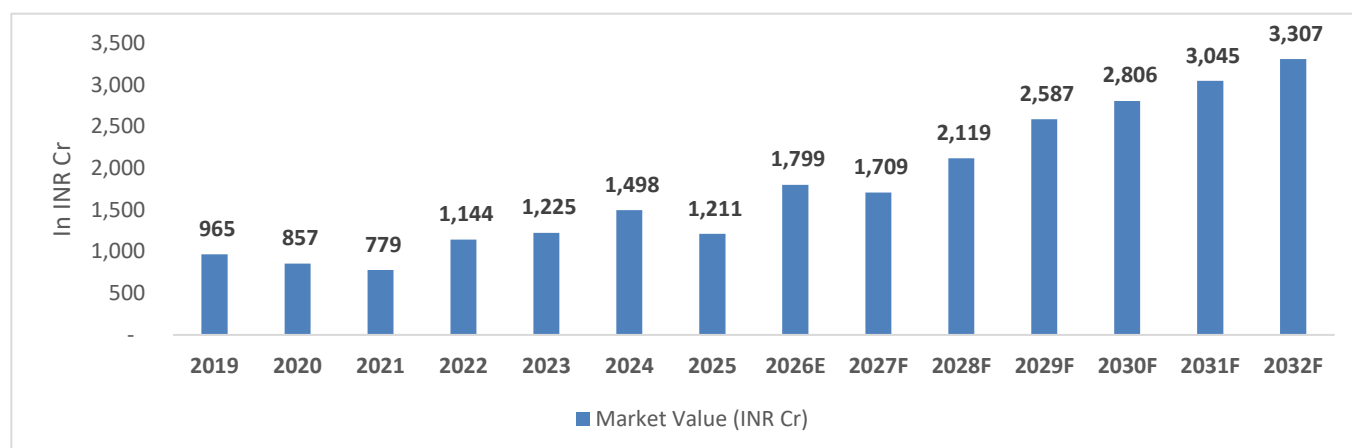
Source: Industry Report

E-Estimated, F-Forecasted

- Indian Energy Turbines market was valued at **INR 53,738 Crores in FY 2026** and is projected to mark **INR 59,728 Crores by FY 2032** with a **CAGR of 4.4%** from FY 2026 to 2032 driven by **rapidly rising investments in the country's power generation infrastructure, coupled with growing concerns about environmental degradation.**

#### India Overall Forgings Market: Energy Turbine, FY 2019-2032

Exhibit 117: India Overall Forgings Market Trend, Energy Turbine, INR Cr, FY 2019-32



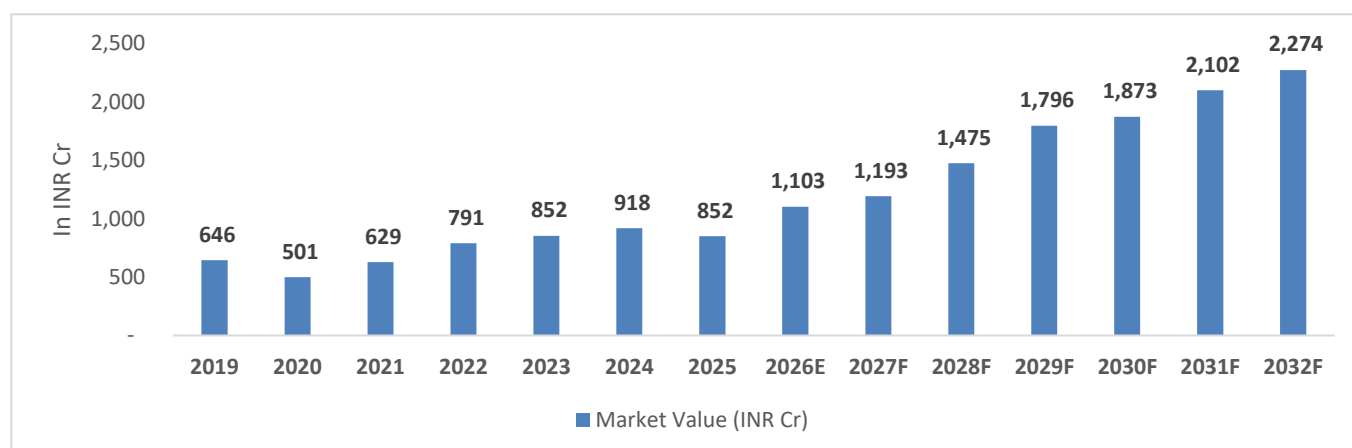
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall forgings market for **Energy Turbines** was valued at **INR 1,799 Crores in FY 2026** and is projected to mark **INR 3,307 Crores by FY 2032** with a **CAGR of 10.7 %** from FY 2026 to 2032 driven by demand of forgings and forged machined components from Gas and Steam Turbines segments.

## India Precision Forged Machined Components Market: Energy Turbine, FY 2019-2032

### Exhibit 118: India Precision Forged Machined Components Market Trend, Energy Turbine, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

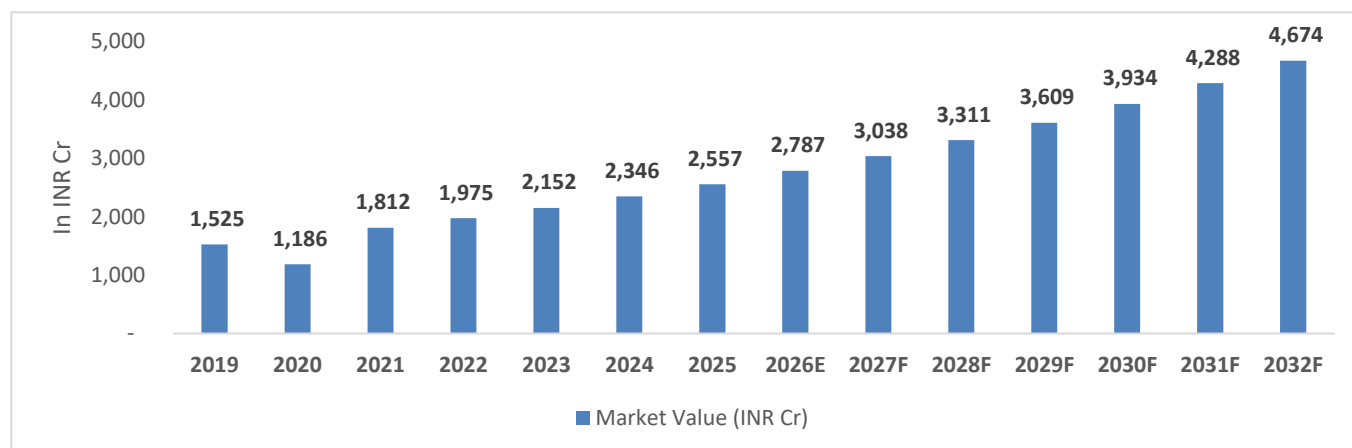
- Indian Precision Forged Machined Components Market for **Energy Turbines** was valued at **INR 1,103 Crores in FY 2026** and is projected to **mark INR 2,274 Crores by FY 2032** with a **CAGR of 12.8 % from FY 2026 to 2032** driven by precision forged machined components from Gas and Steam Turbines segments.
- Precision forged and machined components used in these segments are **Drive Shafts and Rotor Shafts, forged tubes, forged Disks, blocks, blades and vanes of turbines, seamless rings, stators, spacers, retainers, flanges, adapters, nozzles, casings, bearing blocks and shells.**

With the growth of the Renewable Energy segment demand for forged components from various segments such as Wind, Solar, Hydropower, Biomass and Geothermal is increasing.

- Forged Products for Wind Power Segment:** Parts in the nacelle (gearbox, high-speed shaft, low-speed shaft and brake), the yaw drive for upwind turbines (shaft and gear) and tower components for both downwind and upwind turbines.
- Forged Products for Hydropower:** Rings, discs and shafts are ideal for components such as blades, wheels and driveshafts for both turbines and generators.
- Forged Products for Solar Energy Segment:** Solar energy harvesting employs turbines, and solar panels frequently require gearing in the manufacturing process, which are great applications for forgings.
- Forged Products for Biomass Segment:** Kiln Components
- Forged Products for Geothermal Power Segment:** Forged bar used in drilling for steam to blades for turbines, shafts for generators and blanks for gearboxes.

## India Gas Turbine Market Trend FY 2019-2032

Exhibit 119: India Gas Turbine Market Trend, INR Cr, FY 2019-32



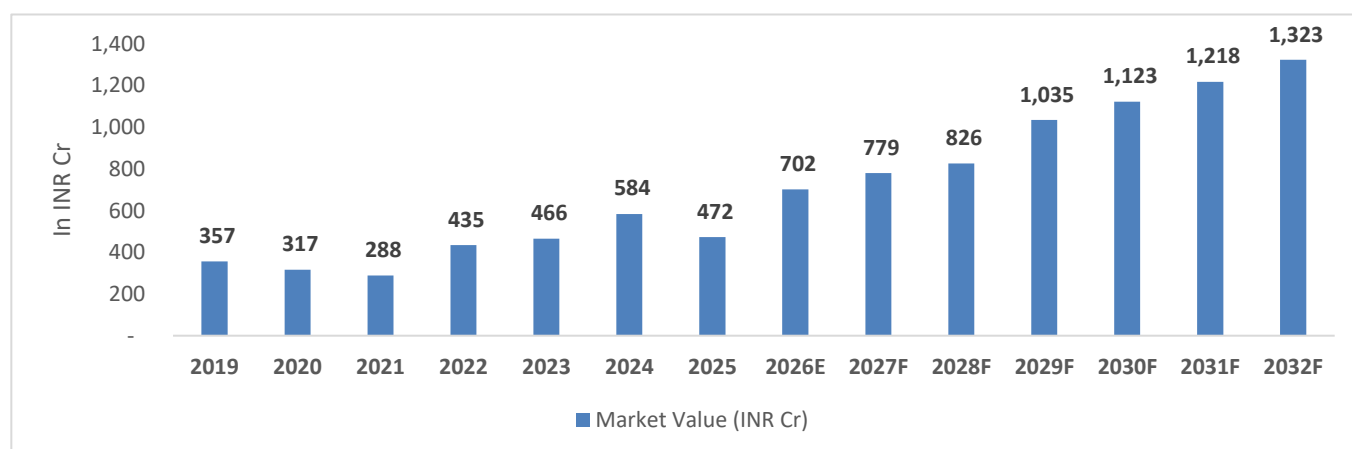
Source: Industry Report

E-Estimated, F-Forecasted

- Indian Gas Turbines market was valued at **INR 2,787 Crores in FY 2026** and is projected to mark **INR 4,674 Crores by FY 2032** with a **CAGR of 9%** from FY 2026 to 2032 driven by rapidly rising investments in the country's power generation infrastructure, coupled with growing concerns about environmental degradation.

## India Overall Forgings Market: Gas Turbine, FY 2019-2032

Exhibit 120: India Overall Forgings Market Trend, Gas Turbine, INR Cr, FY 2019-32



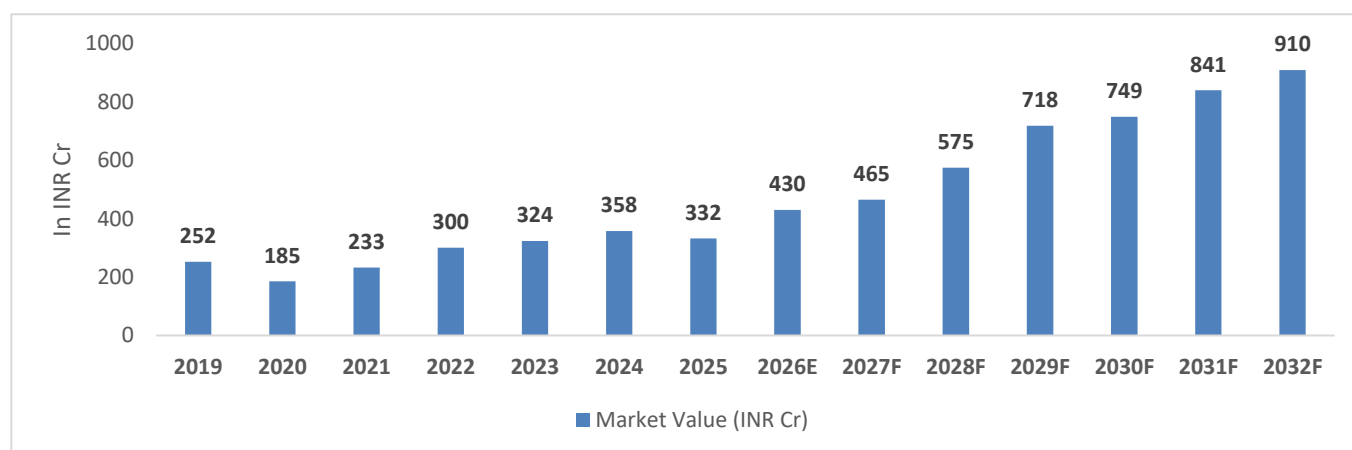
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forgings Market for **Gas Turbines** was valued at **INR 702 Crores in FY 2026** and is projected to mark **INR 1,323 Crores by FY 2032** with a **CAGR of 11.1 %** from FY 2026 to 2032.

## India Precision Forged Machined Components Market: Gas Turbine, FY 2019-2032

### Exhibit 121: India Precision Forged Machined Components Market Trend, Gas Turbine, INR Cr, FY 2019-32



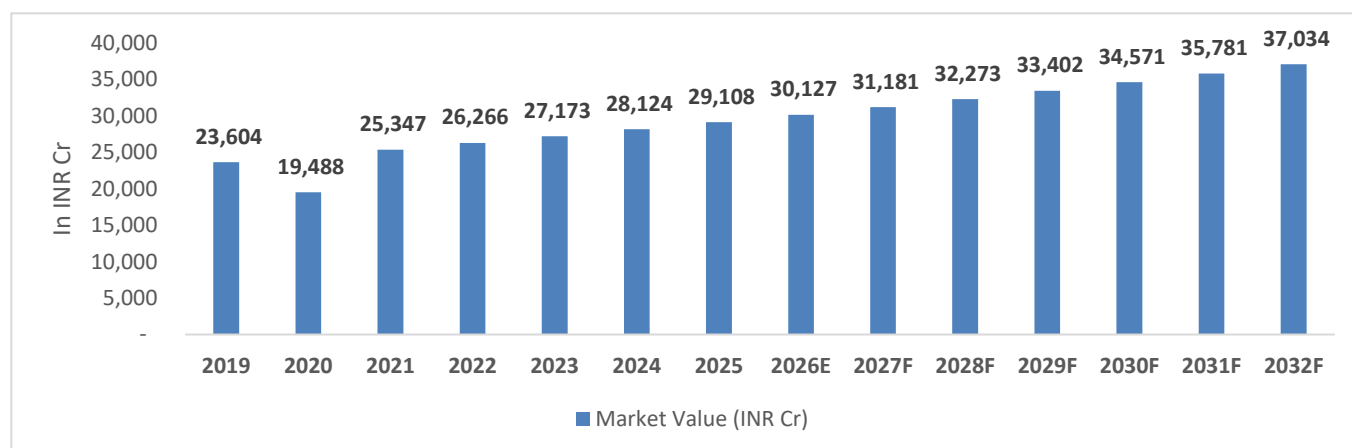
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision Forged Machined Components Market for **Gas Turbines** was valued at **INR 430 Crores** in **FY 2026** and is projected to mark **INR 910 Crores** by **FY 2032** with a **CAGR of 13.3 %** from **FY 2026** to **FY 2032**.

## India Steam Turbine Market Trend FY 2019-2032

### Exhibit 122: India Steam Turbine Market Trend, INR Cr, FY 2019-32



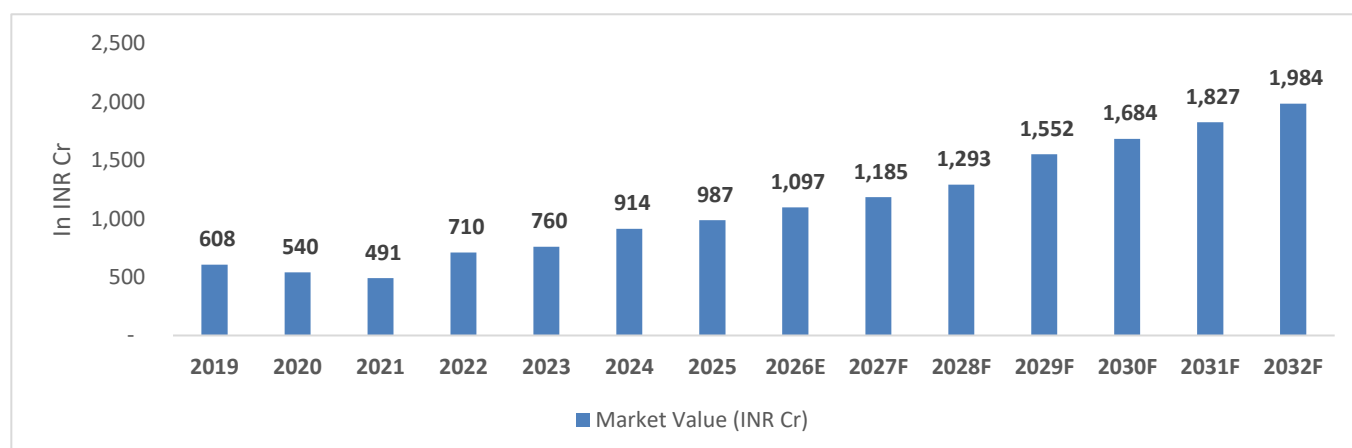
Source: Industry Report

E-Estimated, F-Forecasted

- Indian Steam Turbines market was valued at **INR 30,127 Crores** in **FY 2026** and is projected to mark **INR 37,034 Crores** by **FY 2032** with a **CAGR of 3.5%** from **FY 2026** to **FY 2032** driven by increasing demand of electricity and rapidly rising investments in the country's power generation infrastructure.

## India Overall Forgings Market: Steam Turbine, FY 2019-2032

**Exhibit 123: India Overall Forgings Market Trend, Steam Turbine, INR Cr, FY 2019-32**



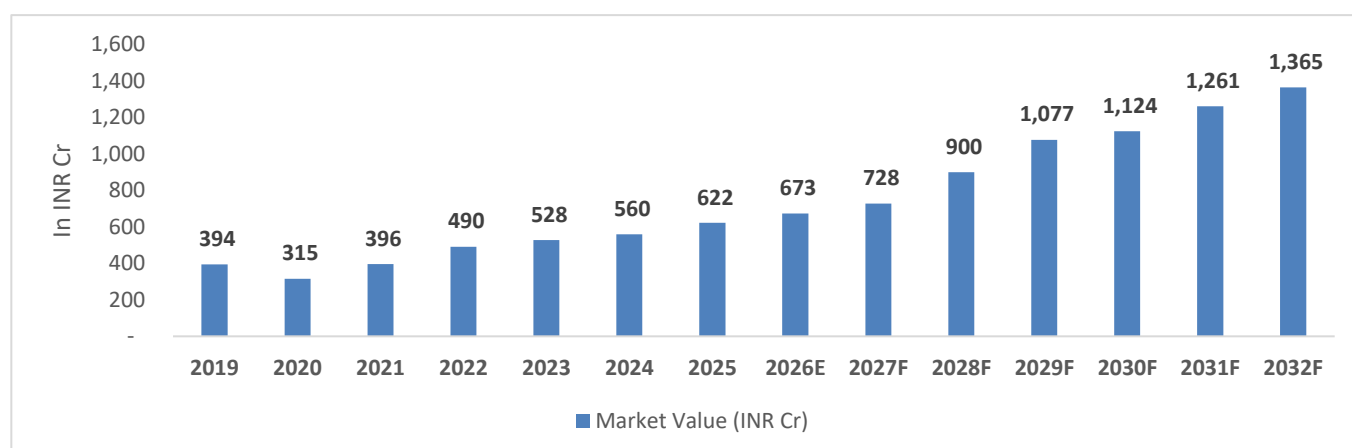
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forgings market for **Steam Turbines** was valued at **INR 1,097 Crores in FY 2024** and is projected to **mark INR 1,984 Crores by FY 2032** with a **CAGR of 10.4 % from FY 2026 to FY 2032**.

## India Precision Forged Machined Components Market: Steam Turbine, FY 2019-2032

**Exhibit 124: India Precision Forged Machined Components Market Trend, Steam Turbine, INR Cr, FY 2019-32**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision Forged Machined Components Market for **Steam Turbines** was valued at **INR 673 Crores in FY 2026** and is projected to **mark INR 1,365 Crores by FY 2032** with a **CAGR of 12.5 % from FY 2026 to 2032**.

## Key Turbine Manufacturers

- In India, the steam-turbine market is best viewed in two distinct segments: large utility-scale turbines, where Bharat Heavy Electricals Limited (BHEL) is the dominant domestic supplier, and industrial/decentralized turbines, where Triveni Turbine Limited and Siemens Energy India Limited are particularly important.

**Exhibit 125: Details of Key Turbine Manufacturers**

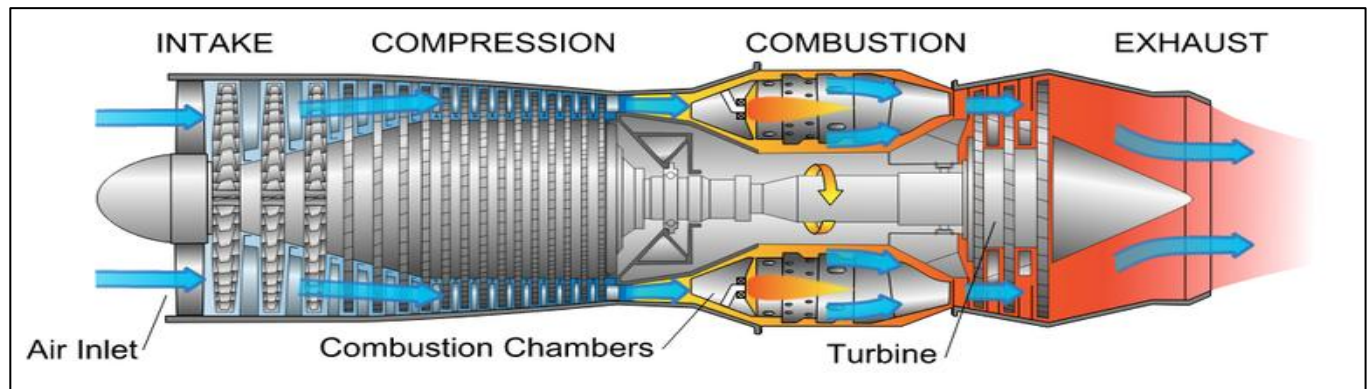
| Manufacturer                                      | Description                                                                                                                    | Energy Related Products                                                                                       | End Use Segments                                                                                        |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>GE Vernova<br/>(Formerly General Electric)</b> | US-based purpose-built company focused exclusively on the energy transition following its 2024 spin-off.                       | Gas Turbine<br>Steam Turbine<br>Generators<br>Boilers,<br>Wind/Renewable equipment                            | Power generation<br>Renewable energy<br>Oil and gas<br>Industrial solutions                             |
| <b>Siemens Energy AG</b>                          | Germany based MNC that provides solutions and services across different industries.                                            | Compressors , Energy<br>Automation &<br>Smart Grid<br>Turbine<br>Other power gen. equipment                   | Power generation<br>Industry & manufacturing<br>Infrastructure & buildings<br>Decarbonization solutions |
| <b>Mitsubishi Power Ltd.</b>                      | Japan-based subsidiary of MHI with expertise in power generation, decarbonization technologies, and industrial infrastructure. | Gas Turbine<br>Steam Turbine<br>Generators<br>Power plant solution<br>Boilers<br>Hydrogen co-firing solutions | Thermal power plants<br>Renewable Energy<br>Integrated Energy solution<br>Environmental solutions       |
| <b>Ansaldo Energia S.P.A.</b>                     | Italy based company recognized for its expertise in power generation equipment.                                                | Gas Turbine<br>Steam Turbine<br>Generators<br>Power Plant solution<br>Microturbines                           | Thermal power<br>Generation<br>Industrial power generation<br>Renewable energy                          |
| <b>Bharat Heavy Electricals Limited (BHEL)</b>    | Indian PSU that manufactures power generation equipment.                                                                       | Gas Turbin<br>Steam Turbine<br>Generators<br>Boilers                                                          | Power Generation (Thermal/Nuclear)<br>Aerospace<br>Defence<br>Electrical Equipment<br>Locomotive        |
| <b>Triveni Turbines Ltd.</b>                      | India-based industrial Steam Turbine manufacturer catering to a global market.                                                 | Industrial Steam<br>Turbines (up to 100 MW)                                                                   | Textiles<br>Sugar<br>Oil & Gas<br>Chemical<br>Biomass/Renewable Power Generation                        |
| <b>Harbin Turbine Co. Ltd.</b>                    | China based enterprise that manufactures all types of turbines                                                                 | Gas Turbine<br>Steam Turbine<br>Nuclear<br>Turbine<br>Fossil Turbine                                          | Power generation<br>Transmission distribution<br>Nuclear<br>Oil and Gas                                 |
| <b>Dongfang Electric Corporation</b>              | China state-owned company that builds power generation equipment including nuclear and thermal systems.                        | Steam Turbine, Gas<br>Turbine, Wind<br>Turbines, Nuclear<br>power equipment                                   | Power generation<br>Transmission distribution<br>Oil and Gas                                            |
| <b>Shanghai</b>                                   | China based MNC that deals in power                                                                                            | Steam Turbine<br>Gas Turbine                                                                                  | Power generation<br>Transmission, distribution                                                          |

| Manufacturer                                  | Description                                                                                                       | Energy Products                                        | End Use Segments                                                        |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------|
| <b>Electric Power Generation Group</b>        | generation & electrical equipment                                                                                 | Wind Turbines                                          | Electrical Equipment                                                    |
| <b>Baker Hughes</b>                           | US-based energy technology company with diverse offerings across the energy & industrial value chain.             | Aeroderivative Gas Turbine, Steam Turbine, Compressors | Oil and Gas (LNG)<br>Industrial applications<br>Hydrogen infrastructure |
| <b>Solar Turbines (A Caterpillar Company)</b> | US-based company which supplies energy solutions for industrial power generation & mechanical drive applications. | Industrial Gas turbines, Gas Compressors               | Oil & Gas production, Industrial, Renewable, Marine                     |

Source: Company websites

## Key Components of a Turbine and its maintenance Cycle

### Exhibit 126: Pictorial Representation of a Gas Turbine



Source: Energy Education

A gas turbine is an internal combustion engine used in power plants. It converts natural gas or other liquid fuels into mechanical energy, which in turn drives a generator to produce electrical energy transmitted through power lines. Major components of a gas turbine include:

1. **Air Inlet:** It is an important component that makes huge amount of air to enter the turbine maintaining the pressure or flow, the filters used remove contaminants from the air. The air inlet is designed to ensure a steady air flow & maximize air compression.
2. **Compressor:** Airfoils in this section perform the function to pull in large air volume, compresses the air to required pressure & pushes it to the combustion chamber at high speed. Usually axial-flow compressors are used due to their ability to maintain continuous air flow. These compressors consist of rotor blades/air foils, drums and stator blades/airfoils which work in creating an 'adverse' pressure gradient to push gas to high static pressure from low across the compressor. Component critically is of high importance to prevent flow reversal and avoid 'stalling' of blades/airfoils which increases power required and decreases component life.

3. **Combustion Chamber:** Here the fuel is injected, post that ignition of fuel-air mixture is done using spark plugs located in the chamber. The job of flame stabilizers is to ensure that the flame stays in the combustion zone & is stopped from moving back in the compressor section.
4. **Power Turbine:** The most vital component that converts the energy from high temperature & high-pressure gas into mechanical energy, which generates electricity. The gas flowing through the turbine expands and exerts a force on the blades and makes them move. The moving blades draw more pressure in the combustion section & spin the generator to produce electricity. Cooling systems are mounted to maintain the temperature of the turbine.
5. **Blades/Airfoils:** A turbine blade can be divided into 4 parts: Air foil, platform, shank & dovetail. They contain rows of hollow airfoils for cooling purposes. The compressor and turbine sections of a gas turbine use two types of blades:
  - **Rotor Blades/Airfoils:** These blades are responsible to accelerate & compress the incoming air in the compressor & extract energy from gas flow in the turbine. They are shaped in aerodynamic manner to hold high centrifugal forces & run at high speeds.
  - **Stator Blades/Airfoils (Guide Vanes):** They are used to compress the air near the rotor blades, optimize the angle of attack & reroute the airflow. These blades are important to the performance & efficiency of the turbine.
  - **Key Components are Casing, Rotor, Blades Airfoils, Diaphragms, Bearings, Governor & support system**

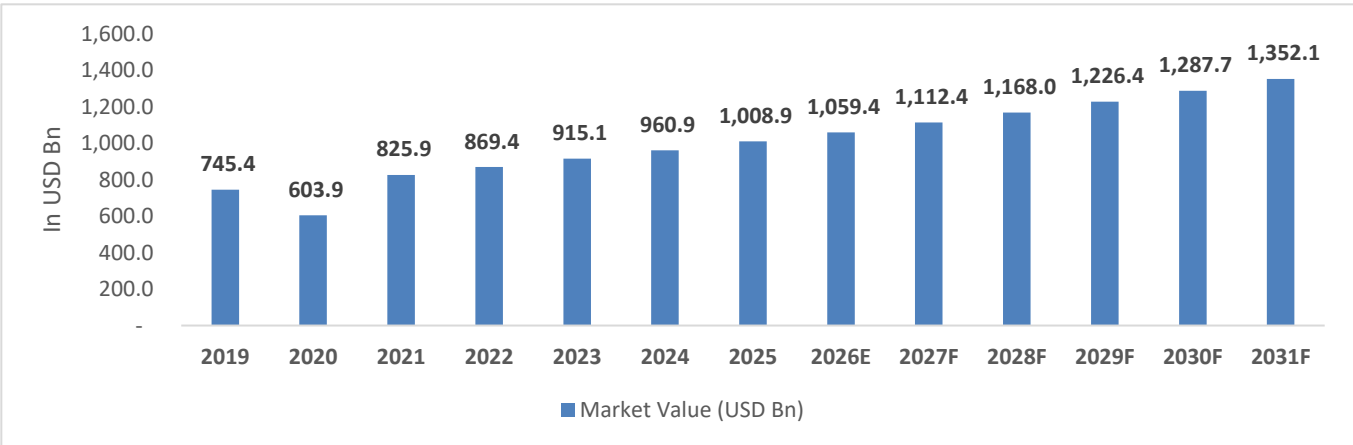
### 3.3 Aerospace

#### 3.3.1 Aerospace Global Overview:

- The Global Aerospace sector is on a high growth trajectory. Rapid Urbanization, increasing commercial aircraft orders, post-pandemic travel resurgence, and rising government support for defense modernization are expected to drive the growth.
- Aircraft orders refer to the contractual agreements between an airline or aircraft operator and an aircraft manufacturer for the purchase of new aircraft. Currently, the industry is witnessing record-high order backlogs stretching into the 2030s due to massive fleet replacement cycles and supply chain constraints.<sup>21</sup>
- Huge demand for next-generation, fuel-efficient aircraft from Airbus and Boeing, coupled with elevated geopolitical defense spending driving orders for other major manufacturers such as Lockheed Martin and Northrop Grumman across the globe, is expected to substantially boost the forging and advanced materials requirement in this segment.<sup>22</sup>
- Aircraft delivery delays are keeping older fleets in service for longer, increasing maintenance activity and demand for replacement parts. With MRO requirements rising and parts availability remaining constrained, this is supporting aftermarket demand for critical aerospace forgings such as engine discs and landing-gear components.<sup>23</sup>

#### Global Overall Components Market Trend: Aerospace CY 2019-2031

Exhibit 127: Global Overall Components Market Trend: Aerospace, Aerospace, USD Bn, CY 2019-31



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall Components market for Aerospace was **valued at USD 960.9 Bn in 2025** and is projected to mark **USD 1,352.1 Bn by 2031 with a CAGR of 5% from 2025 to 2031** driven by increase in demand of aircraft components such as **air fuselage, landing gear, Engine discs, components of wings, undercarriage components, aircraft structural systems** propelled by requirement of a greater number of aircrafts to combat growing air passenger traffic.

<sup>21</sup> Airbus Global Market Forecast (GMF) and Boeing Commercial Market Outlook (CMO) 2025/2026 reports

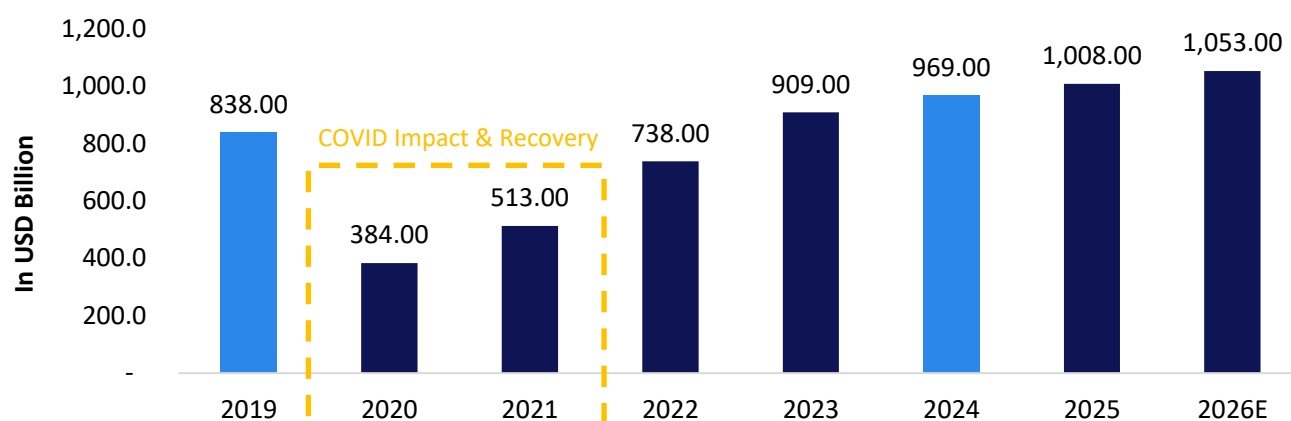
<sup>22</sup> Stockholm International Peace Research Institute (SIPRI) 2025/2026

<sup>23</sup> <https://www.iata.org/en/pressroom/2026-speeches/06-24-wmes-2026-speech-stuart-fox-iata-director-flight-operations/>

## Market Overview and Growth in the Commercial Aircraft Industry

- Air travel passenger volumes have fully rebounded, reaching **4.77 billion in 2024**, and are expected to reach **4.98 billion in 2025** and **5.20 billion in 2026**, according to IATA.
- Passenger revenues are expected to reach **USD 716 billion in 2025**, compared to **USD 687 billion in 2024**. Airline net profits are also expected to reach **USD 39.5 billion in 2025**, compared to **USD 28.3 billion in 2024**, according to IATA.

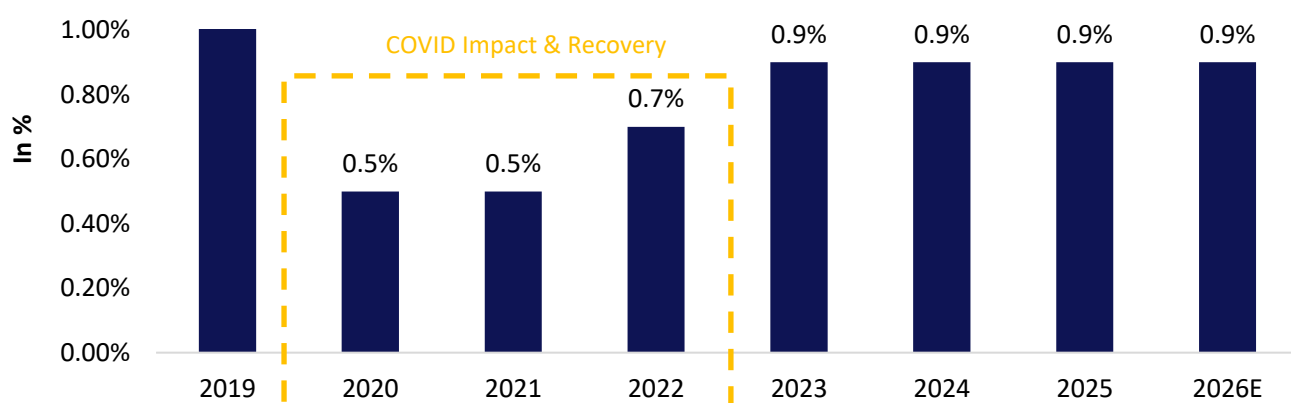
### Exhibit 128: Total Global Spend on Air Travel, 2019-2026F (In USD Billion)



Source: IATA

- Global air travel revenues amounted to **USD 838 billion in 2019**. This contracted by **54.1% in 2020** to **USD 384 billion** due to the COVID-19 pandemic.
- The market recovered by **33.4% to reach USD 513 billion in 2021**. It grew further by **44.1% to reach USD 738 billion in 2022**.
- The milestone of recovery to surpass pre-pandemic levels was reached in 2023 with **USD 909 billion**, continuing its growth to **USD 1053 billion in 2026**.
- The industry has surpassed the USD 1 trillion mark in **2025 at USD 1,008 billion**, reaching **USD 1,053 billion by 2026**.

### Exhibit 130: Total Global Spend on Air Travel as a %age of GDP, 2019-2026F



Source: IATA

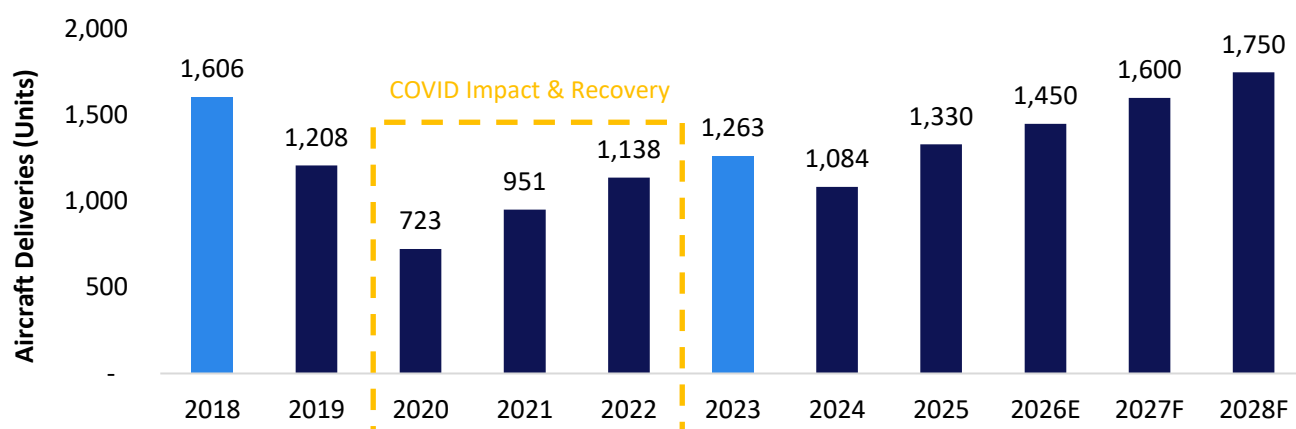
e-Estimated, f-Forecasted

- The contribution of global air travel to global GDP historically fluctuated nearly 1.0% in 2019, before contracting sharply to 0.5% in 2020 and 2021.
- This contribution grew to 0.7% of global GDP in 2022 and further to 0.9% in 2023 and 2024.

- Total industry revenues have crossed the historic USD 1 trillion milestone, reaching USD 1,008 billion in 2025 and USD 1,053 billion in 2026. Despite these record revenues, the sectors spend as a percentage of global GDP is expected to plateau at approximately 0.9%.

## Overview & Outlook on Commercial Aircraft Deliveries

**Exhibit 131: Global Commercial Aircraft Deliveries (in Unit Volume), 2018-2028F**



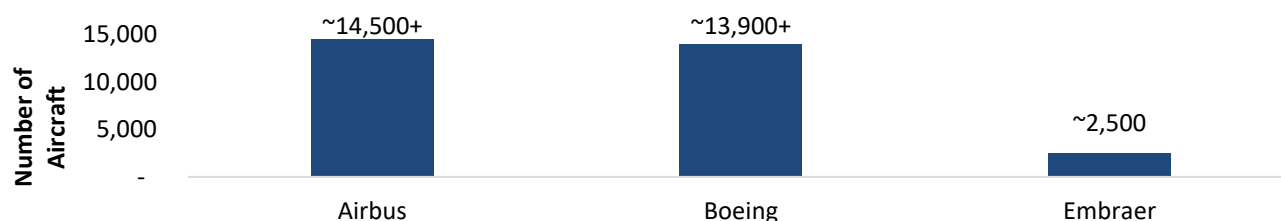
Source: Airbus, Boeing, IATA Global Outlook and Frost & Sullivan Estimates

- The number of passenger fleet deliveries globally reached a substantial **1,606 units aircraft in 2018**, indicating a period of robust growth and investment in the global transportation sector, driven by strong air passenger demands from Asia.
- 2019 witnessed a huge fall in passenger fleet deliveries, dropping to 1,208, across narrow and wide body aircraft due to COVID.
- The year 2020 marked a significant disruption for the transportation sector, with passenger fleet deliveries plummeting to 723 aircraft. Cash flow issues with many airlines resulted in airlines either postponing the delivery of the new aircraft or cancelling the orders altogether.
- 2021 saw a partial recovery in passenger fleet deliveries to **951 aircraft**. The momentum of recovery continued into 2022, with passenger fleet deliveries further increasing to 1,138 aircraft, driven by rebound in air passenger traffic.
- In 2023, the upward trajectory in passenger fleet deliveries continued, reaching **1,263 units**.
- The year 2024 experienced a significant downward correction to **1,084 aircraft**, falling far short of the originally forecasted 1,380. This disruption was primarily caused by the seven-week Boeing machinist strike, FAA-imposed production caps on the 737 MAX, and ongoing supply chain and engine bottlenecks at Airbus.<sup>24</sup>
- In 2025, deliveries rebounded to **1,330 units** as production stabilized. Airbus achieved 793 deliveries, while Boeing recovered to deliver 537 aircraft as it cleared built inventory and shortened delivery timelines.<sup>24</sup>
- Aircraft deliveries are now expected to reach approximately **1,750 aircraft in 2028**. The long-term forecast has been slightly tempered from previous estimates to reflect the structural reality of persistent aerospace supply chain limits, even as monthly production rates for narrow-body aircraft by Airbus and Boeing aggressively ramp up.<sup>24</sup>

<sup>24</sup> IATA Global Outlook for Air Transport (December 2025) - Aircraft and Ownership

## Commercial Aircraft Global Fleet Size

**Exhibit 132: Fleet Size for Commercial Aircraft, 2025 (Estimated Number of Aircraft)**

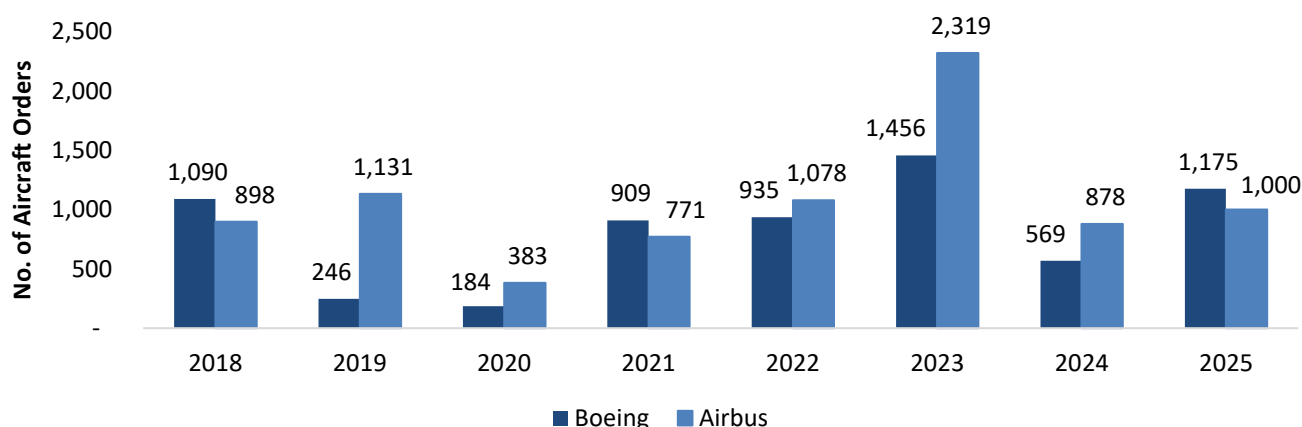


Source: Airbus, Boeing and Embraer report and IATA "The Global Commercial Aircraft Fleet" Report (2025) | Frost & Sullivan Estimates

Note: These are estimates and will not add up to exact fleet

- The global aircraft market is highly consolidated, with Airbus and Boeing together accounting for roughly **80% of the entire 35,550 commercial aircraft fleet globally**.<sup>25</sup>
- Driven by consistent delivery leads in the narrow-body segment, **Airbus accounts for 14,500+ aircraft** in service, while **Boeing accounts for approximately 14,000 aircraft** globally. Embraer dominates the regional segment with an active commercial fleet of around 2,500 aircraft.<sup>26</sup>
- The most popular aircraft families globally remain the Airbus A320 (including neo variants) and the Boeing B737 (including MAX).<sup>27</sup>
- While historical deliveries were concentrated in the Americas and Europe, over 40% of future demand and new fleet growth over the next two decades is expected to be dominated by the Asia Pacific region (particularly China and India).<sup>28</sup>

**Exhibit 133: Airbus and Boeing Aircraft Orders for Commercial Aircraft, 2018-2025**



Source: Airbus and Boeing Report's

- In **2024**, **Boeing's** gross orders dropped significantly to **569** due to a week-long machinist strike and production constraints, while **Airbus secured 878** gross orders.<sup>29</sup>
- In **2025**, Airbus recorded **1,000 gross orders (889 net)** from 57 customers. This robust order mix included **656 A320s, 193 A350s, 100 A330neos, 49 A220s, and two A330 MRTTs**.<sup>30</sup>
- Boeing experienced a strong rebound in **2025**, recording **1,175** commercial gross orders, outpacing Airbus's order intake for the year.<sup>31</sup>

<sup>25</sup> OEM market share reports.

<sup>26</sup> Airbus O&D Database, Boeing Company Factsheet, and Embraer Delivery Logs.

<sup>27</sup> Airbus Global Market Forecast (GMF) and Boeing Commercial Market Outlook (CMO).

<sup>28</sup> IATA Global Outlook (Dec 2025) and OEM 20-year market forecasts.

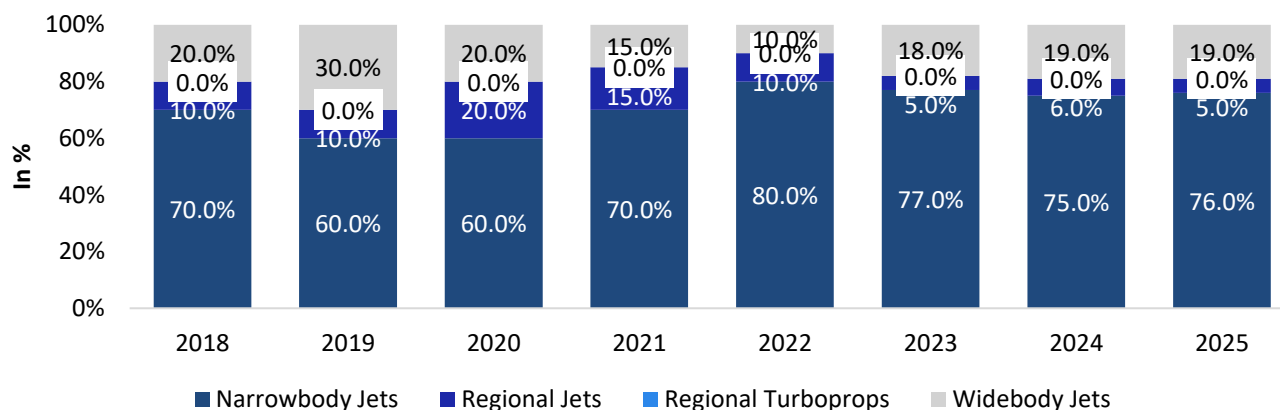
<sup>29</sup> <https://www.manufacturingdive.com/news/boeing-commercial-plane-deliveries-nosedives-64-percent-q4-fy-2024/737433/>

<sup>30</sup> <https://www.airbus.com/en/newsroom/press-releases/2026-01-airbus-reports-793-commercial-aircraft-deliveries-in-2025>

<sup>31</sup> <https://www.manufacturingdive.com/news/boeing-deliveries-q4-full-year-2025-commercial-airbus/809504>

- By the end of 2025, Airbus's total order backlog reached 8,754 aircraft<sup>30</sup>. Boeing's backlog remains strong at nearly 6,000 aircraft<sup>32</sup>, with the narrow-body A320neo and B737 MAX models driving the majority of global demand.

**Exhibit 134: Airbus and Boeing Aircraft deliveries by Type of Aircraft, 2018-2025 (In %)**



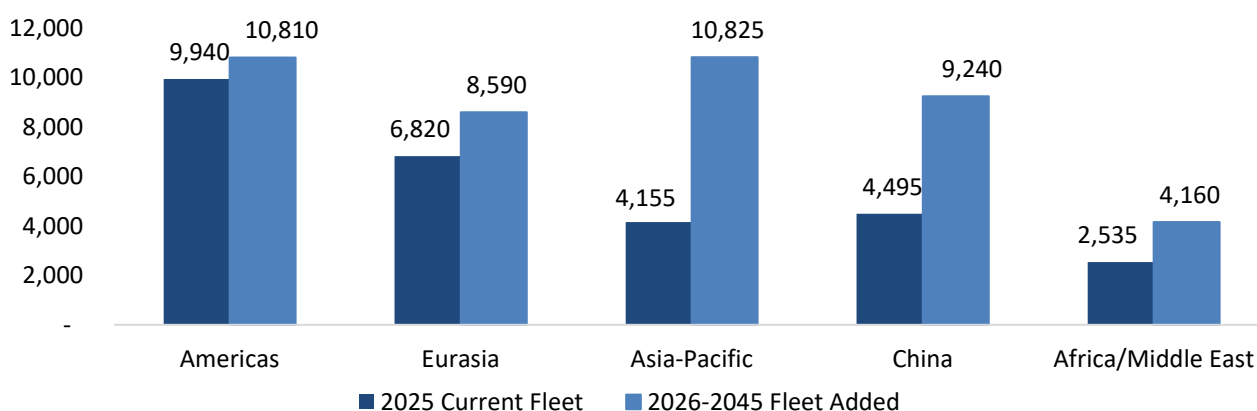
Source: Airbus and Boeing Official Annual Delivery Reports (FY23-FY25).

(Note: Regional Turboprops are 0% as Boeing and Airbus strictly manufacture jets; turboprops like ATR operate as separate joint ventures).

- The narrow body aircraft have traditionally been mostly in demand owing to the increase in air travel for shorter connectivity for flights which last around 3.5 hours (one way).
- Narrow-body aircraft (specifically the B737 and A320 families) have consistently accounted for **75% to 77% of total deliveries** between 2023 and 2025, consolidating their absolute market dominance.
- The narrow body aircraft are usually used by low-cost carriers, the growth of which has been a significant driver for the narrow body aircraft market.
- The share of wide-body aircraft has stabilized at around **19%** in 2024 and 2025 as long-haul international route networks recover, while regional jets (primarily the Airbus A220) make up the remaining minority segment at approximately **5% to 6%**.

#### Commercial Aircraft Regional Fleet Distribution

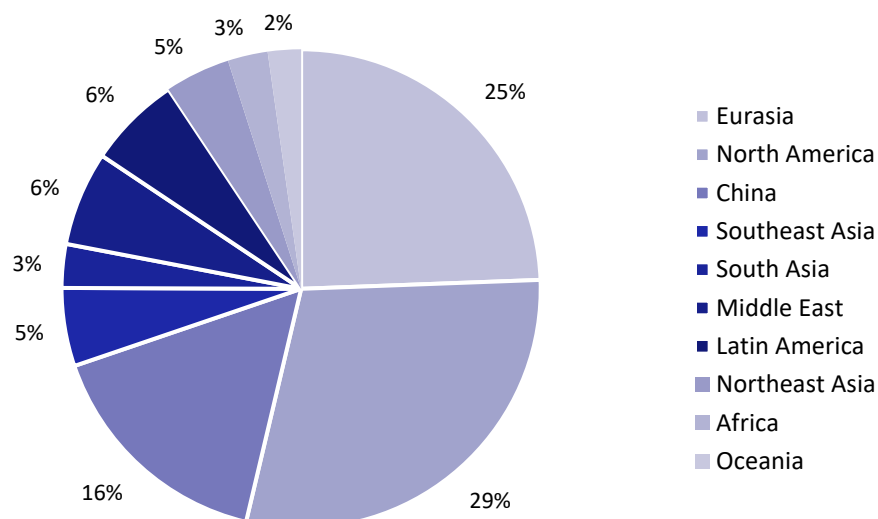
**Exhibit 135: Global Fleet across Regions, Current (2025) vs Forecast (2026-2045)**



Source: Boeing Commercial Market Outlook (2025 Base Fleet Data)

<sup>32</sup> <https://investors.boeing.com/investors/news/press-release-details/2026/Boeing-Reports-Fourth-Quarter-Results/>

**Exhibit 136: Regional Fleet Distribution, 2025 (%)**



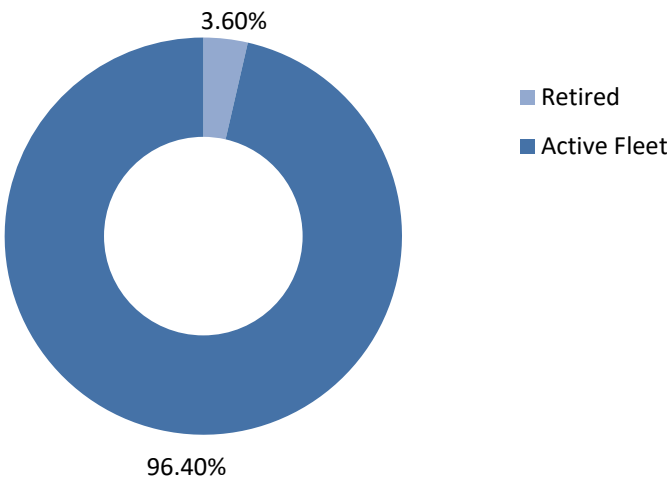
Source: Boeing Commercial Market Outlook (2025 Base Fleet Data)

- **The regional fleet distribution pattern** is currently skewed towards developed economies, with North America and Eurasia accounting for roughly 53% of the total active fleet globally in 2025. The broader Asia-Pacific region (including China and India) accounted for around 31% of the global aircraft fleet in 2025. However, the fleet size of developing economies is expected to grow significantly faster, driven by the rapid expansion of low-cost carrier (LCC) airlines entering these markets.
  - **In the Americas**, 10,810 new aircraft are slated to be added to the fleet by 2045 (comprising 8,405 in North America and 2,405 in Latin America), reflecting sustained demand for air travel and massive fleet replacement cycles in the region.
  - **Eurasia**, comprising Europe and parts of Asia, accounted for a fleet size of 6,820 aircraft in 2025. This region serves as a major hub for air travel, connecting continents and facilitating trade and tourism flows. Eurasia is set to see the addition of 8,590 aircraft, driven by economic recovery, intra-regional travel, and increasing passenger volumes by 2045.
  - **Asia-Pacific region** is the hub of the world's fastest-growing economies, with its baseline fleet size standing at 4,155 aircraft in 2025 (excluding China). The region's strategic importance as a global economic powerhouse fuels the demand for air travel. The combined Asian market (Asia-Pacific + China) is poised to witness the largest global fleet expansion, with over 20,000 new aircraft slated for addition by 2045, solidifying the region's status as a global aviation powerhouse.
  - **China**, with its huge economy and growing aviation market, accounted for a fleet size of 4,495 aircraft in 2025. It is expected to add another 9,240 aircraft by 2045. China plays a pivotal role in shaping global aviation trends, driving massive demand for commercial aircraft as one of the world's fastest-growing aviation markets.
  - **Africa/Middle East region** recorded a combined fleet size of 2,535 aircraft in 2025. Owing to the tourism industry fueling demand for air travel and strategic global connecting hubs, the region supports massive expansion. In the Africa/Middle East region, a total of 4,160 aircraft (2,995 in

the Middle East and 1,165 in Africa) are set to be added through 2045, signaling strong confidence in the region's potential for aviation growth despite near-term challenges.

Commercial Aircraft Fleet Retirement

Exhibit 137: Commercial Aircraft Fleet Retirement, 2026-2030

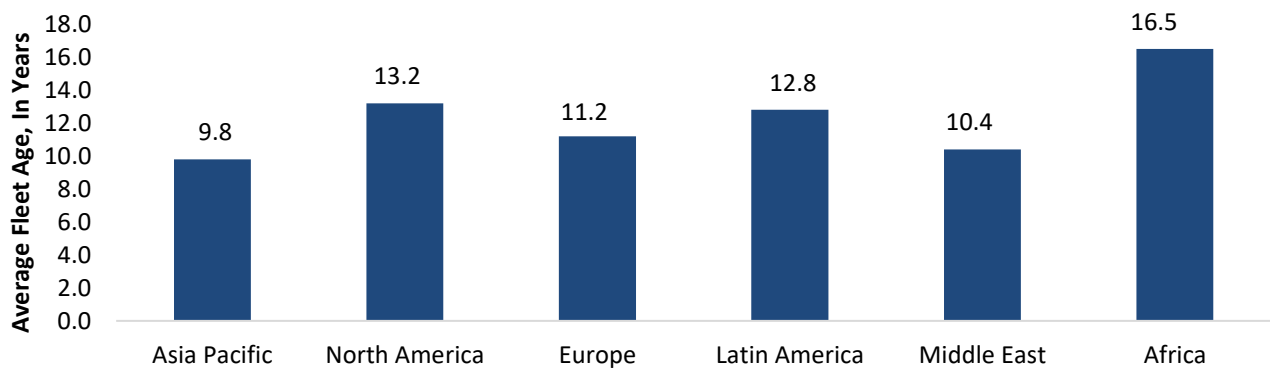


Source: Boeing Commercial Market Outlook (2026-2045) & Aviation News.

- It is estimated that **5,000-5,500** aircraft will retire and be de-fleeted during the 2026-2030 forecast period, aligning with the industry's focus on modernizing older, less fuel-efficient legacy fleets.
- The aviation industry anticipates an **average annual retirement rate of 3.6%** for commercial aircraft during this five-year window.
- The active fleet is projected to comprise **96.4%** of all commercial aircraft in operation, representing the vast majority of aircraft continuing to serve airlines and passengers worldwide.
- Most commercial aircraft removed from passenger service are converted into freighters to extend their life by another 5 to 10 years, with passenger-to-freighter conversions projected to make up roughly two-thirds of all future freighter deliveries.
- Older aircraft models like the **MD80/717, A320ceo, 737NG** have a faster declining rate in the narrow body segment and models like **B747, A380, B767 and early A330s** have a faster declining rate in the wide body segment according to Boeing.

Average Age of Fleet- Commercial Aircraft

Exhibit 138: Average Age of the Fleet based on region (in Years) 2025

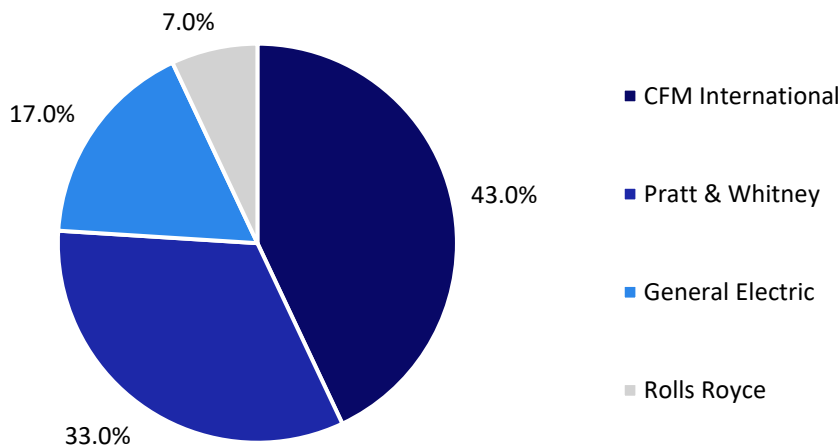


Source: IATA, Cirium, and Oliver Wyman Global Fleet Forecast (2025-2026).

- The global commercial aircraft fleet has a weighted average age of approximately **13-14 years**. The average age varies significantly across regions, reflecting diverse market dynamics, regulatory frameworks, and operational practices.
- **The North America’s average active fleet age reached 13.2 years in 2025**, presenting a mixed picture where mature network airlines maintain older fleets while new entrants renew aggressively.
- **Asia-Pacific and the Middle East continue to operate the world’s youngest fleets (averaging under 11 years)**, largely driven by rapid Low-Cost Carrier (LCC) expansion, strong aircraft deliveries, and large-scale modernization programs.
- **Latin America and Africa exhibit higher average fleet ages (12.8 and 16.5 years, respectively)** due to capital constraints, replacement delays, and longer aircraft service lives before replacement.
- The Asian region is expected to add around **11,925 aircrafts by 2042** due to demand for Low-Cost Carriers (LCC) in this market like Indigo, which order aircrafts in bulk.
- Mounting pressure from regulators, investors, and the IATA 2050 net-zero carbon pledge is accelerating the retirement of older-generation aircraft in favor of next-generation fuel-efficient platforms across all regions.

Overview of Different Types of Engines Used in Commercial Aircrafts

Exhibit 139: Commercial Aircrafts Engine in Service, 2023



Source: Order and Delivery report from OEs

- **Narrow body commercial aircraft** usually have a two-engine configuration, while very large aircraft like **A380 and B747** have a four-engine configuration.
- The recently launched wide body aircraft like the **B787 and the A350** have a two-engine configuration. The use of composites to reduce the weight of the aircraft with focus on environmental sustainability are the key factors which drive this market.
- The commercial aircraft market is dominated by **CFM international**, which accounts for 43% of the commercial aircraft engines. **CFM International is a joint venture between Safran Aircraft Engines and GE Aerospace.**
- The next dominant player is **Pratt & Whitney** which accounts for 33% of the total market. These engines are typically used on the narrow body aircraft like the **B737 and A320** which accounts to about approximately **75-80%** of the delivery of Airbus and Boeing.

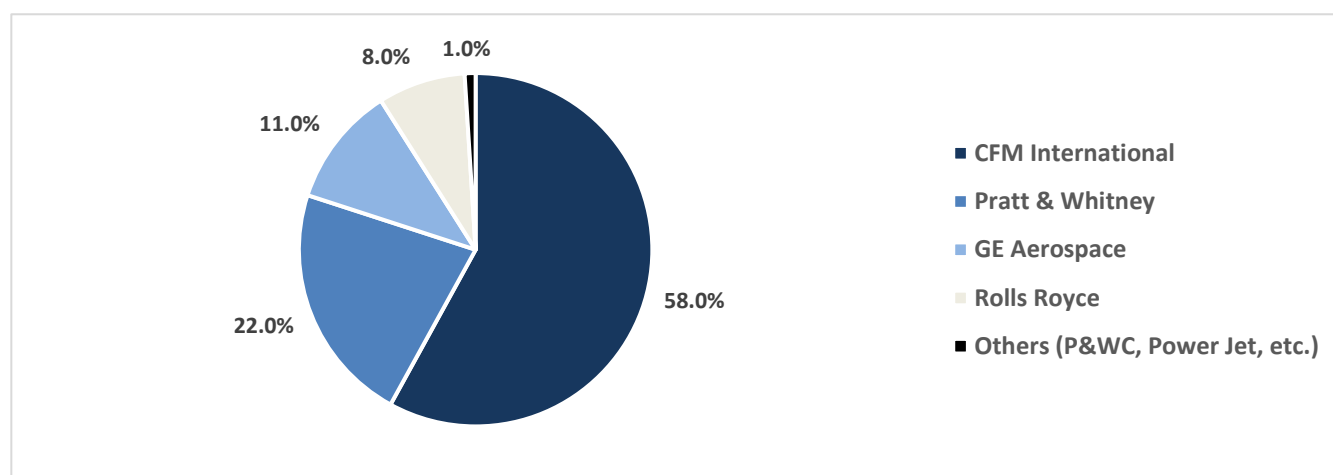
**Exhibit 140: List of Commercial Aircraft Programs and their Engine Supplier**

| Name of the Aircraft Program | Type of Aircraft | Aircraft OEM | Engine OEM                        | Engine Name                                     |
|------------------------------|------------------|--------------|-----------------------------------|-------------------------------------------------|
| E1                           | Narrow Body      | Embraer      | GE Aerospace                      | CF34-8E / CF34-10E                              |
| E2                           |                  |              | Pratt & Whitney                   | PW1700G / PW1900G (GTF)                         |
| A220                         |                  | Airbus       | Pratt & Whitney                   | Pratt & Whitney PW1500GTF                       |
| A320Family (ceo/neo)         |                  |              | CFM International                 | CFM56 / LEAP-1A                                 |
| A320Family (ceo/neo)         |                  |              | Pratt & Whitney                   | V2500 / PW1100G (GTF)                           |
| A330 (ceo/neo)               | Rolls Royce      |              | Rolls-Royce Trent 700/ Trent 7000 |                                                 |
| A330 (ceo)                   | Pratt & Whitney  |              | Pratt & Whitney PW4164/8          |                                                 |
| A330(ceo)                    | GE Aerospace     |              | General Electric CF6-80E1         |                                                 |
| A350                         | Rolls Royce      |              | Rolls-Royce Trent XWB             |                                                 |
| A380                         |                  |              | Rolls-Royce's Trent 900 / GP7200  |                                                 |
| Boeing 737 (NG/MAX)          | Narrow Body      | Boeing       | CFM International                 | CFM56-7B/ LEAP-1B                               |
| Boeing 747                   | Wide Body        |              | GE Aerospace                      | General Electric CF6 / GEnx-2B                  |
| Boeing 767                   |                  |              | GE Aerospace / Pratt & Whitney    | General Electric CF6 / PW4000 series            |
| Boeing 777                   |                  |              | GE Aerospace                      | General Electric GE90 /GE9X                     |
| Boeing 787                   |                  |              | GE Aerospace/ Rolls Royce         | General Electric GEnx-1B/Rolls Royce Trent 1000 |

Source: Frost & Sullivan Analysis

## Commercial Aircraft Engine Orders

### Exhibit 141: Commercial Aircraft Engine Order Backlog Market Share (2025/2026)



Source: Derived from Airbus and Boeing Official Order and Deliveries Backlog Reports (Late 2025/Early 2026).

- Over **80% of the Commercial Aircraft Engine order backlog** lies with just two entities: **CFM International and Pratt & Whitney**, driven entirely by the massive demand for narrow-body aircraft.
- The commercial aircraft order books of Airbus and Boeing are heavily dominated by the **B737 MAX and A320neo** families. **CFM International powers 100% of the 737 MAX backlog** and holds an approximate 55-60% win rate on the A320neo, resulting in a commanding **~58%** share of the overall global engine market backlog.
- **Pratt & Whitney** follows as the second-largest player, accounting for approximately **22%** of the overall market. This is driven by its share of the **A320neo program (via the GTF engine)** and its **exclusive supplier** status for the **Airbus A220 program**.
- The wide-body engine backlog, which makes up roughly 15-20% of total commercial aircraft orders, is split between **GE Aerospace (~11%)** and **Rolls-Royce (~8%)**, powering programs like **777X, 787, A350, and A330neo**.
- Growth in global fleet sizes and this sustained engine backlog will continue to drive aggressive demand for **forging products, advanced alloys, and aftermarket Maintenance, Repair, and Overhaul (MRO) services in the aerospace segment**.

### Market Overview of Global MRO Market

- The global aircraft maintenance, repair, and overhaul (MRO) market is a vital sector supporting the safety, reliability, and efficiency of commercial aircraft.
- **In the 2025/2026 landscape, the MRO market is experiencing an unprecedented demand surge.** Persistent supply chain constraints and new aircraft delivery shortfalls are forcing airlines to retain and operate older, highly maintenance-intensive legacy fleets far longer than historically planned.<sup>33</sup>
- MRO services encompass a wide range of activities, including scheduled maintenance checks, unscheduled repairs, component replacement, and overhaul services.
- The key objective of the MRO is to ensure aircraft safety and compliance with stringent regulatory standards set by aviation authorities like the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA).

<sup>33</sup> Boeing Commercial Market Outlook 2026-2045 (Page 6).

## Key Technologies in Global MRO Market

The aircraft MRO industry is experiencing significant transformations due to the introduction of advanced technologies. These technologies aim to enhance efficiency, quality, cost, safety, and productivity in all maintenance phases and aspects of delivery. Here are the top 5 technologies in aircraft MRO:

- **Artificial Intelligence (AI) and Machine Learning (ML):** AI and ML are being used to optimize maintenance schedules, predict the component failures, and automate inspection processes. With aviation facing skilled maintenance-worker shortages and continued parts supply constraints, AI and advanced data tools are increasingly being used to improve aircraft diagnostics, support predictive maintenance and forecast spare-parts demand. These technologies can help MRO providers identify potential faults earlier, anticipate parts requirements and reduce maintenance-related downtime.<sup>34</sup>
- **Augmented Reality (AR) and Virtual Reality (VR):** AR and VR are being used to provide technicians with real-time information and guidance during maintenance tasks. These technologies can overlay digital information onto the physical world, allowing technicians to see inside components and systems without disassembling them. This can help reduce maintenance time, increase accuracy, and improve safety.
- **Additive Manufacturing:** Also known as 3D printing, it is used to produce spare parts on demand. Boeing reported that it would save around USD 2 million to USD 3 million per B787 aircraft due to the use of 3D-printed titanium parts. Furthermore, airlines and MROs are now heavily relying on on-site 3D printing to bypass global logistics delays and procure non-critical cabin and airframe components immediately.<sup>35</sup>
- **Blockchain:** Blockchain creates a secure and transparent record of maintenance activities and component history. This technology has accelerated in adoption following recent, high-profile industry scandals involving the distribution of unapproved and counterfeit engine parts backed by forged EASA certification documents.<sup>36</sup>
- **Robotics and Automation:** Robotics and automation are being used to perform repetitive and dangerous tasks, such as cleaning and inspection. These technologies can help reduce maintenance time, increase accuracy, and improve safety. They can also help reduce labour costs and improve productivity. These technologies are transforming the aircraft MRO industry, making it more efficient, cost-effective, and safe. However, the adoption of these technologies requires significant investment and expertise. MRO providers must carefully evaluate the benefits and costs of these technologies and develop a clear strategy for implementation.

## Types of Commercial Aircraft MRO

Commercial Aircraft MRO activities can be categorized into four main types: engine, airframe, line maintenance, and component maintenance, it is also referred as Check A, C and D.

- **Engine maintenance:** Involves the inspection, repair, and overhaul of aircraft engines, typically occurring every 6-8 years for mature programs. However, a critical recent trend involves new-generation engines (such as the PW GTF and CFM LEAP) experiencing shorter initial time-on-wing intervals than legacy engines, which has driven a massive spike in premature engine MRO shop visits and strained global engine overhaul capacity.<sup>37</sup>
- **Airframe maintenance:** This type of maintenance focuses on the aircraft's structure, including the fuselage, wings, and control surfaces. Airframe maintenance involves the inspection, repair, and replacement of structural components to ensure the airworthiness of the aircraft. The airframe maintenance is usually scheduled between 18 months to 2 years.
- **Line maintenance:** This type of maintenance is performed on the aircraft during scheduled stops, such as at airports or during flights. Line maintenance checks all operational fluid levels and minor maintenance are undertaken at the parking bay.

<sup>34</sup> Boeing Commercial Services Market Outlook (2025-2044) p.7 & 9

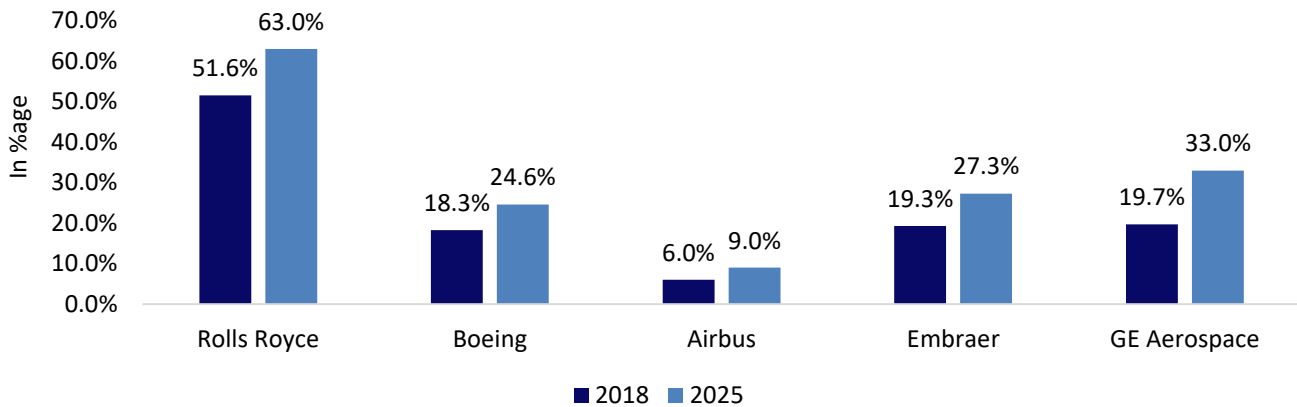
<sup>35</sup> Aviation Week MRO Industry Reports on OEM Supply Chain Bypass.

<sup>36</sup> FAA & EASA Suspected Unapproved Parts (SUP) Notifications (AOG Technics Scandal).

<sup>37</sup> RTX (Pratt & Whitney) Investor Updates & FAA Airworthiness Directives.

- **Component maintenance:** This involves the inspection, repair, and replacement of aircraft components, such as landing gear, hydraulic systems, and electrical systems. Component maintenance ensures that these critical systems function correctly and safely.

**Exhibit 142: Service Revenue Contribution of Major OEMs in Aerospace and Defence, 2018 Vs 2025**

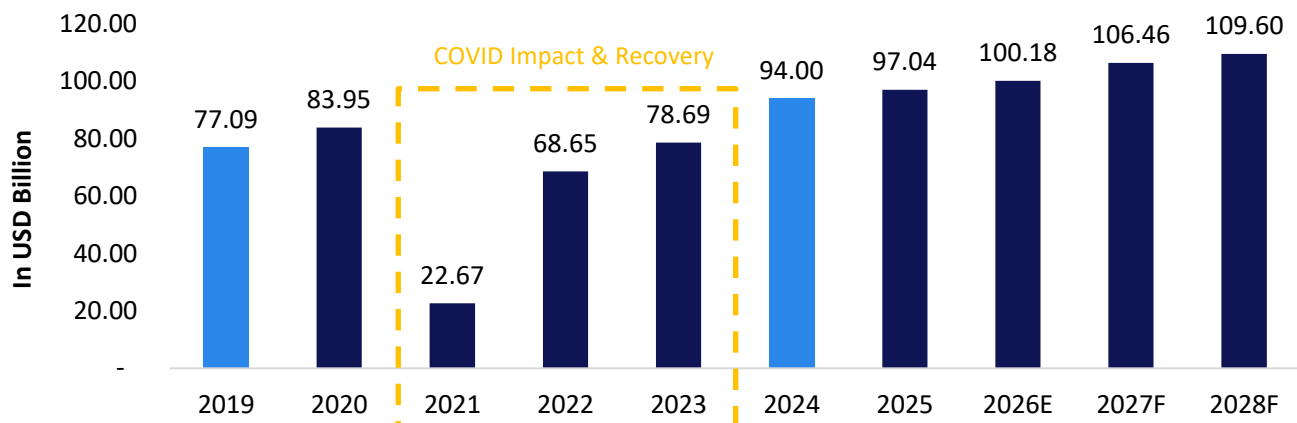


Source: Frost & Sullivan Estimates

The key advantage of the OEM MRO service providers is the superior technology enabled maintenance service with the use of tools like real time monitoring. However, the cost would be high compared to third party or in-house maintenance. In modern engine deals additional areas like standby engines for replacement and services are built into the contract.

#### Global MRO Market: Sizing and Forecast

**Exhibit 143: Global MRO Market, 2018- 2028**



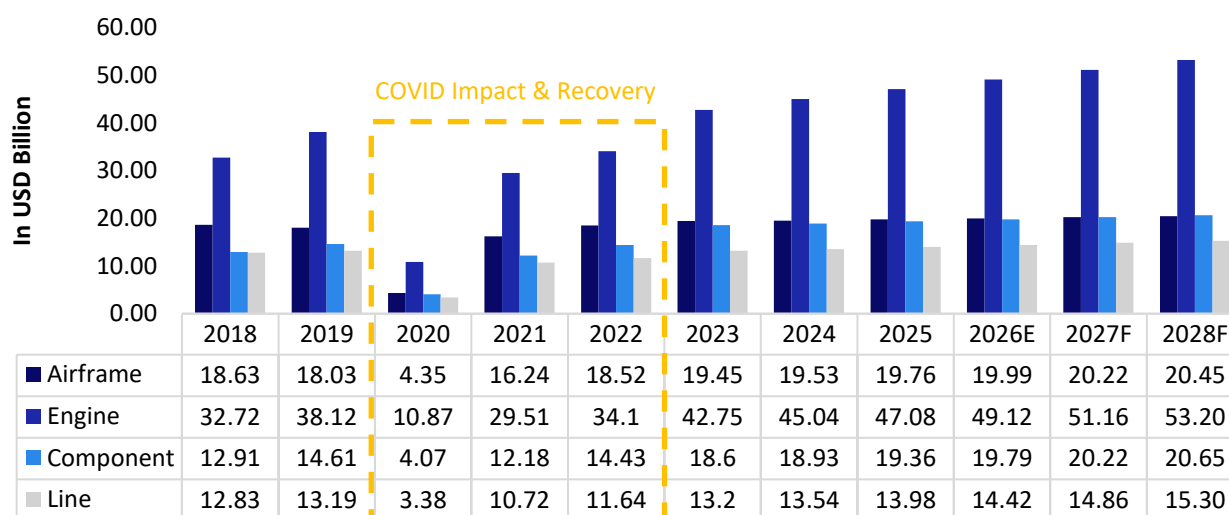
Source: Frost & Sullivan Estimates

E-Estimated, F-Forecasted

- Large airlines in US and Europe have their own in-house MRO services.
- The airlines with in-house MRO also outsource their services to other airlines, thereby generating additional revenue.
- The market in 2023 has recovered from the impact of COVID-19. The Global Commercial aircraft MRO market is estimated at **USD billion 97.04 in 2025** and is expected to grow at a **CAGR of 3.1%** during the period **2026- 2028F** to reach **USD billion 109.60 in 2028F**.
- The key drivers for the market are the increase in aircraft deliveries, ageing of existing fleet and the increase in low-cost carrier models.

## Global MRO: Market Sizing and Forecast: by MRO Type

Exhibit 144: Global MRO Market, By MRO Type, 2018- 2028F



Source: Frost & Sullivan Estimates

E-Estimated, F-Forecasted

- The **Engine MRO** segment accounted to **USD 47.08 billion** or 47% of the total MRO revenue in 2025 and expected to grow to **49% by 2028** to reach **USD billion 53.20 by 2028**.
- The engine MRO market is expected to grow at a **CAGR of 4.5%** and is the fastest growing market. The second fastest growing market is the line maintenance market which is expected to grow at a CAGR of 3.0% during the forecast period **2026-2028F from USD 13.98 billion in 2025 to 15.30 billion in 2028**.
- The line maintenance segment is expected to account for **14% of the total MRO market in 2028F**. CFM 56 & Leap engines have come into maintenance phase increasing the number of tools needed by MRO shops. Further, the establishment of new MRO shops will help increase the overall market demand from MROs. For example: Safran is establishing an aero-engine MRO facility in India, Hyderabad will enable new demand from such MRO and result into significant cost savings in terms of supply and logistics.

### 3.3.2 Aerospace India Overview:

- The Indian Aerospace sector is on a high growth trajectory driven by passenger traffic the past five years at over 15% per year and this has increased from around 70 to 200 million passengers in the past 10 years in domestic and international air travel. Further, the number of flyers from India for international travel is also estimated to be around 100 million last year which indicates high demand for airline services and seats.
- The Indian MRO sector is rapidly expanding as recent government policies reduced the GST on MRO services from 18% to 5% and allowed 100% FDI, attracting major foreign OEMs and service providers to establish local maintenance facilities.<sup>38</sup>
- A typical commercial aircraft incorporates approximately 450 structural forged parts along with numerous forged engine components. Forged parts are favored in aircraft construction due to their excellent strength to weight ratio.
- Backed by a massive, combined order backlog of over 1,000 new aircraft from carriers like IndiGo and Air India, India is expected to overtake China and the United States as the world's third-largest air passenger market by 2030, according to the International Air Transport Association (IATA).<sup>39</sup>

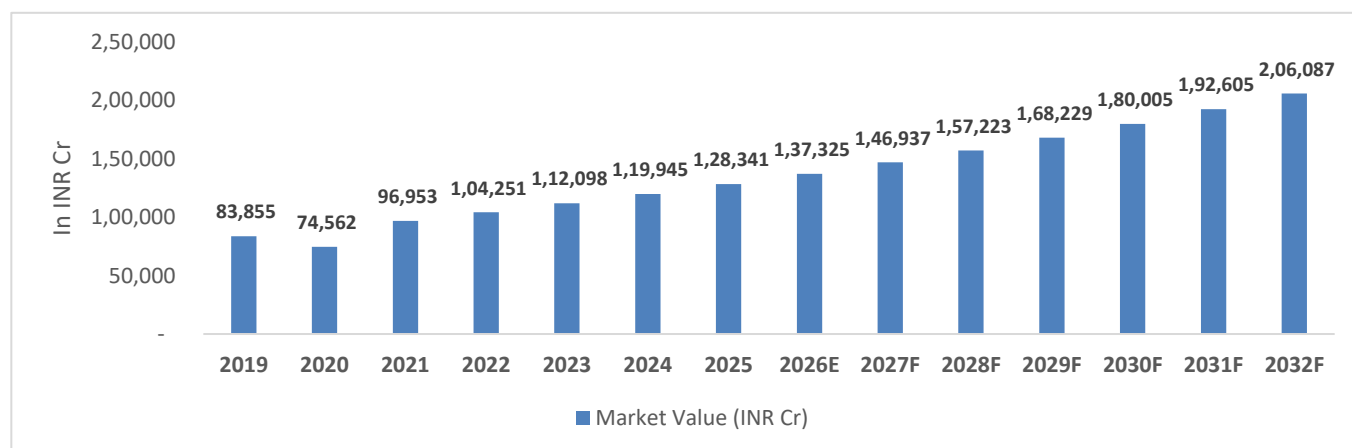
<sup>38</sup> Ministry of Civil Aviation, India Policy Updates

<sup>39</sup> IATA Aviation Forecast & Boeing CMO 2026-2045

- During FY2024-25, passenger traffic at Indian airports reached ~420 million, comprising ~339 million domestic passengers, up ~10.5% YoY, and ~81 million international passengers, up ~16.5% YoY, underscoring robust growth in both domestic and international air travel
- This massive fleet expansion, combined with the retention of older aircraft and the development of local MRO hubs, will exponentially boost the requirement for aerospace-grade forged components, such as landing gears and turbine discs, within the region.<sup>40</sup>

## India Overall Components Market Trend: Aerospace, FY 2019-2032

**Exhibit 145: India Overall Components Market Trend, Aerospace, INR Cr, FY 2019-32**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Aerospace Components Market was valued at **INR 1,28,341 Crores in FY 2025** and is projected to mark **INR 2,06,087 Crores by 2032** with a **CAGR of 7% from FY 2026 to 2032** by increase in demand of aircraft components such as **air fuselage, landing gear, Engine discs, components of wings, undercarriage components, aircraft structural systems propelled by requirement of more number of aircrafts to combat growing air passenger traffic and growing Aerospace MRO market in India.**

## Key Trends and Business Models

There are three key business models in the commercial aircraft MRO market, they are:

- **In- House MRO**
  - In-house MRO (Maintenance, Repair, and Overhaul) business models refer to the strategies adopted by airlines to manage and maintain their aircraft fleets in-house, rather than outsourcing the work to third-party MRO providers. This approach can be beneficial for commercial air carriers that have the resources and capabilities to invest in their own infrastructure, as it allows them to control the entire maintenance process and ensure that their aircraft are maintained to the highest standards.
  - In conclusion, in-house MRO business models can be beneficial for commercial air carriers that have the resources and capabilities to invest in their own infrastructure. However, it requires a significant upfront investment and ongoing maintenance costs.
  - In the current operating environment, airlines with sizeable **in-house MRO** capabilities are increasingly using these facilities beyond their own fleets, while the wider industry is turning to alternative parts and manufacturing solutions to manage supply-chain constraints. PMA parts are gaining adoption among

<sup>40</sup> Aviation Week Fleet & MRO Forecast

airlines, and MRO providers are also exploring technologies such as 3D printing to improve parts availability and reduce lead times.<sup>41</sup>

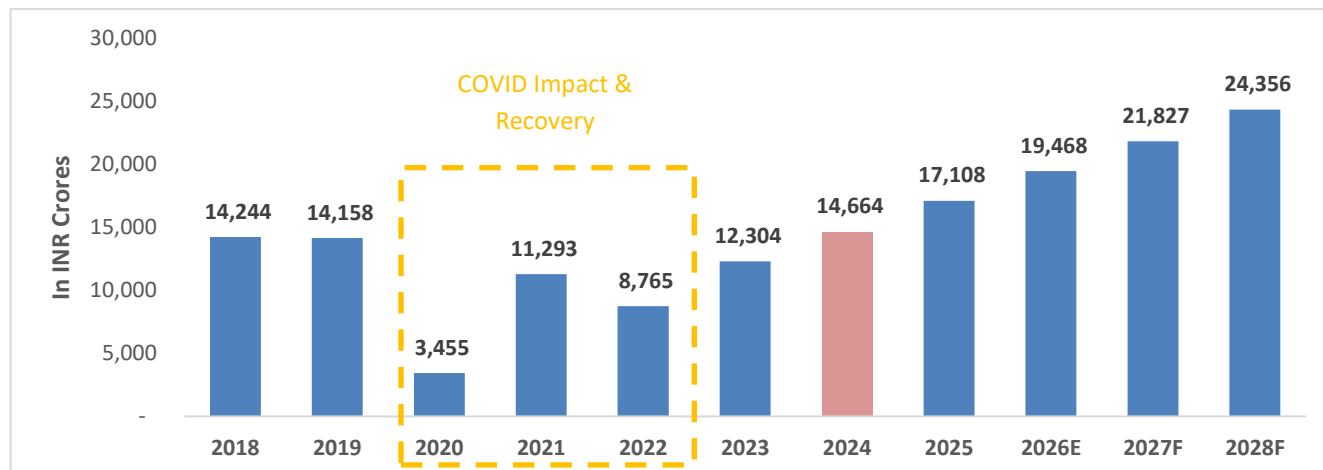
- **Third Party MRO Service Providers**

- Third-party Maintenance, Repair, and Overhaul (MRO) business models have emerged as vital components in industries reliant on complex machinery and equipment. These models offer specialized services to maintain, repair, and overhaul assets, enabling organizations to focus on core operations while outsourcing technical expertise.
- Driven by the acute global shortage of licensed aviation mechanics and the steep capital expenditure required for next-generation aircraft tooling, Low-Cost Carriers (LCCs) are increasingly dependent on third-party MROs. To remain competitive against OEMs, independent third-party providers are undergoing massive market consolidation to offer integrated, "nose-to-tail" maintenance contracts.<sup>42</sup>

- **OEM MRO Service Providers**

- In OEM MRO service provider model the maintenance services are provided by the OEMs. The OEMs are predominantly present in the Engine maintenance segment of the MRO. In companies like Rolls Royce, 64% of the commercial aviation revenues are accounted for by services, which include MRO.
- OEMs (such as GE Aerospace, Pratt & Whitney, and Airbus) are aggressively expanding their aftermarket footprint by locking airlines into long-term, flight-hour-based service agreements (e.g., Rolls-Royce TotalCare, GE TrueChoice). By strictly controlling Intellectual Property (IP), predictive maintenance data, and proprietary repair procedures for next-generation platforms (like the GTF, LEAP, and A350), OEMs are successfully capturing market share and making it difficult for independent third parties to service new aircraft.<sup>43</sup>

**Exhibit 146: Indian MRO Market Size (2018-2028F)**



Source: Frost & Sullivan estimates

E-Estimated, F-Forecasted

- The Indian airlines have been taking aircraft to Southeast Asian countries and Middle East to cater to the MRO needs, predominantly due to the taxation issues and lack of skilled labour in India. Even though the basic checks take place in India, the major MRO works are conducted outside India.
- The Indian MRO commercial market has experienced a rebound post the COVID-19. The market reduced to **INR 3,455 Crores in 2020 from INR 14,158 Crores in 2019**. The bankruptcy of Jet Airways in 2019

<sup>41</sup> <https://bigrep.com/posts/etihad-airways-engineering-to-use-bigrep-3d-printers/>

<sup>42</sup> Aviation Week MRO Industry Reports

<sup>43</sup> Boeing Commercial Market Outlook & RTX/GE Aerospace Investor Briefings

coupled with the impact of COVID-19 are the key reasons for the market to shrink in 2020. The market is projected to grow at a **CAGR of 14.6% between the period 2026- 2028F from INR 17,108 Crores in 2025 to INR 24,356 Crores in 2028F.**

## Potential of MRO in India

Factors which are expected to provide necessary fillip to the Indian MRO Industry are:

- **Rising Demand because of growing fleet size:**
  - Various MRO facilities are being built to promote localization. Reflecting this push, **Air India's Mega MRO facility in Bengaluru, built with an investment of INR 1,400 Crores, successfully commenced its initial operational phases in early 2026, significantly boosting domestic airframe heavy maintenance capacity.**<sup>44</sup>
  - OEMs and leading MROs across the world. Various domestic and foreign investors could also consider investing in the MRO sector in India by way of alliance and collaboration. SR Technics announced its selection by Air India, India's largest full-service global carrier, as the partner of choice for long-term maintenance support of the airline's CFM56-5B/-7B engine fleet.
  - Under the terms of the six-year agreement, SR Technics will provide comprehensive MRO services for Air India's fleet, ensuring the highest levels of engine performance and operational reliability.
  - Furthermore, the formal integration of AI Engineering Services Ltd. (AIESL) into the global Pratt & Whitney MRO network, alongside joint ventures like SIA Engineering Company's expanding footprint, has become critical for addressing the severe regional backlog of next-generation engine overhauls (specifically the PW GTF).<sup>45</sup>
- **Availability of low-cost diverse pool of workforce amid global labor shortages:**
  - India is globally recognized for its strong engineering curriculum. This holds true for the MRO industry as well, wherein the scope of benefiting from a strong and competent workforce is considerable.
  - Persistent shortages of qualified aviation maintenance technicians in mature markets are increasing pressure on the global MRO workforce. At the same time, India is expanding its aviation maintenance talent and infrastructure, with foreign OEMs establishing MRO facilities in the country and policy support enabling subcontracting of foreign OEM/MRO work to Indian providers.<sup>46</sup>
  - Another important reason that puts India on the map for MRO activity is its cost advantage. Labor cost which forms a considerable share of overall cost in airframe and component maintenance is comparatively lower in India, thereby ensuring higher labor arbitrage as compared to global counterparts.
- **Prevalent sale and leaseback model providing a large scope for redelivery maintenance services:**
  - Redelivery maintenance is an important aspect of an airline and lessor's MRO requirements, especially in India, where the sale-and lease-back model is common. This is a big opportunity for component repair as well as heavy maintenance.
  - Persistent Airbus and Boeing delivery delays are keeping older aircraft in service for longer, increasing maintenance requirements. In India, the high prevalence of leased aircraft and sale-and-leaseback arrangements makes redelivery maintenance an important growth opportunity for domestic MRO providers, including heavy maintenance and component repair.<sup>47</sup>

<sup>44</sup> Aviation Week MRO Network Updates, 2026)

<sup>45</sup> RTX/Pratt & Whitney Network Expansion Briefings, 2025/2026

<sup>46</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2194524&lang=2&reg=3&utm>

<sup>47</sup> <https://www.niti.gov.in/node/691>

**Collaboration between Aircraft makers and the technology providers are in trend.**

### **The new face of Indian Aerospace: Tata Boeing JV**

#### **The Tata Boeing Aerospace Limited (TBAL):**

- The Tata Boeing Aerospace Limited (TBAL) facility represents the future of India as a global exporter of aerospace. Spread over 14,000 square meters, the state-of-the-art manufacturing facility located at Hyderabad, India has been producing aero-structures for Boeing's AH-64 Apache helicopter, including fuselages, secondary structures and vertical spar boxes for customers worldwide. TBAL is setting an example of Boeing's commitment towards Aatmanirbhar Bharat and the co-development of integrated systems in aerospace and defence not just for India, but for the world.
- After the foundation of the facility was laid in 2016, TBAL delivered the first Apache fuselages in 2018. In July 2021 TBAL delivered the 100<sup>th</sup> fuselage for the AH-64 Apache combat helicopter to Boeing. TBAL, as of today, has delivered over 250 AH-64 fuselages.
- **TBAL has now firmly established itself as a critical, high-volume single-source global supplier for these Apache aerostructures, while simultaneously scaling its production of complex 737 vertical fin structures to support Boeing's commercial backlog.**<sup>48</sup>

#### **TATA Advanced Systems (TASL):**

- Tata Advanced Systems Limited (TASL), a wholly owned subsidiary of Tata Sons, is the strategic Aerospace and Defence arm of the TATA Group. Tata Advanced Systems Limited is one of the country's leading private players for aerospace and defence solutions and aspires to be the 'Partner of Choice', especially for the government's 'Make in India' program and for global Original Equipment Manufacturers (OEMs).
- Tata Advanced Systems provides full range of Integrated solutions across Aerostructures & Aeroengines, Airborne Platforms and Systems, Defence & Security and Land Mobility.
- Tata Advanced Systems are working with top notch OEMs and Tier 1 global suppliers such as Airbus, Boeing, Collins Aerospace, Dassault Aviation, Lockheed Martin, GKN Aerospace, Spirit Aerosystems.
- As a major milestone for India's Aerospace & Defence industry, Tata Advanced Systems Limited (TASL) and Airbus inaugurated the Final Assembly Line (FAL) complex for the Airbus C295 aircraft in Vadodara, Gujarat in India.
- Representing India's transition from tier-component manufacturing to complete military aircraft integration, this pioneering 'Make in India' project mandates that 40 units be manufactured and assembled domestically by TASL.
- Following the delivery of the initial 16 fly-away units from Spain, the Vadodara facility is currently advancing through its production phases, with the first Indian-assembled C295 slated for rollout in 2026.<sup>49</sup>
- Building on this momentum, TASL's September 2024 agreement with Lockheed Martin to expand C-130J Super Hercules opportunities in India has strategically positioned the country to evolve beyond aerostructures into a comprehensive global hub for heavy transport manufacturing and long-term regional MRO support.<sup>50</sup>

<sup>48</sup> Boeing India Operations & Supply Chain Briefings, 2025/2026

<sup>49</sup> Airbus Defence & Space Operations Updates, 2026

<sup>50</sup> Lockheed Martin India Strategic Announcements

### TATA Sikorsky Aerospace Limited:

- A Joint Venture (JV) based in Hyderabad, Telangana, India, between Tata Advanced Systems Limited, India and Sikorsky Aircraft Company, USA.
- Primarily started with focus on manufacturing parts for the S-92 Helicopter Cabins and has expanded its capacity and capabilities to serve more Customers / Programs in Aerostructures and Aeroengines.
- As of 2025/2026, the joint venture continues to scale its manufacturing footprint, demonstrating double-digit revenue growth as it secures a larger share of the global aerospace supply chain.<sup>51</sup>

### Godrej Aerospace:

- The Company is a tier 1 manufacturer of precision and hi-tech aerospace components, assemblies and systems, executing global aerospace projects as well as partnering with global majors like Honeywell, GE, Rolls-Royce, and Boeing for the manufacture of precision components.
- Won an order for manufacturing eight modules of the DRDO turbojet Engines and became the first Indian Company to manufacture this class of Engines. These modules are critical for indigenous military propulsion programs, directly supporting the DRDO's broader goals for advanced combat and unmanned platforms.<sup>52</sup>
- The Company started with developing high precision components made of exotic alloys for the spacecrafts built by Indian Space Research Organization (ISRO) for its missions.
- Company is committed contributing to the Indian government's Make-In-India initiative and helping India achieve self-sufficiency in developing indigenous advanced fighter jet engines.
- In alignment with this, Godrej Aerospace is currently actively positioning itself to integrate into the domestic supply chain for the upcoming co-production of GE F414 engines, which are slated to power India's next-generation Tejas Mk2 and AMCA fighter jets.<sup>53</sup>
- Invested 500 crores for aerospace and defence projects and has incorporated new processes into its manufacturing processes.

### Upcoming Aerospace Corridors in India

Government has set up some Aerospace Parks in select States of India such as Tamil Nadu, Kerala and Karnataka. to promote the Aerospace Industry.

#### Exhibit 147: Aerospace Corridor: Tamil Nadu

- The Tamil Nadu Industrial Development Corporation (TIDCO) established a 250-acre Aerospace Park, which is designed to be expandable to 500 acres.
- **In addition to the primary Chennai cluster, the state government announced plans in August 2026 for a new 200-acre specialized aerospace park in Suler (near Coimbatore).** This new site aims to serve as a concentrated hub for MRO, final assembly, and R&D, strategically leveraging its proximity to the Suler Air Force Station.<sup>54</sup>

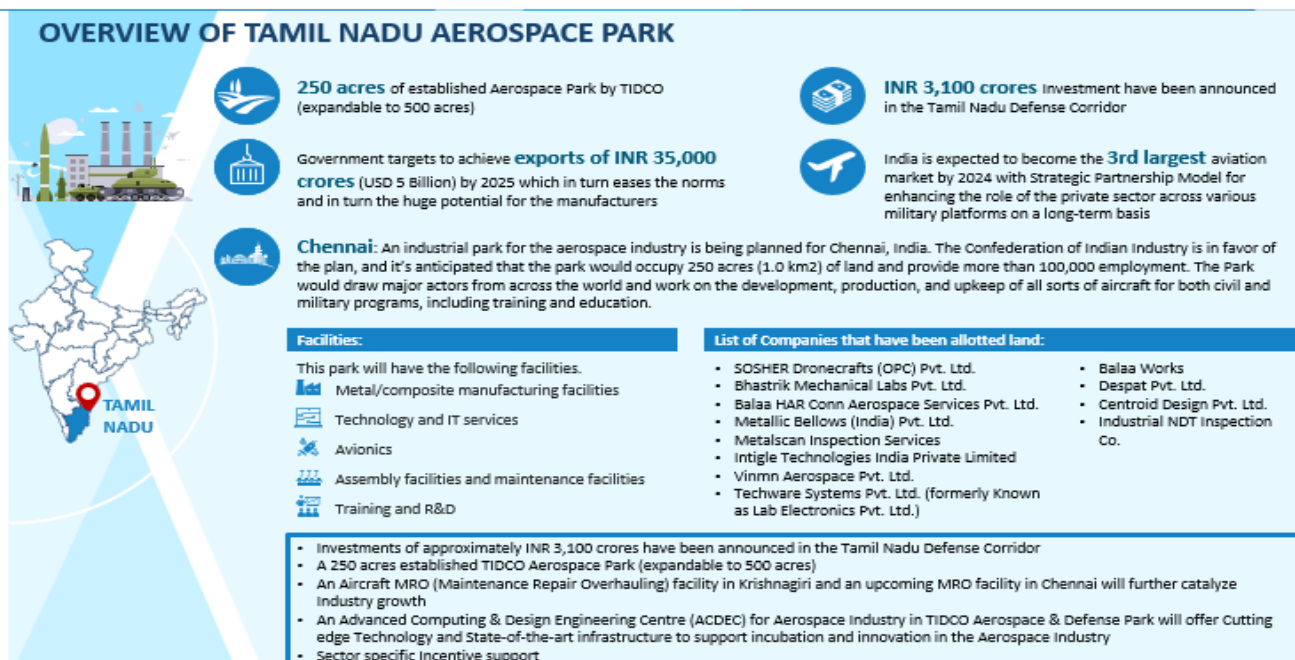
<sup>51</sup> EMIS India Company Profiles, 2026

<sup>52</sup> DRDO & Industry Defence Updates

<sup>53</sup> Defence Industry Supply Chain Reports, 2025/2026

<sup>54</sup> BW Businessworld Aerospace Hub Reports, August 2026

- As of mid-2026, the Tamil Nadu Defence Industrial Corridor (TNDIC) has attracted total investment commitments exceeding INR 32,699 crores, with actual realized (grounded) investments officially crossing INR 6,446 crores across its five strategic nodes (Chennai, Coimbatore, Hosur, Salem, and Tiruchirappalli).<sup>55</sup>



#### Exhibit 148: Aerospace Corridor, Kerala & Karnataka

### OVERVIEW OF KERELA AND KARNATAKA AEROSPACE AND DEFENSE PROGRAM INITIATIVES



IN AN EFFORT TO SUPPORT THE MAKE-IN-INDIA PROGRAM, THE PROJECT SOUGHT TO ESTABLISH KERALA AS A HUB FOR TOP-TIER DEFENSE PRODUCTION.

- The first defense park is prepared for opened in 2020 at Ottappalam in Kerala's Palakkad district.
- The 60-acre park with cutting-edge infrastructure is situated on the Kochi-Coimbatore industrial corridor and is dedicated only to the production of defense equipment for the armed services as well as export markets.
- The park's infrastructure development and civil works have been finished by Kerala Industrial Infrastructure Development Corporation (KINFRA), the project's nodal organization.
- Leading corporations like BEMIL, HAL, and BEL are being considered as anchor investors. 47.50 acres of the 60-acre property would be given to businesses.
- MSMEs are the primary target of the defense park.
- The Union government has been pushing self-reliance in defense production, and the focus on MSMEs is anticipated to further this cause.
- Currently, public sector organizations dominate the defense industry, with MSMEs contributing just somewhat.
- As a result, exports are required to satisfy up to 70% of the defense needs.

A NEW AEROSPACE AND DEFENSE POLICY ANNOUNCED BY KARTANAKA CALLS FOR \$6 BILLION IN INVESTMENTS AND 60,000 EMPLOYMENT OVER FIVE YEARS.

- The Aerospace and Defense Policy 2022-27 was developed by the government of Karnataka.
- The government-approved program aims to increase investment and make Karnataka the preferred location for aerospace and military industry projects.
- During the five-year policy term, the Karnataka Aerospace and Defense Policy 2022-27 seeks to attract investments of Rs. 45,000 crore in the aerospace and defense sector.
- The other goal is to increase job prospects (direct and indirect) for 60,000 people throughout the course of the five-year program term.
- Additionally, it aims to establish Karnataka as a center for aerospace and military production, with a focus on MRO and space applications for the domestic market and exports, as well as to improve R&D infrastructure for the development of cutting-edge and creative technologies.

#### Kerala Defense Production Hub

- To support the Make-In-India program, the project seeks to establish Kerala as a hub for top-tier defense production. The state's first dedicated defense park opened in 2020 in Ottappalam, within Kerala's Palakkad district.
- This 60-acre park, featuring infrastructure completed by the Kerala Industrial Infrastructure Development Corporation (KINFRA), is strategically situated on the Kochi-Coimbatore industrial corridor and is dedicated exclusively to the production of defence equipment for armed services and export markets.

<sup>55</sup> Government of India PIB & Ministry of Defence Updates, July-August 2026

## Karnataka Aerospace and Defense Policy

- The Government of Karnataka announced the Aerospace and Defense Policy 2022–27 to make the state the preferred location for military and aerospace projects. This five-year government-approved program calls for INR 45,000 crore (USD 6 Billion) in investments and aims to increase direct and indirect employment prospects for 60,000 people.
- As of 2025/2026, Karnataka's aerospace ecosystem has matured to physically support these policy targets. The state now commands a 67% share of all aircraft and helicopter manufacturing for Indian defence services and accounts for 65% of the country's aerospace-related exports.<sup>56</sup>
- To further expand this corridor, the state government recently launched the aligned Karnataka Space Policy (2025-2029), which includes the development of a new INR 650 crore Space and Defence Manufacturing Park under a public-private partnership (PPP) model, aimed at capturing a 50% share of India's commercial space market.<sup>57</sup>

## Government Policies and Regulations:

- The Indian government's proactive approach in formulating policies and regulations to support the aviation sector has been instrumental in its growth. Policies aimed at promoting air travel, reducing costs, and enhancing safety are continuously being developed and implemented.
- To specifically incentivize the domestic maintenance sector and reduce airline costs, the government recently implemented a uniform 5% Integrated GST (IGST) on all aircraft parts, components, and testing equipment. This critical tax reform resolves previous tariff inversions and makes Indian MROs globally competitive against hubs in the Middle East and Southeast Asia.<sup>58</sup>
- The relaxation of FDI norms explicitly allowing 100% FDI under the automatic route for MRO and aircraft manufacturing ensures that the industry attracts heavy foreign investment and remains robust.<sup>59</sup>
- The UDAN scheme for regional connectivity continues to drive growth. **As the scheme advances into its latest phases (focusing on tier-3 cities and helicopter connectivity), it is rapidly operationalizing underserved airports and expanding the regional fleet size that requires localized MRO support.**<sup>60</sup>

**Growth of Indian Aerospace segment will create the need for a greater number of airplanes and airports and to maintain the availability of the fleets MRO Service will flourish which is expected to bring opportunities for manufacturers for the supply of aerospace-grade forged parts and other mission-critical components required for the smooth functioning of aircraft.**

<sup>56</sup> Karnataka Economic Survey & Policy Updates, 2025/2026

<sup>57</sup> Karnataka IT-BT Ministry Announcements, 2025

<sup>58</sup> Ministry of Finance / GST Council Notifications

<sup>59</sup> DPIIT FDI Policy Updates

<sup>60</sup> Ministry of Civil Aviation, UDAN Progress Reports, 2025/2026

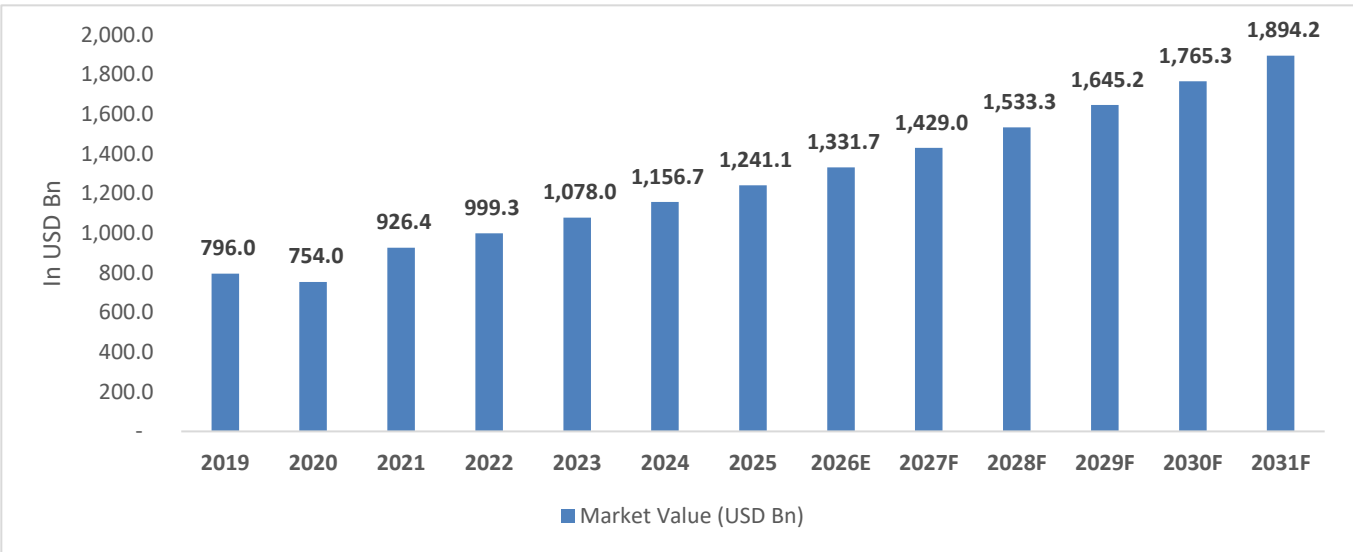
### 3.4 Defence

#### 3.4.1 Defense Global Overview

- The world is ever-changing, and with emerging geopolitical tensions, weapons stock depletion, and increasing global defence spending, the stage is set for significant developments.
- Geopolitical tensions and massive armament drives are fueling an unprecedented surge in global defence spending. **According to the latest SIPRI data released in April 2026, global military expenditure hit a record high of USD 2.89 trillion in 2025, marking the 11th consecutive year of growth. Consequently, the global military burden rose to 2.5% of global GDP, reaching its highest level since 2009.**<sup>61</sup>
- The **United States, China, Russia, Germany, and India** remain the top five spenders, collectively contributing to **58% of the world's total military expenditure**, this highlights the growing focus on national security amidst a complex geopolitical landscape.<sup>62</sup>
- In Europe, defense spending surged by **14% year-on-year in 2025. Germany** alone increased its spending by **24% to USD 114 billion exceeding the NATO 2.0% GDP threshold for the first time since 1990** as part of its response to the **ongoing Ukraine-Russia conflict.**<sup>63</sup>
- This sustained, massive investment in the defense segment, coupled with the urgent need to replenish depleted artillery and missile stocks globally, is expected to heavily boost the requirement for aerospace and military-grade metal forgings.

#### Global Overall Components Market Trend: Defence, CY 2019-2031

Exhibit 149: Global Overall Components Market Trend, Defence, USD Bn, 2019-31



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall Components Market for Defence was valued at **USD 1,241.1 Bn in 2025** and is projected to mark **USD 1,894.2 Bn by 2031** with a **CAGR of 7.3% from 2025 to 2031** driven by the growth of components such as **Armored Vehicles parts for Engines, Suspension, turret, main body, track Armaments and Ammunition: Body, Extractors, ejectors, barrel Military Hardware: Parts for engines, suspension, main body and Track.**

<sup>61</sup> Stockholm International Peace Research Institute [SIPRI] Fact Sheet, April 2026

<sup>62</sup> SIPRI Military Expenditure Database, 2026

<sup>63</sup> SIPRI Global Military Spending Report, April 2026

## Global Conflicts:

### Middle East Tensions

- The ongoing conflicts in the Middle East have spread to critical sea routes like the **Red Sea, the Bab el-Mandeb Strait, and the Strait of Hormuz. Since late 2023, continuous threats to commercial ships have severely disrupted global trade and energy supply chains.**
- To avoid these attacks, many major shipping lines were forced to take much **longer routes around Africa's Cape of Good Hope.** This massive detour sharply reduced traffic through the Suez Canal, causing **major port delays, high freight costs, and ongoing unpredictability in global logistics.**<sup>64</sup>
- Securing these vital waterways has required the constant deployment of naval forces and the heavy expenditure of air-defense systems. Allied naval coalitions have rapidly utilized hundreds of high-end defense interceptors (such as SM-2 and SM-6 missiles) to counter continuous drone and ballistic missile threats.
- **This rapid depletion of munitions is severely straining the global defense manufacturing base. As a result, there is an urgent and sustained demand for heavy naval forgings, precision aerospace components, and interceptor body manufacturing<sup>65</sup> to rebuild and replenish allied military stockpiles.**

### Israel – Palestine Conflict

- The Israel-Palestine conflict of 2023 is one of the most complex conflicts in recent past that has had a strong impact on the geopolitics of the Middle East and significant repercussions in military spending plans globally.
- The ongoing war has created an unprecedented, sustained need for defense equipment from the western region. **By mid-2026, Israel approved massive budget reallocations to push its 2026 defense budget to roughly NIS 184 billion (USD 61.3 billion) the second highest in its history** urgently seeking to replenish severely depleted stockpiles of precision munitions, interceptors, and attack helicopters.<sup>66</sup>
- This urgent regional rearmament is heavily straining the global defense supply chain, with allied nations now competing for limited production slots and facing years of backlogs at major U.S. and European aerospace manufacturers.<sup>67</sup>

### Iran- Israel Tensions

- Iran launched its first direct attack on Israel on 13th April 2024, in response to an air strike on Tehran's consulate in Damascus on 1st April 2024. As tension escalates, the head of the United Nations nuclear watchdog expressed concern about Israel potentially targeting Iranian nuclear facilities.
- The Israel-Iran conflict carries significant implications for the broader international community. The prospect of a military confrontation between two nuclear-capable states in a strategically vital region has sparked fears of a wider conflagration with potentially catastrophic consequences.
- Furthermore, the interplay of regional rivalries and global power dynamics, including the involvement of major players such as the United States and Russia, adds another layer of complexity to the conflict.

<sup>64</sup><https://unctad.org/news/red-sea-black-sea-and-panama-canal-unctad-raises-alarm-global-trade-disruptions>

<sup>65</sup> <https://www.csis.org/analysis/depleting-missile-defense-interceptor-inventory>

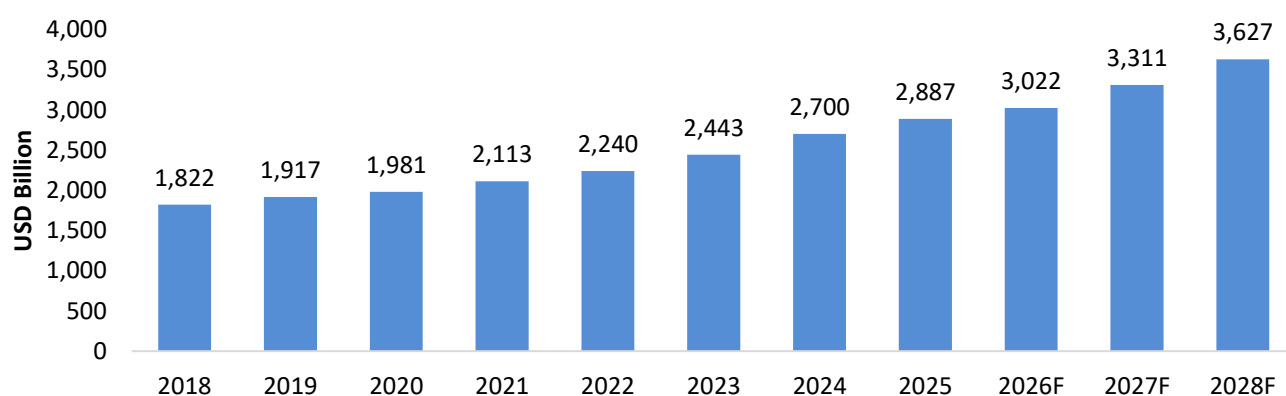
<sup>66</sup> Israel Ministry of Finance / Defense Budget Approvals, August 2026

<sup>67</sup> Defense Industry Procurement Reports, 2026

## Ukraine – Russia Conflict

- The ongoing conflict between Ukraine and Russia has reshaped the geopolitical landscape of Eastern Europe, with significant implications for global military spending for Ukraine and Russia and its allies. Ukraine's political orientation has escalated into a conflict involving military intervention, territorial annexation, and geopolitical maneuvering.
- As of late 2026, the war has evolved into a highly attritional conflict dominated by drone warfare and mid-to-long-range strike campaigns. With massive waves of drones dominating the "kill zones," both nations are relentlessly targeting deep logistics, energy infrastructure, and military production facilities.<sup>68</sup>
- This sustained, high-intensity drone and missile warfare requires vast, continuous replenishment of air defense interceptors, electronic warfare (EW) systems, and unmanned aerial vehicle (UAV) components, fundamentally and permanently altering European defense manufacturing priorities.<sup>69</sup>

**Exhibit 150: Global Military Expenditure Trends and Outlook (In USD billion) (2018-2028F)**



Source: SIPRI Military Expenditure Database, 2026 and Frost and Sullivan estimates

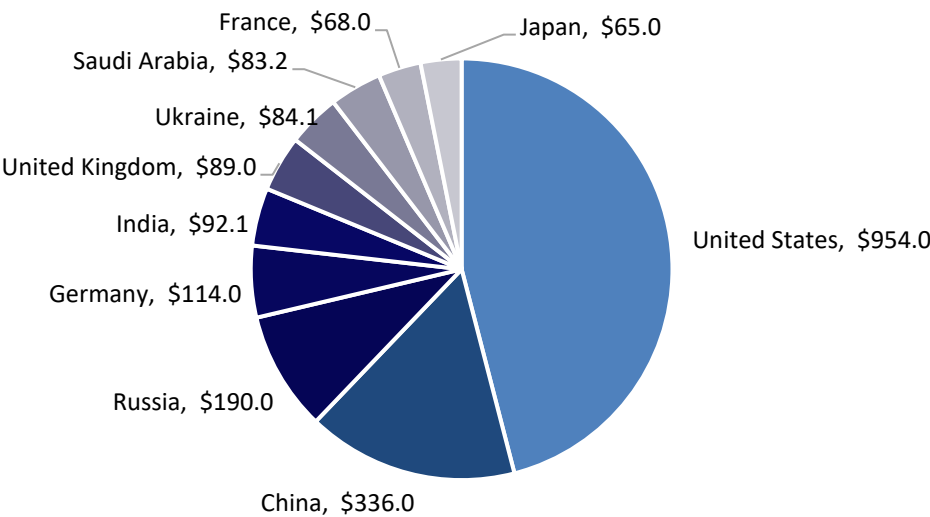
## **Global Defence Spending**

- **Global Total:** Expenditures reached **USD 2.7 trillion in 2024**, and hit a record **USD 2.89 trillion in 2025**, bringing the global military burden to 2.5% of GDP.
- **United States:** Actual spending hit **USD 997 billion in 2024** (far exceeding initial USD 842 billion requests), before slightly adjusting to **USD 954 billion in 2025**. It remains the world's largest defense spender.
- **China:** Exceeding initial estimates, spending reached **USD 314 billion in 2024** and grew a further 7.4% to **USD 336 billion in 2025**, driving retaliatory military investments across the Asia-Pacific.
- **Russia:** Fueled by the ongoing war, spending skyrocketed by 38% in 2024 and reached an estimated **USD 190 billion in 2025**, consuming a massive 7.5% of the nation's GDP.
- **Japan & Germany (Key Allies):** Japan's spending surged by 21% in 2024 (its largest increase since 1952). Meanwhile, Germany's spending grew by 24% to **USD 114 billion in 2025**, exceeding the 2.0% NATO threshold for the first time since 1990.

<sup>68</sup> Strategic Campaign Assessments, September 2026

<sup>69</sup> US Department of State / Foreign Military Sales Briefings, September 2026

Exhibit 151: Global Top 10 Defence Spenders, (In USD Billion), 2025



Source: SIPRI Military Expenditure Database, April 2026 Release

Trends in Global Military Spending:

- Military spending has been on the rise in recent years, with many countries increasing their defence budgets. This trend has now culminated in an 11-year consecutive growth streak, pushing global defense expenditures to record highs.

Regional Variances:

- The distribution of military spending varies significantly by region, depending on the geopolitical situation. While the Middle East has historically been a region with high military spending due to regional conflicts, Europe and the Asia-Pacific are now experiencing the sharpest relative spending surges due to the Ukraine crisis and Indo-Pacific tensions.<sup>70</sup>

Technological Advances:

- Technological advancements are shaping the future of military expenditure. Modernization efforts often focus on acquiring cutting-edge technologies such as cyber capabilities, unmanned systems, and artificial intelligence. Countries are investing heavily in research and development to maintain a technological edge over potential adversaries.

Budgetary Pressures:

- While some countries are increasing their military spending, others face budgetary constraints that limit their ability to invest in defence. Economic downturns or competing domestic priorities can impact military expenditure.

Geopolitical Dynamics:

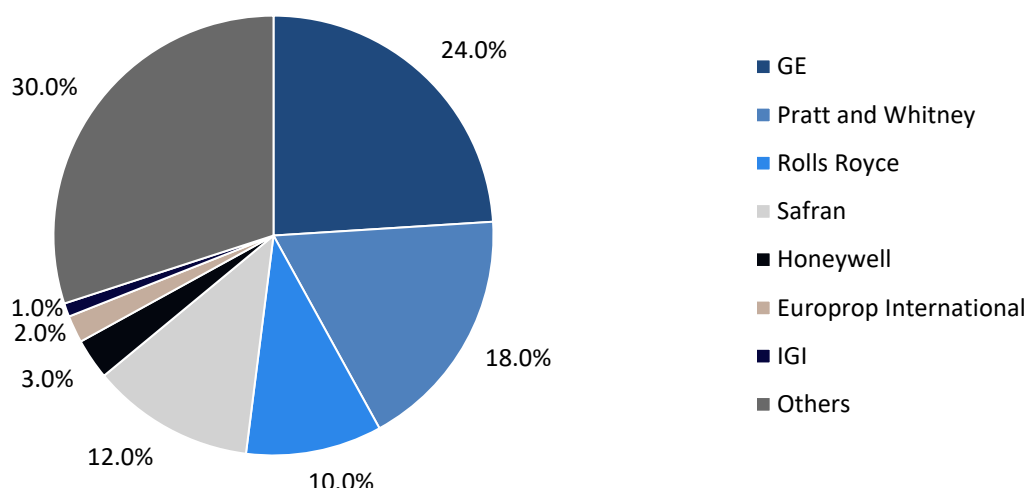
- Following the 2014 commitment by NATO heads to spend 2% of GDP on defense to increase combat readiness, European NATO countries successfully increased their collective spending from 1.5% in 2014 to 2.0% in 2024 (accounting for USD 380 billion). By 2025/2026, major European powers like Germany have firmly sustained budgets above this 2.0% threshold.<sup>71</sup>
- Around **20%** of the collective spending towards defence are expected to be spent on Research & Development of new systems.

<sup>70</sup> SIPRI Regional Trends, 2026  
<sup>71</sup> SIPRI Military Expenditure Database, 2026

- With the rise in conflicts between the nations, across the globe countries have allocated more money to Defence and Security. The growth of Defence sector will boost the opportunities for forgings manufacturer as need for forged components in the segment will increase.

## Overview of Defence Aircraft Engine in Service,2025

### Exhibit 152: Defence Aircraft Engine in Service,2025



Source: Estimated from Ministry documents

- **70%** of the global defence aircraft engine market lies **with 7 companies only in 2025** which represents a competitive market. **General Electric (GE) Aviation** is a significant player in the military aircraft engine market holding a **24% share in 2025**.
- **GE engines**, such as the **F110 and F414**, power a variety of military aircraft worldwide, including fighters such as the **F-15 and F/A-18**. The F110 powers the new, fly-by-wire F-15EX Advanced Eagle, the fifth F-15 variant designed to replace the oldest **F-15s** in the U.S. Air Force fleet. It is estimated that more than **100 F-15EX** multirole fighters will be purchased.
- **Pratt & Whitney** accounts for **18%** of the market share of defence aircraft engines and is the 2<sup>nd</sup> largest player in the same, producing engines such as the **F135**, which powers the **F-35 Lightning II**, one of the world's most advanced fighter aircraft.
- **Pratt & Whitney's F-22 Raptor** and the **C-17 Globemaster III** are some major Engines, controlling 18% of the military air engine market. It recently secured the **sole-source contract for F-35 engine upgrades**. The program, known as **the Engine Core Upgrade (ECU)**, is scheduled to begin with engine testing in **2026 and fielding in 2029**.
- Other significant players in defence aircraft engines are **Safran and Rolls Royce with 12% and 10% market share** respectively in 2023. Other small players are **Honeywell, Euro prop International and IGI with market shares between 1-3% in 2025**.

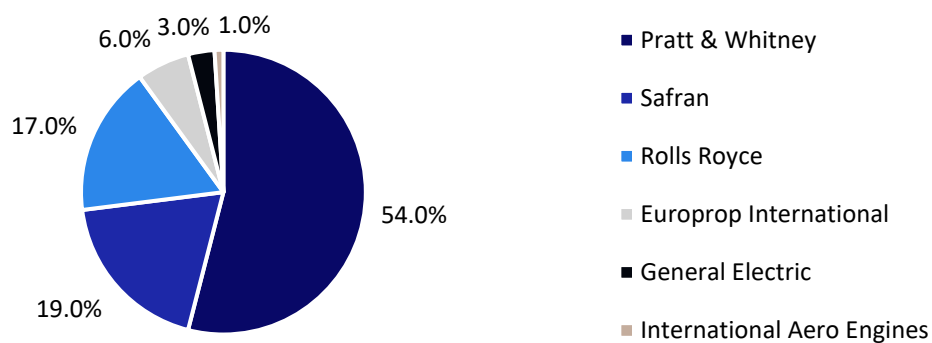
### Exhibit 153: List of Defence Aircraft Programs and their Engine Supplier

| Name of the Aircraft Program | Type of Aircraft | Airframe OEM                  | Engine OEM            | Engine Name |
|------------------------------|------------------|-------------------------------|-----------------------|-------------|
| <b>F-35</b>                  | Fighter          | Lockheed Martin               | Pratt & Whitney       | F- 135      |
| <b>Eurofighter Typhoon</b>   | Fighter          | Eurofighter Jagdflugzeug GmbH | Rolls Royce (Eurojet) | EJ-200      |
| <b>Rafale</b>                | Fighter          | Dassault                      | Safran                | Snecma M88  |

| Name of the Aircraft Program | Type of Aircraft   | Airframe OEM                 | Engine OEM                 | Engine Name |
|------------------------------|--------------------|------------------------------|----------------------------|-------------|
| F-15 E                       | Fighter            | Boeing                       | Pratt & Whitney            | F100 PW 229 |
| F/A-18                       | Fighter            | Boeing                       | GE Aerospace               | F414 GE 400 |
| Gripen E                     | Fighter            | Saab                         | GE Aerospace               | F414 GE 39E |
| LCA-Tejas                    | Fighter            | HAL                          | GE Aerospace               | F404 IN20   |
| C-130                        | Transport Aircraft | Lockheed Martin              | Rolls Royce                | AE 2100     |
| A-400 M                      | Transport Aircraft | Airbus                       | Euro Prop                  | TP400       |
| C-27 J                       | Transport Aircraft | Leonardo's Aircraft Division | Rolls Royce                | AE 2100     |
| C-390/ KC 390                | Transport Aircraft | Embraer                      | International Aero Engines | V2500       |
| C-295                        | Transport Aircraft | Airbus                       | Pratt & Whitney            | PW100       |
| A-330 MRTT                   | Transport Aircraft | Airbus                       | GE Aerospace               | CF6         |
| C-17                         | Transport Aircraft | Boeing                       | Pratt & Whitney            | PW2000      |
| KC-46                        | Transport Aircraft | Boeing                       | Pratt & Whitney            | PW4062      |
| P 8                          | Special Mission    | Boeing                       | CFM International          | CFM56       |
| Embraer E-99                 | Special Mission    | Embraer                      | Rolls Royce                | AE3007      |
| Global 6000                  | Special Mission    | Bombardier                   | Rolls Royce                | BR710A2     |
| EC-37B                       | Special Mission    | General Dynamics             | Rolls Royce                | BR710 C4-11 |
| ERJ-145I                     | Special Mission    | Embraer                      | Rolls Royce                | AE 3007     |

Source: Frost & Sullivan Analysis

#### Exhibit 154: Defence Aircraft Engine Orders, 2025



Source: Estimated from Ministry documents

- The global defence aircraft engine orders are highly concentrated with only 6 players in the market and **87%** of it in the hands of **3 players- Pratt and Whitney, Safran and Rolls Royce in 2025**.
- The US driven F35 program is the leading fifth generation aircraft program in the world to meet the future operational requirements of the US and its allied forces, at an overall estimated cost of USD 1.70 trillion.

- The F35 program is expected to predominantly replace the aging fleet of F16s, A10s and F18s. The F35 is a single engine multirole fighter aircraft developed by Lockheed Martin, capable of delivering a thrust of 43,000 lbs.
- The Pratt and Whitney accounts to about **54 %** of the total defence aircraft engine, which are in order market due to the backlog of the F35 fleet orders as of 31<sup>st</sup> December 2023.

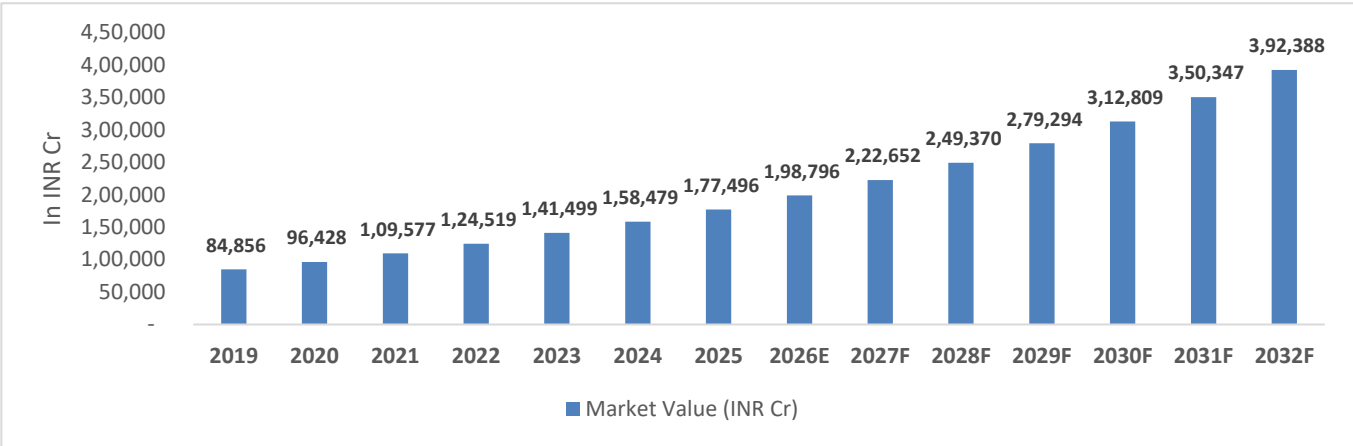
### 3.4.2 Defence India Overview

- India's Defence sector, **the second largest armed force**, is on the verge of a revolution. The government has identified the defence and aerospace sector as a focus area of the **Aatmanirbhar Bharat** initiative, which has a huge push to build a domestic manufacturing infrastructure backed by an R&D ecosystem.
- The Defence segment received **7.85 Lakhs Crore** in the financial year 2026-27. The allocation to MoD **for FY 2026-27 is higher by approx. Rs one lakh crore (15.19%)** over the allocation for FY 2025-26, which clearly shows the growing importance of the Defence sector in India.
- The allocation breakdown highlights the need for self-sufficiency by showing that a sizeable portion, **28.0%**, is set aside for capital expenditures. Furthermore, **46.6%** goes into Defence Services Revenue (which covers pay, benefits, and operational preparedness), **21.8%** goes toward defence pensions, and **3.6%** goes toward MoD-affiliated civil organizations.
- **Forging market for Defence sector** was valued at **INR 1,353 Crores in FY 2025-26** which accounts for **6%** of the total non-automotive forging demand in India. The demand of forgings in Defence sector is estimated to grow at a **CAGR of 13.3 % from FY 2026 to 2032** and estimated to reach **INR 2,859 Crores**.
- The Defence Industry is a major consumer of forging components from small firearm parts to large components for military vehicles and aircraft. **Forged components are integral to various defence equipment including rifle triggers, nuclear submarine drive shafts, heavy tanks missiles and shells.**
- **The ADITI (Acing Development of Innovative Technologies with iDEX) scheme has been approved with an outlay of ₹750 crore for FY 2023-24 to FY 2025-26 to accelerate the development of innovative defence technologies.**<sup>72</sup>
- Through this scheme, Ministry of Defence is engaging with start-ups/MSMEs and innovators to develop Def-Tech solutions and supply the Indian military with innovative and indigenous technological solutions.
- A grant of up to 50% of Product Development Budget with enhanced limit (Max) of Rs 25 crore per applicant will be awarded as per extant iDEX guidelines.
- The Government has announced 2 dedicated Defence industrial Corridors in the States of Tamil Nadu and Uttar Pradesh to act as cluster of defence manufacturing.
- The increase in capital investment in defence is in line with the 'Aatmanirbharta' (self-reliance) strategy. The capital investment would equip the Armed Forces with modern cutting-edge equipment, ships, aircraft, unmanned aerial vehicles, and specialized vehicles.
- The investments are expected to be allocated for the **Su-30 fleet**, further aircraft procurement, upgraded engines for **MiG-29, C-295 transport aircraft**, and **LCA MK-I IOC/FOC program**.
- **As per GFR 2017, amended in June 2020**, Government Initiatives such as Mandate of **No Global Tender Enquiry (GTE) for tenders up to INR 200 Crores** will create **opportunities of localization** by **promoting procurement from domestic manufacturing industries**.

<sup>72</sup> <https://www.pib.gov.in/FactsheetDetails.aspx?Id=150909&lang=1&reg=3+&utm>

India Overall Components Market Trend: Defence, FY 2019-2032

Exhibit 155: India Overall Components Market Trend, Defence, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

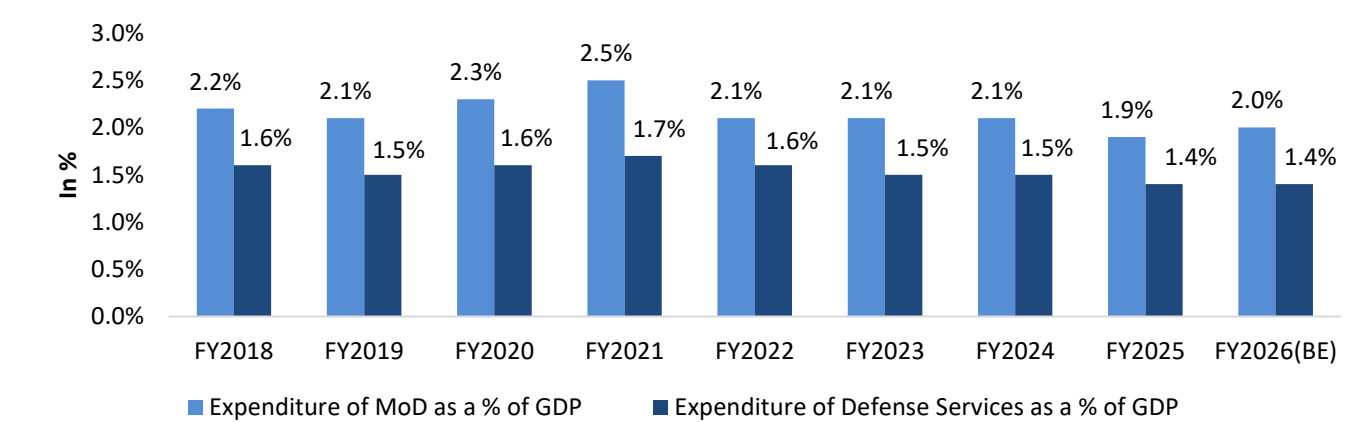
- Indian Overall Components Market for Defence was valued at **INR 1,77,496 Crores in FY 2025** and is projected to mark **INR 3,92,388 Crores by 2032** with a **CAGR of 12% from FY 2026 to 2032** driven growth of demand components such as **Engines, Suspension, turret, main body, track Armaments and Ammunition: Body, Extractors, ejectors, barrel Military Hardware: Parts for engines, suspension, main body and Track and Governments focus on boosting the domestic Defence production.**

Key Components of Defence Aircrafts

An aircraft typically consists of three key components: Outer structure, engine, and operational systems.

- Outer Structure consists of Fuselage, Wings, Empennage, Landing Gears.
- Engine consists of Fan, Compressor, Combustor, Turbine and Nozzle.
- Operational System consists of Avionics Technology, Engine Control Systems, Flight Control Systems, Pneumatic Systems, Hydraulic Systems, Rotary Wing Systems, Fuel Systems and Environmental Control Systems.

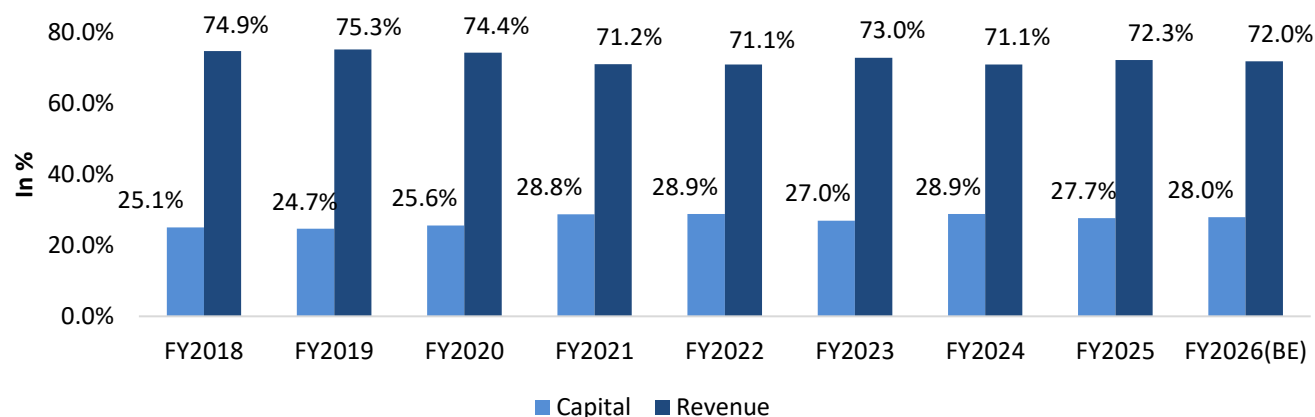
Exhibit 156: MoD and Defence Services expenditure as a % of GDP, (In %), 2018-2026BE



Source: MoSPI Advance GDP Estimates; Ministry of Finance Union Budget Documents; Defence Services Estimates [DSE] 2024-2026  
BE-Budget Estimated

## Split of Defence Budget Revenue and Capital

**Exhibit 157: Revenue and Capital Budget, (In %), 2018-2026F (BE)**



Source: Ministry of Defence / Union Budget Documents, 2024-2026

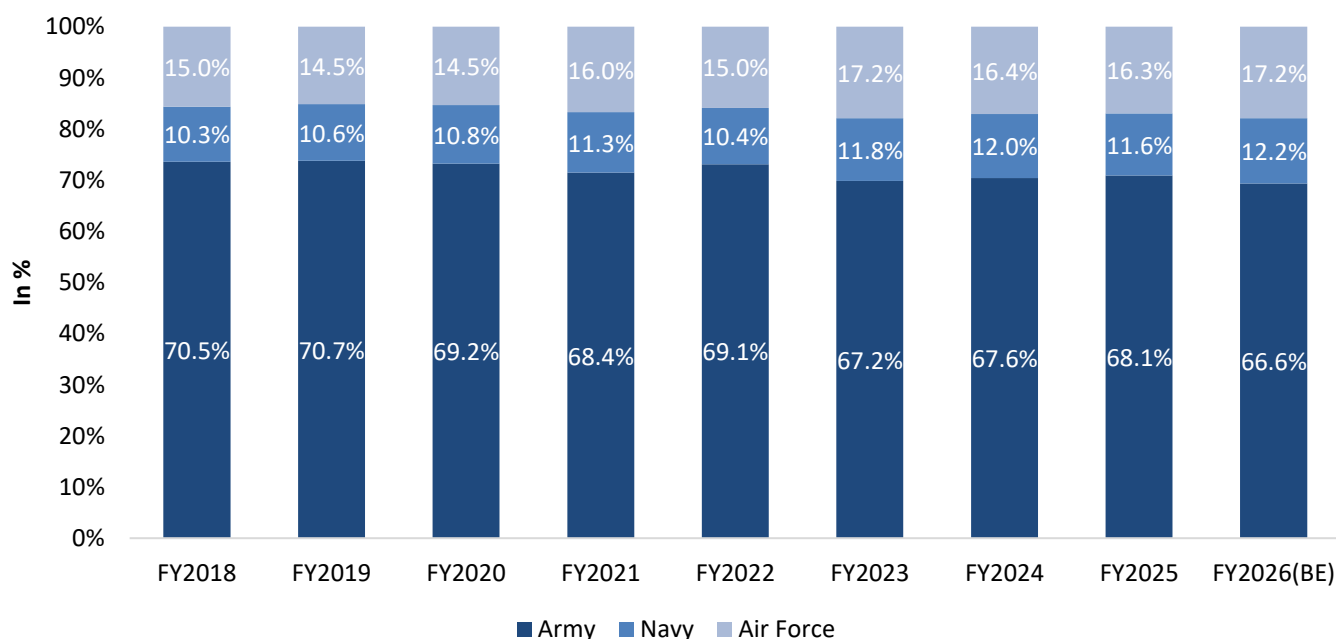
Note: Capital allocation represents Capital Outlay on Defence Services (Demand No. 21) and excludes MoD Civil Capital.

BE-Budget Estimated

- The capital outlay has steadily increased and maintained a strong share, moving from **25.1% in FY2018 to 28.0% in FY2026(BE)**. This sustained capital expenditure allocation showcases the government's intense focus on procuring new, indigenous assets across land, naval, and air platforms under the 'Aatmanirbharta' strategy. During the same period, the consolidated revenue budget (which covers pay, operational maintenance, and pensions) adjusted from **74.9% in FY2018 to 72.0% in FY2026(BE)**.

## Indian Revenue Budget Allocation Across Forces

**Exhibit 158: Revenue Budget Allocation Across Forces, (in %), 2018-2026BE**



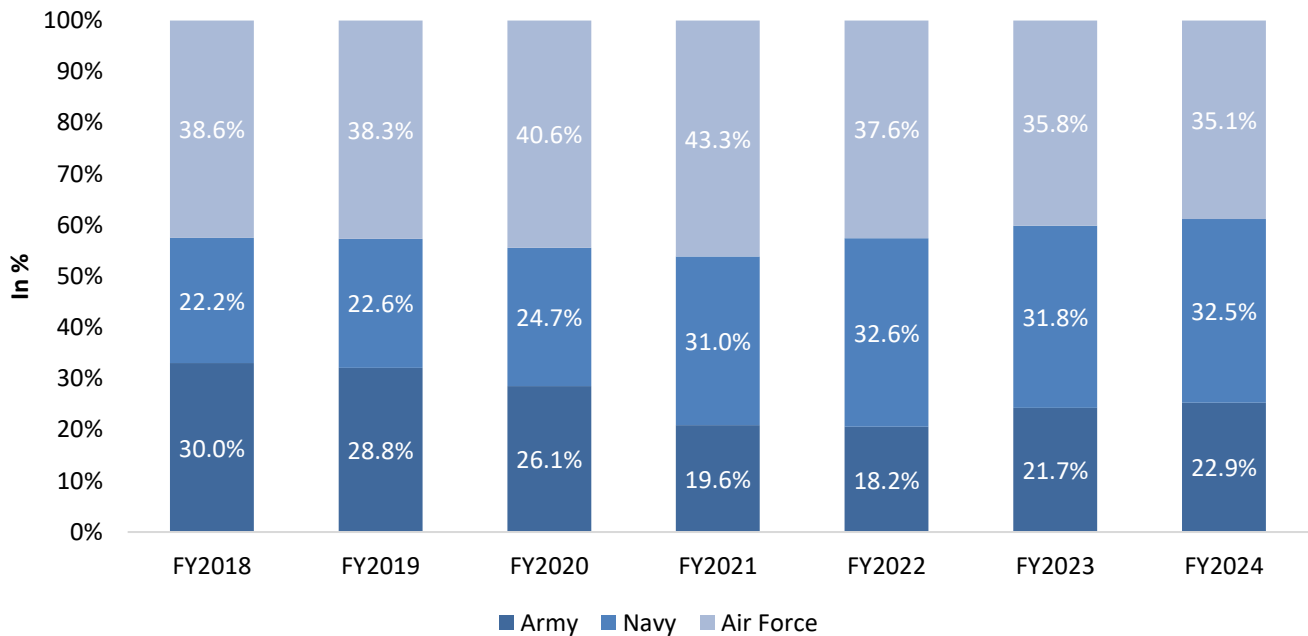
Source: Union Budget 2026-27 (Demand for Grants No. 20 - Defence Services Revenue)<sup>4</sup>, Note: Total will not be equal to 100%

- Revenue includes MoD (Civil Revenue), Defence Services (Revenue) and Defence Pensions. The revenue budget allocation for the Air Force and Navy has steadily increased over the years to support the maintenance of technologically advanced platforms, reaching **17.2% and 12.2% respectively in FY 2026 (BE)**. Consequently, while the Army retains the largest share due to manpower requirements, its revenue

budget allocation has progressively reduced from **70.5% in FY 2018 to 66.6% in FY 2026 (BE)**, reflecting a strategic rebalancing across the forces.

### Revenue Budget Allocation Across Forces

**Exhibit 159: Capital Outlay allocation across forces, (In %), 2018-2024**

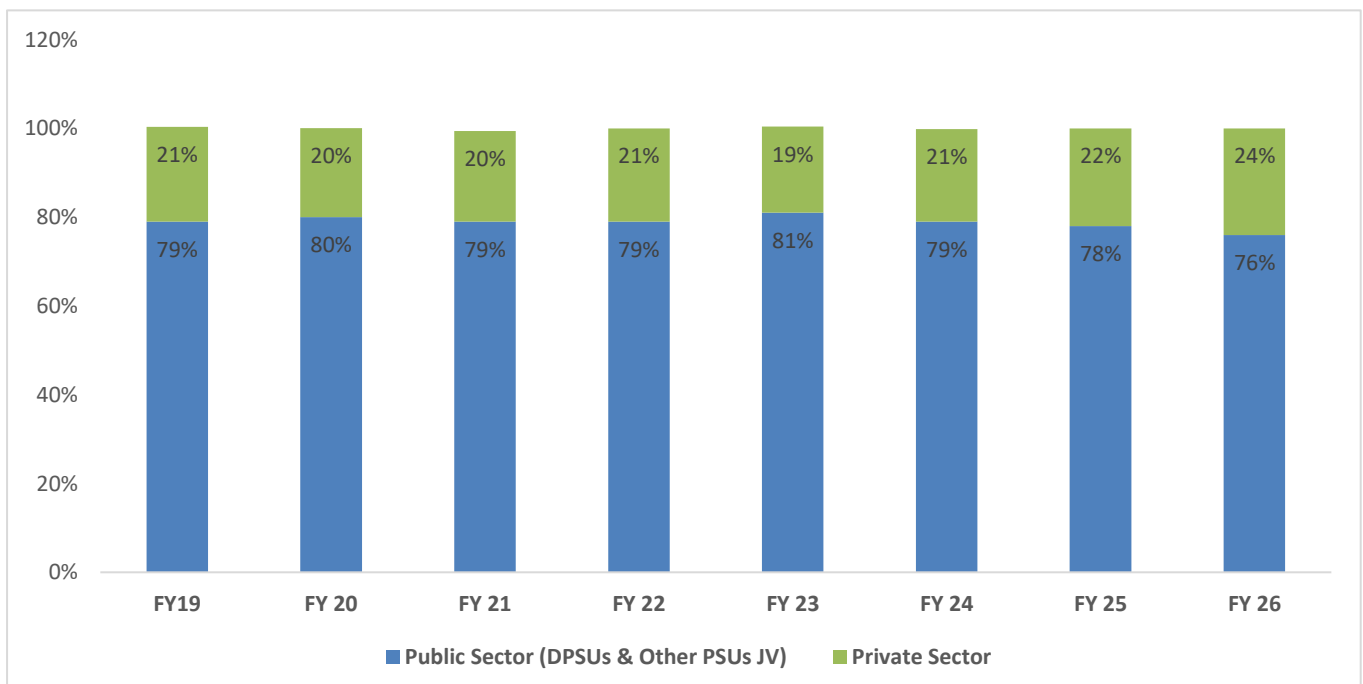


Source: IDSA, Defence Budget 2023-24, Note: Total will not be equal to 100%

- Capital Outlay (Demand No. 21) caters to the modernization and acquisition of new weapon systems. The capital budget allocation for the Navy has significantly increased between the period FY2018 to FY2024 (BE), growing from **22.2% to 32.5%**. The Air Force consistently maintains the largest share due to platform-centric costs, standing at **35.1% in FY2024**. However, the capital budget allocation for the Army has progressively reduced from **30.0% in FY2018 to 22.9% in FY2024**, reflecting a strategic shift in procurement priorities toward maritime and aerospace dominance.

### Trends in Defence Production in India

**Exhibit 160: Trend in Defence Production in India, FY 2019-26**



- For the year FY 26, the DPSUs and other PSUs combined contribute **76%** of the total Defence production, and the rest are private sector companies (**24%**). Total Defence production in FY 26 stood at a record **INR 1.78 Lakh Crores** (up from INR 1,50,590 Crores in FY 25), driven by robust government policy support, indigenization lists, and increased private sector participation under the Aatmanirbhar Bharat initiative.

#### Exhibit 161: Trend in Defence Production sector wise in India, FY 2019-26

| Year  | DPSUs*   | Other PSUs JV | Private Companies | Total Production (INR Crores) |
|-------|----------|---------------|-------------------|-------------------------------|
| FY19  | 58,203   | 5,567         | 17,350            | 81,120                        |
| FY 20 | 56,882   | 6,295         | 15,894            | 79,071                        |
| FY 21 | 61,346   | 6,029         | 17,268            | 84,643                        |
| FY 22 | 67,703   | 7,222         | 19,920            | 94,845                        |
| FY 23 | 80,464   | 7,137         | 21,083            | 1,08,684                      |
| FY 24 | 93,985   | 6,774         | 26,506            | 1,27,265                      |
| FY 25 | 1,20,120 |               | 33,880            | 1,54,000                      |
| FY 26 | 1,35,280 |               | 42,720            | 1,78,000                      |

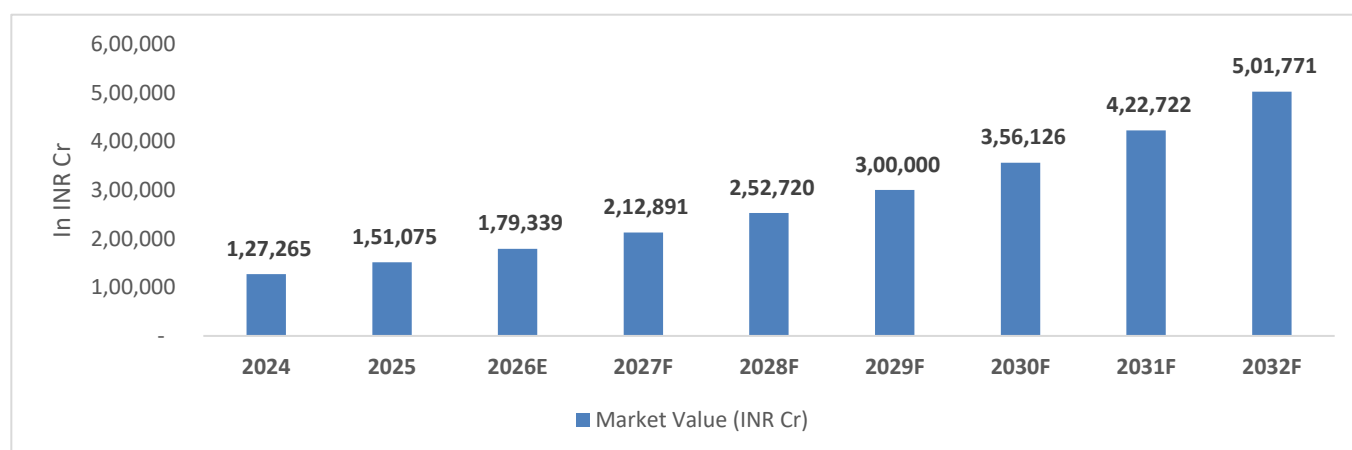
Source: MoD, Dashboard | Ministry of Defence, PIB Press Release (June 17, 2026)

\*DPSUs stand for Defence Public sector Undertakings

- To boost local manufacturing and reduce dependence on imports, the Indian Government recognized defence segment as a core sector for achieving '**AtmaNirbhar**' in 2020. The Scheme pushed for reforms across verticals and adequate funding to achieve 'self-reliance'. Post the launch of the scheme, Defence production has grown at a CAGR of **16.04%** between FY 21 and FY 26.
- As per the Ministry of External Affairs, the Ministry of Defence has set a target of **INR 3 Lakhs Crores** for Defence Production by FY 2028-29 which will drive the Defence precision forged components market.

#### India Projected Production: Defence FY 2024-2032

#### Exhibit 162: India Projected Production Market Trend, Defence INR Cr, FY 2024-32



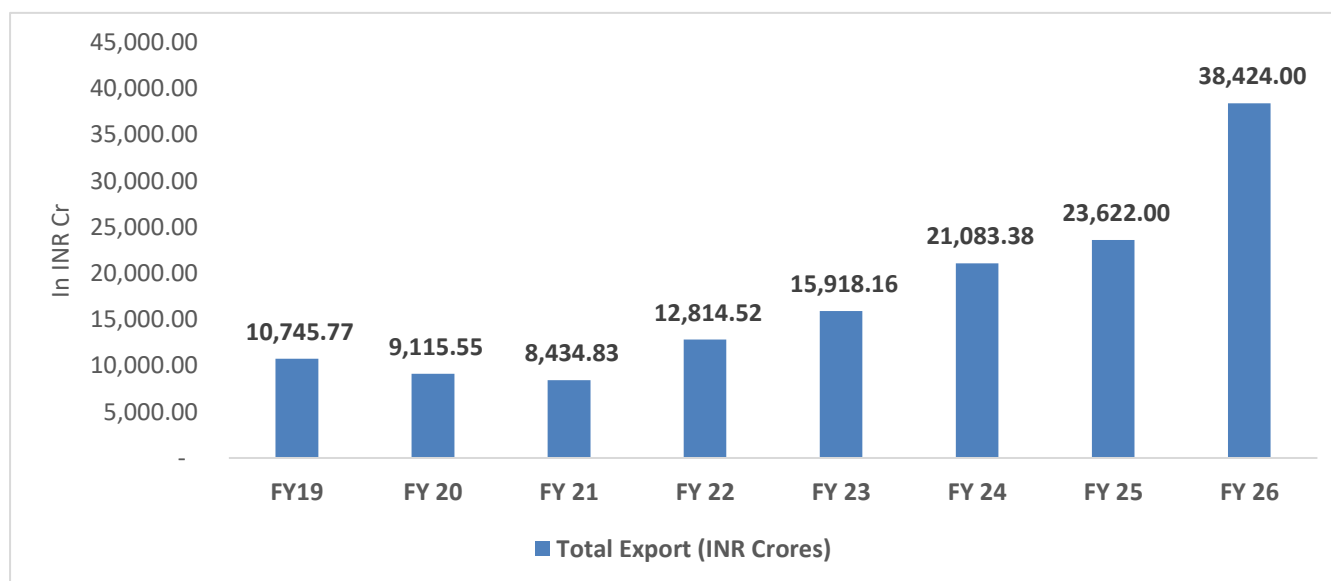
Source: Frost & Sullivan Analysis

F-Forecasted

- Indian Defence Production was valued at **INR 1,51,075 Crores in FY 2025** and is projected to mark **INR 5,01,771 Crores by 2032** with a **CAGR of 18.7% from FY 2024 to 2032** driven by government focus on Indigenization.

## Indian Defence Export FY 2019-26

**Exhibit 163: Defence Export Trend, India, FY 2019-26**



Source: MoD, Dashboard | Press Information Bureau (PIB) - Ministry of Defence (April 02, 2026)

- Defence Export reached an all-time high of **INR 38,424 Crores** in FY 26 and grew at a **CAGR of 35.41% from FY 21 to FY 26**.
- The Ministry of Defence had set a target of INR 35,000 Cr for FY 2025-26** which has already been exceeded, and the long-term target remains achieving **INR 50,000 Cr of Defence Export by FY 2028-29**.
- The country exported to over 85 countries, according to a press release from the defence ministry. Currently, 100 Indian firms have exported products such as Dornier-228, 155 mm Advanced Towed Artillery Guns, Brahmos Missiles, the Akash Missile System, radars, simulators, Arms and Ammunition, Weapon Spares, Chemicals & Explosives, Parachutes, Leather and Clothing items, Electronic Warfare Technologies, radars, composite materials for LCA, AEW&C, Astra, LCA Tejas, ASAT, BrahMos, Nag missile, SAAW, Arjun MBT Mk 1A, 46-meter Modular Bridge, MPR, LLTR Ashwin, and Pinaka multi-barrel rocket launcher.
- Global demand for LCA-Tejas, light combat helicopters and maintenance of naval ship activities has increased. India has been negotiating with several countries, such as Argentina and Egypt, to export the LCA Tejas.
- In FY 26, Defence PSUs contributed around 54.84% to the total Defence exports, while the private sector accounted for 45.16% of the exports.**<sup>73</sup>
- The growth in defence exports is attributed to the government's efforts to promote exports, improve defence manufacturing capabilities, and foster innovation through tie-ups with R&D institutions, startups, and industry.

<sup>73</sup><https://www.financialexpress.com/business/defence/indian-defence-industry-how-policy-reforms-corridors-startups-reshaping-army-navy-air-force-explained/4343701>

## Atmanirbhar Bharat (Self Reliance) in Defence Sector

- The Defence Acquisition Procedure (DAP 2020) is being implemented to maximize the acquisition of defence equipment from indigenous sources and promote domestic manufacturing.
- The Government of India has ensured that the most preferred capital acquisition option is 'Buy Indigenously Designed, Developed, and Manufactured (IDDM)' category equipment, followed by 'Buy (Indian)'.
- To aggressively reduce import dependence, the Ministry of Defence has reserved a record **75% of the capital acquisition budget** for domestic industries<sup>74</sup> and promulgated **five Positive Indigenization Lists (PILs)** comprising over 500 major weapon systems and platforms with strict embargoes on their import.<sup>75</sup>
- The 'Make' categories aim to achieve self-reliance by increasing participation in the Indian industrial ecosystem, including the private sector. Government funding mechanisms have been scaled up, including enhancing the **Technology Development Fund (TDF) limit to INR 50 Crores** per project.<sup>76</sup>
- Under the Innovations for Defence Excellence (iDEX) framework, the government launched the **ADITI (Acing Development of Innovative Technologies with iDEX)** scheme to provide grants up to INR 25 crore to start-ups for developing critical and strategic defence technologies.<sup>77</sup>
- The DRDO's 'Development cum Production Partner (DcPP)' model is implemented, in which Industry serves as the DcPP in system development projects. Industries can now use DRDO test facilities. Two Defence Industrial Corridors have been established in Uttar Pradesh and Tamil Nadu to boost domestic production of defence and aerospace products.

## Defence PSUs in India

- **Defence PSUs (Public Sector Undertakings)** in India play a crucial role in the country's defence production and development. These PSUs are government-owned entities tasked with manufacturing and supplying defence equipment and systems to meet the requirements of the Indian armed forces. Here are some key points regarding defence PSUs in India:
- **Contribution to Defence Production:** Defence PSUs contribute significantly to India's defence manufacturing sector by producing a wide range of defence equipment, including aircraft, missiles, naval vessels, firearms, ammunition, and electronic systems.
- **Strategic Importance:** These PSUs are strategically important for India's self-reliance in defence production. They are often involved in the development of indigenous defence technologies and systems, reducing dependency on foreign suppliers.
- **Maharatna, Navratna, and Mini Ratna Status:** The Government of India confers these prestigious statuses on select defence PSUs, granting them greater operational and financial autonomy to compete effectively in the global market and make significant domestic investments. Notably, the government upgraded Hindustan Aeronautics Limited (HAL) from a Navratna to a **Maharatna CPSE** in October 2024.<sup>78</sup>
- **Collaborations and Joint Ventures:** Defence PSUs often collaborate with foreign defence manufacturers through joint ventures and technology transfer agreements to enhance their capabilities and access advanced technologies.

<sup>74</sup> <https://www.pib.gov.in/PressReleaseFramePage.aspx?PRID=1989502&reg=48&lang=2>

<sup>75</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2008632&ut&reg=48&lang=2>

<sup>76</sup> <https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1832042&utm&reg=48&lang=2>

<sup>77</sup> <https://www.pib.gov.in/PressReleaseFramePage.aspx?PRID=2011171&utmreg=48&lang=2&reg=48>

<sup>78</sup> <https://newsonair.gov.in/govt-approves-upgradation-of-hal-to-14th-maharatna-central-public-sector-enterprise/>

- **Modernization and Expansion:** The Indian government has been emphasizing the modernization and expansion of defence PSUs to meet the evolving requirements of the armed forces and to boost indigenous defence production capacity.

Some of the major defence PSUs in India include:

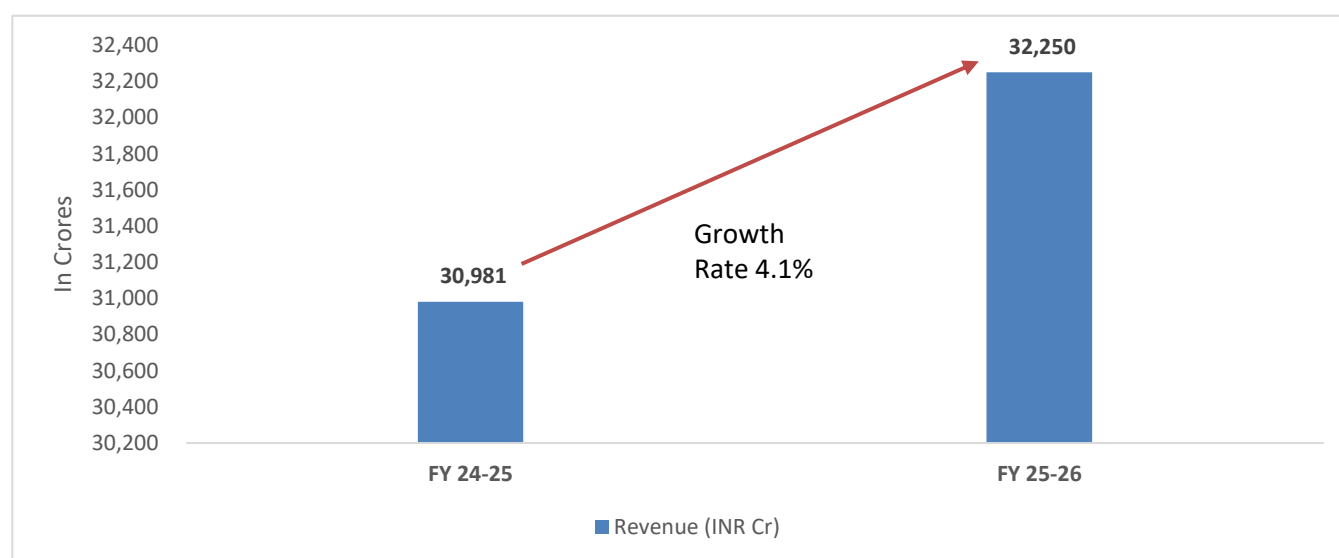
**Hindustan Aeronautics Limited (HAL):** HAL is a Maharatna Central Public Sector Enterprise (CPSE) involved in the design, development, and manufacture of aircraft, helicopters, and related systems.

- HAL's operations are organized into five complexes, namely the Bangalore Complex, MiG Complex, Helicopter Complex, Accessories Complex, and Design Complex, which together include 20 production divisions and 10 Research and Design centers ("R&D Centres") located across India.
- In addition, HAL has 12 commercial joint venture companies and 2 subsidiary companies to enhance their operations. HAL rely on indigenous design and development as well as enter into technology transfer and license agreements with foreign OEMs to manufacture their products. HAL has so far produced 17 types of aircraft from in-house design and development and 14 types under license.

### HAL Revenue Growth

- Hindustan Aeronautics Limited (HAL) had another stellar financial year, showcasing resilience and innovation. The company reported a robust revenue from operations of **INR 32,250 crores for FY '25-'26**, achieving a **4.1%** growth rate compared to the previous year's **INR 30,981 crores**. This steady growth was achieved despite global geopolitical challenges and disruptions in the supply chain.

**Exhibit 164: HAL Revenue Growth Rate, FY24-25 – FY25-26**



Source: HAL Earnings Call

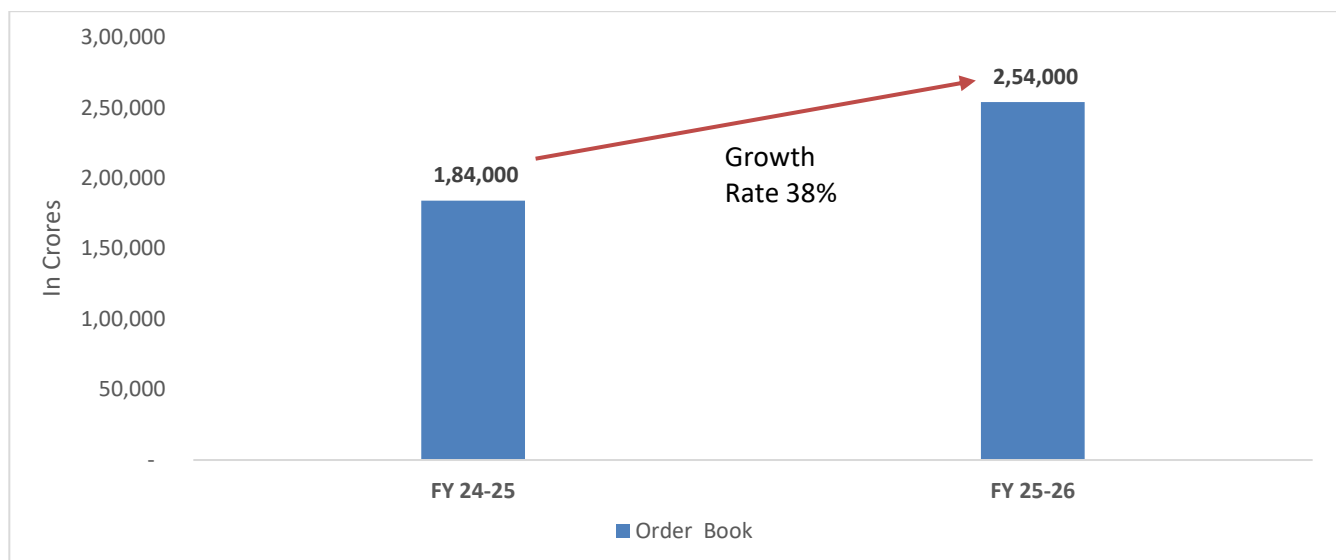
### HAL Enhanced Order Book and Future Prospects

- The company's order book is a significant highlight and has seen unprecedented expansion, standing at a record **INR 2,54,000 crores (INR 2.54 Lakh Crores)** as of March 2026. This is a massive jump from INR 1,84,000 crores at the end of the previous financial year.<sup>79</sup>
- This expansion was driven by the signing of major contracts with the Ministry of Defence, most notably an order for 97 Light Combat Aircraft (LCA) Mk1A units worth **INR 62,370 crores**, 6 ALH CG for INR 2,704 crores, and 8 Dornier CG for INR 2,186 crores, providing long-term revenue visibility over the next 7-8 years.<sup>80</sup>

<sup>79</sup><https://www.thehindu.com/news/national/karnataka/hal-registers-revenue-of-32250-crore-during-fy2025-26/article70807645.ece>

<sup>80</sup><https://www.psuconnect.in/financial/hal-posts-record-revenue-of-32250-cr-in-fy-2025-26>

## Exhibit 165: HAL Order Book Growth



Source: HAL Earnings Release

- Major orders driving this massive backlog are completely driven by indigenous platforms under the Aatmanirbhar Bharat initiative. Key contracts bagged include the massive order for **97 LCA Mark-1A units** (worth over INR 62,000 crores), **156 Light Combat Helicopters (Prachand)**, 15 Sukhoi Su-30MKI upgrades, utility helicopters (UHM/ALH Dhruv), and HTT-40 trainers.<sup>81</sup>

## Strong Product Pipeline and Capacity Expansion

- HAL's strategic focus on capacity and capability building is evident. Significant investments have been made in greenfield projects and capacity augmentation, such as the new helicopter factory in Tumakuru, which recently expanded its footprint by inaugurating a dedicated structure assembly line for the **Prachand Light Combat Helicopter (LCH)** in April 2026.<sup>82</sup>
- The company is prepared to meet growing demands by maintaining independent manufacturing facilities for different platforms, ensuring there is no production bottleneck. To execute its massive order book, HAL recently operationalized a **third production line in Nashik** (complementing the two in Bengaluru). This directly ramps up the LCA Tejas Mk1A production capacity from 16 to 24 aircraft per year and also hosts a newly inaugurated second production line for HTT-40 trainer aircraft.<sup>83</sup>

## Exhibit 166: List of Ongoing Programs of HAL

| Sl No. | HAL Program Name                       | Description and Status                                                                                                                                                                                                                                                                                                                                                                                      |
|--------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | <b>Basic Trainer Aircraft (HTT-40)</b> | HTT-40 is the Basic Trainer Aircraft indigenously designed and developed by the Company. HTT-40 would be used for basic flight training, aerobatics, instrument flying and close-formation flights whereas its secondary roles would include navigation and night flying. Features of the aircraft include Air-conditioned cockpit, Tandem seating, Zero ejection seats and Multifunction Displays. A total |

<sup>81</sup><https://manufacturing.economictimes.indiatimes.com/news/aerospace-defence/hal-says-order-book-tops-2-lakh-crore-amid-focus-on-indigenous-defence-manufacturing-at-national-security-summit/125654806>

<sup>82</sup><https://www.thehindu.com/news/national/karnataka/new-prachand-lch-production-line-inaugurated-in-tumakuru/article70857376.ece>

<sup>83</sup> <https://stratpost.com/lca-mk1a-flies-over-new-production-line/>

| SI No. | HAL Program Name                           | Description and Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |                                            | <p>of 3 prototypes has been built which includes two flying prototype and one Structural Test Specimen (STS).</p> <p>A major milestone was achieved on <b>September 18, 2026</b>, when HAL officially delivered three Final Operational Clearance (FOC) standard HTT-40 trainers to the Indian Air Force.<sup>84</sup></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2.     | <b>Light Combat Aircraft (LCA Mk1A)</b>    | <p>LCA Mk1A is an advanced variant of indigenously developed LCA MK1 equipped with Mission Computers (MC), Digital Map Generator (DMG), Smart Multi-function Displays (SMFD), Combined Interrogator and Transponder (CIT), Advanced Radio Altimeter and integrated with Air to Air and Air to Ground weapons. The design and development activities for LCA Mk1A systems were undertaken, and certification activities are progressing. Concurrently, series production activities are also being progressed. The first production series Fighter Aircraft of LCA Mk1A completed its maiden flight. Further, fine-tuning software and flight tests for weapon trials are being progressed to facilitate delivery of aircraft.</p> <p>Following the delivery of a fresh batch of GE F404 engines in August 2026, HAL's production has been kickstarted across its assembly lines, with the first deliveries to the IAF targeted by the <b>end of 2026</b>.<sup>85</sup></p> |
| 3.     | <b>Light Utility Helicopter (LUH)</b>      | <p>The LUH is a single engine, 3 Ton weight class helicopter having Glass Cockpit with Multi-Function Displays. LUH is intended to meet different role requirements including high altitude operation. Three flying prototypes have been built and were extensively flight tested.</p> <p>Work on Automatic Flight Control System (AFCS), Autorotation, Emergency Flotation System (EFS), Helmet Mounted Display System (HMDS) is progressing.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 4.     | <b>Indian Multi Role Helicopter (IMRH)</b> | <p>The Company has undertaken design and development of IMRH, a Medium Lift Helicopter of 13 Ton class primarily for high altitude troop and cargo transport. The sea variant of IMRH is named Deck Based Multi Role Helicopter (DBMRH).</p> <p>IMRH and DBMRH would be designed to meet the requirements of all three military services, and its future extension will cater to offshore operations, utility, VVIP transport roles will help diversify into Civil market.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 5.     | <b>Utility Helicopter-Maritime (UH-M)</b>  | <p>Utility Helicopter – Maritime (UH-M) is a 5.7 Ton dedicated Helicopter for deck-based operations with all four Main Rotor Blades foldable, to enable stowage in Navy's ships. Ministry of Defence accorded Acceptance of Necessity (AoN) for procurement of Utility Helicopter-Maritime.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 6.     | <b>25 KN Turbofan Engine (HTFE-25)</b>     | <p>Design and Development of a 25 KN thrust class turbofan engine, which can be used on Basic/ Advanced military trainers, on small business jets and also large UAV applications are under progress. The engine can be used on a 5 Ton weight class aircraft in single engine configuration and on aircraft of up to 9 Ton weight</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

<sup>84</sup> <https://www.janes.com/defence-intelligence-insights/defence-news/defence/indian-air-force-receives-htt-40-completes-tejas-foc-trainer-acquisition>

<sup>85</sup> <https://defence.in/threads/fresh-ge-f404-deliveries-kick-start-tejas-mk1a-work-but-integration-hurdles-and-steep-production-backlog-leaves-iaf-waiting.18697/>

| SI No. | HAL Program Name                              | Description and Status                                                                                                                                                                         |
|--------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |                                               | class with twin engine configuration. Two core engines have been produced so far and are undergoing development trials.                                                                        |
| 7.     | <b>1200 kW Turbo Shaft Engine (HTSE-1200)</b> | The 1200 kW Turbo shaft engine would be used as a power plant for 3 to 6 Ton category helicopters. One Technology Demonstrator of HTSE-1200 engine has been built and presently under testing. |

Source: HAL Annual Report 2025

- Ministry of Defence (MoD) has signed a contract with Hindustan Aeronautics Limited (HAL) for **240 AL-31FP Aero Engines for Su-30MKI aircraft** at a cost of over INR **26,000 crores**.
- HAL aims to **deliver 30 Aero engines annually over the next eight years**, with plans to enhance indigenization to **63% by the program's completion, significantly increasing local content in repair and overhaul tasks**.
- This initiative emphasizes collaboration with India's defence manufacturing ecosystem, **including MSMEs and both public and private sectors**, reinforcing the nation's self-reliance in defence production.

**Bharat Electronics Limited (BEL):** BEL manufactures a range of defence electronics, including radars, communication systems, and electronic warfare equipment. **As of July 1, 2026, the standalone order book of BEL stood at INR 72,258 Crores, providing solid revenue visibility for its defence electronics, radars, and communication systems.**<sup>86</sup>

**Bharat Dynamics Limited (BDL):** BDL is engaged in the production of missiles and missile systems for the Indian armed forces. BDL is a leading manufacturer of missiles and missile systems in India. It designs, develops, produces, and integrates surface-to-air and surface-to-surface missile systems. BDL's products include the Akash surface-to-air missile, Prithvi series of surface-to-surface missiles, and various other missile systems. **Total order book of BDL stood at INR 26,176 Crores as of March 31, 2026. The company also anticipates an additional pipeline of INR 15,000 crores in the current financial year.**<sup>87</sup>

**Mazagon Dock Shipbuilders Limited (MDL):** MDL constructs naval vessels, including warships and submarines, for the Indian Navy. It builds a variety of ships for the Indian Navy, including destroyers, frigates, corvettes, and submarines. **MDL currently commands a massive order book exceeding INR 1.70 Lakh Crores (INR 1,70,000 Crores) as of mid-2026, granting it revenue visibility for nearly a decade, primarily driven by submarine and advanced destroyer projects.**<sup>88</sup>

**Garden Reach Shipbuilders & Engineers (GRSE):** GRSE is another major shipbuilding company in India, specializing in the construction of naval vessels and commercial ships. It builds a range of ships, including frigates, corvettes, offshore patrol vessels, and amphibious warfare vessels. **Total order book of GRSE stood at INR 15,324 Crores as of March 31, 2026. The shipyard also emerged as the lowest bidder for five Next Generation Corvettes worth approximately INR 33,000 crores, which will further enhance its backlog.**<sup>89</sup>

**Bharat Earth Movers Limited (BEML):** BEML is involved in the design, manufacture, and supply of a variety of defence equipment, including earthmoving equipment, armoured recovery vehicles, and transporters. It also manufactures high-mobility vehicles for the Indian Army and other defence forces.

<sup>86</sup> TradingView / BEL Q1 FY27 Earnings

<sup>87</sup> BDL Investor Presentation

<sup>88</sup> FutureCaps MDL Analysis 2026

<sup>89</sup> CARE Ratings GRSE Report, June 2026

The defence PSUs in India play a vital role in ensuring the country's defence preparedness, promoting self-reliance in defence production, and contributing to the nation's security and sovereignty. **BEML's total order book reached a record milestone of INR 16,285 Crores as of July 1, 2026, strongly supported by inflows from both defence manufacturing and rail/metro segments.**<sup>90</sup>

Indian Defence Acquisition Procedure (DAP)

- It promotes indigenous development and production of defence equipment through the "Make in India" initiative.
- The DAP serves as a comprehensive framework for the acquisition of defence materiel by the Indian Ministry of Defence, aims to modernize the Indian Armed Forces, promote indigenous production, and enhance the nation's defence capabilities while adhering to principles of transparency, efficiency, and accountability.
- It encourages the involvement of the Indian defence industry in the acquisition process, promoting self-reliance, technology transfer, and the development of domestic manufacturing capabilities. Under the "Make in India" category, projects are classified into Make-I (government-funded up to 90% of prototype cost), Make-II (industry-funded), and Make-III (indigenously manufactured for import substitution), each aimed at fostering innovation and indigenous production.
- The DAP also lays down procedures for the procurement of defence equipment from foreign vendors through various routes, such as Inter-Governmental Agreements (IGA), Foreign Military Sales (FMS), and international competitive bidding.
- It includes updated provisions for offset obligations. To reduce overall acquisition costs, the government removed offset clauses for IGAs, FMS, and single-vendor cases. The requirement for foreign vendors to invest a certain percentage (typically 30%) of the contract value in India's defence industry now strictly applies only to international competitive multi-vendor bidding contracts valued over INR 2,000 crores.<sup>91</sup>

Upcoming Defence corridors: India

Government has set up Strategic Defence corridors in select States of India such as Tamil Nadu, Karnataka and Uttar Pradesh to promote the Defence sector.

Exhibit 167 Tamil Nadu Defence Corridor



TAMIL NADU

### OVERVIEW OF TAMIL NADU DEFENCE INDUSTRIAL CORRIDOR (TNDIC)



**TIDCO** (Tamil Nadu Industrial Development Corporation)



**Location:** Chennai, Coimbatore, Hosur, Salem, and Tiruchirappalli.



**Total Land Area:** Over 1000 acres



**Investment Proposed:**  
₹32,699 Crore in investment commitments ( ₹6,446 Crore actual investment realized)

#### Connectivity



**Air**

- Chennai International Airport.
- Coimbatore International Airport.
- Tiruchirappalli International Airport.



**Rail**

- Integrated Southern Railway network connecting all 5 defence nodes directly to national freight routes.



**Sea**

- Chennai Port.
- Kamarajar Port (Ennore).
- V.O. Chidambaranar Port (Thoothukudi).

#### Thrust

- Aerospace and Avionics Manufacturing.
- Armoured Vehicles and Heavy Auto Components.
- Unmanned Aerial Vehicles (UAVs).
- Tactical Communication & Defence Electronics.
- Naval Systems and Shipbuilding.
- Precision Machining and Metallurgy.

#### Facilities

- Plug-and-play land parcels for defence manufacturing.
- Standard Design Factories (SDF) to be leased out.
- **Four State of the Art Defence Testing Infrastructure Scheme (DTIS) Facilities:** Backed by 75% MoD funding, establishing advanced testing for:
  - **Mechanical & Material Domain (Tiruchirappalli):** Joint SPV with Micro Labs, HAL, BEML, and TIDCO.
  - **Unmanned Aerial Systems (UAS), Electronic Warfare (EW), and Electro-Optics (EO) (Chennai/Vallam Vadagal):** Joint SPVs involving BEL and Keltron.
- Common Facility Centres (CFC) and Innovation Hubs.
- Dedicated warehousing and logistics zones.
- Uninterrupted Water & Power Supply.

<sup>90</sup> <https://www.sahi.com/news/beml-international-business-order-book-hits-all-time-high-led-by-rail-metro>

<sup>91</sup> [https://www.pib.gov.in/PressReleasePage.aspx?PRID=1659746&utm\\_s&reg=48&lang=2](https://www.pib.gov.in/PressReleasePage.aspx?PRID=1659746&utm_s&reg=48&lang=2)

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## Tamil Nadu Aerospace and Defence Policy,

- The Tamil Nadu Defence Industrial Corridor (TNDIC) spans five key manufacturing hubs: Chennai, Coimbatore, Hosur, Salem, and Tiruchirappalli.
- As of April 2026, TNDIC has secured **INR 32,699 Crores** in total investment commitments, with **INR 6,446 Crores** already realized on the ground.<sup>92</sup>
- Goal is to attract investments to the tune of **INR 75,000 Crores, over a period of 10 years.**
- Creating direct and indirect employment prospects for 1 lakhs person in 10 years.

### Exhibit 168: List of Aerospace and Defence SEZ in Tamil Nadu

| Sl No. | Industrial Park                   | Proposed Aerospace and Defence Focus Sector |
|--------|-----------------------------------|---------------------------------------------|
| 1.     | Aerospace Park, Vallam Vadagal    | A&D (R&D and Manufacturing)                 |
| 2.     | Sulur                             | Military Aircraft Assembly                  |
| 3.     | Varapatti Village near Coimbatore | Defence components Manufacturing Park       |
| 4.     | Annur                             | Dual Use Industrial Park                    |
| 5.     | Manallur                          | Defence Electronics                         |
| 6.     | Hosur                             | Aircraft components                         |
| 7.     | Tindivanam (Phase II)             | Helicopter MRO                              |
| 8.     | Thoothikudi                       | Space Industrial Park                       |

Source: Tamil Nadu Defence Corridor

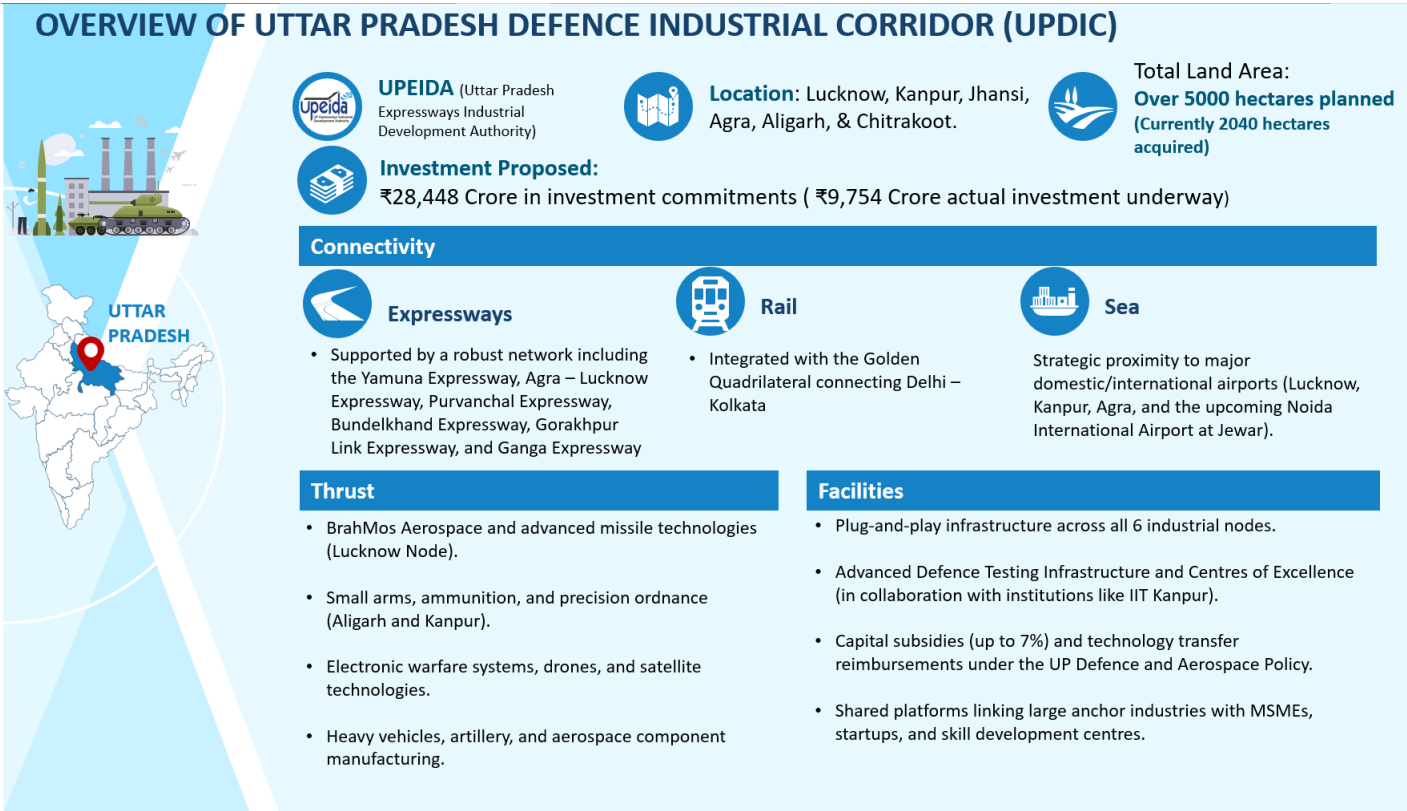
- The creation of thematic A&D industrial parks will provide a plug and play ecosystem for the companies planning to expand or set up new industrial facilities related to the A&D sector.
- Recent infrastructure progress includes the operationalization of the **Varapatti Defence Park (Coimbatore)**, where TIDCO recently allocated land to 20 defence manufacturing companies.<sup>93</sup>
- Additionally, the **Thoothukudi Space Industrial Park** is being rapidly developed to support private startups and align with ISRO's upcoming Kulasekarapattinam spaceport, securing major MoUs for ammunition and space manufacturing in early 2026.<sup>94</sup>

<sup>92</sup><https://www.financialexpress.com/business/defence/rs-74756-crore-promised-rs-10855-crore-grounded-where-are-indias-defence-factories/4327504/>

<sup>93</sup><https://manufacturing.economictimes.indiatimes.com/news/aerospace-defence/tidco-allocates-land-to-20-companies-in-coimbatore-to-manufacture-defence-products/125342601>

<sup>94</sup> <https://defence.newsd.in/aviation/tamil-nadu-secures-1600-crore-investment-in-aerospace-defence>

Exhibit 169: UTTAR PRADESH DEFENCE INDUSTRIAL CORRIDOR (UPDIC)



- The corridor spreads across Central, East, West regions of Uttar Pradesh connecting Lucknow, Kanpur, Jhansi, Agra, Aligarh, and Chitrakoot, supported by networks of expressways.
- Investment Progress: UPDIC has secured 197 **MoUs** with investment commitments of **INR 28,448 Crores**.
- Major Projects: Key operational facilities now include the BrahMos missile manufacturing center in Lucknow and South Asia's largest ammunition manufacturing complex in Kanpur (inaugurated in early 2024).<sup>95</sup>

Karnataka Aerospace and Defence

Karnataka has rolled out Karnataka Aerospace and Defence Policy 2022-27, which is driving and regulating the segment in the State and promoting it as a leading hub in the country.

- **25%** of the India's Aircraft and Spacecraft Industry is based in Karnataka.
- **67%** of all Aircraft and Helicopters manufacturing for Defence Services is done in Karnataka.
- With **65%** of India's Aerospace related exports originating from Karnataka, the state is a preferred investor destination for Aerospace & Defence companies.
- Karnataka's strong ecosystem blossomed with decades of presence of PSUs like **HAL, DRDO, BEML**. Today the state is home to all major global leaders like Airbus and Boeing.
- Expertise in Aerospace with more than **2,000 SMEs** and **70%** of India's supplier base which execute niche sub-contracting work for the Defence PSUs.

<sup>95</sup><https://www.financialexpress.com/business/defence-adani-defence-amp-aerospace-boosts-self-reliance-with-inauguration-of-south-asias-largest-ammunition-amp-missiles-complex-3405922>

## Incentives for Large, Mega, Ultra Mega and Super Mega Enterprises

- Up to **2.25%** of turnover as investment promotion subsidy for 6-10 years up to 40-60% of fixed asset value.
- Low concessional registration charges of 0.1%.
- **50% subsidy** on cost of CETP/ETP/STPs (up to INR 6 Cr.)
- Up to **100% exemption** on stamp duty.
- Up to **100% reimbursement** on land conversion fee.
- Investment subsidy for anchor industries of up to INR 10 Cr.

**Vinir Engineering Limited, with their plant location in the Aerospace and Defence hub of the country, will have a strategic advantage over their competitors in the precision forged and machined components market of Aerospace and Defence.**

## Indian Defence Offset Policy

- It's an FDI initiative to gain and leverage the technology prowess of leading Global Defence players.
- It is an obligation by foreign suppliers to invest in India and aid the domestic defense industry either through direct investment or by partnering with domestic defense players or by transfer of technology to an Indian defense enterprise.
- The offset policy is now applicable only to international competitive multi-vendor procurements where the contract value exceeds **INR 2,000 crores** (significantly increased from the previous INR 300 crores limit).<sup>96</sup>
- Presently, when applicable, the standard offset obligation for the foreign vendor is **30% of the total contract value**.
- To reduce procurement delays and costs, the government has removed offset obligations for Inter-Governmental Agreements (IGA), Foreign Military Sales (FMS), and single-vendor procurements.

## Exhibit 170: List of OEMs having Offset Contracts

| S. No. | OEM Name                              | Offset Contracts Description                                           |
|--------|---------------------------------------|------------------------------------------------------------------------|
| 1      | Airbus Defence and Space S.A.         | Procurement of 56 Transport Aircraft (C-295) with Associated Equipment |
| 2      | BAE Systems GCS International Limited | 145 X 155 mm 39 calibre Ultra-Light Howitzers (M777A2)                 |
| 3      | Dassault Aviation                     | 36 Aircraft Package Supply Protocol Offset Contract (RAFALE EH/DH)     |
| 4      | Elbit System Ltd                      | Search and Rescue Equipment (SAR)                                      |
|        |                                       | 12.7MM stabilized remote control guns (SRCG) AND AMMUNITION WITH TOT   |
|        |                                       | Radio Sets (RS) Tadiran                                                |

<sup>96</sup> [https://www.pib.gov.in/PressReleasePage.aspx?PRID=1659746&utm\\_ni&reg=48&lang=2](https://www.pib.gov.in/PressReleasePage.aspx?PRID=1659746&utm_ni&reg=48&lang=2)

| S. No. | OEM Name                                          | Offset Contracts Description                                     |
|--------|---------------------------------------------------|------------------------------------------------------------------|
|        |                                                   | Upgrade in Medium Lift Helicopters                               |
|        |                                                   | Thermal Imaging Fire Control Systems (TIFCS) for T-72 Tanks      |
| 5      | Elbit Systems Electro Optics ELOP Ltd             | TISK                                                             |
| 6      | ELTA Systems Ltd                                  | 12 x Recce pods (Su-30)                                          |
|        |                                                   | 06 SETS of RADAR AMDR-2D                                         |
|        |                                                   | Medium Power Radar (MPR)                                         |
|        |                                                   | Air Route Surveillance Radar (ARSR)                              |
| 7      | Fincantieri - Cantieri Navalli Italiani S P A     | Fleet Tanker (Option)                                            |
|        |                                                   | FLEET TANKER (MAIN)                                              |
| 8      | Israel Aerospace Industries (IAI)                 | UAV HERON                                                        |
|        |                                                   | Two Troops Heron UAV (Indian Army)                               |
| 9      | Israel Aerospace Industries MBT Missiles Division | Augmentation of Barak System Repair Facility                     |
|        |                                                   | HAROP                                                            |
|        |                                                   | Air Defence Fire Control Radars                                  |
| 10     | James Fisher Defence Ltd                          | Deep Submergence and Rescue Vessel (DSRV)                        |
| 11     | Lockheed Martin Corporation                       | C-130J-30 Aircraft (Main)                                        |
|        |                                                   | Indian Navy 24 MRH (MH-60R Romeo)                                |
|        |                                                   | C-130J Aircraft                                                  |
| 12     | MBDA                                              | MICA for M2000                                                   |
|        |                                                   | 36 RAFALE FIGHTER WEAPONS PACKAGE SUPPLY PROTOCOL (RAFALE EH/DH) |
| 13     | MBDA UK LIMITED                                   | New Generation Close Combat Missile                              |
| 14     | Nexter Munitions                                  | 20 MM Gun Ammunition (Indian Air Force)                          |
|        |                                                   | 20 MM Ammunition and associated equipment for ALH (WSI)          |
| 15     | Pilatus Aircraft Ltd                              | Basic Trainer Aircraft Pilatus                                   |
| 16     | Qinetiq Target Systems Ltd                        | MEAT                                                             |
| 17     | Rafael Advanced Defence Systems Ltd               | Barak 1 (Option)                                                 |
|        |                                                   | 164 LDPs                                                         |
|        |                                                   | SDR GLOBAL LINK NETCOR                                           |

| S. No. | OEM Name                                              | Offset Contracts Description                                                       |
|--------|-------------------------------------------------------|------------------------------------------------------------------------------------|
|        |                                                       | SPICE-2000 NGPGM Weapon Systems (OPTION)                                           |
|        |                                                       | BARAK 1 SAM                                                                        |
|        |                                                       | Medium Altitude EO/IR Recce System for Jaguar                                      |
|        |                                                       | Spice 2000 Weapon Systems                                                          |
|        |                                                       | Medium Altitude EO/IR Recce System for Jaguar Option Clause                        |
| 18     | Rosoboron Export                                      | 80 Helicopters Mi-17V-5                                                            |
|        |                                                       | KAMOV 28 MID LIFE UPGRADE                                                          |
| 19     | Russian Aircraft Corporation "MIG" Russian Federation | Extension of service Life and Upgrade of MiG-29                                    |
| 20     | Textron Systems Corporation                           | SENSOR FUZED WEAPONS (SFW)                                                         |
| 21     | Thales Air Systems SA                                 | Low Level Transportable Radar (LLTR)                                               |
| 22     | Thales Belgium S.A                                    | Procurement of 70 MM Rockets and Associated Equipment for ALH(WSI) for Indian Army |
|        |                                                       | Procurement of 70 MM Rockets and Associated Equipment for ALH(WSI)                 |
| 23     | Thales Systemes Aeroportes                            | UPGRADE OF MIRAGE 2000 AIRCRAFT                                                    |
| 24     | The Boeing Company                                    | C-17 Globemaster III Aircraft                                                      |
|        |                                                       | P-8I Training Solutions                                                            |
|        |                                                       | Four(04) P-8I LRMRASW Aircraft                                                     |
|        |                                                       | AH-64E APACHE ATTACK HELICOPTERS (OPTION CLAUSE)                                   |
|        |                                                       | HARPOON MISSILES                                                                   |
|        |                                                       | AH-64E Apache Attack Helicopters                                                   |
|        |                                                       | CH-47F(I) Chinook Heavy Lift Helicopters                                           |
|        |                                                       | P-8I Main                                                                          |
| 25     | Ultra Electronics Maritime Systems                    | New Torpedo Defence System                                                         |

Source: MoD

## 6<sup>th</sup> Positive Indigenization List

- The **6<sup>th</sup> Positive Indigenization List** was officially notified by the Ministry of Defence in **August 2026**, advancing the 'Aatmanirbhar Bharat' initiative.<sup>97</sup>

<sup>97</sup> [https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2300723&utm\\_&reg=48&lang=2](https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2300723&utm_&reg=48&lang=2)

- It mandates the domestic procurement of **405 additional defence items** (389 for DPSUs and 16 for the Indian Coast Guard) with an estimated business potential of **INR 3,070 Crores**.<sup>97</sup>
- The list covers highly complex line replaceable units (LRUs), sub-systems, and components for major platforms like the Su-30MKI, LCA Tejas, T-90 tanks, warships, and missile systems.
- **This list also provides an excellent opportunity for ‘Startups’ as also MSMEs which will get tremendous boost from this initiative (facilitated via the SRIJAN portal) and lead to creation of a world class defence industrial ecosystem in the country.**

**Exhibit 171: 6th Positive Indigenisation list, w.e.f 2026**

| S No.                                 | Description                                                                         |
|---------------------------------------|-------------------------------------------------------------------------------------|
| <b>With Effect from December-2023</b> |                                                                                     |
| 1.                                    | Quantum Key Distribution System for Optic Fiber based Networks (Up to 200 Km range) |
| 2.                                    | Satellite Based ELINT System                                                        |
| 3.                                    | Very High Frequency (VHF) Radar                                                     |
| 4.                                    | Electro Optic Fire Control System for Naval Platforms                               |
| 5.                                    | Front, Middle and Rear Outer for Tank (ARV VT-72B)                                  |
| 6.                                    | Torque Motor (EU) for 155mm Bofors Gun                                              |
| 7.                                    | Armour Plates for Cabin Nose Section for Mi-17 Helicopter                           |
| 8.                                    | Directional Control Valve (EU) for 155mm Bofors Gun                                 |
| <b>With Effect from December-2024</b> |                                                                                     |
| 9.                                    | Automated Mobile Test System (AKIPS) for OSA-AK-M Missile System                    |
| 10.                                   | Wire Rope Antenna for Mi-17 Helicopter                                              |
| 11.                                   | Transmitter (Power Amplifier Assembly for LLLWR)                                    |
| 12.                                   | 5KW & 10 KW HF Transmitter for Naval Ships                                          |
| 13.                                   | 4G LTE Secure Handset for Navy                                                      |
| 14.                                   | Multifunction Aviation Ground Equipment (MFAGE) for Air Force                       |
| 15.                                   | Self-Generating Nitrogen Servicing Cart for Chinook Helicopter                      |
| 16.                                   | Gravity Rollers for Mi-17 V5 Helicopter                                             |
| 17.                                   | Air Conditioning Unit for Chinook Helicopter                                        |
| 18.                                   | Foaming Agent Morpene                                                               |
| 19.                                   | Hydraulic Supply Cart for Chinook Helicopter                                        |
| 20.                                   | Poly Urethane Block for Mi-17 V5 Helicopter                                         |
| 21.                                   | Tail Rotor Cable for Mi-17 V5 Helicopter                                            |
| 22.                                   | Canister Missile (CM) Transportation Module for SPYDER Missile System               |
| 23.                                   | HP Air Compressor for Ships and Submarines                                          |

| With Effect from December-2025 |                                                                                    |
|--------------------------------|------------------------------------------------------------------------------------|
| 24.                            | Futuristic Infantry Combat Vehicle (FICV)                                          |
| 25.                            | Articulated All-Terrain Vehicles (AATV)                                            |
| 26.                            | Remotely Piloted Air Borne Vehicles (RPAV) up to 25 Km with 2 Kgs Payload for Army |
| 27.                            | Naval Shipborne Unmanned Aerial System (NSUAS)                                     |
| 28.                            | Medium Upgrade Low Endurance (MULE) Class Tactical Drone                           |
| 29.                            | Electric Light Vehicle for Army                                                    |
| 30.                            | Nag Missile System (NAMIS) Tracked (Limited Series Production)                     |
| 31.                            | Medium Range Precision Kill System (MRPKS) for Artillery                           |
| 32.                            | Next Generation Low Level Light Radar (LLLR) for Army                              |
| 33.                            | Automatic Chemical Agent Detection & Alarm System (ACADA)                          |
| 34.                            | Armored Fighting Vehicle (AFV) Protection and Counter Measures System              |
| With Effect from December-2026 |                                                                                    |
| 35.                            | Line Replaceable Units (LRUs) and Spares for Su-30MKI Fighter Aircraft             |
| 36.                            | Sub-systems for Light Combat Aircraft (LCA Tejas)                                  |
| 37.                            | Spares for Advanced Light Helicopter (ALH) and Light Utility Helicopter (LUH)      |
| 38.                            | Critical components for AL-31FP Aero Engines                                       |
| With Effect from December-2027 |                                                                                    |
| 39.                            | Sub-assemblies and components for T-90 and T-72 Main Battle Tanks                  |
| 40.                            | Spares for BMP-II Infantry Combat Vehicles                                         |
| 41.                            | Sub-systems, spares, and raw materials for indigenous Warships                     |
| 42.                            | High Explosive Anti-Tank (HEAT) Ammunition                                         |
| With Effect from December-2028 |                                                                                    |
| 43.                            | Components for Medium Range Surface to Air Missile (MRSAM) system                  |
| 44.                            | Spares for Konkurs-M and Invar Anti-Tank Guided Missiles                           |
| 45.                            | Advanced Defence Electronics (Radars, Sonars, and Fire Control Systems)            |
| 46.                            | Tactical Satellite Communication Equipment                                         |
| With Effect from December-2029 |                                                                                    |
| 47.                            | Navigation Systems and Gyros for Akash-NG Missile and Dhanush Systems              |
| 48.                            | Foldable Hangar Door Structures and Control Systems for Warships                   |
| 49.                            | Avionics and Torque Controllers for Dornier-228                                    |
| With Effect from December-2030 |                                                                                    |
| 50.                            | Laser Systems and Components for LYNX U2 Fire Control System                       |

|                                       |                                                                   |
|---------------------------------------|-------------------------------------------------------------------|
| 51.                                   | Engine components and warning sensors for MiG-29 Fighter Aircraft |
| 52.                                   | Power Supply and Control Units for Su-30MKI                       |
| <b>With Effect from December-2031</b> |                                                                   |
| 53.                                   | Advanced Thermal Imagers and Tracking Electronics                 |
| 54.                                   | Inertial Navigation Units (with software) for Akash Missile       |
| 55.                                   | Critical Engine Components and Gaskets for ICG Patrol Vessels     |
| <b>With Effect from December-2032</b> |                                                                   |
| 56.                                   | Multi I/O Avionic Devices for Electronic Warfare (EW) Systems     |
| 57.                                   | Solid State Oscillators for Short-Range Air Defence Radars        |
| 58.                                   | Advanced Day Zoom Lenses for T-90 Main Battle Tanks               |

Source: Srijan Defence August 2026 | Official PIB Release (August 18, 2026)

### Tank Upgradation

- The modernization of ageing T-72M tanks has also been a priority with the Army. India currently possesses around 2,500 T-72M tanks which were first introduced since 1970's.
- Despite their age these tanks are still considered reliable and continue to be in demand globally. Countries in Africa, Middle East, Far East Asia have expressed in acquiring T-72M tanks even as India prepares to phase them out.
- Modernization and Export of T-72 M tank aligns with India's Border Strategy of promoting Defence Exports.
- By Upgrading these tanks India will have cost effective and reliable solution for potential buyers.

### Brahmos Indigenization Program

- BrahMos Aerospace, the Indo-Russian Joint Venture of Supersonic Cruise Missile has achieved 83% to 85% Indigenization level. This Milestone is an attribute to the Systematic Approach and Renewed Push for Self-Reliance.
- BrahMos in Collaboration with various Indian Industries has successfully manufactured crucial sub systems like boosters and seekers as well as several smaller components.
- With current localization touching advanced thresholds and strategic roadmaps targeting near-complete self-reliance, the program continues to cut down foreign dependencies and optimize unit costs for international export markets. <sup>98</sup>

<sup>98</sup> <https://raksha-anirveda.com/decisive-push-india-targets-95-indigenous-content-in-brahmos-missile/>

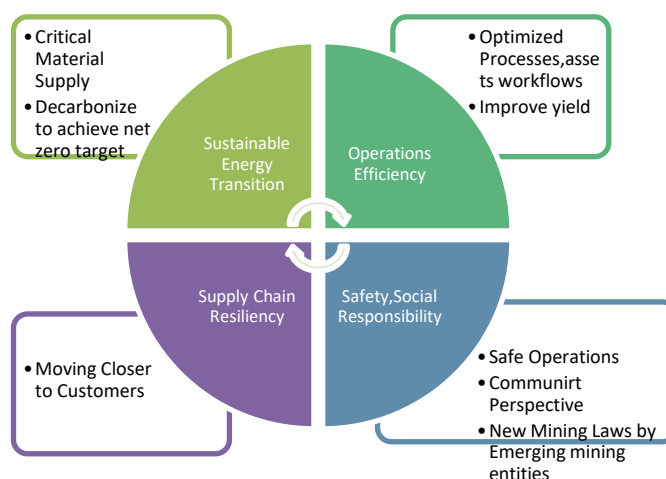
## 3.5 Mining and Construction Equipment:

### 3.5.1 Mining and Construction Equipment Global Overview:

#### Mining and Construction Equipment:

- The mining industry powers the global economy with the building blocks of metals, minerals, and fossil fuels such as coal.
- Mining contributed **around 1.5% of US GDP in recent years** yet casts a much longer shadow in its overall economic impact. Efficiently mining critical materials such as lithium, cobalt, and copper is now essential to satisfy current demand, achieve energy transition goals, and meet net-zero carbon emissions in multiple industries.
- The worldwide mining market is projected to expand significantly, **scaling beyond USD 3.5 trillion by the early 2030s with a CAGR approaching 6%**<sup>99</sup>. However, a critical supply deficit persists; current operational mines are forecast to satisfy **only 50% of lithium and cobalt, and roughly 80% of the copper** needed by the end of the decade to sustain green initiatives like EV battery production.
- There is increasing focus on circularity at the end of the product life cycle to reuse, recycle, or refurbish parts and materials, reducing demand for virgin resources. Manufacturers must now report the proportion of virgin materials compared to recycled product content. Additionally, mining for battery raw materials may peak by 2030s due to advanced recycling efficiencies and alternative battery chemistries.
- With Four business trends in the mining sector have emerged: sustainable energy transition from supply of critical materials and decarbonization; operational efficiency for better yield with cheaper, faster workflows; supply chain resiliency to spring back from unforeseen disruptions; and safe and socially responsible operations.
- Technologies driving these trends are artificial intelligence (AI) for autonomous site operations; industrial internet of things (IoT) with IT-OT integration for enhanced visibility from the top floor of the enterprise to the mines; 5G for real-time communication; and edge/fog computing for local decision-making between data sources like IoT at the edge with central cloud systems.
- The broad operational trends in the mining industry are sustainable mining for energy transition, operations efficiency that includes workforce skill development, safe and socially responsible mining, and supply chain resilience.

**Exhibit 172: The four broad business trends in the mining sector**



<sup>99</sup> Global Mining & Metals Market Outlook 2026 / World Economic Forum (Transition Minerals Report)

## Strategic Changes in Mining

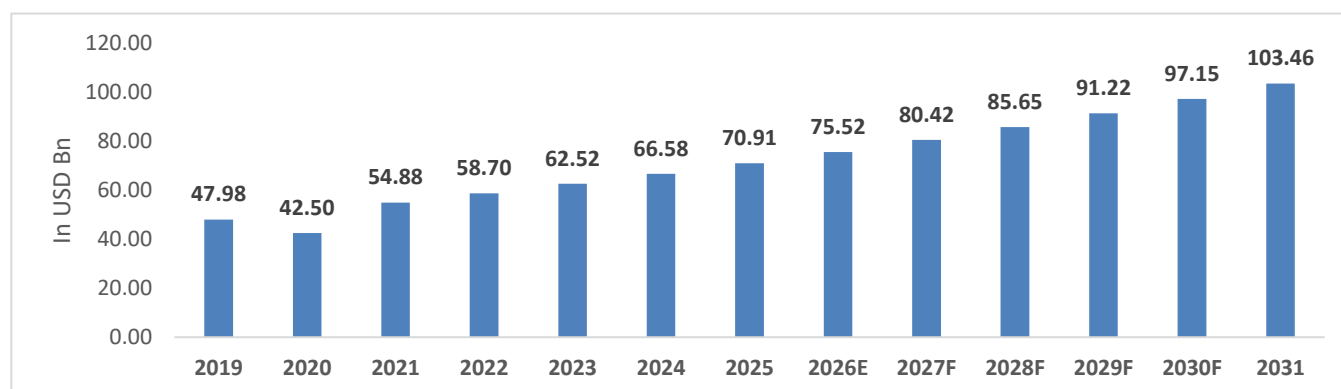
- Traditional mining companies face challenges to keep pace with growing demand for critical materials. Organic growth is a long business cycle in mining. Traditional mining sectors operate slower than fast-moving, competitive critical materials businesses, where quick decisions are necessary.
- Critical materials need to follow and catch up with trends like electrification, renewable energy, and energy transition. These conditions have led to and will continue to see mergers, acquisitions, business consolidations, and carve out critical material business.
- Building on foundational deals like Rio Tinto's 2022 Turquoise Hill acquisition and BHP's 2023 OZ Minerals buyout, **the 2025–2026 market has seen an accelerated wave of aggressive consolidations as tier-one miner's race to secure long-term copper, nickel, and lithium portfolios to dominate the evolving EV ecosystem.**<sup>100</sup>

## Sustainable Mining for Energy Transition

- With the mining sector contributing **roughly 4% to 7% of global greenhouse gas emissions**<sup>102</sup>, operators are under intense pressure from environmental regulators and capital markets to execute strict net-zero frameworks.
- The International Council on Mining and Metals (ICMM) and major industry players have formally committed to achieving **net-zero Scope 1 and 2 emissions by 2050**, backed by aggressive interim reduction targets for 2030.<sup>101</sup>
- Companies are deploying green technologies at the operational level to minimize their carbon footprint. This includes transitioning to **fully electrified mining fleets (haul trucks and underground equipment) and establishing captive renewable energy grids (solar, wind, and large-scale battery storage) to reliably power 24/7 remote operations.**<sup>102</sup>
- Furthermore, the industry is prioritizing the ethical and responsible sourcing of battery-critical metals (lithium, cobalt) by enforcing strict guidelines against habitat destruction. **This trend directly supports downstream industrial decarbonization, such as the green steel manufacturing initiatives currently driving strategic alignments across Asian and Middle Eastern markets.**<sup>102</sup>

## Global Mining and Construction Equipment Market

### Exhibit 173: Global Mining and Construction Equipment Market Trend, USD Bn CY 2019-2031



Source: Frost & Sullivan Analysis

<sup>100</sup> <https://www.osmosisim.com/minings-great-consolidation-why-efficiency-will-decide-the-winners/>

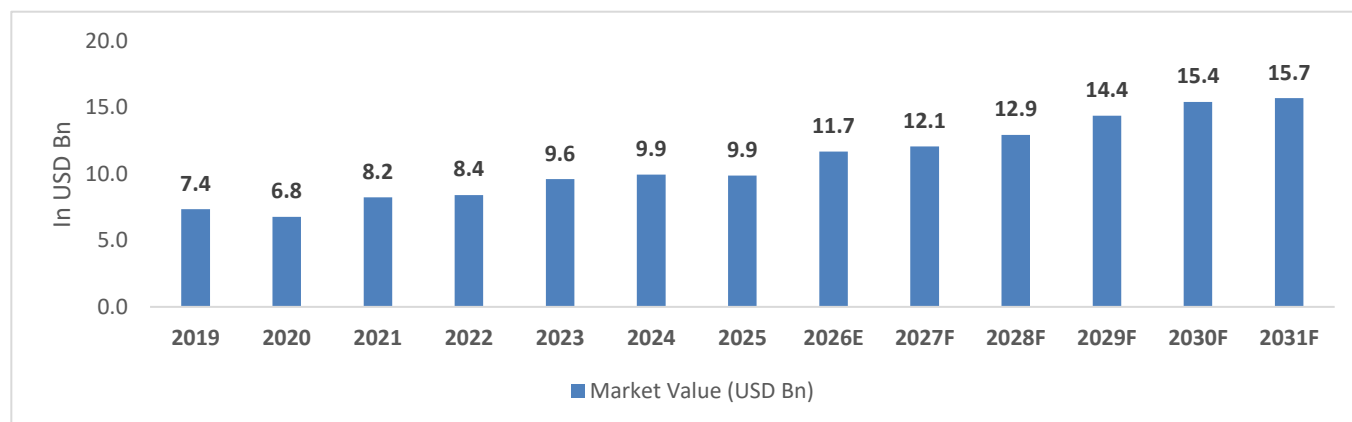
<sup>101</sup> <https://sustainabilitymag.com/news/icmm-minings-climate-impact-lower-than-expected>

<sup>102</sup> <https://www.whitecase.com/insight-our-thinking/net-zero-2050-mining-metals-sector-track-reduce-greenhouse-gas-emissions>

- Global Mining and Construction Equipment Market was valued at **USD 90.91 Bn in 2025** and is projected to grow at a **CAGR of 6.5% from 2025 to 2031** driven by increasing infrastructure development activities in developing countries and rise in commercial and industrial construction activities.

#### Global Overall Forgings Market: Mining and Construction Equipment CY2019-2031

**Exhibit 174: Global Overall Forgings Market Trend, Mining and Construction Equipment, USD Bn, CY2019-31**



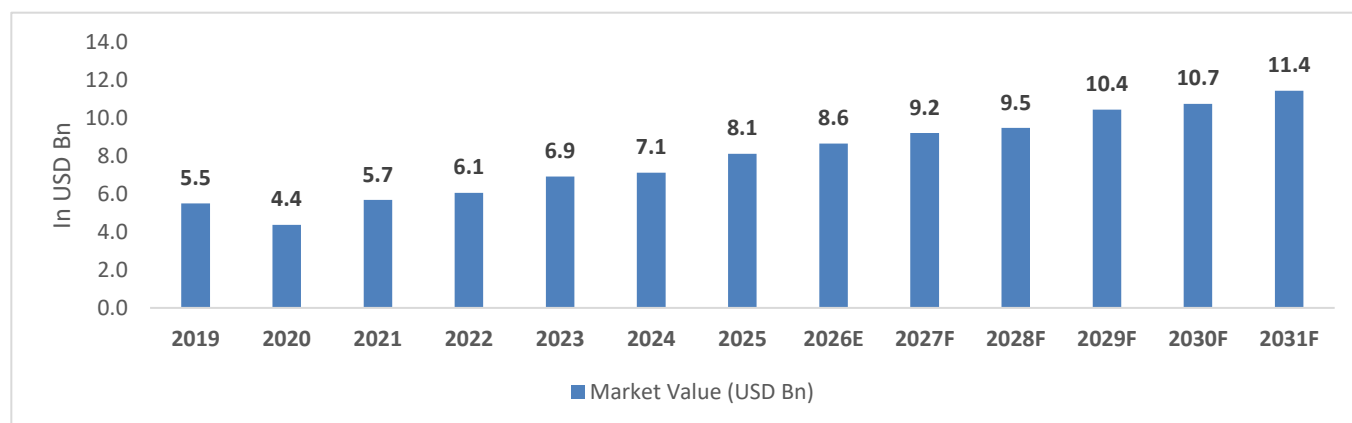
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall forgings market for Mining and Construction Equipment was valued at **USD 9.9 Bn in 2025** and is projected to mark **USD 15.7 Bn by 2031** with a **CAGR of 8.0 % from 2025 to 2031**.

#### Global Precision Forged Machined Components Market: Mining and Construction Equipment CY 2019-2031

**Exhibit 175: Global Precision Forged Machined Components Market Trend, Mining and Construction Equipment, USD Bn, CY 2019-31**

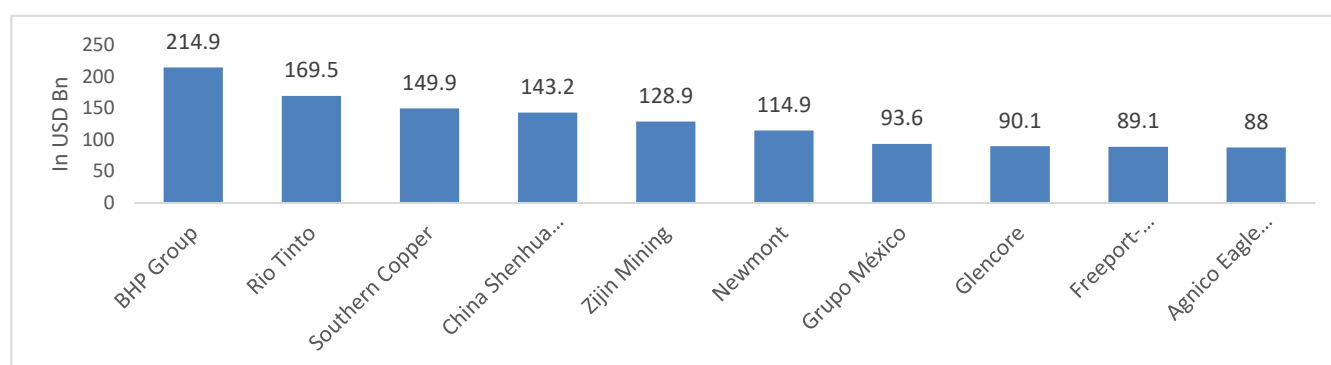


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Mining and Construction Equipment was valued at **USD 8.1 Bn in 2025** and is projected to mark **USD 11.4 Bn by 2031** with a **CAGR of 5.9 % from 2025 to 2031** driven by key components such as Rod Eyes, Caps, Trunnions, Spindles, Cam Shafts, Track rollers, teeth's ball stud, Arm Steering, Arm Centre, Rod Head, Caps and Vertical Shafts, parts of track, parts of boom, parts of bucket and attachments.

## Exhibit 176: Top 10 Mining Companies by Market Value, 2026



Source: Mining.com (2026 Market Capitalization Data)

- **Forged products such as Rod Eyes, Caps, Trunnions, Spindles, Cam Shafts, Track rollers, teeth's, ball stud, Arm Steering, Arm Centre, Rod Head, Caps, Vertical Shafts, Idler Rims, Support Rings, Profile Rings will experience a boost with the growth of this sector.**
- Broken Hill Proprietary Company (BHP Group) is the leading Mining Company Globally with a market capitalization **to USD 214.9 Bn in early 2026.**
- Heavy Earthmoving Machines (HEMMs) generate standard business opportunities for forged components as they are driven by lifecycle of components. It is worn of spare parts-based Industry and needs replacement or repair in case of failure or malfunctioning of the component.
- Growing mining activity is also driving the earth moving equipment market. Continued growth in infrastructure, mining and construction projects is expected to increase the use of earthmoving equipment and **thereby the requirement of forged products is expected to increase.**

**Key HEMMs used in the Mining sector include Excavators, Dump trucks, Loaders, Motor Graders and Dozers.**

- The Demand of forgings in Mining and Construction Equipment is linked to factors such as rapid industrialization, urbanization and increased import-export activities. Countries such as India, China, and Australia are focused on improving the present infrastructure by initiating multiple projects related to roadway development, airport developments.
- Key HEMM manufacturers globally are Caterpillar Inc, Komatsu Ltd, CNH Industrial NV, AB Volvo, Terex Corporation, Sandvik AB, Epiroc Mining Limited, John Deere, Liebherr, Metso Corporation, Wirtgen Group, Sany Heavy Industry Company Ltd.
- Precision Forged and machined components markets look promising globally and HEMMs will drive the growth of forged products in the Mining Industry.

### 3.5.2 Mining and Construction Equipment India Overview:

- The adoption of the new and highly stringent **CEV Stage V (Construction Equipment Vehicles Stage V) emission standards, officially enforced from January 1, 2025**, presents significant opportunities for Indian Earthmoving equipment manufacturers to align with European/US parity and seamlessly enter developed markets.<sup>103</sup>
- The Indian construction equipment market is witnessing massive growth, valued at **USD 9.24 Billion in 2026**, with earthmoving equipment commanding a dominant **71% share of total industry volume.**

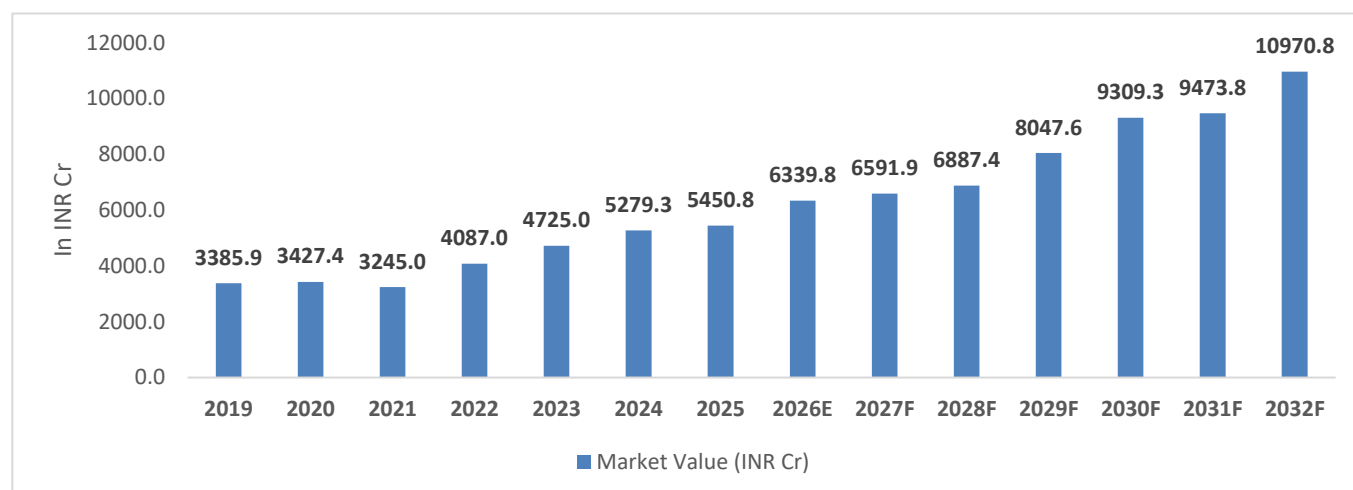
<sup>103</sup> <https://gsasindia.com/blog/cev-stage-v-construction-equipment-india>

This growth is heavily backed by the government's record **INR 12.2 lakh crore infrastructure capex commitment** for FY27.<sup>104</sup>

- Key Precision Forged components such as **Rod Eyes, Caps, Trunnions, Spindles, Cam Shafts, Track rollers, teeth's, ball stud, Arm Steering, Arm Centre, Rod Head, Caps, Vertical Shafts, Idler Rims, Support Rings, Profile Rings** will experience a massive boost with sustained growth and high utilization rates of this sector.

## India Overall Forgings Market: Mining and Construction Equipment, FY 2019-2032

**Exhibit 177: India Overall Forgings Market Trend: Mining and Construction Equipment, INR Cr, FY 2019-32**



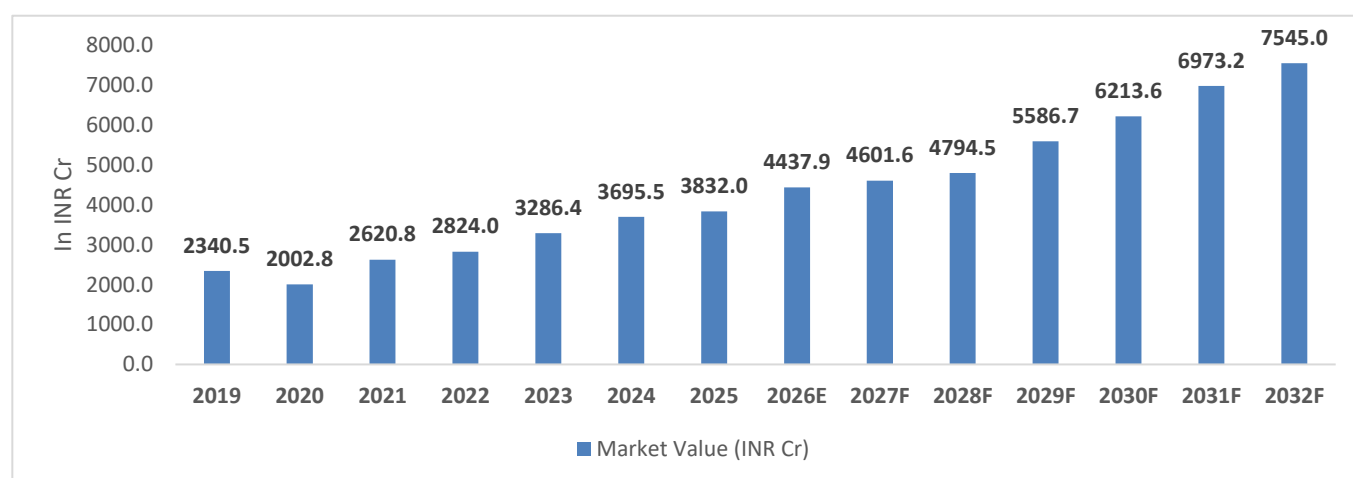
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall Forgings Market for Mining and Construction Equipment was valued at **INR 5,450.8 Crores** in **FY 2025** and is projected to mark **INR 10,97.8 Crores** by **2032** with a **CAGR of 9.6 %** from **FY 2026 to 2032** driven by rapid industrialization, urbanization and increased import-export activities.

## India Precision Forged Machined Components Market: Mining and Construction Equipment, FY 2019-2032

**Exhibit 178: India Precision Forged Machined Components Market Trend, Mining and Construction Equipment, INR Cr, FY 2019-32**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

<sup>104</sup> <https://maximinfra.in/construction-machinery-industry-in-india-growth-2026.html>

- Indian Precision Forged Machined Components Market for Mining and Construction Equipment was valued at **INR 3,832 Crores in FY 2025** and is projected to mark **INR 7,545 Crores by 2032** with a **CAGR of 9.2% from FY 2026 to 2032** driven by rapid industrialization, urbanization and increased import-export activities.

### Drivers Supporting the growth of Mining and Construction Equipment Sector in India

#### Policy Support

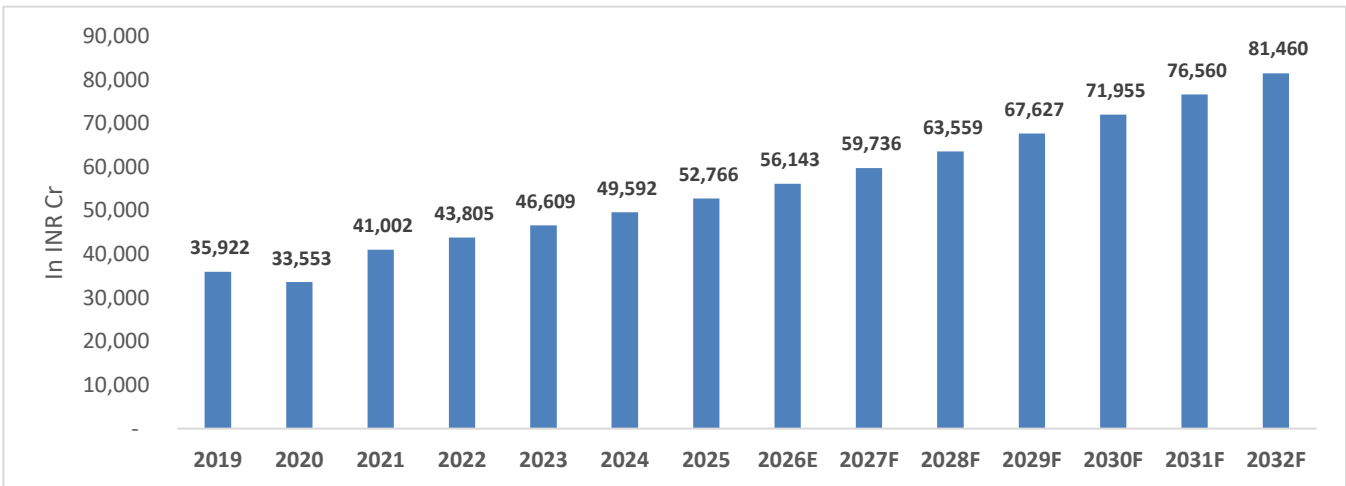
- The MMDR Amendment Act, 2025 has completely removed the previous 50% cap on mineral sales from captive mines**, allowing operators to sell 100% of their production in the open market. Additionally, it introduced operational flexibility by permitting a one-time area extension of up to 10% for mining leases and 30% for composite licenses, aggressively promoting private sector expansion.<sup>105</sup>
- In January 2025, the Government launched the National Critical Mineral Mission (NCMM) with a massive initial outlay of INR 16,300 crore** (projected to reach INR 34,300 crore with PSU investments). By mid-2026, the Ministry of Mines had **successfully auctioned over 56 critical and strategic mineral blocks across seven tranches**. This rapid operationalization of new mineral blocks will exponentially boost the demand for Heavy Earthmoving Machines (HEMMs), directly driving the growth of the precision forging components market.<sup>105</sup>

#### Lifecycle of Parts

- Earthmoving Equipment deployed in these new large-scale critical mineral and deep-seated mining projects consists of wearable parts subjected to extreme environmental stress.
- These parts have a standard life cycle and require mandatory replacement at regular intervals or in the event of component failure. **The aggressive expansion of operational mining hours nationwide will generate a high-volume, sustained replacement demand for forged components in this specific segment.**

### India Earthmoving Equipment Market

**Exhibit 179: India Earthmoving Equipment Market Trend, INR Cr FY 2019-2032F**



Source: Frost & Sullivan Analysis

- India Earthmoving Equipment Market was valued at **INR 52,766 Crores in FY 2025** and is projected to grow at a CAGR of **6.4% from FY 2026 to 2032** driven by increasing infrastructure activities countries and rise in commercial and industrial construction activities.

<sup>105</sup> <https://www.impriindia.com/insights/policy-update/measuring-indias-critical-mineral-supply-chain-progress-2024-2026/>

## Government Initiatives on Critical Minerals: 2025-26 Budget

- In January 2025, the Union Cabinet officially approved the National Critical Mineral Mission (NCMM) with a total outlay of INR 34,300 crore over seven years to secure a robust domestic supply chain, encompassing exploration, processing, and recycling.<sup>106</sup>
- In a major move to boost domestic recycling and secondary production, the Union Budget 2024-25 fully exempted 25 critical minerals (including lithium, cobalt, nickel, and copper) from basic customs duties.<sup>107</sup>
- Further strengthening supply chains, the Cabinet approved a INR 1,500 crore Incentive Scheme in September 2025 specifically for critical mineral recycling, targeting e-waste and spent lithium-ion batteries.<sup>108</sup>
- These initiatives were built upon the Mines and Minerals (Development and Regulation) Amendment Act, 2021, notified on 28.03.2021, for giving boost to mineral production, improving ease of doing business in the country and increasing contribution of mineral production to GDP.

The government is focusing on introducing a Production-linked Incentive (PLI) Scheme for Earth Moving Machinery (HEMM) and Underground mining equipment.

- With a strong commitment to reducing India's dependence on imports and promoting domestic production, Ministry of Coal is taking consistent steps to foster indigenous manufacturing capabilities within the coal mining sector. These efforts are closely aligned with the core principles of Atmanirbhar Bharat, driving the "Make in India" campaign.
- In pursuit of this goal, an interdisciplinary high-level committee under the chairmanship of Director (Technical), CIL was constituted to provide recommendations for bolstering domestic manufacturing of Heavy Earth Moving Machinery (HEMM) and underground mining equipment, including High Wall Miners, Standard and Low-Capacity Miners, and associated ancillary equipment. It is projected that coal will remain as the **predominant energy source even beyond 2030**, thus, the Committee expected a huge requirement of equipment in the next 10 years in the country, both for Opencast mines and Underground mines.
- Coal India Limited (CIL) imports high-capacity equipment, such as **Electric Rope Shovels, Hydraulic Shovels, Dumpers, Crawler Dozers, Drills, Motor Graders, and Front-End Loaders Wheel Dozer**, valued at INR 3,500 Crores, incurring additional expenses of INR 1,000 Crores in customs duty.
- To curb these imports and boost domestic manufacturing, **CIL has devised a strategic plan to phase out imports gradually over the next six years**. This approach aims to encourage and develop domestically manufactured equipment. Notably, high-capacity machines are already being procured from domestic manufacturers.
- This push is heavily backed by the **INR 11 lakh crore capital expenditure allocation for infrastructure in Budget 2025, which will directly drive massive domestic demand for commercial vehicles, construction machinery, and Heavy Earthmoving Machinery (HEMM)**.<sup>109</sup>
- The government has also readied a massive **INR 13,000-crore Production-Linked Incentive (PLI) Scheme** dedicated strictly to Heavy Construction and Mining Equipment. This scheme mandates a **50% Domestic Value Addition (DVA)**, ensuring core components like engines and control systems are manufactured locally, directly driving the "Make in India" mandate.<sup>110</sup>

<sup>106</sup> <https://www.drishtiias.com/daily-updates/daily-news-analysis/national-critical-mineral-mission>

<sup>107</sup> <https://www.jindalstainless.com/blog/india-announces-customs-duty-exemption-on-25-critical-minerals>

<sup>108</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2182108&utm&reg=48&lang=2>

<sup>109</sup> <https://www.motorindiaonline.in/budget-2025-a-growth-oriented-push-for-economic-and-industrial-transformation/>

<sup>110</sup> <https://desimachines.com/blog/construction-equipment-pli-scheme-india/>

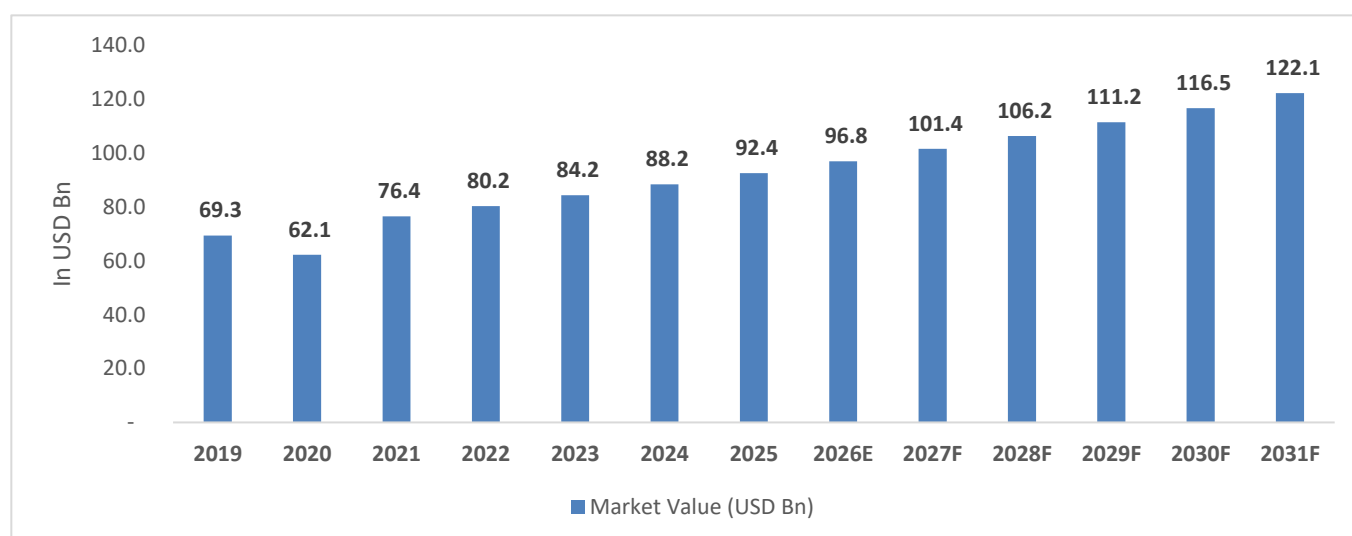
## 3.6 Railway

### 3.6.1 Global Railways Overview:

- Advancements in storage facilities and power sources, as well as improvements in transportation timings are likely to create new growth prospects for the railways which eventually will boost the metal forging requirements in Railways.
- Rail traffic can be broken down into passenger rail travel and cargo rail transport. Around the world railway activities and infrastructure are a range of public and private operations as well as mixed systems, depending on location and the aspect of the rail sector.
- One of the boldest projects currently underway is being undertaken by China, which has become one of the largest investors in rail in recent years, both at home and abroad. The country intends to invest in almost **70 countries through its Belt and Road Initiative**, which includes large-scale investment in rail.
- In 2022, China had nearly a million freight trains in operation, while the number of train passengers reached 2.2 billion people. **The largest passenger rail provider, however, can be found in India. Indian Railways holds an 11% market share globally, achieving a record passenger traffic of 7.41 billion (741 crore) in 2025–26.**<sup>111</sup>
- While the crises of recent years have affected the global rail industry severely through plummeting passenger numbers, supply chain disruptions, and rising energy prices, the rail sector is back on a path towards growth.
- Global freight transport by rail is expected to grow in the coming years, as are global rail passenger numbers. This is supported by investment in expanding rail infrastructure in many countries around the world, notably in China and in the United States.
- **Forged Products such as Gears, Pinions, Couplings, shafts and cylinder heads, Gear Blanks, Pinions and Shafts, Rings, Profile Rings, Bearing Cap, Bevel Pinions and Yoke Forgings will experience a boost with the growth of the Railways.**

### Global Rail Components Market: Railways CY 2019-2031

Exhibit 180: Global Rail Components Market Trend, Railways, USD Bn, CY 2019-31



Source: Frost & Sullivan Analysis

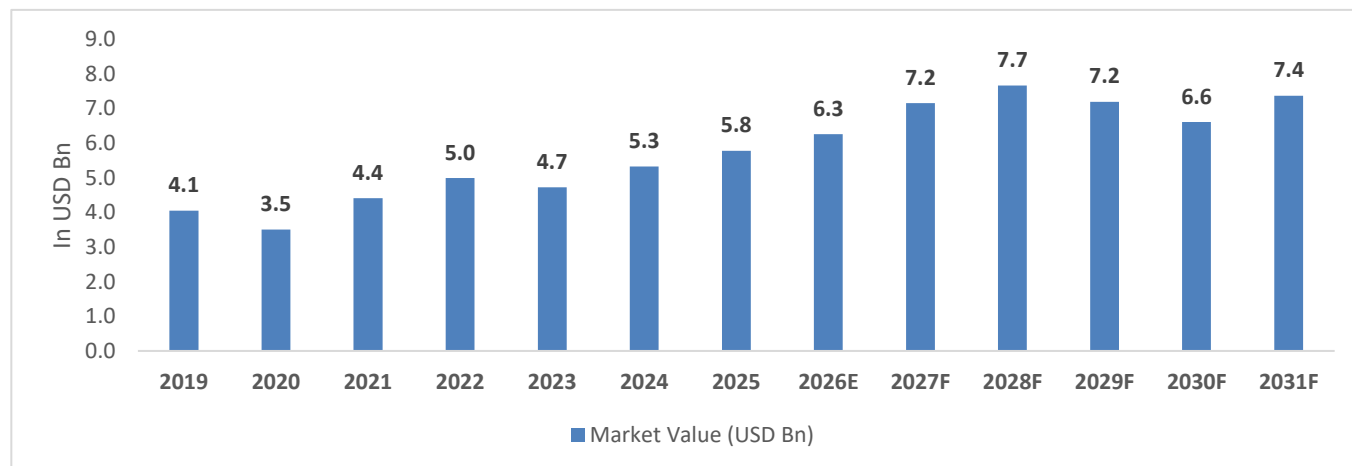
E-Estimated, F-Forecasted

<sup>111</sup><https://www.travelmedia.in/2026/04/02/Railways-New-Record-in-Passenger-Traffic-in-2025%E2%80%93741-Crore-Passengers.html>

- Global Rail Components Market was valued at **USD 92.4 Bn in 2025** and is projected to mark **USD 122.1 Bn by 2031** with a **CAGR of 4.75 %** from **2025 to 2031** driven by increasing population, rising investment in infrastructure and increased use of trains as mode of transport especially in the region of Asia Pacific region.

#### Global Overall Forgings Market: Railways CY 2019-2031

**Exhibit 181: Global Overall Forgings Market Trend, Railways, USD Bn, CY 2019-31**



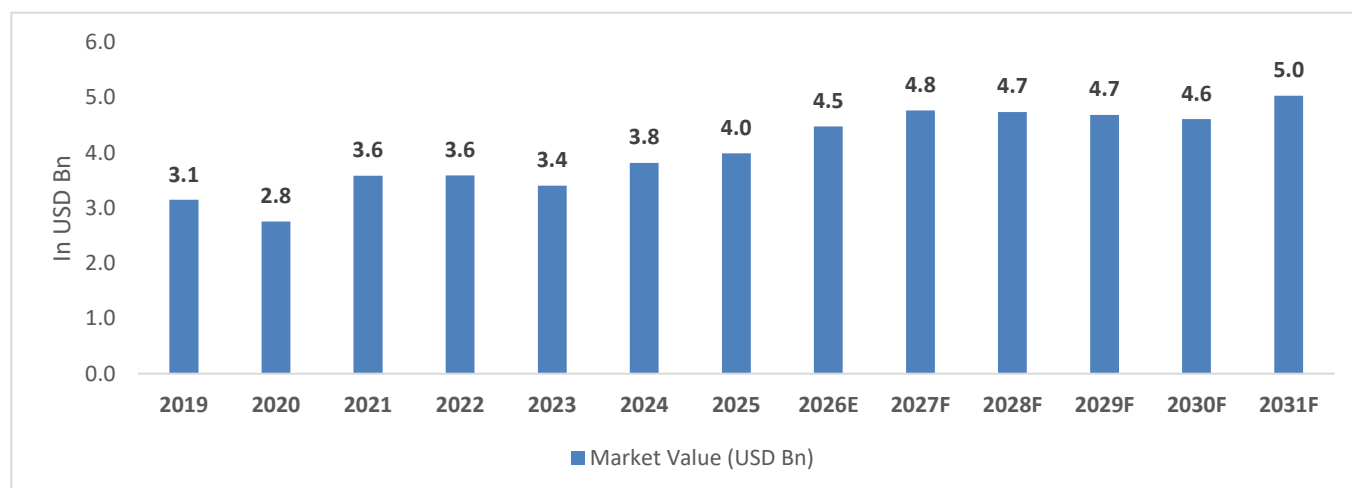
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Overall forgings market for Railways was valued at **USD 5.8 Bn in 2025** and is projected to mark **USD 7.4 Bn by 2031** with a **CAGR of 4.1 %** from **2025 to 2031**.

#### Global Precision Forged Machined Components Market: Railways CY 2019-2031

**Exhibit 182: Global Precision Forged Machined Components Market Trend, Railways, USD Bn, CY 2019-31**

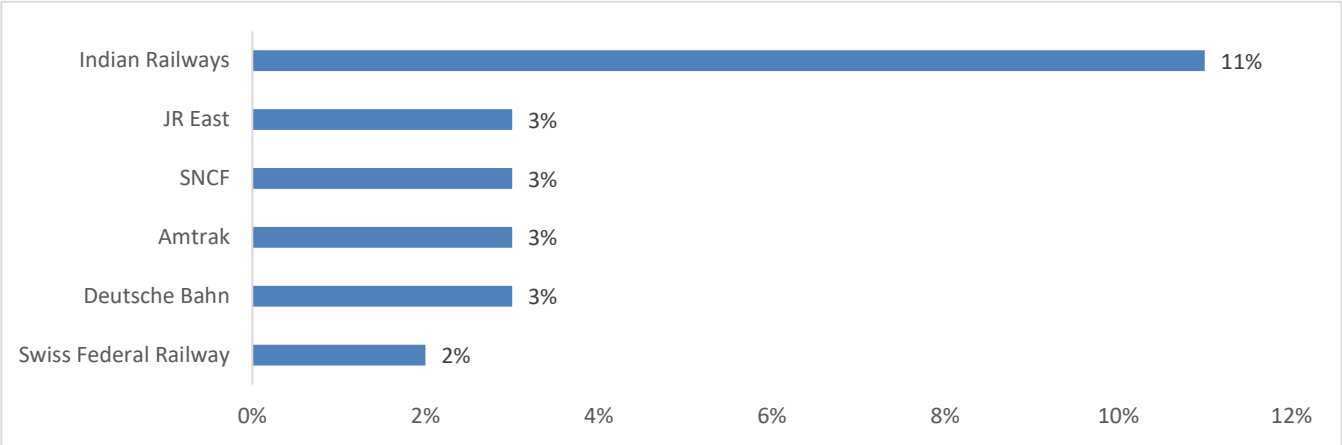


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Railways was valued at **USD 4.0 Bn in 2025** and is projected to mark **USD 5.0 Bn by 2031** with a **CAGR of 3.9 %** from **2025 to 2031**.

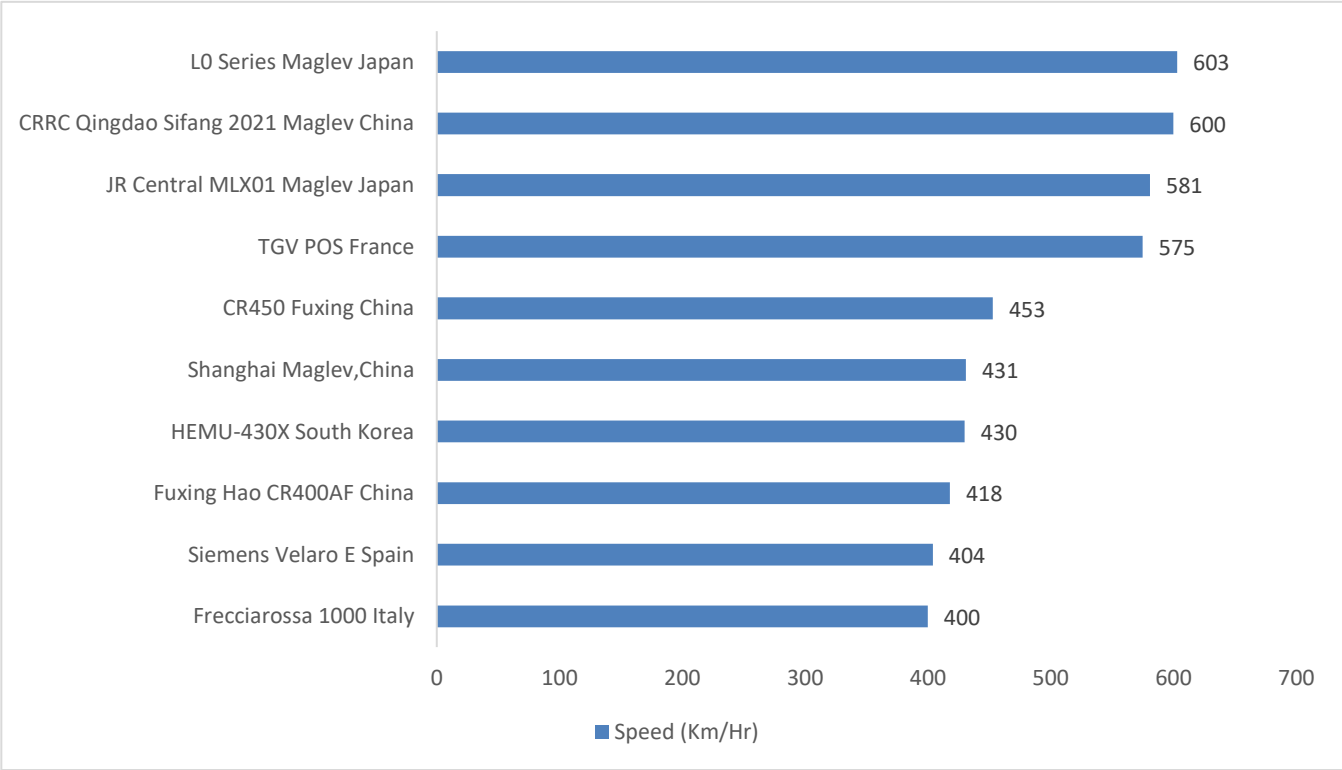
Exhibit 183: Market shares of leading passenger rail providers worldwide 2025



Source: Statista

- Indian Railways is the leading Passenger rail provider with **11% global share**, followed by JR East, SNCF, **Amtrak, Deutsche Bahn each 3% and Swiss Federal Railway 2%**
- The largest companies in the rail sector are rail freight operators, which often also own and run the railway infrastructure on which they transport goods. This is the case for the leading rail company worldwide, the U.S.-based freight operator Union Pacific, which owns large swathes of the U.S. rail network.
- Its closest competitor is the Canadian National Railway. Among passenger rail operators, Indian Railways hold the largest market share globally.

Exhibit 184: World’s fastest trains (Till 25-26), ranked by speed (Km/hr)



Source: Statista | 2026 Global Rail Updates

- As of 2026, the fastest train on Earth, based on its absolute record speed, remains the **Japanese L0 Series Maglev** with a staggering record speed of **603 kilometers per hour**.<sup>112</sup>

<sup>112</sup> <https://www.infoplease.com/top-10s/top-10-fastest-trains-in-the-world>

- The L0 Series is followed closely by the **CRRC Qingdao Sifang 2021 Maglev of China**, with a record speed of **600 kilometers per hour**, although both ultra-high-speed maglevs are still in the advanced testing and development phase and not yet in full commercial operation.
- While legacy data cited the Japanese MLX01 (which was a test vehicle), the absolute fastest train currently in **active commercial operation is the Shanghai Maglev in China**, which routinely transports passengers at a top speed of **431 kilometers per hour**.<sup>112</sup>
- In the conventional wheel-on-rail category, **China's next-generation CR450 (Fuxing series) recently achieved 453 km/h during 2025–2026 pre-service trials**, preparing for a commercial rollout at 400 km/h to become the fastest non-maglev train in regular service globally.<sup>112</sup>

#### Japan is a highspeed Pioneer since the 1960s

- Originally built to connect distant regions with Tokyo, the Shinkansen (colloquially called “the Bullet Train” in English) is a highspeed railway network in Japan.
- The first Shinkansen line was inaugurated in 1964 and was considered the first modern highspeed rail in the world, with the 0 Series Shinkansen train reaching a top speed of 210 kilometers per hour. Today, the Shinkansen network has an operating length of approximately 3,000 kilometers, covering most of the Japanese territory.
- From 2015 to 2019, ridership of Japanese highspeed trains remained relatively consistent, but dropped significantly from 370 million to 156 million passengers in 2020 because of the COVID-19 pandemic. However, recent data indicates that by 2024–2025, passenger traffic has strongly recovered, returning to pre-pandemic levels with steady year-over-year ridership growth.<sup>113</sup>

#### China takes the lead

- The history of highspeed rail in China is relatively recent compared to other highspeed leaders worldwide. The first highspeed dedicated rail line in China started operations in 2008, connecting the cities of Beijing and Tianjin.
- Despite being considered a newcomer to the industry, China has grown exponentially in the last two decades and has managed to take the lead among countries with highspeed trains. **As of late 2025, China's high-speed rail network surpassed a massive milestone of 50,000 kilometers in total operational length, which accounts for roughly two-thirds of the world's commercial high-speed tracks.**<sup>114</sup>

#### Rail Freight

- Despite setbacks related to the pandemic, the transport of cargo by rail remains a sizeable industry. In 2020, global rail freight boasted a market size of just under **USD 247.4 billion** which is projected to steadily increase to around **USD 278.6 billion by 2026**.
- Railway businesses consistently rank amongst the leading freight transportation companies, with the China State Railway Corporation recorded as the third major freight company worldwide as of 2020. Russian Railways and North American Class I railways also made the ranking.
- Rail freight transport is a dominant issue worldwide. Throughout North and South America, 2.5 trillion tonne-kilometers of freight cargo were hauled by rail as of 2019.
- The year 2021 recorded the unveiling of the world's first all battery-electric freight locomotive, introduced by Wabtec in September of that year. **This green infrastructure transition is now actively scaling up; by**

<sup>113</sup> UIC Statistics Platform / CNA (2025/2026 Updates)

<sup>114</sup> <https://www.globaltimes.cn/page/202609/1370708.shtml>

late 2025, operators like BHP took delivery of the first fleet of purpose-built Wabtec FLXdrive battery-electric locomotives for commercial heavy-haul mining operations.<sup>115</sup> Rail freight is also one of the modes of freight transport with the lowest greenhouse gas emissions.

- In Europe, in 2018, this amounted to 24 grams of carbon dioxide per tonne-kilometer. Comparatively, heavy goods vehicles reported emissions fivefold greater than rail freight.
- Growing Demand for Railway Passenger Transport drives the expansion of the Rail Transport Market. Advanced driver assistance system (ADAS) technology is becoming popular in the rail transportation industry to optimize energy usage, enhance operational management, and safety aid in cost reduction.

**Exhibit 185: List of top 10 Countries with Railway Network Lengths**

| Sl. No. | Country   | Total Length (Kms) | % of Total Electrified |
|---------|-----------|--------------------|------------------------|
| 1.      | USA       | 220,044            | 0.84%                  |
| 2.      | China     | 165,000            | 75.2%                  |
| 3.      | Russia    | 105,000            | 53.48%                 |
| 4.      | India     | 69,873             | 99.6%                  |
| 5.      | Canada    | 49,422             | 0.2%                   |
| 6.      | Argentina | 36,966             | 0.51%                  |
| 7.      | Germany   | 33,351             | 62.52%                 |
| 8.      | Australia | 33,168             | 10.23%                 |
| 9.      | Brazil    | 29,817             | 30.27%                 |
| 10.     | France    | 27,483             | 58.46%                 |

Source: Frost & Sullivan Research | Published Data | PIB (2026 Updates)

- USA is the leading country in railway network globally with 220,044 Kms, followed by **China whose network reached a record 165,000 Kms by the end of 2025<sup>116</sup>**, and Russia with 105,000 Kms.
- India is positioned at fourth place in terms of Railway network, **expanding to 69,873 Kms as of March 2026. Notably, India has achieved an exceptional 99.6% electrification of its Broad-Gauge network in a mission-mode transformation.**<sup>117</sup>
- The continued expansion and modernization of the Railway network will drive the requirements for more locomotives and rail coaches, which in turn will strongly boost the growth of forged products such as Connecting rods, draw bars, Gears, Braking Systems, Structural components, and Couplings.

<sup>115</sup> Mining Weekly (2025/2026 updates)

<sup>116</sup> <https://www.globaltimes.cn/page/202601/1352251.shtml?>

<sup>117</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2254620&utm&reg=48&lang=2>

### 3.6.2 Indian Railways Overview:

- Indian railways span thousands of kilometers practically covering the entire nation, making it the fourth largest in the world after the US, China, and Russia. The Railways Board, which has a monopoly over the provision of rail services in India, oversees overseeing the whole infrastructure. Due to its low cost and effective operations, railways continue to be the most popular means of transportation for most Indians when travelling long distances.
- Forged Products such as **Gears, Draw Bars, Pinions, Connecting Rod, Couplings, shafts and cylinder heads, Gear Blanks, Pinions and Shafts, Rings, Profile Rings, Bearing Cap, Bevel Pinions and Yoke Forgings** will experience a boost with the growth of the Railways in India.
- Under the National Rail Plan (NRP) 2030, Indian Railways aims to increase its **freight modal share from the current 27% to 45% by 2030**. Following the mantra "**Hungry for Cargo**", the railways carried 1,591 million tonnes of freight in FY 2023–24. The continuous operationalization of Dedicated Freight Corridors (DFCs) is central to decongesting high-density routes and increasing average freight train speeds to 50 kmph.<sup>118</sup>
- Indian Railways marked **total revenue of INR 2.56 lakh Crores by the end of FY 24**. In 2022-23, Railways Indian railways earned 69% of its internal revenue from freight and 24% from passenger traffic. The remaining 7% was earned from other miscellaneous sources such as parcel service, coaching receipts, and sale of platform tickets.
- To support 100% electrification and modernization, Indian Railways is heavily investing in indigenous locomotive manufacturing and rolling stock upgrades. As of Dec 2025, **164 Vande Bharat services and 2 Namo Rapid Rail services are operational**<sup>119</sup>. Domestic production facilities are scaling up not just for internal demands, but also to tap into **global export opportunities (such as diesel-electric shipments to Africa)** for Indian-manufactured locomotives & rolling stock.<sup>120</sup>
- The expansion of indigenous manufacturing under the "Atmanirbhar Bharat" initiative mandates the **localization of components**. This push directly mitigates import dependence and generates massive domestic demand for critical forged components, bogies, wheel sets, and braking systems.
- Indian Railways is developing and creating technology in areas such as signaling and telecommunication with 15,000 km being converted into automatic signaling and 37,000 km to be fitted with 'KAVACH', the domestically developed Train Collision Avoidance System.
- **Kavach Version 4.0**, the highly technology-intensive, indigenously developed Train Collision Avoidance System (SIL-4 certified), was approved in July 2024. **As of March 2026, Kavach 4.0** has been **successfully commissioned on 1,452 Route Kilometers** across the high-density Delhi-Mumbai and Delhi-Howrah routes, with trackside implementation taken up on a massive 24,427 Route Kms.<sup>121</sup>

<sup>118</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1806617&utm&reg=48&lang=2>

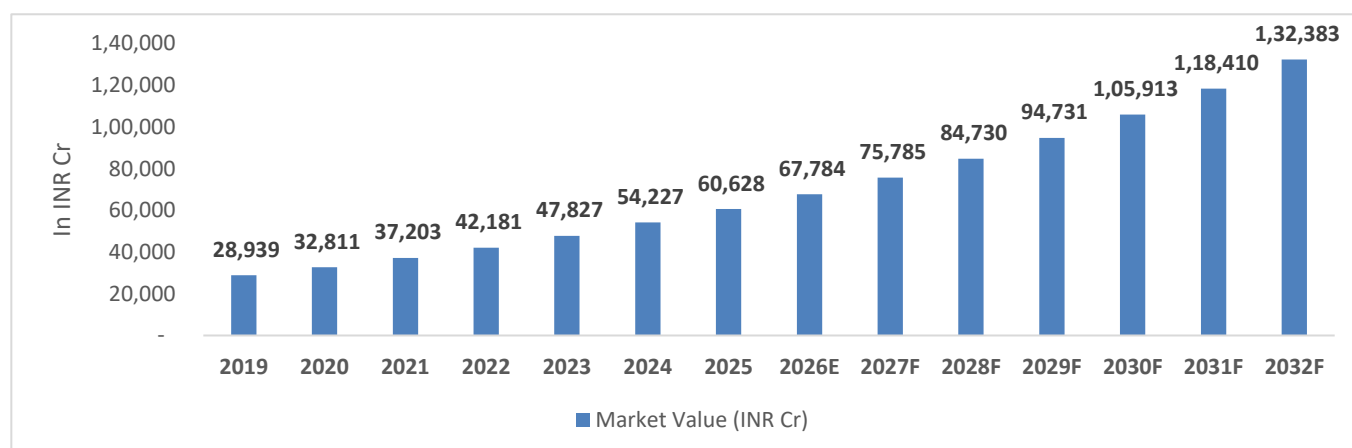
<sup>119</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2215265&reg=48&lang=2>

<sup>120</sup> [https://www.pib.gov.in/PressReleasePage.aspx?PRID=2204768&utm\\_i&reg=48&lang=2](https://www.pib.gov.in/PressReleasePage.aspx?PRID=2204768&utm_i&reg=48&lang=2)

<sup>121</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2238425&utm&reg=48&lang=2>

## India Rail Components Market: Railways, FY 2019-2032

Exhibit 186: India Rail Components Market Trend, Railways, INR Cr, FY 2019-32F



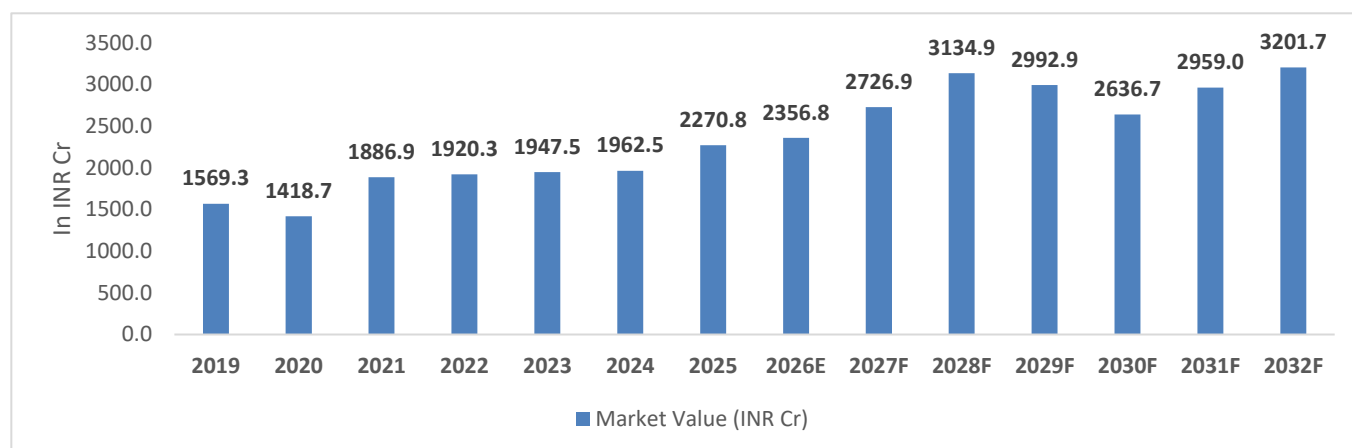
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Rail Components Market was valued at **INR 60,628 Crores in FY 2025** and is projected to mark **INR 1,32,383 Crores by 2032** with a **CAGR of 11.8 % from FY 2026 to 2032** driven by Infrastructure expansion of Railways as per **National Rail Plan 2030**.

## India Precision Forged Machined Components Market: Railways, FY 2019-2032

Exhibit 187: India Precision Forged Machined Components Market Trend, Railways, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision Forged Machined Components Market for Railways was valued at **INR 2,270.8 Crores in FY 2025** and is projected to mark **INR 3,201.7 Crores by 2032** with a **CAGR of 5.2 % from FY 2026 to 2032** driven by expansion of Railways as per **National Rail Plan 2030**.

## National Rail Plan 2030

### Integration with High-Speed Rail (HSR)

#### Exhibit 188: Phasing of HSR Corridors

| SI No. | HSR Corridor                    | Proposed Year of Implementation |
|--------|---------------------------------|---------------------------------|
| 1      | Mumbai Ahmedabad                | 2026                            |
| 2      | Delhi Varanasi Via Ajodhya      | 2031                            |
| 3      | Delhi Ahmedabad                 | 2031                            |
| 4      | Varanasi to Patna               | 2031                            |
| 5      | Patna to Kolkata                | 2031                            |
| 6      | Hyderabad Bangalore             | 2041                            |
| 7      | Nagpur Varanasi                 | 2041                            |
| 8      | Mumbai Nagpur                   | 2051                            |
| 9      | Mumbai Hyderabad                | 2051                            |
| 10     | Patna Guwahati                  | 2051                            |
| 11     | Delhi Chandigarh Amritsar       | 2051                            |
| 12     | Amritsar-Pathankot-Jammu        | 2051                            |
| 13     | Chennai to Mysuru via Bangalore | 2051                            |

Source: National Rail Plan 2030

- As per the HSR master plan, 13 (no.) corridors have been identified for the implementation as a part of the National Rail Plan. The corridors along with their phasing are given in the table above. These expansions will generate opportunities for a greater number of trains and eventually growth opportunities for forging manufacturers.
- Accelerated by the massive railway **Capex** allocations, the Union Budget 2026–27 officially confirmed the active rollout of 7 new high-speed rail corridors out of this master plan, committing approximately INR 16 lakh crore toward a ~4,000 km network.<sup>122</sup>

## Investment in Railways in India

#### Exhibit 189: Summary of Investments Required in Coaches

| Type of Coach  | 2022         | 2023         | 2024         | 2025         | 2026         | 2027         | 2028         | 2029         | 2030         | 2031         | 2041          | 2051          | Total           |
|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|-----------------|
| No. of Coaches |              |              |              |              |              |              |              |              |              |              |               |               |                 |
| Non-AC         | 8398         | 8398         | 8398         | 8398         | 8398         | 3716         | 3716         | 3716         | 3716         | 3716         | 26790         | 34464         | 121824          |
| AC             | 1446         | 1446         | 1446         | 1446         | 1446         | 863          | 863          | 863          | 863          | 863          | 7521          | 11618         | 30684           |
| MEMU/<br>DEMU  | 126          | 126          | 126          | 126          | 126          | 67           | 67           | 67           | 67           | 67           | 443           | 471           | 1878            |
| Train<br>Sets  | 20           | 20           | 20           | 20           | 20           | 9            | 9            | 9            | 9            | 9            | 70            | 92            | 306             |
| <b>Total</b>   | <b>9,990</b> | <b>9,990</b> | <b>9,990</b> | <b>9,990</b> | <b>9,990</b> | <b>4,655</b> | <b>4,655</b> | <b>4,655</b> | <b>4,655</b> | <b>4,655</b> | <b>34,824</b> | <b>46,645</b> | <b>1,54,692</b> |

<sup>122</sup><https://blog.nobrokerage.com/development/indias-7-new-high-speed-rail-corridors-routes-timelines-and-what-they-mean-for-cities>

| Investment Required (INR Crores) |               |               |               |               |               |               |               |               |               |               |               |                 |                 |
|----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-----------------|-----------------|
| Non-AC                           | 15116         | 15116         | 15116         | 15116         | 15116         | 6688          | 6688          | 6688          | 6688          | 6688          | 48222         | 62035           | 219277          |
| AC                               | 3109          | 3109          | 3109          | 3109          | 3109          | 1856          | 1856          | 1856          | 1856          | 1856          | 16170         | 24979           | 65974           |
| MEMU/<br>DEMU                    | 1010          | 1010          | 1010          | 1010          | 1010          | 533           | 533           | 533           | 533           | 533           | 3544          | 3768            | 15027           |
| Train<br>Sets                    | 5000          | 5000          | 5000          | 5000          | 5000          | 2200          | 2200          | 2200          | 2200          | 2200          | 17500         | 23000           | 76500           |
| <b>Total</b>                     | <b>24,235</b> | <b>24,235</b> | <b>24,235</b> | <b>24,235</b> | <b>24,235</b> | <b>11,277</b> | <b>11,277</b> | <b>11,277</b> | <b>11,277</b> | <b>11,277</b> | <b>85,436</b> | <b>1,13,782</b> | <b>3,76,778</b> |

Source: National Rail Plan 2030

- **INR 1,77,560 crores** of investments could be required for the acquisition of coaches over the next **10 years till 2031**. About **61%** of this is estimated to be required for the purchase of non-AC coaches. About **20%** is expected for the purchase of train sets, and the balance for AC/MEMU/DEMU coaches.
- Beyond 2031, it is expected that another **INR 1,99,218 crore** of investments may be needed for acquisition of coaches up to **2051**. While these requirements would be subject to change based on various developments, about half of this amount is expected to be needed for the purchase of non-AC coaches, and the balance for mainly AC coaches and train sets.

#### Exhibit 190: Summary of Investments in Locomotives

| Particulars                      | 2022   | 2023   | 2024   | 2025   | 2026   | 2027   | 2028   | 2029   | 2030   | 2031   | 2041     | 2051     | Total    |
|----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|
| No. of Locomotives               | 2,205  | 2,205  | 2,205  | 2,205  | 2,205  | 929    | 929    | 929    | 929    | 929    | 13,510   | 16,837   | 46,017   |
| Investments Required (INR Crore) | 30,867 | 30,867 | 30,867 | 30,867 | 30,867 | 13,009 | 13,009 | 13,009 | 13,009 | 13,009 | 1,89,140 | 2,35,718 | 6,44,238 |

Source: National Rail Plan 2030

- **INR 2,19,380 crores of investments** could be required for the acquisition of locomotives over the next 10 years till 2031.
- Beyond 2031, it is expected that another **INR 4,24,858 crore of investments** may be needed for acquisition of **locomotives up to 2051**. These requirements would however be subject to change based on various market and system developments such as demand variations, increased capacity, better speeds, heavier and longer trains.

#### Key Developments in Indian Railways

- **As on 01<sup>st</sup> April 2026**, across Indian Railways, **514 Railway infrastructure projects (169 New Line, 29 Gauge Conversion and 316 Doubling)** of total length **40,000 Km**, costing approx. **Rs. 8.31 lakh crore**.<sup>123</sup>
- **As of December 2025**, **164 Vande Bharat train** services are operational across the Indian Railways network, linking states with a broad-gauge electrified network. Furthermore, **the first commercial Vande Bharat Sleeper train was officially launched in January 2026 to cater to long-distance overnight travel**.<sup>124</sup>
- **Cost-Effective Mass Mobility: To ensure inclusive and affordable long-distance travel, Indian Railways has operationalized 30 Amrit Bharat Express trains since December 2023**, with 9 additional services launching soon.<sup>125</sup>
- Indian Railways is also working on upgrading its infrastructure, with a focus on electrification of lines, the construction of new lines, and the redevelopment of existing stations. The government has also announced

<sup>123</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2287689&reg=48&lang=2>

<sup>124</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2215265&reg=48&lang=2>

<sup>125</sup> <https://www.pib.gov.in/PressNoteDetails.aspx?NotelD=156972&ModuleId=3&reg=3&lang=2>

plans to invest in high-speed trains, such as the Mumbai-Ahmedabad High-Speed Rail project, which is being implemented with the assistance of Japan.

- As of November 2025, Indian Railways had expanded its installed solar power capacity to ~898 MW, as part of its broader push toward cleaner and more sustainable railway operations. With ~99.2% of its broad-gauge network electrified by November 2025, Indian Railways continues to integrate renewable energy into its power mix, creating substantial opportunities for solar power development and associated infrastructure.

### Government Initiatives

- As of September 2026, the entire **2,843 kilometers** of the Dedicated Freight Corridor (DFC) network comprising 1,337 km on the Eastern DFC and 1,506 km on the Western DFC has been **100% commissioned and operationalized**, handling over 400 freight trains daily.<sup>126</sup>
- Government announced about the MoU signed with USAID India in June 2023 to achieve Net Zero Carbon Emission by 2030.
- The Ministry of Railways plans to monetize assets including Eastern and Western Dedicated Freight Corridors after commissioning, **induction of 150 modern rakes through PPP**, station redevelopment through PPP, railway land parcels, multifunctional complexes (MFC), railway colonies, hill railways and stadiums.

**Railway network expansion and inclusion of new coaches and locomotives will drive the forging components market in India.**

### Overview of New Government Schemes in Railways Sector

#### PM Gati Shakti

- PM Gati Shakti - National Master Plan for Multi-modal Connectivity, essentially a digital platform to bring 16 Ministries including Railways and Roadways together for integrated planning and coordinated implementation of infrastructure connectivity projects.
- The multi-modal connectivity will provide integrated and seamless connectivity for movement of people, goods and services from one mode of transport to another.
- The estimated outlay under the program is **INR 100 trillion** and it aims to reduce logistics cost and enhance export competitiveness of the country.
- Indian Railways have set up a separate directorate within the Railway Board to prioritize projects under the PM Gati Shakti scheme for handling rail cargos, a new 'Gati Shakti Multi-modal Cargo Terminal (GCT)' policy has been framed.
- It has been initially targeted 100 Gati Shakti Cargo Terminals (GCT), **By August 2026, this target was surpassed with 149 GCTs fully commissioned to improve last-mile freight connectivity.**<sup>127</sup>

<sup>126</sup> <https://www.indiaunfolding.com/en/connectivity/dedicated-freight-corridors>

<sup>127</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2309663&reg=3&lang=1>

## Exhibit 191: New Projects Sanctioned Under PM Gati Shakti

| Sl No. | Name of the section for doubling                                  | Length in Kms | Estimated Cost (INR Cr) | State                      |
|--------|-------------------------------------------------------------------|---------------|-------------------------|----------------------------|
| 1.     | Ajmer-Chanderiya                                                  | 178.28        | 1813.28                 | Rajasthan                  |
| 2.     | Jaipur-Sawai Madhopur                                             | 131.27        | 1268.57                 | Rajasthan                  |
| 3.     | Luni-Samdari-Bhildi                                               | 271.97        | 3530.92                 | Gujarat & Rajasthan        |
| 4.     | Agthori-Kamakhya with new Rail cum Road Bridge                    | 7.062         | 1650.37                 | Assam                      |
| 5.     | Lumding-Furkating                                                 | 140           | 2333.84                 | Assam & Nagaland           |
| 6.     | Motumari-Vishnupuram and Rail over Rail at Motumari               | 99.68         | 1746.2                  | Telangana & Andhra Pradesh |
| 7.     | Secunderabad (Sanathnagar) – Wadi 3rd and 4th Line <sup>128</sup> | 173           | 5012                    | Karnataka & Telangana      |
| 8.     | Bhagalpur – Jamalpur 3rd line <sup>128</sup>                      | 53            | 1156                    | Bihar                      |
| 9.     | Furkating – New Tinsukia Doubling <sup>128</sup>                  | 194           | 3634                    | Assam                      |
| 10.    | Sainthia – Pakur 4th Line <sup>129</sup>                          | 81            | 1569                    | West Bengal & Jharkhand    |
| 11.    | Santragachi – Kharagpur 4th Line <sup>129</sup>                   | 111           | 2905                    | West Bengal                |

Source: PIB

### Dedicated Freight Corridor (DFC)

- The Dedicated Freight Corridor Corporation of India (DFCCIL) spearheads the DFC project, constructing dedicated freight railways across India.
- As of September 2026, the entire **2,843 kilometers** of the Dedicated Freight Corridor (DFC) network comprising 1,337 km on the Eastern DFC and 1,506 km on the Western DFC has been **100% commissioned and operationalized**, handling over 400 freight trains daily.<sup>126</sup>
- The Objective of DFC is to reduce the logistic cost below 10% as per the National Logistic Policy.

### Amrit Bharat

- The Amrit Bharat Station Scheme was launched in March 2023 for development of railway stations to upgrade and modernize the Railway Stations.

<sup>128</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2161227&utm&reg=48&lang=2>

<sup>129</sup> <https://www.pib.gov.in/PressReleaseDetail.aspx?PRID=2237562&utm&reg=48&lang=2>

- Currently, **1,309 railway stations** have been identified for development. Budgetary funds and under Public Private Partnership Model are followed. Work on more than 500 stations is in progress.

#### **Energy, Mineral and Cement Corridor, Port connectivity corridors and High traffic density corridors**

- India is a strategic initiative aimed at developing a dedicated industrial corridor that leverages the country's vast reserves of energy, metals, and cement.
- 40,000 Km Rail tracks are expected to be laid under these corridors to enhance the network capacity by FY 2031.

#### **High Speed Rail Projects**

- To reduce the transit time, 12 high speed rail corridors with train speeds exceeding 250 km/hour have been proposed by the government, spanning approximately **7,200 Km**.
- The flagship 508 km Mumbai-Ahmedabad corridor is advancing rapidly with an expected capital expenditure of **INR 1.1 trillion**. The project has achieved major civil milestones in 2026, including the ongoing construction of **India's first 7 km undersea rail tunnel beneath Thane Creek, with the Surat-Bilimora section targeted for opening by August 2027**.<sup>130</sup>

#### **Semi High-Speed Rail Projects**

- The Government of India has taken various initiative under 'Make in India' campaign like **Semi- High-Speed train, Vande Bharat Express**.
- India has embarked on several semi-high-speed rail projects to enhance the speed, efficiency, and connectivity of its railway network. These projects aim to upgrade existing rail lines to support speeds of up to **160-200 km/h**, significantly reducing travel times between major cities and boosting economic growth.
- **As of 2026**, track upgrades under **Mission Raftaar** have enabled **over 81% of the Indian Railways network to support speeds of 110 kmph and above, directly supporting the 164 active Vande Bharat services**.<sup>131</sup>
- Beyond the 164 operational chair-car services, **2026 marks the commercial rollout of Vande Bharat Sleeper trains for overnight routes and Namoo Bharat (Vande Metro) for rapid inter-city transit**, diversifying the required component specs for manufacturers.<sup>132</sup>

<sup>130</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2286128&reg=48&lang=2>

<sup>131</sup> [https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=2294805&utm\\_i&reg=48&lang=2](https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=2294805&utm_i&reg=48&lang=2)

<sup>132</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2215265&reg=48&lang=2>

### 3.7 Other Segments:

#### 3.7.1 Other Segments, Global

- Forged components are crucial for construction and agricultural equipment, and their growth trajectory is bolstered by government initiatives including easy financing for tractors and other agricultural equipment.
- This sector includes any general engineering segment such as manufacturing sector, Construction, Agricultural equipment and Spaceframes is expected to have a growth due to growing population, industrialization, investments in infrastructure development by the Government and urbanization.
- The demand for new structural forms along with the growing innovation in building techniques has resulted in the increasing adoption of space frames in various commercial & industrial infrastructures. The penetration of new & improved industrial structures coupled with increasing demand for lightweight materials is anticipated to further amplify the space frame industry growth.
- Space frames are gaining wide popularity across the globe and have been widely seen in exhibition pavilions, sports arenas, transportation terminals, assembly halls, warehouses, airplane hangars, and workshops. These frames are not only used on roof tops but also find applications in exterior walls, floors, and canopies.
- Furthermore, these structures also aid in hosting various concerts, sports tournaments, and mass assemblies with the advantage of extension and contraction as per gathering strength, which are the major advantages of space frames on concrete roofing systems.
- **Marine & Shipping:** Operations are strategically expanding into the high-demand marine sector, heavily driven by the **IMO Net-Zero push. With over 50% of global new ship orders in 2024–2025 being for alternative fuel vessels, there is a massive new market requirement for entirely custom, heavy forgings for dual-fuel engines.** In addition to engine components, **forged parts such as propeller shafts, couplings, and connecting rods are strictly specified in these next-generation vessels** to provide the extreme fatigue resistance and sheer strength necessary for safe operations in harsh, deep-sea environments.<sup>133</sup>
- **High-Pressure Valves & Fittings: Global LNG Surge**<sup>134</sup>
  - The industry is actively targeting the precision valves market, driven directly by an unprecedented wave of global LNG infrastructure expansion. **According to the International Energy Agency (IEA), around 300 billion cubic meters (bcm) per year of new LNG export capacity is set to be added globally by 2030.**
  - This massive scaling of liquefaction capacity creates a surging, long-term demand for custom forged valves. The forging process eliminates microscopic porosity, delivering the superior, leak-proof sealing performance strictly required for these critical high-pressure and cryogenic LNG applications.
- **Space Exploration & Commercialization**<sup>135</sup>
  - To capture future growth, operations are expanding into the rapidly commercializing space sector, driven by a booming commercial launch market and the development of new orbital infrastructure.

<sup>133</sup> [https://unctad.org/system/files/official-document/rmt2025\\_en.pdf](https://unctad.org/system/files/official-document/rmt2025_en.pdf)

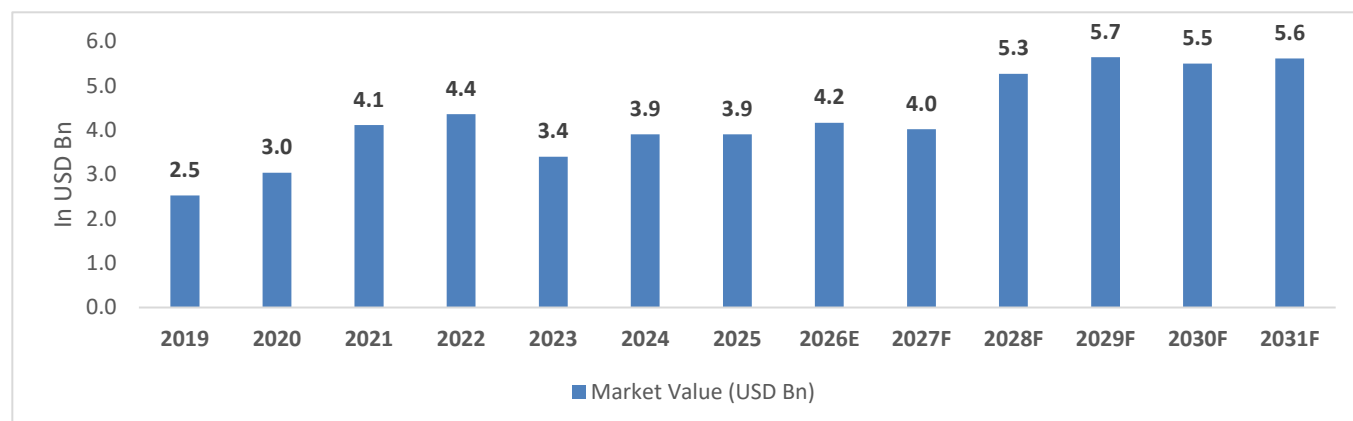
<sup>134</sup> <https://www.iea.org/reports/gas-2025/executive-summary>

<sup>135</sup> <https://www.spacefoundation.org/2025/07/22/the-space-report-2025-q2/>

- In this high-stakes environment, advanced forged components particularly utilizing titanium and high-grade aluminum alloys are mission-critical. Forgings deliver the unparalleled strength-to-weight ratios, absolute structural reliability, and extreme fatigue resistance required for reusable launch vehicles, satellite structural frames, and deep-space habitats operating in zero-gravity.

#### Global Overall Forgings Market: Other Sectors CY 2019-2031

**Exhibit 192 a: Global Overall Forgings Market Trend, Other Sectors USD Bn, CY 2019-31**



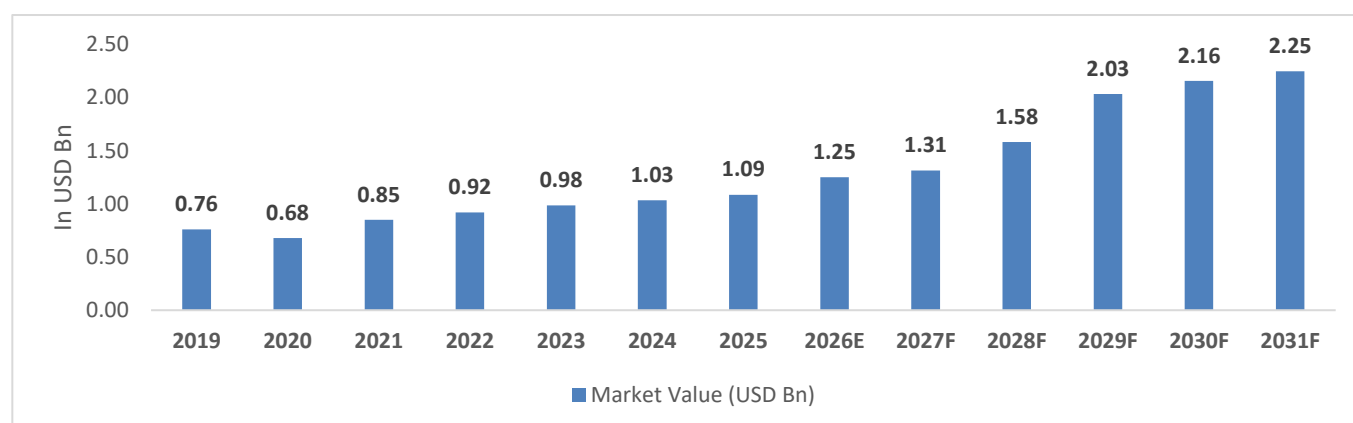
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

Other sector includes general engineering segment such as Marine and Shipping, Agricultural equipment and Spaceframes

- Global overall forgings market for other sectors was valued at **USD 3.9 Bn in 2025** and is projected to mark **USD 5.6 Bn by 2031** with a **CAGR of 6.2 % from 2025 to 2031** driven by demand for new structural forms along with the growing innovation in building techniques has resulted in the increasing adoption of space frames in various commercial & industrial infrastructures

**Exhibit 192 b: Global Overall Forgings Market Trend, Marine & Shipping USD Bn, CY 2019-31**



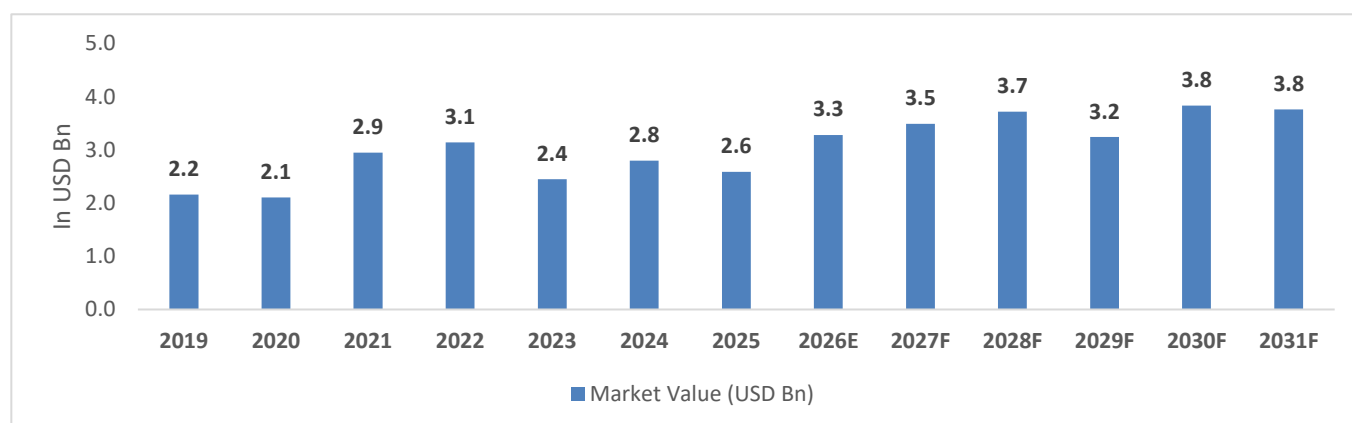
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global overall forging market for Marine and shipping was valued at **USD 1.09 Bn in 2025** and is projected to grow at a **CAGR of 12.9% from 2025 to 2031** and expected to mark **USD 2.25 Bn** driven primarily by the need for high-strength, fatigue-resistant and precisely machined components used in propulsion, powertrain, steering and critical vessel systems.

## Global Precision Forged Machined Components Market: Other Sectors CY 2019-2031

**Exhibit 193 a: Global Precision Forged Machined Components Market Trend, Other Sectors USD Bn, CY 2019-31**



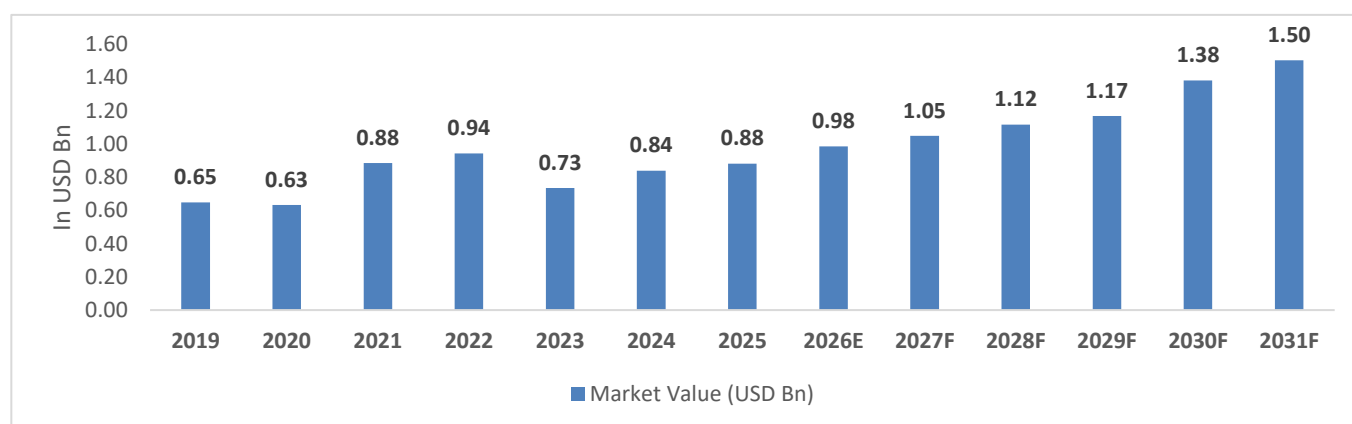
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

Other sector includes general engineering segment such as manufacturing sector, marine and shipping, Agricultural equipment and Spaceframes

- Global Precision Forged Machined Components Market for other sectors was valued at **USD 2.6 Bn in 2025** and is projected to mark **USD 3.8 Bn by 2031** with a **CAGR of 6.4 %** from **2025 to 2031** driven by demand for new structural forms along with the growing innovation in building techniques has resulted in the increasing adoption of space frames in various commercial & industrial infrastructures.

**Exhibit 193 b: Global Precision Forged Machined Components Market Trend, Marine & Shipping USD Bn, CY 2019-31**



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Global Precision Forged Machined Components Market for Marine and Shipping was valued at **USD 0.88 Bn in 2025** and is projected to mark **USD 1.5 Bn by 2031** with a **CAGR of 7.3 %** from **2025 to 2031** driven primarily by the need for high-strength, fatigue-resistant and precisely machined components used in propulsion, powertrain, steering and critical vessel systems.

### 3.7.2 Other Segments, India

- This sector includes any general engineering segment such as manufacturing sector, Construction, Agricultural equipment, Spaceframes which is a high-end segment and is expected to have a growth due to growing population, industrialization, investments in infrastructure development by the Government and urbanization.
- Forged components are crucial for construction and agricultural equipment, and their growth trajectory is bolstered by government initiatives including easy financing for tractors and other agricultural equipment. The confluence of favourable financing options, government incentives, and policy reforms is expected to drive sustained growth and adoption of tractors across different segments in India's agriculture and rural development sector.
- **Shipping & Marine Motion Control:** Under the **Maritime Amrit Kaal Vision 2047** and the **Sagarmala Programme**, India is actively modernizing its maritime infrastructure. **The Sagarmala initiative is expanding domestic commercial and naval shipbuilding, accelerating the demand for critical forged components like propeller shafts, rudder stocks, and heavy-duty couplings** that provide high fatigue resistance and extreme strength in maritime environments.<sup>136</sup>
- **Advanced Cryogenics & Green Hydrogen:** Driven by the **National Green Hydrogen Mission** and a growing focus on clean energy storage, India is rapidly developing its cryogenic equipment manufacturing base. **Specialized heavy forgings (such as ultra-low temperature valves, high-pressure pumps, and flanges)** are strictly required for liquid hydrogen and LNG handling, maintaining structural integrity and leak protection under extreme deep-freeze conditions.<sup>137</sup>
- **Space Exploration & Launch Infrastructure (IN-SPACe & Private Sector):** Driven by the Indian Space Policy 2023 and the establishment of IN-SPACe, India's private space economy is rapidly expanding. With the advent of private orbital launch vehicles (like Vikram-1) and an ecosystem of over 400 space startups in 2026, there will be a **surging requirement for advanced titanium and aerospace-grade aluminum forgings**. These high-strength components are essential for launching vehicle structures and liquid rocket engines, delivering absolute reliability in mission-critical, zero-gravity, and high-stress operations.<sup>138</sup>
- **Healthcare & Medical Equipment:** The Production Linked Incentive (PLI) scheme is rapidly scaling the domestic manufacturing of high-end medical devices, including MRI machines, surgical C-arms, and structural implants. **This aggressive localization directly accelerates the demand for precision-forged components and biocompatible alloys, which are strictly required to ensure the structural integrity, superior fatigue strength, and non-magnetic properties necessary to build these advanced diagnostic and surgical systems.**<sup>139</sup>
- **High-Pressure Valves & Fittings (CGD & Energy Pipelines):** The rapid nationwide expansion of **City Gas Distribution (CGD) networks, cross-country pipelines, and refinery infrastructure** is driving the need for **high-integrity forged valves and fittings**. The forging process aligns the metal's grain structure to eliminate microscopic porosity, ensuring the leak-proof sealing necessary for hydrocarbon processing and high-pressure networks.<sup>140</sup>

<sup>136</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2115878&utm&reg=48&lang=2>

<sup>137</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2039091&utm&reg=48&lang=2>

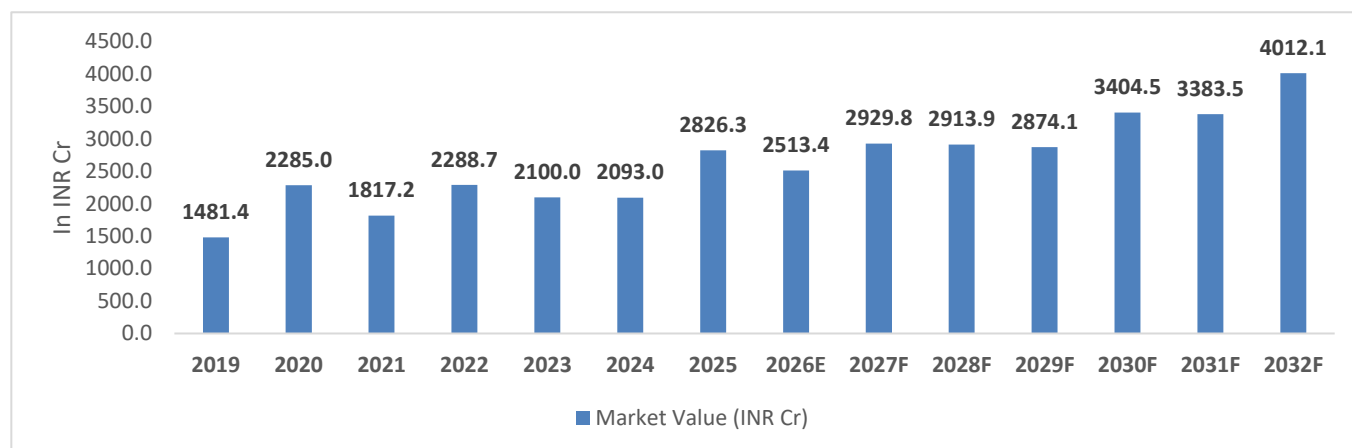
<sup>138</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2286011&reg=3&lang=1&utm>

<sup>139</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2227618&utm&reg=48&lang=2>

<sup>140</sup> <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2244760&utm&reg=48&lang=2>

## India Overall Forgings Market: Other Sectors, FY 2019-2032

**Exhibit 194 a: India Overall Forgings Market Trend, Other Sectors, INR Cr, FY 2019-32**

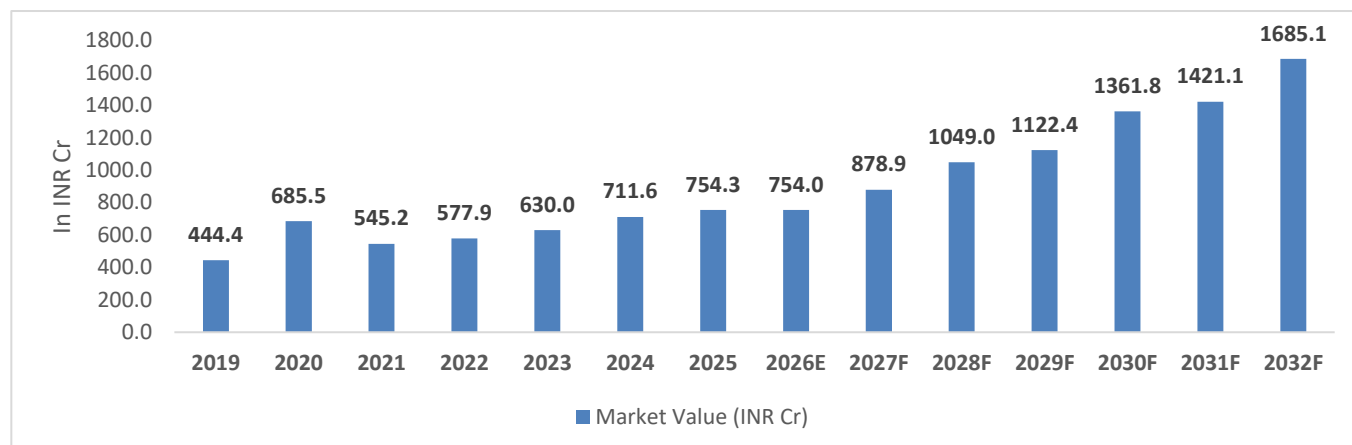


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Overall forgings market for Other Sectors was valued at **INR 2,826.3 Crores in FY 2025** and is projected to **mark INR 4,012.1 Crores by FY 2032** with a **CAGR of 8.1 % from FY 2026 to 2032** driven by growing population, industrialization, investments in infrastructure development by the Government and urbanization.

**Exhibit 194 b: India Overall Forgings Market Trend, Marine & Shipping INR Cr, FY 2019-32**



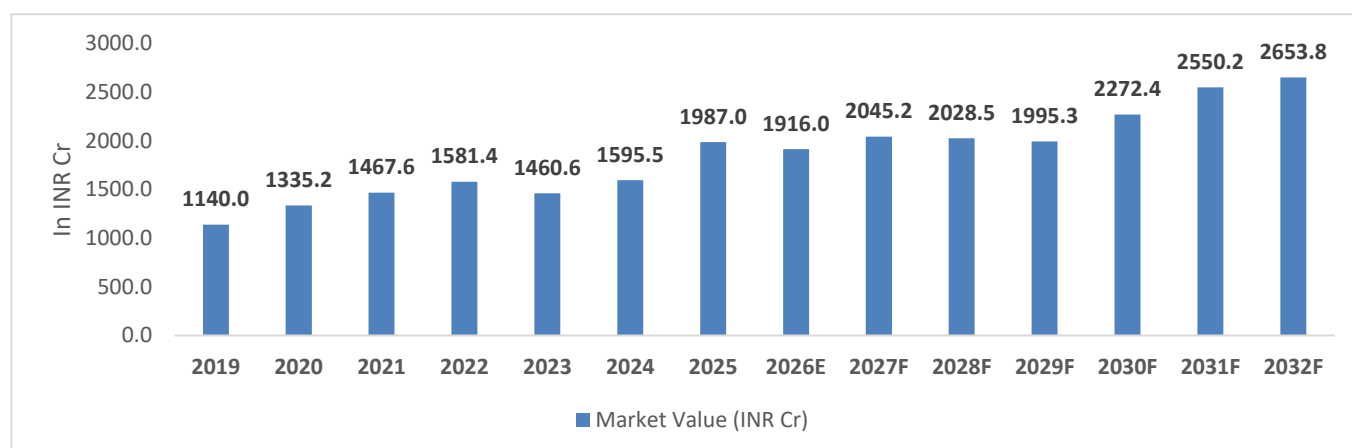
Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian overall forging market for Marine and shipping was valued at **INR 754 Crores in FY 2026** and is projected to grow at a **CAGR of 14.34% from FY 2026 to 2032** and **expected to mark INR 1,685.1 Crores by FY 2032** driven primarily by the need for high-strength, fatigue-resistant and precisely machined components used in propulsion, powertrain, steering and critical vessel systems.

## India Precision Forged Machined Components Market: Other Sectors, FY 2019-2032

### Exhibit 195 a: India Precision Forged Machined Components Market Trend, Other Sectors, INR Cr, FY 2019-32

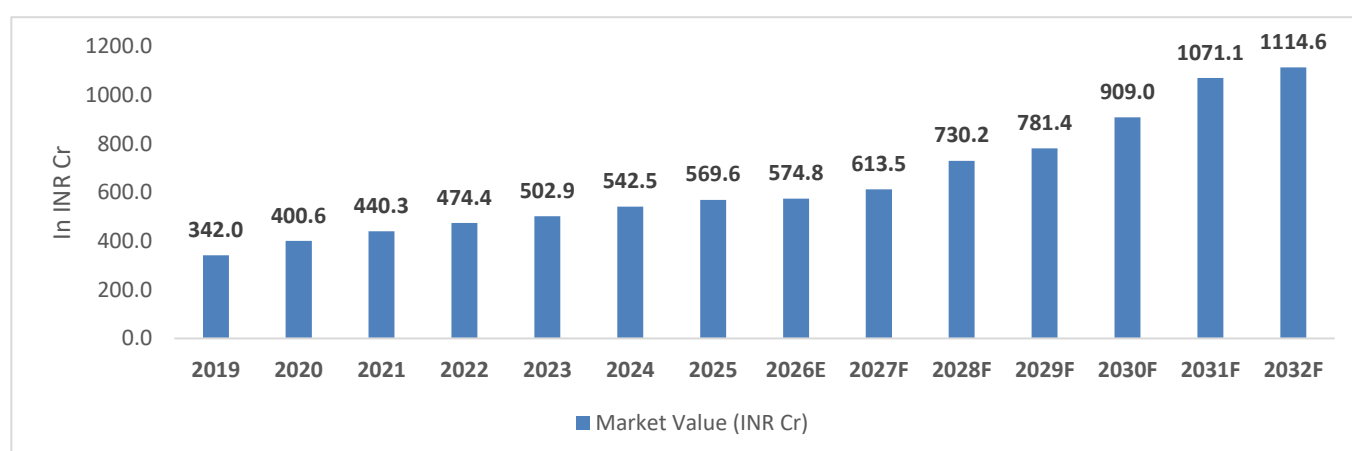


Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

- Indian Precision Forged Machined Components Market for Other Sectors was valued at **INR 1,987 Crores** in **FY 2025** and is projected to mark **INR 2,653.8 Crores by 2032** with a **CAGR of 5.6 % from FY 2026 to 2032** driven by growing population, industrialization, investments in infrastructure development by the Government and urbanization.

### Exhibit 195 b: India Precision Forged Machined Components Market Trend, Marine & Shipping, INR Cr, FY 2019-32



Source: Frost & Sullivan Analysis

E-Estimated, F-Forecasted

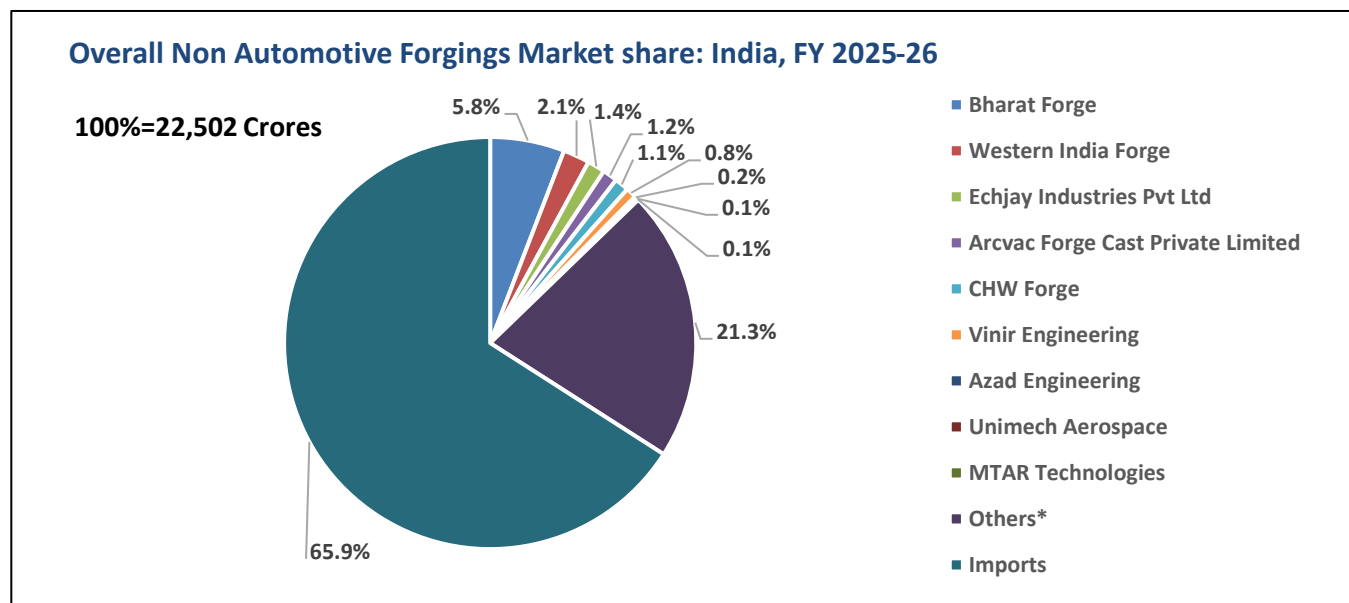
- Indian Precision Forged Machined Components Market for Marine and Shipping was valued at **INR 574.8 Crores** in **FY 2026** and is projected to mark **INR 1,114.6 Crores by FY 2032** with a **CAGR of 11.6 % from FY 2026 to 2032** driven by a combination of domestic shipbuilding expansion, naval indigenization, fleet renewal, government incentives and localization of critical marine equipment.



Competition Landscape of Non-Automotive Forgings in India

## 4.1 Competition Landscape of Overall Non-Automotive Forging Market in India

Exhibit 196: Competition Landscape of Overall Non-Automotive Forging Market in India, FY 2025-26



Note: Market share is based on the domestic non-automotive revenues of each of the companies relative to overall domestic non-automotive forging market size of India in FY 2025-26

The Indian non-automotive forging market was valued at **INR 22,502 crore** in **FY 2025-26**, with domestic manufacturers meeting **34.1% of total demand**, while the remaining **65.9% was met through imports**.

### Domestic Supply:

- Bharat Forge Limited is the market leader with 5.8%, followed by Western India Forgings Pvt Ltd being the 2<sup>nd</sup> largest with 2.1%. Followed by Echjay industries Pvt Ltd (1.4%), Arcvac Forgecast Pvt Ltd (1.2%), CHW Forge Pvt Ltd (1.1%), Vinir Engineering Limited (0.8%) which is one of the prominent players in this niche segment of precision-forged and machined components industry, especially for critical and high-end applications, positioned under top 10 category and solely operates in the precision forged machined components segment of non-automotive end use segments such as Oil and Gas and Energy, Nuclear, Aerospace & Defence, Mining and Construction Equipment, Railways and other miscellaneous applications. Azad Engineering (0.2%), Unimech Aerospace (0.1%) and MTAR Technologies (0.07%) are close competitors of Vinir Engineering Limited in precision forged machined components, though their larger focus is on export markets.
- Other smaller players are Bay Forge (0.5%), followed by SE Forge (0.4%), which operates in Ring Rolling, Unique Forgings Pvt Ltd (0.4%), and Punjab Hammers (0.3%). 14.37% market demand of non-automotive forging in India is met by the above producers which are close competitors of each other.
- The remaining 19.73% demand out of domestic supply share of 34.1% is catered by the other\* players which are spread across four forging clusters such as north, south, east and west.
- Key players among others category are Ramakrishna Forgings Ltd, Happy Forgings Ltd which are predominantly present into Automotive forgings, MM Forgings Pvt Ltd, Echjay Forgings Pvt Ltd, Ganga Forgings Ltd, Ambe Forge Pvt Ltd, Harika Industries, Happy Steel Pvt Ltd, JVR Forgings, Microtek Forgings Pvt Ltd, RB Forgings Pvt Ltd, Sadhu Forgings Pvt Ltd, Fine Forge limited, GSB Forge Pvt Ltd, AMIC Forgings Pvt Ltd, BMN Alloy Steel Pvt Ltd, BTM forgings Pvt, Ltd, Creative Forgings Pvt Ltd, Genova Forgings Pvt Ltd, Inno Forge Pvt Ltd, LBG Forge Limited, Phoenix Forge Pvt Ltd, Steel and Industrial Forgings Pvt Ltd, Unity Forge Pvt Ltd, Ambar Forge Pvt Ltd, Arora Forgings Pvt Ltd, Jeko Industries, Padmavati Forge Pvt Ltd, Sachin Forge Pvt Ltd, Varsha Forgings Pvt Ltd and Balu Forge Industries Ltd.

## Exhibit 197: Revenue Assessment of Close Competitors of Vinir Engineering Limited, India, INR Cr, FY 2025-26

Vinir Engineering: Close Competitors Revenue Assessment, FY 2025-26

| INR Crores                     |                        |                         |                                   |
|--------------------------------|------------------------|-------------------------|-----------------------------------|
| Name of Manufacturer           | Total Revenue (INR Cr) | Export Revenue (INR Cr) | Domestic Revenue Non-Auto, INR Cr |
| Bharat Forge Limited           | 7600.0                 | 4050.0                  | 1313.5                            |
| Western India Forgings Pvt Ltd | 700.0                  | 84.0                    | 468.2                             |
| Echjay Industries Pvt Ltd      | 1475.0                 | 590.0                   | 309.8                             |
| Arcvac Forgecast               | 290                    | 29.0                    | 261.0                             |
| CHW Forge                      | 575                    | 322.0                   | 253.0                             |
| Vinir Engineering Limited      | 204.8                  | 19.4                    | 185.4                             |
| Azad Engineering               | 590.4                  | 549.05                  | 41.3                              |
| Unimech Aerospace              | 240.5                  | 216.5                   | 24.1                              |
| MTAR Technologies              | 88                     | 73.0                    | 14.9                              |

Source: Company Annual Reports FY 2025-26 and Frost & Sullivan Primary Research

### Imports:

- 65.9% ( INR 14,837 Crore) of total non-automotive forging demand is met via imports in FY 2025-26, China is a major exporter of overall forgings to India with an overall share of 35-40%. Key exporters of forgings to India for Oil and Gas sector are China (46%), Japan (7%), USA (6%) and rest of the world contributing to (41%) including Germany, Kingdom of Saudi Arabia (KSA), United Arab Emirates (UAE), Kuwait and United Kingdom (UK).
- For Mining and Construction Equipment forged components major exporter to India were China (53%), South Korea (13%),Germany (9%), Japan (5%),Korea (3%), Italy (3%) and Rest of the world (17%). For Aerospace precision forged components major exporter to India were Germany (22.11%),France (17.03%),KSA (13.98%),USA (13.96%),UAE (12.41%),Kuwait (4.23%),Oman (3.32%),Israel (1.93%),Bangladesh (1.80%) and rest of the world (9.23%). Defence sector precision forged and machined components were imported to India from Israel (62%),S. Africa (11%),Brazil (9%),Germany (4%), Serbia (2%) and Rest of the world (11%).
- The Non-Automotive Industry as a whole has a large addressable opportunity for import substitution to penetrate the domestic precision forged and machined components market by capturing the portion of imports and reducing the dependency and becoming a self-reliant country. Significant import-substitution potential opportunity exists across India's non-automotive forging market, supported by defence indigenization, China+1 supply-chain diversification, strengthening domestic metallurgy and precision-machining capabilities, competitive manufacturing costs and growing end-market scale. Together, these factors are progressively improving the ability of Indian suppliers to localize high-value imported components, reduce external supply-chain dependence and strengthen indigenous manufacturing capabilities.

**Exhibit 198 a: Capability Comparison Between Key Competitors of Vinir Engineering Limited**

| Capability Parameters              | Vinir Engineering Limited                                        | Unimech Aerospace and Manufacturing Ltd                                                                                     | MTAR Technologies Ltd                                                                                                                                                    | Azad Engineering Ltd                                                                                                                                 | Bharat Forge Ltd                                                                 |
|------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Closed Die Forging                 | Yes                                                              | No                                                                                                                          | Yes                                                                                                                                                                      | Yes                                                                                                                                                  | Yes                                                                              |
| Open Die Forging                   | Yes                                                              | No                                                                                                                          | No                                                                                                                                                                       | No                                                                                                                                                   | Yes                                                                              |
| Ring Rolling                       | Yes                                                              | No                                                                                                                          | No                                                                                                                                                                       | No                                                                                                                                                   | Yes                                                                              |
| Radial Forging                     | Yes                                                              | No                                                                                                                          | No                                                                                                                                                                       | No                                                                                                                                                   | Yes                                                                              |
| Machining                          | Yes                                                              | Yes                                                                                                                         | Yes                                                                                                                                                                      | Yes                                                                                                                                                  | Yes                                                                              |
| Manufacturing Capability           | Forging, Heat Treatment, 5 axis Machining, Assembly & Testing    | 3/4/5-Axis CNC Machining, Turning, Turn-Mill, VTL, EDM, Grinding, TIG/MIG Welding, Fabrication, Assembly, Special Processes | CNC Machining, Specialized Fabrication, Sheet Metal & Heavy Fabrication, Welding, Vacuum Brazing, Assembly & Integration, Surface Treatment, Heat Treatment, Electronics | Forging, 3/4/5-Axis Machining, Turning, Grinding, Sheet Metal, Welding, Brazing, Heat Treatment, Shot Peening, Special Processes, Assembly & Testing | Forging, Machining, Gear Cutting, Specialized Heat Treatment, Testing & Assembly |
| Alloy Capability                   | Inconel, Titanium, Aluminium, Alloy Steels, Duplex, Super Duplex | Aluminium (7075, 6061, 2024), Titanium, Stainless Steel, Inconel/Nickel Alloys, Tool Steels                                 | 17-4 PH, SS 410, 13-8 MO PH, Alloy Steel, Aluminium, Titanium & Inconel                                                                                                  | Titanium, Nimonic, Inconel & High-Grade Steels                                                                                                       | Steel, Aluminium, Titanium, Inconel, Stainless Steel Alloys                      |
| Component Size Weight Ranges (Kgs) | 5 -6,000 Kgs                                                     | -                                                                                                                           | 0.2 – 30,000 Kgs                                                                                                                                                         | -                                                                                                                                                    | 2 – 12,000 Kgs                                                                   |
| Heat Treatment                     | Yes                                                              | Yes                                                                                                                         | Yes                                                                                                                                                                      | Yes                                                                                                                                                  | Yes                                                                              |

| Capability Parameters | Vinir Engineering Limited | Unimech Aerospace and Manufacturing Ltd | MTAR Technologies Ltd | Azad Engineering Ltd | Bharat Forge Ltd |
|-----------------------|---------------------------|-----------------------------------------|-----------------------|----------------------|------------------|
| Export                | Yes                       | Yes                                     | Yes                   | Yes                  | Yes              |

Source: Frost & Sullivan Analysis, Primary Interviews & Annual Reports

**Exhibit 198 b: Financial Metrics of Vinir Engineering Limited (INR Million)**

| Particular              | FY 2025-26 | FY 2024-25 | FY 2023-24 |
|-------------------------|------------|------------|------------|
| Total Income            | 2,084.37   | 1,924.59   | 2,351.13   |
| Revenue From Operations | 2,048.24   | 1,899.61   | 2,295.27   |
| PAT                     | 243.87     | 248.25     | 346.57     |
| PAT Margin (%)          | 11.91%     | 13.07%     | 15.10%     |

Source: Vinir Engineering Limited

**Exhibit 198 c: Financial Metrics of Bharat Forge (INR Million)**

| Particular              | FY 2025-26  | FY 2024-25  | FY 2023-24  |
|-------------------------|-------------|-------------|-------------|
| Total Income            | 1,70,103.3  | 1,53,365.67 | 1,59,094.95 |
| Revenue From Operations | 1,68,116.53 | 1,51,228.03 | 1,56,820.71 |
| PAT                     | 10,893.98   | 9,132.75    | 9,101.59    |
| PAT Margin (%)          | 6.48%       | 6.00%       | 5.80%       |

Source: Annual Report, Investor Presentations

**Exhibit 198 d: Financial Metrics of MTAR Technologies Ltd (INR Million)**

| Particular              | FY 2025-26 | FY 2024-25 | FY 2023-24 |
|-------------------------|------------|------------|------------|
| Total Income            | 8,992.96   | 6,811.45   | 5,865.59   |
| Revenue From Operations | 8,762.00   | 6,759.95   | 5,807.52   |
| PAT                     | 940.30     | 528.87     | 561.13     |
| PAT Margin (%)          | 10.73%     | 7.82%      | 9.66%      |

Source: Annual Reports, Investor Presentations

**Exhibit 198 e: Financial Metrics of Azad Engineering (INR Million)**

| Particular              | FY 2025-26 | FY 2024-25 | FY 2023-24 |
|-------------------------|------------|------------|------------|
| Total Income            | 6,486.29   | 4,679.45   | 3,727.64   |
| Revenue From Operations | 6,029.75   | 4,573.54   | 3,407.71   |
| PAT                     | 1,335.63   | 865.34     | 585.80     |
| PAT Margin (%)          | 22.15%     | 18.92%     | 17.19%     |

Source: Annual Reports, Investor Presentations

## 4.2 Brief Profile of Vinir Engineering Limited

| Ownership                                | Privately Held                                     | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Founded                                  | 1983                                               | <ul style="list-style-type: none"> <li>Vinir Engineering Limited is an integrated manufacturer of mission-critical precision forgings and fully machined, ready-to-assemble components, leveraging 40+ years of manufacturing expertise to serve high-reliability applications with stringent quality and performance requirements.</li> <li>Vinir Engineering Limited serves six key end-use segments Oil &amp; Gas and Energy, Aerospace and Defence, Nuclear, Marine &amp; Shipping, Mining &amp; Construction Equipment, Railways and other miscellaneous industrial applications providing a diversified customer and end-market base and reducing reliance on any single industry.</li> <li>A key differentiator is Vinir Engineering Limited's ability to accelerate product development and delivery. Its integrated engineering, tooling and manufacturing infrastructure facilitates faster development, streamlined qualification and shorter delivery lead times, particularly for high-mix, low-volume and mission-critical components where responsiveness and execution reliability are critical.</li> <li>Vinir Engineering Limited produces mission critical products for all types of forgings namely Closed, Open, Ring Rolling and Radial Forging for the niche precision forged and machined components market.</li> <li>Vinir Engineering Limited has integrated raw-material sourcing, inspection and preparation processes ensuring that only high-quality materials are used for the production process. These initial steps are critical to maintaining the integrity and performance of the final components, forming the foundation of their production efficiency and quality assurance.</li> <li>Vinir Engineering Limited specialises in producing critical and heavy precision-forged and machined components using a wide range of metals, including alloy steel, titanium, Hastelloy, carbon steels, stainless steels, duplex steels, special steels, Inconel, Monel, and aluminium, amongst others.</li> </ul> |
| Headquarters                             | Bangalore                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Manufacturing Facilities                 | 3<br>Bangalore-1<br>Hosur -1<br>Kalukondanapalli-1 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Capacity (MTPA)                          | 36,000                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Total Revenue, FY 26                     | INR 204.82 Crores                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Total Domestic Revenue (Non-Auto), FY 26 | INR 185.43 Crores                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Export Revenue, FY 26                    | INR 19.39 Crores                                   | <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>Vinir Engineering Limited is an established player in the niche non-automotive precision forged and machined components market in India, with ~90% of its total sales focused on the Indian Market, the firm has a large addressable market of <b>INR 22,502 Crores</b> i.e. Imports (65.9%) <b>INR 14,837 Crores</b> providing high potential import substitution opportunities and domestic addressable market of (34.1%) <b>INR 7,665 Crores</b>.</li> <li><b>Sector Wise Revenue Split:</b> Oil and Gas and Energy (40.2%), Aerospace and Defence (29.4%), Nuclear (8.2%), Mining and Construction Equipment (6.4%), Marine and Shipping (4.6%), Railways and other miscellaneous industries (11.1%).</li> <li>Vinir Engineering Limited's focus on emerging, high-entry-barrier segments such as Nuclear, Oil and Gas and Energy, Marine &amp; Shipping, Aerospace &amp; Defence and Railways provides a competitive advantage, as these industries entail long approval cycles and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                          |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Ownership | Privately Held | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                | <p>stringent qualification, certification, testing and traceability requirements.</p> <ul style="list-style-type: none"> <li>• With the requisite approvals and certifications already in place, Vinir Engineering Limited is well positioned relative to less-qualified peers to accelerate customer onboarding and new product development, while creating meaningful barriers to entry. Established qualifications can also support stronger customer stickiness, repeat business and long-term revenue visibility.</li> <li>• Vinir Engineering Limited benefits from repeat business from established customers, supported by long-standing customer relationships and an expanding qualification and product-development pipeline across its six business verticals. Ongoing development programmes and increasing participation in higher-value, mission-critical applications provide a platform for sustained customer engagement and visibility into future growth opportunities.</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>• Vinir Engineering Limited operates a comprehensive manufacturing platform encompassing specialised closed-die and open-die forging, radial-axial ring rolling, radial forging, advanced multi-task CNC machining, and supporting heat-treatment, testing and inspection capabilities. The integrated manufacturing setup enables the company to produce complex, high-precision components while maintaining stringent quality and process-control standards.</li> <li>• The company is also progressively transitioning selected heating processes from conventional gas-based systems to induction/electric heating, with the objective of enhancing energy efficiency, process control and productivity while improving overall manufacturing cost competitiveness.</li> <li>• Vinir Engineering Limited Produces Open Die forgings up to 6,000 Kgs/piece (rough, proof machined or full machined) and produces closed die forging up to 1400 Kgs/piece.</li> <li>• Vinir Engineering Limited have three rolling mills which produces rings up to 4500 mm outer diameter on Wagner ring rolling and up to 1500 mm diameter and 325 mm height on another type of Wagner ring rolling machines.</li> <li>• Inhouse heat treatment, test labs certified by National Accreditation Board for Testing and Calibration Laboratories (NABL) and machining facilities to finish machined parts.</li> <li>• Have forged based machined assemblies in ready to use condition duly tested and certified for all sectors including oil and gas and energy, nuclear, aerospace and defence, mining and construction equipment, marine and shipping, railways and other miscellaneous industries.</li> <li>• Vinir Engineering Limited have inhouse capability of design and manufacturing of precision dies tailored to produce the final precision components. Vinir Engineering Limited has a portfolio of over 5,000 die designs.</li> </ul> |

| Ownership | Privately Held | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                | <ul style="list-style-type: none"> <li>The backward integration spanning raw material preparation to die design and production provides Vinir Engineering Limited a significant competitive edge by ensuring superior quality control, optimizing cost and reducing process lead times.</li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li><b>Oil and Gas and Energy:</b> Parts of valve bodies, Gates, Stem, Studded Tee, Crosses, Rings, Slip Bowls, coupling hub, clamp, body, adapters, flange, caps, blocks, Rings, Profile Rings, seat rings, Parts of surface well heads, slip bowls, flanges, Parts for subsea applications including adapter bodies, Parts of cryogenic applications including valve bodies, extended bonnets, Parts for chokes, Bonnet forgings, Bail rod elevator, Rotor Shafts, Gear Box, Low and High-Speed Drive Shafts, Hubs, Turbine Discs.</li> <li><b>Nuclear:</b> Hub, Body, forged Clevis, rod eye forgings, clamp, Turn buckle and rod eye assembly</li> <li><b>Aerospace:</b> Disks, Diffusers, Structural parts, Barrels, Swing arms, Hub, Turbine Discs, Integral axle arm, carrier, bushing, bearing body, rod wheel arm</li> <li><b>Defence: Armoured Vehicles:</b> Parts for Engines, Suspension, turret, main body, track</li> </ul> <p><b>Armaments and Ammunition:</b> Body, Extractors, ejectors, barrel</p> <p><b>Military Hardware:</b> Parts for engines, suspension, main body, Track</p> <ul style="list-style-type: none"> <li><b>Railways:</b> Braking Systems, Connecting Rods, Gears, Pinions, Couplings, shafts and cylinder heads, Gear Blanks, Pinions and Shafts, Rings, Profile Rings.</li> <li><b>Mining and Construction Equipment:</b> Parts for Engine, Structural, Couplings, parts for track, Parts for boom, Connecting Rods, Gears, Hydraulic Cylinder parts, Parts for bucket and attachments</li> <li><b>Marine and Shipping:</b> Clevis slip hook, crankshaft, hollow shaft, large, forged crankshaft</li> <li><b>Other Miscellaneous:</b> Parts for space frames including node, cones, sleeves, Gears, shafts, connecting rods, crankshafts, hubs, rotors</li> </ul> <p><b>Key Certifications:</b></p> <ul style="list-style-type: none"> <li>ISO 9001</li> <li>API 20C</li> <li>API 20B</li> <li>ISO 14001</li> <li>ISO 45001</li> <li>Pressure Equipment Directive (PED)</li> <li>AD 2000</li> <li>IBR Well Known Forge</li> <li>AS 9100D</li> <li>ISO 50001</li> <li>ISO 17025 - NABL</li> <li>'Green Co'</li> <li>ABS</li> <li>IRIS</li> </ul> |

### 4.3 Brief Profile of Bharat Forge

| Ownership                                 | Public Listed                                                       | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Founded</b>                            | 1961                                                                | <ul style="list-style-type: none"> <li>Bharat Forge Limited (BFL) is the flagship company of the Kalyani Group and a global provider of high performance innovative, safety &amp; critical components and solutions to various sectors including Automotive, Railways, Defence, Construction &amp; Mining, Aerospace, Marine, Oil &amp; Gas sectors &amp; emerging technology applications. It is the India's largest Forging company with the presence of world's largest forging facility located at Mundhwa in Pune, India.</li> <li>Bharat Forge has diversified business presence across Automotive and Industrial applications including Power, Oil &amp; Gas, Railways &amp; Heavy Engines, Aerospace, Defence, Construction &amp; Mining, Marine, Agriculture and emerging technology applications.</li> <li>Bharat Forge produces Green Forgings. It is one of the few companies in the world with majority of power being produced by renewable sources.</li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>Bharat Forge is a key player in the non-automotive Forging space in India and witness 5.8% market share in domestic non-automotive forgings market.</li> <li><b>Sector Wise Revenue Split:</b> Energy (Oil &amp; Gas) (30%), Aerospace &amp; Défense (35%), Railways (6%), Earthmoving Equipment (17%), Others (12%) which includes manufacturing sectors, marine and shipping construction and agricultural equipment.</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>Bharat Forge's forging facilities consists of fully automated forgings press lines ranging from 1600T to 16000T. All the forging press lines are highly flexible, which gives the company the inherent advantage to simultaneously meet different customer demands and optimize production. This allows Bharat Forge to meet the growing demands of its customers continuously.</li> <li>Bharat Forge is expanding aerospace manufacturing through new ring-mill, forging and machining capacity at Baramati, including capabilities for specialty-alloy aerospace forgings and complex components.<sup>141</sup></li> <li>A high-precision landing-gear machining facility has been inaugurated in Pune to support aerospace programmes.<sup>142</sup></li> <li>New forging and machining capabilities are being developed for data-centre energy systems and semiconductor manufacturing equipment.<sup>141</sup></li> <li>Defence manufacturing capabilities now include large-calibre ordnance, small arms, artillery, naval and unmanned autonomous vehicles, with machined artillery barrels and turrets in the portfolio.<sup>141</sup></li> <li>Produces Product Ranges from 2Kgs to more than 12 Ton Finished Weight</li> </ul> |
| <b>Headquarters</b>                       | Pune<br>Maharashtra,<br>India                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Manufacturing Facilities</b>           | 5<br>Pune-1,<br>Baramati-1,<br>Satara-1,<br>Chakan-1,<br>Vadodra-1, |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Capacity MTPA</b>                      | 3,70,400                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Total Revenue, FY 26</b>               | INR 8,396 Crores                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Domestic Revenue (Non-Auto), FY 26</b> | INR 1313.50 Crores                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Export Revenue, FY 26</b>              | INR 4,050 Crores                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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<sup>141</sup> BFL FY26 AR p.43<sup>142</sup> BFL FY26 AR p.11

| Ownership | Public Listed | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |               | <ul style="list-style-type: none"> <li>Plants are equipped with Material sourcing, design and simulation, Tools and Die Making, Forging and Precision Forging, Precision Machining, Specialized heat treatment and testing and validation all under one roof providing customers with one stop solutions.</li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li><b>Energy:</b> Rotor Shaft, Generator, Welded Rotor, Disc, Thrust Block, Trunion, Bush, Main wind, Ring Wheel, Planet Wheel, Fast Wheel, High pressure valve bodies, Y Blocks, Spool body, Mandrel, Connectors, Rings, Gate valve body, Shell, Y Block, Fluid Ends, Turbine Impellers, Power Pistons.<sup>143</sup></li> <li><b>Aerospace:</b> Fan Blades, Compressors, Turbine, Aero-Engine Blades, Landing Gear Systems, UAV Landing Gear, and Aerostructures.<sup>144</sup></li> <li><b>Defence &amp; Marine:</b> parts of artillery gun systems, protected vehicles, small arms, Ammunitions, Marine, Gun Barrels &amp; Turrets, Artillery Shells, Missile Warheads, Armored Vehicle Drivetrain Parts, and Submarine/Naval Rotor Assemblies.<sup>145</sup></li> <li><b>Railways:</b> Crankshafts, connecting rod, Gear box support, Motor Support, Primary Support, Locomotive Pistons, Hollow Shafts and Locomotive Turbochargers (ALCO, 710G EMD).<sup>145</sup></li> <li><b>Earthmoving and Mining:</b> Machined Crankshaft, Injector body, front spindle, track links.</li> <li><b>Industrial / Emerging Applications:</b> Large-engine forged components for data-centre backup power systems and forged components for semiconductor manufacturing equipment.<sup>146</sup></li> </ul> <p><b>Key certification</b></p> <ul style="list-style-type: none"> <li>ISO 9001:2015</li> <li>IATF 16949:2016</li> <li>DAQA</li> <li>ISO 14001:2015</li> <li>ISO 45001:2018</li> <li>ISO 27001:2022</li> <li>ISO 50001:2018</li> <li>ISO 17025:2017</li> <li>AS 9100:2016</li> <li>NADCAP</li> <li>API Spec Q1 &amp; 20B</li> <li>ABS</li> <li>IRS</li> </ul> <p><b>Key Customers:</b></p> |

<sup>143</sup> <https://www.bharatforge.com/businesses/power>

<sup>144</sup> <https://www.bharatforge.com/aerospace/component-details>

<sup>145</sup> <https://www.bharatforge.com/businesses/rail>

<sup>146</sup> BFL FY26 AR p.42-43

| Ownership | Public Listed | Company Overview                                                                                                                                                                                                                                                                                                     |
|-----------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |               | Halliburton, Cummins, Boeing, Daimler, Caterpillar, John Deere, Baker Hughes, Schlumberger, BHEL, Siemens Gamesa, Indian Railway, HAL, Safran, IOF, Ministry of Defence, Embraer, Rolls-Royce, Liebherr Aerospace, Pratt & Whitney Canada, Indian Army, Indian Navy, DRDO & Volvo Eicher Commercial Vehicles (VECV). |

Source: Frost & Sullivan Research

#### 4.4 Brief Profile of Azad Engineering

| Ownership                                 | Public Listed                        | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Founded</b>                            | 1983                                 | <ul style="list-style-type: none"> <li>Azad Engineering Limited is a Hyderabad-based precision engineering company that manufactures highly engineered, mission and life critical components for the Energy, Aerospace &amp; Defence, and Oil &amp; Gas sectors.</li> <li>Azad Engineering has grown from a single machine shop into a manufacturing group with 5 facilities in Telangana, with capabilities spanning precision components, assemblies and complete propulsion engine manufacturing and integration.</li> <li>Azad Engineering is among a very select group of manufacturers worldwide qualified to produce complex 3D rotating air foils, hot-section nozzle guide vanes, and nuclear-grade turbine components.</li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>Azad Engineering focuses largely on export market with the domestic market share limited to only 0.2%.</li> <li><b>Sector Wise Revenue Split:</b> Energy (Oil &amp; Gas) (81.5%), Aerospace &amp; Defence (17.2%), &amp; Others (1.3%).</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>AZAD combines engineering and manufacturing under one ecosystem, covering <b>precision forging, 3/4/5-axis machining, ultra-precision turning, grinding, sheet metal, heat treatment, shot peening, coatings, welding, testing and automation.</b></li> <li>The company has also expanded in-house special processes such as <b>heat treatment, vacuum heat treatment, shot peening and coatings</b>, helping it control more of the overall manufacturing chain.</li> <li>Pioneered the dedicated Lean Manufacturing Facility model building dedicated, customer-specific plants co-engineered with global OEMs including <b>GE Vernova, Siemens Energy, Mitsubishi Heavy Industries, and Baker Hughes.</b></li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li><b>Energy:</b> Rotating &amp; stationary airfoils, compressor airfoils, hot-gas components, combustion components, diaphragms, casings, critical machining parts and assemblies.</li> <li><b>Aerospace &amp; Defence:</b> Aero-engine assemblies, APUs, air-generation &amp; valve assemblies, actuator and hydraulic systems, airframe/booster,</li> </ul> |
| <b>Headquarters</b>                       | Hyderabad, Telangana, India          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Manufacturing Facilities</b>           | 5 facilities in Telangana, Hyderabad |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Capacity MTPA</b>                      | Not Available                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Total Revenue, FY 26</b>               | INR 590.38 Crores                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Domestic Revenue (Non-Auto), FY 26</b> | INR 41.31 Crores                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Export Revenue, FY 26</b>              | INR 549.08 Crores                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Ownership | Public Listed | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |               | <p>Missiles, Engine Propulsion, Fuel &amp; Inerting components and critical rotating/stationary air foils.</p> <ul style="list-style-type: none"> <li>• <b>Oil &amp; Gas:</b> Drill bits, slips, bonnet frames, hatch covers and other precision components for oilfield and industrial energy applications.</li> </ul> <p><b>Key certification</b></p> <ul style="list-style-type: none"> <li>• ISO 9001:2015 (QMS)</li> <li>• ISO 14001:2015(EMS)</li> <li>• AS 9100 D (AQMS)</li> <li>• BS45001:2018 (OHSAS)</li> <li>• ISO 27001:2013 (ISMS)</li> <li>• NADCAP</li> <li>• ISO 17025:2017 (NABL)</li> </ul> <p><b>Key Customers:</b></p> <p>Arabelle Solutions, GE Vernova, Mitsubishi Power, Baker Hughes, Siemens Energy, BHEL, MAN, HAL, Boeing, Honeywell Aerospace, Rolls Royce, GE Aerospace, BrahMos</p> |

Source: Frost & Sullivan Research, Annual Report, Investor Presentation

#### 4.5 Brief Profile of MTAR Technologies

| Ownership                       | Public Listed                                                                                                              | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Founded</b>                  | 1969                                                                                                                       | <ul style="list-style-type: none"> <li>• MTAR Technologies Limited is a Hyderabad-based precision engineering company with more than five decades of experience in manufacturing complex, mission-critical products for <b>Clean Energy, Aerospace &amp; Defence, Oil &amp; Gas, and emerging data-centre infrastructure applications.</b></li> <li>• The company has evolved from supplying nuclear and space components to offering <b>integrated systems, sub-assemblies and precision-engineered products</b> across multiple industries.</li> <li>• The company has over five decades of experience in developing complex, mission-critical assemblies, ranging from fuel handling systems for nuclear reactors to liquid propulsion engines for space launch vehicles.</li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>• MTAR Technologies holds domestic market share of 0.07% in the precision forged machined components as company focuses largely on export market</li> </ul> |
| <b>Headquarters</b>             | Hyderabad, Telangana, India                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Manufacturing Facilities</b> | 11 (Telangana)<br>Balanagar - 4<br>Gandhinagar - 2<br>Jeedimetla - 1<br>Adibatla - 2<br>Pashamylaram - 1<br>Doolapally - 1 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Capacity MTPA</b>            | Not Available                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Ownership                                 | Public Listed     | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Total Revenue, FY 26</b>               | INR 876.2 Crores  | <ul style="list-style-type: none"> <li>• <b>Sector Wise Revenue Split:</b> Clean Energy - Fuel Cells, Hydro Power &amp; others <b>(70.16%)</b>, Aerospace &amp; Defence <b>(11.84%)</b>, Clean Energy - Civil Nuclear <b>(2.69%)</b>, and Products &amp; Others <b>(15.31%)</b> (Comprising specialised products and import substitutes such as ball screws, roller screws, valves, electro-mechanical actuators, bearings and ASP assemblies)</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>• MTAR capabilities include product design, advanced CNC machining, specialised fabrication, assembly &amp; integration, quality control, heat treatment, surface treatment &amp; painting, electronics manufacturing and cable-harness assemblies.</li> <li>• MTAR operates dedicated manufacturing facilities across Hyderabad, Telangana, including NADCAP-approved special-process facilities at Unit 5, Jeedimetla and Gee Pee Aerospace, Pashamylaram; an Aerospace-focused Export Oriented Unit(EOU) at Gandhinagar, Balanagar.</li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li>• <b>Civil Nuclear:</b> Nuclear reactor assemblies, coolant channel assemblies and other critical nuclear components.</li> <li>• <b>Space:</b> Liquid propulsion engines, cryogenic engine systems, fluid-control components and precision assemblies for launch vehicles.</li> <li>• <b>Aerospace &amp; Defence:</b> Precision aerospace components, actuation systems, aerostructures, engine components and defence assemblies.</li> <li>• <b>Clean Energy:</b> Fuel-cell and electrolyser assemblies, along with fabricated structures for hydropower, wind and other clean-energy applications.</li> <li>• <b>Oil &amp; Gas:</b> Precision-machined oilfield components and assemblies, including whipstocks, mandrels, slips, anchors and related equipment.</li> <li>• <b>Power:</b> Precision-engineered components and fabricated structures for power-generation and process-industry applications (Such as: Grid plate assembly, Control plug assembly &amp; Inclined fuel transfer mechanism).</li> </ul> <p><b>Key certification</b></p> <ul style="list-style-type: none"> <li>• AS9100D</li> <li>• ISO 9001:2015</li> <li>• ISO 14001:2015</li> <li>• ISO/IEC 27001:2022</li> <li>• ISO 45001:2018</li> <li>• IPC 610 &amp; 620</li> <li>• NADCAP</li> </ul> <p><b>Key Customers:</b></p> <p>NPCIL, ECIL, ISRO, DRDO, Colins Aerospace, GE Power, Voith, Andritz, Bloom Energy, Elbit, Bharat Electronics, IAI, Thales, Weatherford, SLB</p> |
| <b>Domestic Revenue (Non-Auto), FY 26</b> | INR 14.96 Crores  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Export Revenue, FY 26</b>              | INR 717.89 Crores |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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Source: Frost & Sullivan Research, Annual Report

## 4.6 Brief Profile of Western India Forge

| Ownership                                 | Privately Held                                             | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Founded</b>                            | 1980                                                       | <ul style="list-style-type: none"> <li>Western India Forge is one of the prominent players in the non-automotive forgings market in India and produces open die, closed die and ring rolled forgings under one roof in the weight range of 1kg to 10,000 Kgs.</li> <li>Western India Forgings mainly serves Railways, Construction &amp; Mining, Oil &amp; Gas, Gear &amp; Transmission, Automotive &amp; Tractors, Material Handling, Wind, Hydro and Thermal Power and General Engineering sectors.</li> <li>The company has an integrated design and simulation capability with in-house tooling/die manufacturing, supporting faster product development and customized forgings.<sup>147</sup></li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>Western India Forge is one of the prominent players in the non-automotive Forging space in India and witness 2.1% market share in domestic non-automotive forgings market.</li> <li><b>Sector Wise Revenue Split:</b> Energy (49%), Mining and Construction Equipment (18%), Railways (17%), and others (16%) which includes manufacturing sectors, construction and agricultural equipment.</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>Western India Forge have capability to produce Open Die forgings ranging from diverge raw materials such as carbon, alloy, stainless, tool and duplex steels. Small open die forgings range up to 300 kgs, while other heavy press products range from 300Kgst to 1 ton (and up to 13,000 Kgs using their 1600T ZDAS Open Die Hydraulic Press).<sup>148</sup></li> <li>Downstream facilities are equipped with gas fired heat treatment setup qualified as per CQ-9 and AMS 2750E and AMS 6875. Facilities have well defined QMS Integrating requirements of ISO, TS and API.</li> <li>Plant is equipped with 16-ton hammer which enables Western Forge to produce closed die components up to 750 Kgs and serves segments of Railways, Oil and Gas and Power.</li> <li>Capable of producing huge range of products from 35 Kgs to 10 tons.</li> <li>With the support of three Vertical Ring Mills and one Horizontal Ring Mill Western India Forge is capable of producing rings from 350mm OD to 3000 mm OD and weight range of 15Kgs to 3200 Kgs.</li> <li>Western India Forgings has in-house design, simulation and die/tooling development, with dedicated tooling manufacture supporting its forging operations.<sup>149</sup></li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li><b>Oil and Gas:</b> Bonnets, Body, Housing, Gates, Square Block, Cross, Studded Tees, Weldneck Flanges, Rings, Shape Forgings, Casing Hanger, Ram Block, Gate Valve Bodies.<sup>150</sup></li> </ul> |
| <b>Headquarters</b>                       | Pune, Maharashtra                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Manufacturing Facilities</b>           | 3; WIF Bhosari, Kran Rader (Kharadi), WIF Sanaswadi (Pune) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Capacity (MTPA)</b>                    | Not Available                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Total Revenue, FY 26</b>               | INR 700 Crores                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Domestic Revenue (non-auto), FY 26</b> | INR 468.16 Crores                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Export Revenue, FY 26</b>              | INR 84 Crores                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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<sup>147</sup> <https://westernindiaforgings.com/about-us/>

<sup>148</sup> <https://westernindiaforgings.com/open-die-forging/>

<sup>149</sup> <https://westernindiaforgings.com/design/>

<sup>150</sup> <https://westernindiaforgings.com/product/>

| Ownership | Privately Held | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                | <ul style="list-style-type: none"> <li>• <b>Railways &amp; Metro:</b> Gears, Trolley Wheel, Axle Arm, Bearing Cap, Bevel Pinions, Rings, Yoke Forgings, Arm Ring Forgings, Bearing Cover, Cam Shaft, Connecting Roads, Hubs, Input &amp; Output Shafts.<sup>150</sup></li> <li>• <b>Energy:</b> Round Bar, Spring Plate, Rotor-Pole End Plate, Planet Bucket Ring, Gear Blank, Cross Head, Diaphragm Ring Forging, Shaft, Tubular Pin, Connect Flange, Pole End Plate, Ring Forgings, Piston Rods, Deflector Forgings, Brake Cylinders, Pelton Buckets.<sup>150</sup></li> <li>• <b>Mining and Construction Equipment:</b> Cone Forging, Coupler, Back Head, Drive Shafts, Handle Forgings, Rings, Shafts, Valve Forgings, Base Trunion, Bearing Yoke, Blank Pinion, Rings, Spindle, Cone Head Shaft, Spacers, Gears, Main Shaft, Piston Eye, Hub &amp; Housing, Bearing FR &amp; RR Arm.<sup>150</sup></li> <li>• <b>General Engineering:</b> Shaft Forging, Inner Core Forging, Hub Forging, Chain Link, Coupling Sprocket, Thrust Plate, Clutch Body, Wheels Forgings, Sleeve Forging, Support Roller, Thrust Roller, Pinion, Seamless Forged Ring, Gear Wheel, Drum Shaft.<sup>150</sup></li> </ul> <p><b>Key certification:</b></p> <ul style="list-style-type: none"> <li>• ISO 14001:2015 and OHSAS 18001:2007</li> <li>• ISO / TS16949 from TUV SUD</li> <li>• PED 97/23/EC from DNV-GL</li> <li>• ABS approved Forging facility</li> </ul> <p><b>Key Customers:</b></p> <ul style="list-style-type: none"> <li>• Alstom, AAM, Andritz Hydro, GE Oil and Gas, Goodwin International Ltd, Mahindra, Siemens, Perkins, Wesco, Volvo, Knorr-Bremse, NOV, OneSubsea, Tata, Trane, Valveworks India.</li> </ul> |

Source: Frost & Sullivan Research

#### 4.7 Brief Profile of Arcvac Forge Cast Private Limited

| Ownership                          | Privately Held                                     | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Founded                            | 2005                                               | <ul style="list-style-type: none"> <li>Arcvac Forge Cast Private Limited is a specialized open die forging company strategically located in Eastern India operating in non-automotive segments such as Oil and Gas, Aerospace, Railways, Energy, Mining, Ship building, Heavy Engineering and Ports and Yards.</li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>Arcvac Forge Cast Private Limited is a key player in the non-automotive Forging space in India and witness 1.2% market share in domestic non-automotive forgings market.</li> <li><b>Sector Wise Revenue Split:</b> Energy (27%), Aerospace &amp; Defence (17%), Mining and Construction Equipment (9%), Railways (15%) and others (19%) which includes manufacturing sectors, construction and agricultural equipment.</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>Inhouse Electric Arc Furnace with Eccentric Bottom Tapping for slag free liquid metal, subsequently refined in Ladle Refining Furnace and Vacuum Degassed under 1 Torr.</li> <li>Forge Shop with multiple Hydraulic Hammers and Manipulators to forge ingots up to 8 tonne single piece.</li> <li>Inhouse machining facility equipped with more than 100 horizontal and Vertical Turning Lathes, Horizontal and Vertical Boring Machines for rough and precision machining.</li> <li>Over 25 Cranes from 5t to 60t capacity</li> <li>Multiple sawing options from 300 mm to 1300mm.<b>Error! Bookmark not defined.</b></li> <li>Heat Treatment Shop with precision-controlled and ISO-certified furnaces.<b>Error! Bookmark not defined.</b></li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li>Customized open die forgings up to 6 ton a piece.<sup>151</sup></li> <li>Forged Bar Stocks from 150 to 450 mm and weighing up to 8 ton a piece.<sup>151</sup></li> <li>Forging Quality Ingots from 3 to 25 ton a piece.<sup>151</sup></li> </ul> <p><b>Certification:</b></p> <ul style="list-style-type: none"> <li>ISO 9001:2000</li> <li>ISO 14001:2004</li> <li>Modern NABL (ISO:17025) accredited laboratory facilities</li> <li>ABS Certified</li> <li>Lloyds Approved Steel Mill</li> </ul> <p><b>Key Customers:</b></p> <ul style="list-style-type: none"> <li>Confidential</li> </ul> |
| Headquarters                       | Kolkata, India                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Manufacturing Facilities           | Kolkata                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Capacity MTPA                      | 16,000 (Planned Capacity Expansion to 20,000 MTPA) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Total Revenue, FY 26               | INR 290 Crores                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Domestic Revenue (non-Auto), FY 26 | INR 261 Crores                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Export Revenue, FY 26              | INR 29 Crores                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

<sup>151</sup> <https://www.arcvacforge.com/products.php>

#### 4.8 Brief Profile of CHW Forge

| Ownership                                 | Privately Held                              | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Founded</b>                            | Founded in 1956 & started operation in 1960 | <ul style="list-style-type: none"> <li>CHW Forge, formerly known as Chaudhry Hammer Works, was established in 1956. Key end-use sectors include <b>oil and gas, Aerospace &amp; Defence, Shipbuilding, Nuclear power, Mining and Infrastructure</b>. The company also makes parts for <b>Construction, General Engineering, and Drilling Machines</b>.</li> <li>CHW Forge manufactures a wide range of steel forging products which find application across diverse industries.</li> </ul> <p><b>Market Position:</b></p> <ul style="list-style-type: none"> <li>CHW Forge is a key player in the non-automotive Forging space in India and witness 1.1% market share in domestic non-automotive forgings market.</li> <li><b>Sector Wise Revenue Split:</b> Energy (75%), Aerospace &amp; Defence (25%)</li> </ul> <p><b>Plant Capability:</b></p> <ul style="list-style-type: none"> <li>CHW Forge produces large diameter bearing rings in sizes ranging from external diameters of 500mm to 4800mm.</li> <li>Maximum forged weight capability up to 20,000 Kgs.<sup>152</sup></li> <li>CHW Forge operates a fully integrated radial-axial ring rolling machine, enabling rolled rings and flanges with controlled grain flow and near-net-shape production.<sup>153</sup></li> <li>CHW has gas and electric reheating furnaces operating up to 1,270°C, along with heat-treatment facilities for normalising, hardening, tempering, annealing and hydrogen flaking.<sup>153</sup></li> <li>CHW Forge uses wide range of materials for Carbon &amp; Special Steels, Alloy Steel, Stainless Steel, Aluminium Alloys, Titanium Alloys and Super Nickel Alloys.</li> <li>CHW Forge is equipped with a 4000T Fully Automatic hydraulic press and a 3,800 MT automatic hydraulic Open Die Forging press<sup>153</sup>, and Machining facilities.</li> <li>Material-handling capability includes a 30 MT rail-bound manipulator, 14 MT mobile manipulator and 2 MT mobile manipulator, supporting large and specialised forgings.<sup>153</sup></li> </ul> <p><b>Key Products Manufactured:</b></p> <ul style="list-style-type: none"> <li>Key products manufactured by CHW Forge includes aluminium forgings, Forged Flanges, Tower Flanges for windmills, Seamless Rolled Rings, Rings for Slew Bearings, Gear Rings and Y Rings, Forged Disc, Forged Shafts and Stepped Shafts, Forged Gear Blanks and Crane Wheels, Forged Blocks, Titanium Forging, Hemispherical/ Ellipsoidal/ Torispherical Domes, Forged Disc &amp; Hubs, Self-Reinforced Nozzles, Hollow Forgings, Sleeves, Hollow Cylinders &amp; Shells.<sup>154</sup></li> </ul> <p><b>Rolling Infrastructure:</b></p> <ul style="list-style-type: none"> <li>CHW Forge has a fully integrated Ring Rolling Machine from SMS group Germany, automatic hydraulic press 4000T, and Automatic Hydraulic Open Die Forging Press 3800 MT for producing high-speed</li> </ul> |
| <b>Headquarters</b>                       | Ghaziabad, UP                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Manufacturing Facilities</b>           | 4;<br>2-Ghaziabad;<br>2- Greater Noida      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Capacity (MTPA)</b>                    | 40,500                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Total Revenue, FY 26</b>               | INR 575 Crores                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Domestic Revenue (Non-Auto), FY 26</b> | INR 309.84 Crores                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Export Revenue, FY 26</b>              | INR 253 Crores                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

<sup>152</sup> <https://chwforge.com/forged-gear-blanks-crane-wheels/>

<sup>153</sup> <https://chwforge.com/investments/technology/>

<sup>154</sup> <https://chwforge.com/aluminium-forgings/>

| Ownership | Privately Held | Company Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |                | <p>open die forging. They also use modern gas-fired and electric-operated furnaces to reduce energy costs and carbon emissions.</p> <ul style="list-style-type: none"> <li>CHW Forge has heat treatment facilities for normalizing, hardening, tempering, annealing, and hydrogen flanking at high temperatures. They also have the latest manipulators from Dango &amp; Dienenthal and an integrated ERP system for accurate material control and quality standards.</li> </ul> <p><b>Key Certifications:</b></p> <ul style="list-style-type: none"> <li>CHW Forge is certified by world renowned certifying agencies for ISO 9001, ISO 14001, ISO 45001, API 6A, PED, AD 2000-Merkblatt WO, EN 9100, IBR, NABL, NABCB, PESR UK, and ISO 27001.</li> </ul> <p><b>Key Customers:</b></p> <ul style="list-style-type: none"> <li>Hyundai Heavy Industries, Samsung Engineering Company Limited, National Petroleum Construction Company (NPCC), Technimont, Toyo Engineering India Limited, Komatsu India Ltd, KYB Conmat India Pvt. Ltd., Liebherr India Private Limited, Schwing Stetter India Pvt. Ltd. Kirloskar Brothers Limited, Larsen &amp; Toubro (Power Division), Abu Dhabi National Oil Company (ADNOC), BPCL, HPCL, Voith Hydro Pvt. Ltd.</li> </ul> |

Source: Frost & Sullivan Primary Research



**Conclusion: Vinir Engineering Limited**

## 5. Conclusion: Vinir Engineering Limited

### 5.1 Key Drivers and Challenges in Indian Precision Forged and Machined Components Market

Indian Precision Forged and Machined Industries is mainly influenced by the dynamics of various end use segments where applications of forgings are prevailing.

**Exhibit 199: Key Drivers and Challenges in Indian Precision Forged and Machined Components Market**

| Key Drivers                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Government's Initiatives &amp; Import Substitution</b> | India's push for indigenization in aerospace & defence manufacturing and the "Make in India" program provide opportunities for domestic forging manufactures to expand their capabilities and cater the growing forging demand both domestically and internationally. Make in India and Atmanirbhar Bharat are strengthening localization of strategically important industrial and engineering products, creating opportunities for domestic forging and machining suppliers to replace imported components |
| <b>Railway Modernization &amp; Expansion</b>              | India's significant investments in modernizing and expanding its railway infrastructure create a steady demand for high-quality components, enabling local forging manufacturers to expand their capabilities and diversify their portfolio. Investment in railway infrastructure and equipment supports demand for forged and machined axles, wheels, gear components, couplings, braking-system parts and other safety-critical components.                                                                |
| <b>Aerospace &amp; Defence Localization</b>               | Increasing indigenous manufacturing and localization are raising demand for high-strength, tight-tolerance forgings used in aircraft engines, landing gear, defence platforms and other mission-critical applications. India's increasing defence capital expenditure further supports domestic component manufacturing                                                                                                                                                                                      |
| <b>Industrial &amp; Capital-Goods Growth</b>              | India's focus on large-scale infrastructure projects drives demand for earth-moving equipment, directly boosting the need for forged components manufactured by the local players. The growing demand for construction and mining equipment in India presents a steady market for forged and machined parts                                                                                                                                                                                                  |
| <b>Infrastructure Investment</b>                          | India's infrastructure build-out generates downstream demand from construction equipment, heavy machinery, power and industrial equipment, expanding the addressable market for non-automotive forgings.                                                                                                                                                                                                                                                                                                     |
| <b>Energy, Oil &amp; Gas and Power Investments</b>        | Investment across oil & gas, power and energy infrastructure supports demand for forged valves, flanges, shafts, rings and pressure-/temperature-resistant components where metallurgical integrity and machining accuracy are critical.                                                                                                                                                                                                                                                                     |
| <b>Shift Toward High-Value Precision Components</b>       | Adoption of automation and precision-forging technologies allows manufacturers to improve productivity, minimize material waste and                                                                                                                                                                                                                                                                                                                                                                          |

|                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                   | supply increasingly value-added components, supporting a transition from basic forgings toward machined and ready-to-assemble products.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Global Supply-Chain Diversification &amp; Export Potential</b> | India's expanding engineering manufacturing capabilities create opportunities for domestic suppliers to participate more deeply in global supply chains, particularly as aerospace and defence manufacturing scales and the industry develops greater export competitiveness.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Demand for Advanced Materials &amp; Complex Components</b>     | Aerospace, defence and other demanding industrial applications require forged components made from alloy steel, stainless steel, aluminium, titanium and nickel-based alloys, expanding the opportunity for technologically capable precision forging and machining companies.                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Challenges</b>                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Oil and gas sector</b>                                         | Oil and gas sector is subject to global market fluctuations, affecting demand for forged products and services. Compliance with strict industry regulations for Oil and Gas sector can increase operational costs and complexity. Intense competition from global suppliers and low-cost manufacturers can pressure pricing and margins.                                                                                                                                                                                                                                                                                                                                                      |
| <b>Lengthy Empanelment &amp; Qualification Cycles</b>             | Aerospace, defence, railways, oil & gas and other safety-critical customers typically require extensive vendor approval, process validation, testing, audits and component qualification, lengthening the time between initial investment and commercial-scale revenues. The hurdle is especially important for companies diversifying from conventional forgings into high-value sectors where reliability and precision requirements are substantially higher. Establishing trust and securing contracts in these sectors often requires extensive documentation, lengthy approval processes, and robust quality systems creating hesitation among players for venturing into these sectors |
| <b>Dependency on Government Procurement</b>                       | The defence sector in India is heavily reliant on government procurement, which can be influenced by budget constraints and policy shifts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Raw Material Price Volatility</b>                              | Fluctuations in the cost and availability of raw materials could impact production costs and delivery timelines, affecting profitability and customer relationships.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Cyclical Demand from Earthmoving and Hydraulics segment</b>    | The earth-moving sector is highly dependent on economic cycles and infrastructure spending, leading to fluctuating demand.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Advance Technology &amp; Capex Requirements</b>                | Moving into high-value non-auto applications requires investment in advanced forging presses, multi-axis CNCs, robotics, heat treatment, inspection/testing, digital traceability and automation. These requirements raise entry barriers and can extend payback periods when volumes initially remain low                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Steel &amp; Alloy Price Volatility</b>                         | Forging Industry remain exposed to fluctuations in alloy steel, stainless steel and specialty-grade material prices, while customer contracts may offer delayed or incomplete price pass-through. This creates pressure on margins and working capital, particularly for smaller suppliers. Raw-material economics remain structurally important given alloy steel's significant role in Indian forging                                                                                                                                                                                                                                                                                       |

|                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geopolitical &amp; Supply-Chain Disruptions</b>   | Geopolitical tensions can disrupt availability and lead times for specialty steels, nickel/titanium alloys, tooling, machine components and other imported inputs, increasing procurement risks for aerospace, defence, energy and other high-specification applications.                                                                                                                                                                             |
| <b>Tariff &amp; Trade Barriers</b>                   | Import duties, anti-dumping measures, local-content requirements and evolving trade policies can affect the price competitiveness of Indian exports and increase uncertainty around access to key overseas markets.                                                                                                                                                                                                                                   |
| <b>Shortage of Specialized Skilled Labour</b>        | Precision forging increasingly requires expertise across metallurgy, die design, CNC machining, heat treatment, NDT, automation and quality control. The industry's transition toward automated and digitally integrated manufacturing is creating a need for new combinations of traditional metallurgical and digital skills.                                                                                                                       |
| <b>Competition from Established Global Suppliers</b> | Indian players face competition from established international suppliers with long-standing OEM relationships, proprietary process know-how, advanced-material expertise and global certifications. Indian suppliers therefore need to compete beyond cost on quality, reliability, traceability and engineering capabilities. The industry's move toward global quality benchmarks and higher-value products highlights this competitive requirement |

## 5.2 Entry Barriers for New Entrants in Precision Forged and Machined Components Industry

### Exhibit 200: Entry Barriers for New Entrants

| Entry Barriers                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>High Capital Investment</b> | <p>Setting up manufacturing facilities for precision forging and machining involves extensive financial resources due to the need for advanced infrastructure and specialized equipment.</p> <p>New entrants must acquire high-value machinery, including CNC machines for precision machining, open-die and closed-die forging presses for various forging applications, seamless ring rolling mills for producing high-strength rings, and temperature-controlled heat treatment facilities to enhance material properties, amongst others. Beyond equipment and machines, substantial costs are incurred in setting up auxiliary systems for testing, inspection, and material handling. Establishing backward integration, such as in-house die design and manufacturing, further compounds the financial requirements, as it necessitates specialized software, skilled personnel, and additional machinery like CAD/CAM systems and CNC die-manufacturing setups.</p> |
| <b>Technological Expertise</b> | <p>The precision-forged and machined components industry demands a comprehensive understanding of advanced forging and machining techniques.</p> <p>New entrants face a steep learning curve in mastering processes like closed-die forging, which requires intricate die design, and open-die forging, which involves manipulating large components with precise control. Processes such as seamless ring rolling and radial forging demand not only technical proficiency but also sophisticated machinery and process optimization. Additionally, the ability to work with diverse and challenging materials, such as Alloy Steel, Titanium, Hastelloy,</p>                                                                                                                                                                                                                                                                                                              |

|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                    | Inconel, and Duplex Steels, requires expertise in material properties, heat treatment, and machining characteristics. Building this knowledge base and acquiring skilled personnel to execute these processes effectively takes years of experience and investment in training.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Long Customer Approval Cycles</b>               | Winning contracts in the precision-forged and machined components industry involves protracted approval and qualification processes. Customers in critical sectors require extensive testing, prototyping, and performance validation before awarding contracts. For example, aerospace and defense components undergo rigorous fatigue testing, metallurgical analysis, and dimensional accuracy checks to ensure compliance with strict safety and operational standards. These approval cycles can span months or even years, making it difficult for new entrants to achieve a steady revenue stream or build a track record. Moreover, established companies like Vinir Engineering Limited often have pre-qualified vendor status, giving them a competitive edge that new players struggle to overcome.                                                                            |
| <b>Established Relationships and Reputation</b>    | The industry places a high value on trust and reliability, with customers often favoring suppliers that have demonstrated consistent performance over many years. Companies like Vinir Engineering Limited benefit from long-standing relationships with customers across critical industries, which are built on a history of delivering quality, tailored solutions. For new entrants, establishing this level of trust is a significant challenge, as they lack a proven track record and the industry connections necessary to secure large contracts. Customers are also hesitant to shift to untested suppliers due to the risks and costs associated with validating a new source.                                                                                                                                                                                                 |
| <b>Economies of Scale and Vertical Integration</b> | Established players in the industry achieve competitive advantages through economies of scale and vertical integration. Large-scale production allows players to distribute fixed costs over higher output volumes, reducing per-unit costs. Additionally, vertical integration such as in-house capabilities from raw material sources, inspection, and preparation to die design, forging, machining, and heat treatment, and final testing enables them to streamline operations, reduce lead times, and maintain tighter control over quality. For new entrants, achieving similar economies of scale is challenging without significant upfront investment and a steady pipeline of orders. The lack of integrated capabilities also forces them to rely on external suppliers, increasing costs and lead times, further limiting their ability to compete with established players. |

### 5.3 Exit Barriers for Customers in Precision Forged and Machined Components Industry

The precision-forged and machined components industry is characterized by significant exit barriers for customers, making it challenging for them to switch suppliers with ease for highly customized, critical, and heavy components for demanding applications. These exit barriers arise from a mix of factors including technical, economic, and operational, inherent in the industry, ensuring a strong and lasting relationship between suppliers and customers

**Exhibit 201: Exit Barriers for Customers**

| Exit Barriers                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>High Switching Costs</b>                                     | Customers in specialized and critical end user industries rely on components that must meet exact specifications and perform flawlessly under stringent conditions. Changing suppliers involves substantial switching costs, including requalification of new vendors, tooling adjustments, and the need to revalidate the production processes. This often requires significant investment of time, money, and resources, making it economically unfeasible for customers to move away from their existing suppliers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Dependence on Tailored Solutions</b>                         | Precision-forged and machined components are often designed and manufactured to suit the unique operational needs of each customer. Our Company, for example, delivers highly customized components, leveraging technologies and processes such as closed-die forging, open-die forging, and seamless ring rolling, coupled with in-house die design capabilities. This customization creates a high level of dependency, as transitioning to a new supplier would necessitate redesigning, retooling, and revalidating parts, potentially disrupting the customer's supply chain and operational schedules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Quality, Reliability and Breach of Confidentiality Risks</b> | The critical nature of components means that even minor deviations in quality can have catastrophic consequences. Customers place a high degree of trust in suppliers who have demonstrated consistent quality and reliability over time. Transitioning to a new supplier introduces the risk of quality issues, which can result in operational failures, increased downtime, and reputational damage. This risk further discourages customers from exploring alternative sources. Also, in industries where precision-forged and machined components are very critical, a significant amount of proprietary information, including design specifications, engineering data, and operational requirements, is shared between the customer and the supplier. This reliance on confidentiality creates a substantial exit barrier for customers, as the trust and secure systems established with an existing supplier cannot be easily replicated. As a result, customers are more inclined to maintain long-term relationships with existing trusted suppliers, where data security and intellectual property are safeguarded. |
| <b>Integrated Supply Chain Relationships</b>                    | Well established suppliers integrate closely into the customers' supply chains, offering end-to-end solutions that streamline the operations. From in-house die design and manufacturing to precision machining and rigorous quality assurance processes, such integration ensures seamless delivery and minimizes lead times. Shifting to a new supplier would require customers to rebuild this supply chain relationship, which is both time-consuming and operationally disruptive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## 5.4 Overall Business Revenue: FY 2021-FY 2026

**Exhibit 202: Vinir Engineering Limited: Business Revenue, FY 21-26**

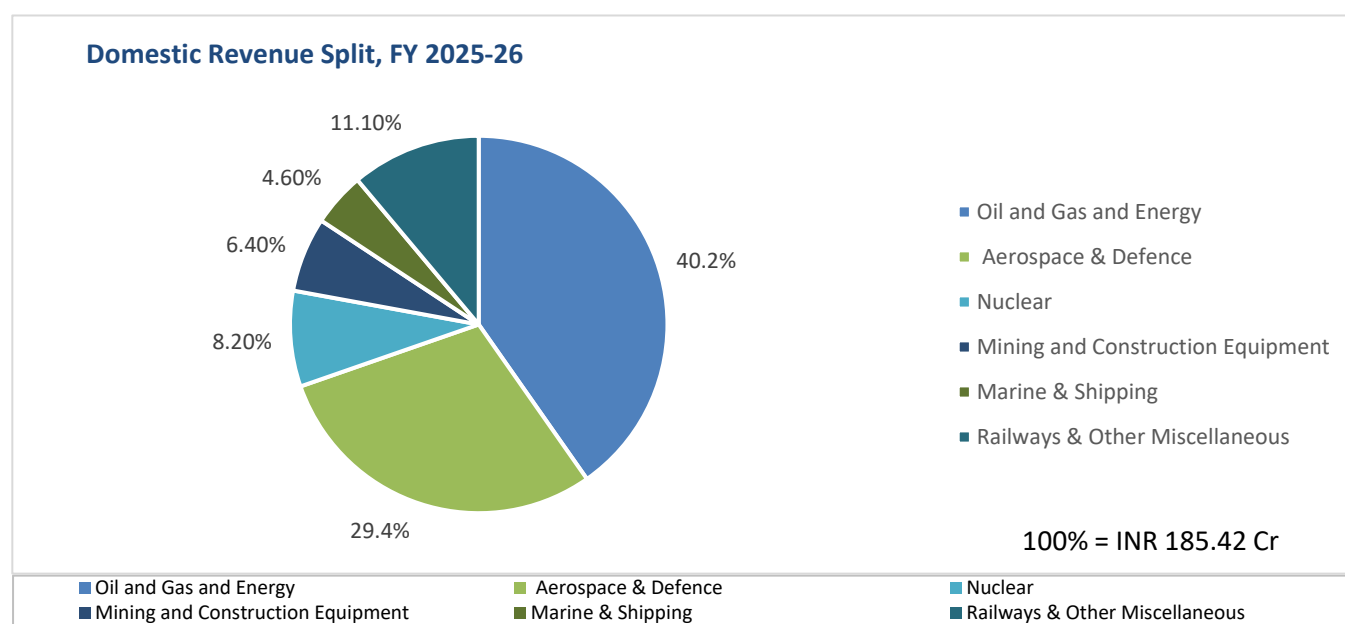
| Sector Focus                | FY 21        | FY 22         | FY 23         | FY 24      | FY 25         | FY 26         |
|-----------------------------|--------------|---------------|---------------|------------|---------------|---------------|
| Domestic Sales (INR Cr)     | 77.69        | 140.84        | 205.83        | 205        | 173.88        | 185.43        |
| Export (INR Cr)             | 15.53        | 12.82         | 21.69         | 25         | 16.08         | 19.39         |
| <b>Total Sales (INR Cr)</b> | <b>93.22</b> | <b>153.66</b> | <b>227.52</b> | <b>230</b> | <b>189.96</b> | <b>204.82</b> |

Source: Vinir Engineering Limited

- Vinir Engineering Limited has demonstrated strong business performance, with total revenue increasing from INR 93.22 crore in FY21 to INR 204.82 crore in FY26, representing a CAGR of ~17%. Growth has been primarily driven by the domestic market, where revenue expanded from INR 77.69 crore to INR 185.43 crore, registering a ~19% CAGR over the same period. Export revenue also recorded steady growth, increasing from INR 15.53 crore in FY21 to INR 19.39 crore in FY26, at a CAGR of ~4.5%. In the last 40 years, Vinir Engineering Limited have served Numerous clients across 18 countries.

## 5.5 Vinir Engineering Limited Domestic Revenue Split by End Use Segments: FY 2025-26

**Exhibit 203 a: Vinir Engineering Limited: Domestic Revenue Split, FY 2025-26**



Source: Vinir Engineering Limited

- Vinir Engineering Limited's total revenue stood at **INR 204.82 Crore in FY 2025-26**, out of which 90.52% (INR 185.42 Crores) revenue was generated by the sales in the domestic market and the remaining 9.47% (INR 19.39 Crores) was contributed by the sales in the export market. Key export market for Vinir Engineering Limited in FY 2025-26 were USA (51%), Tunisia (30%), Canada (9%), Spain (5%), Malaysia (4%) and Rest of the world (1%).
- Vinir Engineering Limited has developed comprehensive, end-to-end in-house capabilities spanning die design and manufacturing, forging simulation and process engineering, forging, heat treatment, metallurgical testing and NDT, advanced CNC machining including 5-axis machining, and dimensional inspection and testing. This vertically integrated manufacturing model enables Vinir Engineering Limited to deliver fully finished, ready-to-assemble, mission-critical components with greater speed, precision, quality control, and execution efficiency, positioning the company as a value-added component manufacturer rather than merely a supplier of forgings.

- Vinir Engineering Limited’s domestic revenue in FY2025-26 was anchored by the Oil & Gas and Energy and Aerospace & Defence sectors, which together contributed ~70% of domestic sales. The remaining revenue was diversified across Nuclear (8.2%), Mining & Construction Equipment (6.4%), Marine & Shipping (4.6%), and Railways and other miscellaneous industries (11.1%), reflecting the company’s presence across multiple mission-critical end-use sectors.
- Vinir Engineering Limited can be positioned as a one-stop, integrated manufacturing partner capable of taking components from engineered forgings through precision machining and finishing ready-to-assemble parts. This integrated model enables company to address complex, customized and mission-critical requirements while maintaining tight dimensional tolerances, consistent quality and shorter development and delivery cycles. By supplying near-finished or fully finished components rather than merely forged blanks, Vinir Engineering Limited helps customers reduce downstream processing, shorten lead times, simplify vendor management and lower overall supply-chain complexity. Consequently, Vinir Engineering Limited moves higher up the manufacturing value chain, creating stronger customer stickiness, higher entry barriers and greater value addition per component.
- Vinir combines an embedded customer base with a growing pipeline of qualified and under-development products across six verticals, creating visibility into future revenue streams. High repeat business, long qualification cycles and increasing exposure to mission-critical applications reinforce customer retention and support sustainable, higher-value growth

**Exhibit 203 b: Repetitive Customer: Vinir Engineering Limited**

| Particulars            | FY 2025-26 | FY 2024-25 | FY 2023-24 |
|------------------------|------------|------------|------------|
| Total no. of customers | 91         | 87         | 63         |

Source: Audited Data Vinir Engineering Limited

**Exhibit 203 c: Customer Concentration: Vinir Engineering Limited**

| Particulars                                | FY 2025-26 | FY 2024-25 | FY 2023-24 |
|--------------------------------------------|------------|------------|------------|
| Revenue from top 10 customers (% of total) | 64.44      | 64.51      | 74.39      |
| Revenue from largest customer (% of total) | 13.88      | 21.53      | 14.36      |

Source: Audited Data Vinir Engineering Limited

## 5.6 SWOT Analysis: Vinir Engineering Limited

Exhibit 204: Vinir Engineering Limited: High level SWOT Analysis

| Strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Weakness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• <b>Diversified Product Range:</b> Capable of manufacturing diverse products for industries such as Oil &amp; Gas and Energy, Aerospace and Defence, Nuclear, Mining and Construction Equipment, Marine and Shipping, Railways and other miscellaneous industries. Vinir Engineering Limited has a broad addressable market.</li> <li>• <b>Technical Proficiency:</b> Vinir Engineering Limited is skilled in both forge-based and machine-based engineering solutions. A rare blend that gives us a competitive advantage.</li> <li>• <b>Green Certification:</b> Vinir Engineering Limited is 'GreenCo' certified. An increasingly important credential in today's environmentally conscious business world.</li> <li>• <b>Integrated Forge-to-Finish Capability:</b> Vinir combines die manufacturing, forging, heat treatment, machining and testing in-house, enabling end-to-end production of critical components.</li> <li>• <b>Broad Forging Capabilities:</b> Offers closed-die, open-die, ring-rolling and radial forging, components up to 1400 Kgs for CDF and 6000 Kgs per piece for ODF.</li> <li>• <b>Special-Alloy Expertise:</b> Works with Inconel, titanium, aluminium, alloy steels, duplex and super-duplex materials for different applications.</li> <li>• <b>High-Mix, Low-Volume Specialisation:</b> Manufacturing model is tailored towards complex, variable-volume requirements across critical industries rather than standardised high-volume production.</li> <li>• <b>Established Certifications &amp; Market Reach:</b> Over 40 years of manufacturing experience, certifications including AS9100, API20B/C, PED-AD2000, IBR &amp; ABS, with exports to 18+ countries (such as USA, Brazil, China, France, Saudi Arabia &amp; Romania).</li> <li>• <b>Engineering &amp; Metallurgical Expertise:</b> In-house die design, simulation, metallurgy, heat treatment, NDT and precision machining enable faster development and delivery of high-precision, complex components with shorter lead times.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Exposure to Energy Sector Capex:</b> Exposure to energy-sector capex cycles, commodity market fluctuations and project-driven activity may result in variability in demand and order inflows. Any slowdown or deferment in capital expenditure by customers, particularly across energy and other project-intensive end-markets, could impact order conversion, capacity utilization and revenue growth.</li> <li>• <b>Long Qualification Cycles:</b> Expansion into Defence, Aerospace and Nuclear involves lengthy customer qualification, testing and approval processes before meaningful volumes are achieved.</li> <li>• <b>Expansion Execution Requirements:</b> Vinir's capacity expansion, including the proposed Unit 4 at Hosur, will require additional manpower &amp; management bandwidth, commissioning of new equipment &amp; processes, and significant capital deployment before the expanded facilities reach optimal utilization.</li> </ul> |
| Opportunity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Threat                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <ul style="list-style-type: none"> <li>• <b>Diversification:</b> Expanding into adjacent sectors such as Energy (Wind, renewable energy), Marine and shipping, Aerospace and Defence.</li> <li>• <b>Partnerships and Alliances:</b> Collaborating with global companies in Energy (O&amp;G), Defence &amp; Aerospace etc. or EPC contractors can create new business opportunities.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• <b>Economic Slowdown:</b> A general economic downturn could reduce capital expenditure in most sectors, impacting demand for Vinir Engineering Limited's services.</li> <li>• <b>Regulatory Changes:</b> Shifting environmental or industrial regulations, both domestically and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

- **Growing Environmental Focus:** Vinir Engineering Limited's environmentally friendly operations can be leveraged as a differentiator as industries and governments increase their focus on sustainability.
- **Defence & Aerospace Localisation:** Increasing domestic sourcing of mission-critical components creates an opportunity for Vinir to expand its forged and machined component portfolio in Defence & Aerospace.
- **Marine & Shipping Expansion:** Vinir's ABS-certified manufacturing capabilities create scope to increase its presence in marine and offshore applications requiring certified forged components.
- **Capacity Expansion:** The proposed Hosur Unit 4 is planned for larger and specialised closed-die/open-die forging, radial-axial ring rolling, and advanced CNC machining, creating additional capacity for specialised high-value applications.
- **Global Supply-Chain Diversification:** Vinir's presence across the 18+ Countries (USA, Canada, Brazil, France, Germany, Romania, Saudi Arabia, Malaysia and China) provides a base for deeper participation in international engineering supply chains.
- **Nuclear Market Expansion:** Vinir's established forging, special-alloy, quality and pressure-equipment capabilities provide a base to expand participation in nuclear power equipment and component supply, subject to applicable customer and regulatory qualifications.
- **Higher Finished-Component Value Addition:** Expanding machining, inspection and assembly alongside forging can increase the share of higher-value finished components in Vinir's product mix.
- internationally, may require costly operational adjustments.
- **Foreign-Exchange Volatility:** Fluctuations in the rupee against foreign currencies can affect the rupee value of Vinir's export revenues and overall realisations, with potential impact on margins.
- **Steel & Energy Cost Volatility:** Changes in steel, alloy and energy costs can increase manufacturing costs and put pressure on margins in forging-intensive operations.
- **Trade & Export-Market Uncertainty:** Changes in tariffs, trade policies and market-access conditions across export markets such as the USA, Canada and Europe can affect the competitiveness of Indian component exports.
- **Customer Qualification Delays:** Delays in customer approvals, testing or qualification can postpone commercialization of new products in Defence, Aerospace and Nuclear markets.
- **Domestic & International Competition:** Vinir competes with established Indian and overseas suppliers in precision forgings and machined components, particularly across aerospace, defence, energy and heavy-engineering applications.
- **Energy and Oil & Gas Sector Cyclicity:** Demand from Energy and Oil & Gas customers is linked to project activity and industry investment cycles, which can create variability in order flows for forged and machined components.

Source: Frost & Sullivan Analysis and Primary Research

## 5.7 Unique Selling Proposition (USP) and Key Success Factors of Vinir Engineering Limited

### Unique Selling Proposition (USP)

- Vinir Engineering Limited manufactures **heavy, precision-forged and machined components for mission-critical and safety-critical** applications across **Oil & Gas and Energy, Aerospace & Defence, Nuclear, Mining & Construction Equipment, Marine & Shipping, Railways & other miscellaneous industries** specializing in complex, high-mix, low-volume components.
- Capable of producing heavy components through closed-die, open-die and ring-rolling processes, with its current forging range extending up to 1400 Kgs for CDF and 6000 Kgs for ODF per component.
- The combination of **CDF, ODF, ring rolling** and supporting downstream processes allows customers to source different forging requirements through a single manufacturing partner.
- Environmentally friendly operations and has **GreenCo certification**.
- Vinir Engineering Limited has an established presence in the global market, expanding its reach through exports to 18+ countries (Such as USA, Canada, Brazil, France, Germany, Romania, Saudi Arabia, Malaysia and China).

- Delivering products faster than typical industry lead times.
- In-house certified laboratory and various other certifications required for oil and gas, defence, railways, marine and shipping.
- Vinir Engineering Limited's value-added machining capabilities form a key pillar of its integrated manufacturing strategy, enabling the Company to transition from supplying forged components to delivering fully finished, ready-to-assemble products.
- Vinir Engineering Limited processes demanding materials including Inconel, titanium, aluminium, alloy steels, duplex and super-duplex, supporting applications with stringent material and performance requirements.
- The company maintains advanced CNC machining capabilities supporting precision machining of complex forged components and finished parts.
- Good strategic relations with legacy customers.
- Vinir Engineering Limited integrates forging, heat treatment, machining, testing and inspection within its manufacturing ecosystem, enabling greater process control and reducing supply-chain handoffs
- Vinir Engineering Limited's in-house die design, simulation, metallurgy, heat treatment, NDT and precision machining enable faster development and delivery of high-precision complex components with shorter lead times.

## 5.8 Key Success Factors

- **Specialized Industry Focus:** Vinir Engineering Limited is an integrated engineering solutions company engaged in the manufacturing of specialized, critical and heavy, precision-forged and machined components for a wide range of industries and applications, including oil and gas and energy, aerospace and defence, mining and construction equipment, nuclear, marine and shipping, railways and other miscellaneous industries and tailor its offerings to meet the specific needs of this industry, setting it apart from competitors.
- **Low-Volume, Heavy Component Production:** The ability to produce low-volume, heavy components efficiently is a critical advantage, as many clients in the Oil & Gas sector require such specialized manufacturing.
- **Comprehensive Solutions (ODF, CDF, RR):** Offering a full range of solutions under one roof ensures that clients can depend on Vinir Engineering Limited for all their production needs, making the company a one-stop shop for diverse sectors. Supplying fully machined or near-finished components, rather than forged blanks, enables manufacturers to capture a larger share of the value chain while reducing machining requirements, lead times and supply-chain complexity for customers. For Vinir Engineering Limited, its integrated forging and precision-machining capabilities provide a competitive advantage by enabling delivery of high-value, application-ready components with tighter tolerances and greater customization. This positions Vinir Engineering Limited as a strategic supplier for mission-critical applications, supporting higher customer stickiness, stronger entry barriers and better value realization compared with conventional forging-only players
- **Faster Delivery Times:** Delivering products faster than industry standards gives Vinir Engineering Limited a significant competitive advantage, particularly in time-sensitive projects where delays can be costly. Vinir Engineering Limited's integrated product development and engineering capabilities enable faster product development and customer qualification, while fostering long-term customer partnerships and positioning the Company as a trusted, value-driven partner.

- **In-House Capabilities:** With an in-house certified laboratory and machine shop, Vinir Engineering Limited maintains high-quality control standards, reduces dependency on external suppliers, and ensures faster turnaround times.
- **Expertise in Steel Grades:** Deep knowledge of a wide range of steel grades and special alloys and expertise in processing enables Vinir Engineering Limited to cater to diverse and complex client requirements, further enhancing its market competitiveness.
- **Environmental Commitment:** Being environmentally friendly aligns with global sustainability trends and regulatory requirements, making Vinir Engineering Limited a preferred partner for clients with similar values.
- **Strategic Market Targeting:** With a pan-India customer base and an established presence across 18+ countries, Vinir Engineering Limited is well positioned as a trusted supplier of precision-engineered components across domestic and international markets.
- **Value-Added Manufacturing:** Offering precision machining, heat treatment, testing, inspection and other value-added manufacturing capabilities enables Vinir to provide comprehensive, ready-to-assemble component solutions.
- **Customer Qualification & Approval Management:** Timely completion of testing, first-article requirements, audits and qualification processes is essential for converting opportunities in Defence, Aerospace and Nuclear into recurring commercial business.
- **Capacity Expansion & Utilization:** Successful commissioning, staffing, equipment deployment and ramp-up of **Unit 4 at Hosur** will be important to support growth while maintaining delivery, quality and capacity utilization.
- **Customer Retention:** Maintaining long-term customer relationships will remain important in qualification-driven markets.

Vinir Engineering Limited's prospects are promising, supported by strategic diversification, technological upgrades, and quality-focused practices. While challenges exist, particularly from market volatility and economic factors, the company's proactive strategies and robust operational foundation position it well capitalized on emerging opportunities and navigate potential risks.

## 5.9 Best Practices and Continuous Process Improvements of Vinir Engineering Limited

- **ISO 9001:** Ensures that Vinir Engineering Limited's quality management systems meet international standards.
- **API 20C:** This is a certificate of authority granted to use the official API monogram on manufactured products by the American Petroleum Institute (API).
- **API 20B:** This is an American Petroleum Institute standard that sets quality, qualification, and manufacturing requirements for open-die shaped forgings used in the oil and gas industry.
- **ISO 14001:** Demonstrates Vinir Engineering Limited's commitment to environmental management systems.
- **ISO 45001:** Related to occupational health and safety management systems, ensuring a safe work environment.
- **Pressure Equipment Directive (PED):** Ensures equipment meets the standards required for fabrication of pressure equipment within the EU.
- **AD 2000:** German regulation for pressure vessels and other pressure equipment.
- **IBR Well Known Forge:** Indicates recognition under the Indian Boiler Regulations as a well-known forge.
- **AS 9100D:** Certification for quality management systems in the aerospace industry.
- **ISO 50001:** Pertains to energy management, helping organizations to continually reduce energy use, costs, and environmental impacts.
- **ISO 17025 - NABL:** Accreditation signifies the competence of testing and calibration laboratory.
- **'Green Co':** Reflects Vinir Engineering Limited's adherence to environmentally sustainable practices.
- **ABS:** This is a certificate of forging facility and process approval granted by ABS for being considered capable of manufacturing steel forging components for marine applications.
- **IRIS:** This is an internationally recognized quality management certificate for the railway industry.
- Vinir Engineering Limited is presently using Piped Natural Gas (PNG) to meet its energy requirements at unit 1 located at Bangalore.

**These certifications showcase Vinir Engineering Limited's dedication to maintaining the highest quality standards across diverse aspects, from environmental practices to industry-specific production quality, enhancing its credibility, focusing on sustainability and trustworthiness in international markets.**

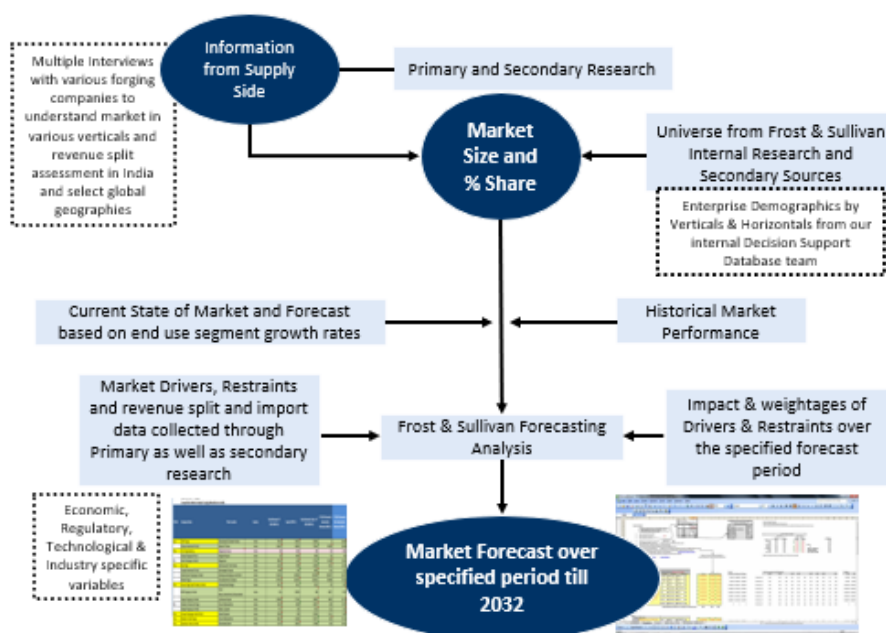


**Annexure: Approach and Methodology**

## 6. Approach and Methodology

### Flow Diagram of Approach and Methodology Adopted

#### Approach & Methodology for the Project



#### Steps of Approach and Methodology adopted in this project

F&S team have followed both top to bottom approach and then bottom to top approach to perform the Indian non-automotive forging market assessment for data validation. We have considered inputs from key market players for the revenue assessment and end-use-wise revenue split for the companies considered for the assessment to size the market. Also, F&S team have done import assessment considering various HS codes to finalize the market size and obtain the market shares of the Vinir Engineering Limited and other manufacturers.

- Relevant Data such as annual revenue of the companies, domestic sales, exports, split by forging types and split by end use segments has been collected from various primary interviews and credible secondary sources.
- Import data were collected from primary research and credible secondary sources with the end use segment specific HS Codes for forging products.
- Revenue assessment and analysis of the data collected was performed to obtain the domestic market share of Vinir Engineering Limited and its other competitors.
- Historical trends were finalized based on the input from the primary and secondary sources and past growth of the end use segments.
- Forecast was performed by considering the drivers and restraints of each of the end use segments and potential growth rate and by considering weighted average of each of the end use segments.